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### ORAL PRESENTATIONS

#### ISEE-0003

##### What Measure of Temperature is the Best Predictor of Mortality?

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**Background and Objective:** Hot and cold temperatures significantly increase the risk of death in many regions of the world. Different measures of temperature, including minimum, maximum and apparent temperature, have been used in previous research. Which temperature measure is the best predictor of mortality is not known.

**Methods:** We used mortality data from 106 cities in the US NMMAPS study (years 1987–2000). We examined the association between temperature and mortality using Poisson regression and fitted a non-linear spline for temperature. We examined five measures of temperature, the effect of including relative humidity, and various degrees of freedom for the temperature spline. The best model was defined as that with the minimum absolute residual. The residuals were calculated using cross-validation.

**Results:** Maximum temperature was selected as the best temperature measure the most often (40 cities in the  $\geq 65$ -year age group), and apparent temperature the least often (8 cities in the  $< 65$ -year age group). Maximum temperature was the best measure in 10 out of 12 months in both age groups. Geographically, maximum temperature was the best measure in cold regions, and minimum temperature in warm regions. Humidity was important in almost every city in the  $\geq 65$  year age group. The seasonal variation in humidity showed a surprising peak in usefulness in winter.

**Conclusion:** Apparent temperature is no better than standard measures of temperature in predicting mortality. Maximum temperature was generally the best measure in cold climates and minimum temperature in warm climates. Humidity is an important predictor of mortality in the elderly and its effect should be estimated separately from temperature.

#### ISEE-0005

##### Investigation of Nephrolithiasis in Children with Tainted Chinese Dairy Product Consumption in Taiwan

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**Background:** Little is known about the renal effects of melamine in humans. We evaluated risk factors, clinical manifestations, exposure patterns, and biomarkers for nephrolithiasis in children who consumed melamine-contaminated dairy products.

**Methods:** From September 24 to October 31 in 2008, 1222 children whose parents were concerned that they may have consumed melamine-contaminated dairy products were investigated at Department of Health hospitals in Taiwan. The high exposure group was those who consumed China-brand dairy products with melamine levels  $> 2.5$  ppm. The low exposure group was those who consumed dairy products imported from China with melamine levels 0.05–2.5 ppm. Our control group was those who consumed dairy products without detected melamine levels  $< 0.05$  ppm. Clinical presentation, urinalysis, urine calcium, creatinine, and renal ultrasonography were evaluated. Urine melamine tests were checked for those with nephrolithiasis and age- and gender-matched controls selected from the study population.

**Results:** No hematuria, hypercalciuria, flank pain, or acute renal failure was noted in the high exposure group. Nine out of the 14 nephrolithiasis cases had a history of having resided in China and China-brand dairy product consumption. The age of children with nephrolithiasis in the high exposure group was younger than those without nephrolithiasis ( $P = 0.011$ ). The duration of contaminated product consumption was longer in children with nephrolithiasis in the high exposure group than those without nephrolithiasis ( $P = 0.017$ ). The risk of nephrolithiasis was found to increase with estimate melamine exposure levels ( $P$  for trend  $< 0.001$ ). Of the 10 nephrolithiasis cases that received urine melamine analysis, two had elevated levels. Comparatively, age- and gender-matched controls were all lower than the detection limit.

**Conclusions:** Due to lack of symptoms and signs, we recommend renal ultrasonography for children with high melamine exposure. Urine melamine tests might be helpful in confirming the diagnosis of melamine related nephrolithiasis.

#### ISEE-0008

##### The Association Between Socioeconomic Status and Exposure to Mobile Telecommunication Networks in Children and Adolescents

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**Background:** A potential association between socioeconomic status (SES) and self-reported use of mobile phones has been investigated in a few studies. Whether objective exposure to mobile phone networks differs by SES in children and adolescents has not yet been studied.

**Methods:** Data was taken from a cross-sectional study investigating a possible association between exposure to mobile phone networks and well-being in children and adolescents. In total, data of 1481 children and 1505 adolescents was used. During a Computer Assisted Personal

Interview (CAPI) on participants' mobile phone use, socio-demographic characteristics and potential confounding variables were collected. Sociodemographic data was used to stratify participants into three "status groups" (low, middle, high). Using a personal dosimeter (ESM-140 Maschel Electronics), we obtained an exposure profile over 24 hours for three mobile phone frequency ranges for each of the participants. Exposure levels were expressed as a mean percentage of the reference level.

**Results:** Children with a low SES were more likely to own a mobile phone (OR 2.1; 95% CI 1.1–3.9) and also reported to use their mobile phone longer per day (OR 2.4; 95% CI 1.1–5.4) than children with a high SES. For adolescents, mobile phone ownership was independent of SES, but self-reported duration of phone use per day was also higher in adolescents with a low SES (OR 3.4; 95% CI 1.4–8.4) compared to adolescents with a high SES. No association was seen for children or adolescents between SES and objective exposure to mobile telecommunication networks.

**Conclusion:** Mobile phone use may differ between status groups with higher use among disadvantaged groups. However, this does not result in a higher overall exposure to mobile telecommunication networks. Whether the short duration of personal phone calls or the small numbers in the low SES group are causal has to be investigated in further studies.

#### ISEE-0014

##### Zinc Deficiency in Soils, Crops and Food in Mali and Options for Remediation

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**Abstract:** Mali has a high child mortality of 220/1000. Children in the Niger inland delta die at birth and at weaning age. Zinc deficiency weakening the immuno-system could be responsible for 20% of the child mortality. The objective of this work has been to study zinc availability along the food chain from soils to humans.

200 soil samples were sampled at five locations and assessed for Zn plant availability. Crops were analysed for total zinc and iron. 20 meals have been sampled and analysed for energy, iron, and zinc. Effects of food preparation have been studied by phytate analysis.

Soil zinc deficiency is present along a stretch of 700 km in the Niger inland delta. Contents of zinc in crops are lower than reference values. A fertilization test adding 10 kg Zn per ha gave little effect on the rice crop. Another test with intermittent irrigation indicated higher zinc uptake. An assessment of the zinc and iron intake made in the centre of the delta showed that the zinc intake was half the recommended while iron intake was double the recommended. Nevertheless anemia is common among women and children, due to the cereal-dominated diet with less than 10% of the energy from animal food. The phytate/zinc and phytate/iron ratios are high making the trace elements less available.

Fertilisers with trace elements are not available but foliar application may be more efficient. Zinc supplementation of food items is not applicable as food is entirely produced and consumed locally. A weaning powder with cereals treated by fermentation which can lower the phytate/zinc ratio is under development. The production could be done by women's cooperatives.

#### ISEE-0016

##### Prenatal Exposure to Low Molecular Weight Phthalates and Childhood Behavior and Executive Functioning

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**Background and Objective:** Several studies have reported possible antagonistic effects of phthalates on the thyroid gland in vivo and thyroid tissue in vitro, suggesting that phthalate exposure may have neurodevelopmental consequences. We undertook an investigation of the neurobehavioral consequences of prenatal phthalate exposure in a prospective birth cohort.

**Methods:** The Mount Sinai Children's Environmental Health Study enrolled a multiethnic prenatal population of 404 singleton, primiparous women in New York City between 1998–2002. Maternal urine was collected in the third trimester, and children were reassessed for growth and neurodevelopment at approximately ages 4, 6 and 8 years. At their exam, mothers completed the parent-report form of the Behavioral Assessment System for Children (BASC) and the Behavior Rating Inventory of Executive Function (BRIEF). In total, 181 (45%) children returned for at least one visit (n = 343 visits). Prenatal urine was analyzed for phthalate metabolites, which were grouped by molecular weight into monoester metabolites of high- (>250 dalton) (HMW), and low- (<250 dalton) (LMW) molecular weight.

**Results:** In multivariate adjusted generalized linear models, increased log-LMW phthalate metabolite concentrations were associated with poorer BASC scores on the Aggression (B = 1.24, 95% CI 0.15–2.34), Attention Problems (1.29, 0.16–2.41), Conduct Problems (2.40, 1.34–3.46), and Depression (1.18, 0.11–2.24) clinical scales; and Externalizing Problems (1.75, 0.61–2.88) and Behavioral Symptom Index (1.55, 0.39–2.71) composite scales. For the BRIEF, in multivariate adjusted models, increased log-LMW phthalate concentrations were associated with poorer scores on the Global Executive Composite index (1.23, 0.09–2.36), and the Emotional Control scale (1.33, 0.18–2.49).

**Conclusion:** These associations include domains that are typically affected in childhood Conduct Disorder, ADHD, and Depression clinical groups. Given the ubiquity of phthalates in the environment, the public health impact of even small adverse effects of phthalates on neurodevelopment could be significant. Replication of these findings is needed.

#### ISEE-0022

##### Meteorological Variables and Malaria in a Chinese Temperate City: A Twenty-Year Time-Series Data Analysis

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**Background and Objective:** Re-emergence of malaria has been observed in China recently. Although the association between climate variation and malaria has been addressed in many countries, little is known about the impact of climate variation on malaria in temperate regions of China.

**Methods:** A 20-year historical time-series data analysis was conducted to examine the relationship between meteorological variables, including maximum and minimum temperatures, rainfall, humidity, air pressure, and cases of malaria in Jinan, a temperate city in northern China. Data were retrieved for the period 1959 to 1979 and analyzed on a monthly basis. Spearman correlation and cross-correlation analyses were performed between each meteorological variable and the number of malaria cases, to identify time lag values. A Seasonal Autoregressive Integrated Moving Average (SARIMA) model was used to quantify the relationship between the meteorological variables and malaria cases.

**Results:** The SARIMA models indicate that a 1°C rise in maximum temperature may be related to a 4.2% to 13.9% increase, and a 1°C rise in minimum temperature, may result in an approximately 6.8% to 14.8% increase in the number of malaria cases. A clear association between malaria and other selected weather variables, including rainfall, humidity and air pressure, has not been detected in this study.

**Conclusion:** Results suggest that temperature could play an important role in the transmission of malaria in temperate regions of China, and climate change may bring about more malaria cases in this region of China if no action is taken.

## ISEE-0023

**Time-Series on Mortality Related to Air Pollution in Vienna: A Sensitivity Analysis**

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**Abstract:** Many studies world-wide have demonstrated the acute health effects of air pollution. Time series approaches have been most favoured because of the relative ease of calculation and data availability. In time series studying daily mortality only time-varying factors can confound the results. Seasonal trends and indicators of short term weather variability (temperature, air pressure, and humidity) are the most important.

In recent years a lively debate has sparked over the best way to model these possible confounders since their association with mortality does not follow a simple linear form. The splines modelled under the S-Plus GAM (General Additive Model) routine have been criticised as leading to an overestimation of the effects of the linear terms (i.e. the pollutants' concentrations).

Various alternative models have been proposed using more stringent criteria and fully parametric models. Also the degrees of freedom reserved for the modelling of the seasonal fit have been lively debated.

The city of Vienna has run an air pollution monitoring system with consistent methodology for the gaseous pollutants since the early 1990s. In a shorter time series (since 2000) we have recently shown risk estimates for NO<sub>2</sub> and particles that were in accordance with international findings.

In a sensitivity analysis we calculated risk estimates for NO<sub>2</sub> and O<sub>3</sub> for total daily mortality using GAM (with varying degrees of freedom for the seasonal fit and with inclusion of a varying number of possible confounding variables), General Estimation Equations (with and without auto-regression terms), Poisson regression, ARIMA model, and case-crossover design. Results not so much depended on the statistical model but on the list of confounders. Daily weather patterns influence mortality directly. Additionally there could be an indirect effect by their influence on pollutants' concentration. Consequently an overly exhaustive list of possible confounding variables might lead to an over-adjustment in the model.

## ISEE-0033

**Association Between Insulin Resistance and Co-Exposure to Dioxins and Mercury in Taiwanese Living Near a Deserted Pentachlorophenol and Chloralkali Factory**

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**Background and Objective:** Insulin resistance and the dysfunction of pancreatic b-cells can occur several years before the development of type 2 diabetes. Dioxins and mercury can cause pancreatic endocrine dysfunction in experimental animals. Because humans are exposed to dioxins and mercury primarily in fish that they eat, it is necessary to investigate and clarify the effects of the interaction of these two pollutants on the homeostasis model assessment-insulin resistance (HOMA-IR) and pancreatic  $\beta$ -cell function.

**Methods:** This cross-sectional study investigated 1449 non-diabetic residents near a deserted pentachlorophenol and chloralkali factory. Metabolic syndrome-related factors were measured to examine associations between serum dioxin and blood mercury levels. We also investigated associations between the risk of insulin resistance (HOMA-IR >75th percentile), pancreatic  $\beta$ -cell dysfunction (HOMA  $\beta$ -cell >75th

percentile), serum dioxins, and blood mercury levels and their potential interaction.

**Results:** After adjusting for confounding factors, residents with higher serum dioxin levels or blood mercury levels (reference: <25th percentile; higher: >75th percentile) were at a significant risk for insulin resistance (adjusted odds ratio [AOR] 4.0 [95% CI 2.3–7.3] for dioxins; AOR 2.3 [95% CI 1.5–3.5] for mercury) and HOMA  $\beta$ -cell dysfunction (AOR 2.5 [95% CI 1.4–4.3] only for dioxins). Residents with higher serum PCDD/F and blood mercury levels had a much greater risk of having insulin resistance (AOR 27.3 [95% CI 7.0–129.9]). In addition, participants with higher serum PCDD/F levels, but not for higher blood mercury levels, were at significant risk for having pancreatic  $\beta$ -cell dysfunction (AOR 2.3 [95% CI 1.3–3.9]) versus (AOR 1.0 [95% CI 0.7–1.6]), respectively.

**Conclusion:** We found a significant association between serum PCDD/Fs, blood mercury, and insulin resistance after adjusting for confounding factors: interaction between dioxins, mercury, and insulin resistance exists even in persons without diabetes. Accumulated dioxins and mercury may synergistically increase the risk of developing insulin resistance.

## ISEE-0034

**Interrelationship Between Exposure to Dioxins, Blood Pressure, and Insulin Resistance in Metabolic Syndrome of Non-Diabetics in Taiwan Living Near a Highly Contaminated Area**

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**Background and Objective:** Metabolic syndrome (MetS) is a cluster of metabolic risk factors and a reliable predictor of diabetes and cardiovascular disease. However, little is known on the impact of dioxins on insulin resistance and components of MetS and their interrelationship. The aims of this study were to study the impact of PCDD/Fs on MetS and some of its components (blood pressure and insulin resistance) and examine the associations between the prevalence of MetS, homeostasis-model-assessment insulin resistance (HOMA-IR), and serum PCDD/F concentrations, and their potential interaction.

**Methods:** We investigated MetS-related factors and serum dioxin levels in 1423 non-diabetic persons near a deserted pentachlorophenol factory. We also used factor analysis with a set of core variables considered central features of MetS and dioxins to group similar risk factors. Finally, we investigated associations between the risk of insulin resistance (HOMA-IR >75th percentile), MetS, and serum dioxin levels and their potential interaction.

**Results:** Serum dioxins were significantly increased with the number of MetS components ( $P_{\text{trend}} < 0.05$ ). In factor analysis, four risk factors: lipidemia, blood pressure, body size, and glycemia, accounted for 73.1% of the variance in the 10 core factors in participants and revealed that dioxins were linked to MetS through shared correlations with high blood pressure. After adjusting for confounding factors, participants with higher serum dioxin levels or insulin resistance were at significant risk for having MetS (adjusted odds ratio [AOR] 1.40 [95% CI 1.03–1.90] for dioxins; AOR 6.69 [95% CI 5.03–8.99] for insulin resistance). Participants exposed to higher levels of dioxins and possessed insulin resistance had a much greater risk (AOR 20.1 [95% CI 10.0–43.6]) of having MetS.

**Conclusion:** High-dose exposure to dioxins is suggested to be a blood pressure-related factor which raised MetS risk by modifying the effect of insulin resistance on MetS.



## ISEE-0039

**Monitoring to Resolve the Air Quality-Health Issue**

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**Background and Objective:** A relatively small number of air pollutants are regularly monitored. The “criteria” pollutants are monitored with far greater frequency than others. These measures are supplemented at a limited number of sites by measurements of several particulate matter components. Further supplementation is rare. Epidemiological studies require monitoring data to estimate exposures. Cohort studies require these estimates for locations where study subjects reside; the studies are limited to the air quality components monitored.

**Methods:** A cohort study was undertaken to examine several pollution variables, including those regularly monitored and measures of pollutants less regularly monitored. All pollution variables were related to the mortality experience of the cohort using Poisson regression, adjusting for other factors which influence health status.

**Results:** Initial analyses related the survival status of this group to the “criteria” pollutants; positive associations were found for both ozone and NO<sub>2</sub>. With more extensive particulate matter species data included in the analyses, the “criteria” pollutants were no longer important, and EC, nitrate, vanadium and nickel were of greatest concern. Further analyses were undertaken using estimated concentrations of several hazardous air pollutants variables, derived by US EPA. These analyses pointed to several pollutants which were more important than the previous variables in joint analyses; these pollutants included benzene, formaldehyde, and polycyclic organics, none of which are routinely monitored.

**Conclusion:** Epidemiological studies are limited by available monitoring data. Limited data can affect the ability to find statistically significant relationships as well as the ability to determine the details of these relationships. This may stymie the identification and subsequent control of key air quality components that may cause health impacts.

## ISEE-0041

**Exposure to Suspended Chromium Compounds in Air and Its Association with Urinary  $\beta$ -2-Microglobulin Level among Welders in an Automotive Components Manufacturing Plant, Selangor**

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**Background and Objective:** The main objective of this study is to determine the correlation between suspended chromium concentrations and urinary  $\beta$ -2-microglobulin levels among welders in an automotive components manufacturing plant in Selangor. 49 welders and 39 workers involved in stamping process were selected as the exposed and the comparative group.  $\beta$ -2-microglobulin is a protein renal tubular dysfunction marker that can indicate renal dysfunction caused by heavy metal.

**Methods:** Air samples of worker's breathing zone were collected using personal air sampling pump and filter papers. Filter paper were then diluted and analyzed with Atomic Absorption Spectrophotometry (AAS). Workers urine was collected at the end of 8-hour work shift and analyzed with  $\beta$ -2-microglobulin ELISA Kit (IBL-Hamburg) and a microtiter reader. Meanwhile, creatinine levels were analyzed with creatinine test strips and Reflotron®.

**Results:** Mean concentrations of suspended chromium compounds in air for the exposed group was  $0.135 \pm 0.043 \mu\text{g}/\text{m}^3$  while for the non-exposed group was  $0.124 \pm 0.029 \mu\text{g}/\text{m}^3$ . The mean level of urinary  $\beta$ -2-microglobulin per creatinine for the exposed group was  $84.996 \pm 39.246 \mu\text{g}/\text{g}$  while that of the comparative group was  $61.365 \pm 21.609 \mu\text{g}/\text{g}$ . The concentrations of suspended chromium compounds were higher in the exposed group compared

to the comparative group ( $Z = -2.444$ ,  $P = 0.015$ ).  $\beta$ -2-microglobulin level was also higher in the exposed group compared to the non-exposed group ( $t = 3.821$ ,  $P = <0.001$ ). However, there was no significant correlation between suspended chromium compounds in air and urinary  $\beta$ -2-microglobulin levels ( $r = 0.080$ ,  $P = 0.457$ ) among the respondents. A multiple stepwise regression analysis showed that the most influence variable or confounding factor to  $\beta$ -2-microglobulin level was the education year ( $\beta = -0.020$ ,  $P = 0.010$ ).

**Conclusion:** All respondents were exposed to concentrations of chromium below regulated limit. Years of education seemed to be a secondary factor that influenced  $\beta$ -2-microglobulin level.

## ISEE-0043

**Fish Consumption, Seasonal Variations, and Impact on Hair-Mercury of Subsistence Riverside Dwellers of The Rio Madeira (Amazon)**

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**Background and Objective:** Subsistence riverside dwellers (ribeirinhos) of the Amazon Basin depend on fish for their principal source of protein, but fish availability changes with seasonal high and low waters. We report monthly changes in fish consumption and attendant methyl-mercury (meHg) concentrations and hair-Hg of a traditional village population of the Rio Madeira in Brazilian Amazonia.

**Methods:** A total of 120 villagers in 18 households were followed for six months (August to February) for weighed portions of fish consumed. Mean daily per capita fish-consumption was high (406 g/day) with a household eating a fish meal 4 to 14 times a week; the integrated yearly consumption was estimated at 148.2 kg/person. Carnivorous fish are the major source of meHg, but six of the more consumed fish species contributed the most to Hg exposure: curimatã (*Prochilodus* spp.), pacú (*Mylossoma* spp.), tucunaré (*Cichla monoclus*), cará (*Astronotus* spp.), chora (*Potamorhina* spp.), and jaraquí (*Semaprochilodus ocellaris*) comprised more than 50% of the fish caught and consumed.

**Results:** In these species (as consumed) median total-Hg concentrations ranged from 0.011 to 0.409 ppm. The villagers mean hair-Hg concentration was high ( $17.4 \mu\text{g}\cdot\text{g}^{-1}$ ), with both inter- and intra-household variation despite similar high fish consumption; only 7% showed hair-Hg concentrations  $<5 \mu\text{g}/\text{g}$ , but 75% had hair-Hg levels above  $10 \mu\text{g}/\text{g}$ . However, hair-Hg concentrations were well correlated within families; maternal hair-Hg was significantly correlated with respective children's hair-Hg (Spearman  $r = 0.5390$ ;  $P < 0.0001$ ). Due to high levels of consumption these villagers exceeded recommended Hg exposure in 40 of 45 species regularly consumed, regardless of trophic position in the food web.

**Conclusions:** Although predatory species carry the highest concentrations of Hg, the high daily fish intake of these villagers is predominantly of species with much lower Hg concentrations. Therefore, fish advisories aiming at predatory species may not be effective in lowering hair-Hg of subsistence villagers.

## ISEE-0045

**Pesticide Exposure of Pregnant Women in Guadeloupe: Ability of a Food Frequency Questionnaire to Estimate Blood Concentration of Chlordecone**

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**Background and Objective:** Chlordecone, an environmentally persistent organochlorine insecticide used intensively in banana culture in the French West Indies until 1993, has permanently polluted soils and contaminated foodstuffs. Consumption of contaminated food is the main source of exposure nowadays. Exposure indicators are required to assess its potential health effects today. We sought to validate an exposure indicator based on food intake as an alternative to blood measurements.

**Methods:** We used a food frequency questionnaire completed by a sample of 194 pregnant women to estimate their dietary exposure to chlordecone and compared it to blood levels. In a first approach, chlordecone daily intake was estimated as the product of frequency of consumption of 214 foodstuffs, multiplied by their chlordecone content, and summed over all items. We then predicted individual blood chlordecone levels with empirical weight linear regression models based on frequency of food consumption and without contamination data.

**Results:** Mean blood chlordecone levels were 1.3 ng/mL (range: 0.5–13.2) among the 59% of subjects with detectable values. Mean per capita dietary intake of chlordecone was estimated at  $3.3 \mu\text{g} \cdot \text{day}^{-1}$  (range: 0.1–22.2). Blood chlordecone levels were significantly correlated with food exposure predicted from the empirical weight models ( $r = 0.47$ ,  $P < 0.0001$ ) and, to a lesser extent, with chlordecone intake estimated from food consumption and food contamination data ( $r = 0.16$ ,  $P = 0.03$ ).

**Conclusion:** These results demonstrate that our food frequency questionnaire is able to estimate dietary chlordecone exposure. Estimates from empirical weight models correlated better with blood levels of chlordecone than did estimates from the dietary intake assessment.

#### ISEE-0048

##### Occupational History and Risk of Non-Hodgkin Lymphoma: The Multiethnic Cohort

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**Background and Objective:** Employment in some industries, e.g., farming, and printing, has been associated with Non-Hodgkin Lymphoma (NHL), possibly due to exposure to hazardous chemicals or infectious agents. The objective of this analysis was to explore the relation of occupational history with NHL risk within the Multiethnic Cohort (MEC).

**Methods:** The MEC was established in Hawaii and Los Angeles during 1993–96. After excluding individuals who did not meet study criteria, 87,079 men and 105,972 women of African-American, Caucasian, Japanese, Latino, and Native Hawaiian ancestry, aged 45–75 years, were part of the analysis. All subjects completed a self-administered questionnaire at cohort entry that asked about 9 occupational categories and 13 industries/occupations in which subjects worked 10 years or longer. By 2003, 514 male and 425 female NHL cases were diagnosed. We applied Cox regression with age as the time metric while adjusting for potential confounders.

**Results:** The number of NHL cases who reported working in the different industries was small: 27 were laborers/farmworkers, 42 were craftspersons, and 91 were factory workers, while 525 cases reported office-based occupations. None of the associations with NHL was statistically significant. Compared to all others, the hazard ratio (HR) and 95% confidence interval (CI) for farming and pesticide production combined was  $\text{HR} = 0.87$  (95% CI: 0.60–1.25). The respective HRs for workers in industries exposed to chemicals (textile, plastic, gasoline, chemicals, rubber, paint) and for those reporting other industries (metal production, mining, shipyard, woodworking) were 0.83 (95% CI: 0.63–1.09) and 0.96 (95% CI: 0.73–1.25). Stratification by ethnicity did not result in any significant associations for any ethnic group.

**Conclusions:** We detected no association between NHL and employment in industries with potential exposure to hazardous substances. However, the small number of NHL cases per category and the lack of job details and actual exposures limited this analysis.

#### ISEE-0050

##### Double Burden of Deprivation and High Concentrations of Ambient Air Pollution at the Neighbourhood Scale in Montreal, Canada

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**Background and Objective:** Some neighbourhoods in urban areas are characterised by concentrations of socially and materially deprived populations. Additionally, levels of ambient air pollution can be variable at the local scale, creating disparities in air quality between neighbourhoods. Socioeconomic and physical characteristics of neighbourhood environments can affect the health and well-being of local residents. We identify whether neighbourhoods in Montreal characterised by social and material deprivation have higher levels of ambient air pollution than do others.

**Methods:** We collected two-week integrated samples of nitrogen dioxide ( $\text{NO}_2$ ) at 133 sites across Montreal during three seasons between 2005 and 2006. We used these data in a geographic information system, along with data describing characteristics of land use, roads, and traffic, to create a spatial model of predicted mean annual concentrations of  $\text{NO}_2$  across Montreal. Next, we collected neighbourhood socioeconomic information for 501 census tracts and overlaid their boundaries on the pollution surface. We calculated Pearson correlation coefficients and 95% confidence intervals (CI) between neighbourhood-level indicators of deprivation and levels of pollution.

**Results:** We found associations between  $\text{NO}_2$  and neighbourhood-level indicators of material deprivation, including median household income ( $r = -0.38$ , 95% CI:  $-0.45$ – $-0.30$ ), and with indicators of social deprivation, including proportion of people living alone ( $r = 0.46$ , 95% CI: 0.39–0.53). We identified specific neighbourhoods characterised by a double burden of high levels of deprivation and high concentrations of ambient  $\text{NO}_2$ .

**Conclusion:** Because of the unique social geography in Montreal, we found that not all deprived neighbourhoods had high levels of pollution and that some affluent neighbourhoods in the downtown core had high levels. Our results underscore the importance of considering social contexts in interpreting general associations between social and environmental risks to population health.

#### ISEE-0055

##### Health Impacts of Climate Change: Setting Surveillance Priorities

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**Background:** Climate change will impact human health. At the French Institute for Public Health Surveillance we assessed if our existing surveillance systems would still be efficient in a changing climate, and if new systems should be developed as risks emerge, in order to adapt the public health response.

**Methods:** We assessed flexibility and adaptability of our existing surveillance programmes to monitor and detect changing patterns of diseases which are possibly linked to climate change. We focused on risks commonly identified for European countries, i.e. extreme weather events, vector-borne diseases, and long-term environmental changes. This assessment was based on literature reviews, expert judgment and feedback from situations experienced in France, such as heat waves, floods or emerging infections.

**Results:** Most threats identified are either covered by a monitoring of the risk (e.g. weather events), of the effect or of the exposure. Effects can be monitored through specific systems (e.g. reporting of infectious diseases) or syndromic systems. In addition, direct reporting of unusual health events by clinicians allows for the detection of unexpected threats. Monitoring of behaviours and exposure is less developed. Complex interactions between climate and other health determinants, as well as imprecise geographical and time scales of climate projections, represent major challenges to assess the capacity of existing systems to cope with climate change.

**Conclusion:** While climate change is recognized as a public health priority, the organization of the public health response remains difficult. Many threats are monitored by different programmes, but we still need to strengthen our surveillance systems, to gain knowledge on possible impacts and to foresee which tools could be useful to detect emerging threats. A better knowledge of the exposure patterns would be a key to understand adaptation and should be promoted.

#### ISEE-0060

##### Monetisation Review on Environmental Health Effects in Health Impact Assessments/HIA

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**Background and Objective:** Environmental pollutants can have direct and indirect effects on human health. Moreover there are economic effects, e.g. on health care, productivity, recreation and intrinsic losses through disruption of ecosystems. National and international organisations increasingly request monetisation of such effects for cost-effectiveness or cost-benefit evaluations. While some environmental health professionals regard the valuation of human health as unethical, others consider it a natural (though utilitarian) extension of burden of disease assessments.

Our aim is to review the key monetisation issues and valuation approaches for the economic aspects of traffic health impacts. Secondly, we compare the authors' economic view and the application of willingness-to-pay/WTP approach and Hedonic Pricing/HP approach on different environmental health endpoints.

**Methods:** We performed a search in the main open literature for the past 30 years concerning the monetisation of environmental health effects. Relevant publications were reviewed against a set of key criteria.

**Results:** We retrieved over 250 relevant publications and rapports with a majority of theoretical concepts of monetisation related to traffic, air pollution and noise. After the screening, circa 40% of the studies were used for our paper where we focused on key literature findings regarding the WTP and HP approaches. In less than 10% of the literature original valuation data were collected and applied. The reported monetary values obtained from separate studies vary widely between studies.

**Conclusion:** The findings of a study depend strongly on the type of method utilised to assess the subject's values. According to our theoretical review, the economic values of the subjects, when analysis is performed correctly, can be aggregated to a societal level and are transferable to another similar population. There is a growing trend of applying the WTP method as a means to directly assess the respondent's values on non-marketed goods such as environmental health.

#### ISEE-0062

##### Seasonal Variation in Birth and Diagnosis of Cancer in Children and Young People in Northern England, 1968–2005

Richard McNally, Nermine Basta, Peter James, and Sir Alan Craft, Newcastle University, Newcastle upon Tyne, United Kingdom.

**Background and Objective:** Seasonal variation is consistent with an environmental aetiology. The aim of this study was to investigate seasonal variation in cancer incidence in children and young people, using population-based data.

**Methods:** Data on all cases diagnosed during the period 1968–2005 were extracted from The Northern Region Young Person's Malignant Disease Registry. The following diagnostic groups were analysed: leukaemia, lymphoma, central nervous system tumours, sympathetic nervous system tumours, retinoblastoma, renal tumours, hepatoblastoma, bone tumours, soft tissue sarcoma, germ cell tumours and carcinomas. The chi-squared heterogeneity test was used to test for departure from uniform distribution. Poisson regression analysis was used to fit sinusoidal (harmonic) models to the data, using month of birth and month of diagnosis, respectively, as covariates in separate models. The sinusoidal model assumption was assessed using the chi-square goodness of fit test. Analyses were carried out separately by gender and age group (0–14, 15–24 years).

**Results:** There were a total of 5909 childhood cancer cases; 2959 aged 0–14 years (1659 males, 1300 females) and 2950 aged 15–24 years (1590 males, 1358 females). For 0–14 year old boys, there was statistically significant seasonal variation in month of birth for acute non lymphocytic leukaemia ( $P = 0.04$ ; peak in September) and astrocytoma ( $P = 0.03$ ; peak in October). Based on month of diagnosis, there was statistically significant seasonal variation in girls for lymphomas ( $P = 0.05$ ; peak in March) and Hodgkin lymphoma ( $P < 0.01$ ; peak in January), and in boys for osteosarcoma ( $P = 0.05$ ; peak in October). For 15–24 year olds, significant seasonal variation in month of birth for malignant melanoma in females ( $P = 0.03$ ; peak in March) and cervical carcinoma ( $P = 0.03$ ; peak in October) was observed.

**Conclusion:** These findings suggest that seasonal environmental factors, particularly around the time of birth, such as infections or exposure to sunlight may be involved in the aetiology of specific diagnostic groups.

#### ISEE-0063

##### Incidence of Bronchial Hyperresponsiveness among Apprentices Exposed to Flour Dust and Hairdressing Chemicals and Changes in Exhaled Nitric Oxide

Paul Tossa,\* Christophe Paris,\*† Valérie Demange,‡ Pascal Wild,‡ Stéphanie Acouetey,\* Jean-Pierre Michaely,\* Thomas Remen,\* Abraham Bohadana,\* and Denis Zmirou-Navier,†§ \*Inserm, U954, Nancy, France; †Nancy University, Nancy, France; ‡INRS, Nancy, France; and §EHESP School of Public Health, Rennes, France.

**Background and Objective:** The fractional concentration of exhaled nitric oxide (FENO), a simple, non-invasive and reproducible test, has been used as a surrogate marker of airways inflammation in several studies on asthma. It is still unclear, however, how useful FENO is to investigate occupational asthma (OA) or detect bronchial hyperresponsiveness (BHR).

**Methods:** The association between changes in FENO levels since inception of exposure among bakery, pastry-cooking and hairdressing apprentices and the incidence of BHR was studied along their two-year training programme. At months 3, 9, 15 and 18, on average, after start of the programme, a metacholine challenge and measurement of FENO were performed during a medical visit, with completion of a standardized questionnaire and skin prick tests with common and specific occupational allergens.

**Results:** Among 441 apprentices initially included, 351 completed the study. FENO values are influenced by gender (males>females), atopy (atopics>non atopics), smoking (non smokers>smokers). Increase in FENO values since inception of exposure was associated with the incidence of BHR (OR = 2.00 [95%CI = 1.21–3.32] per unit increase in log ppb), both among atopic and non-atopic volunteers, and was unrelated to past or current smoking habits, gender or training track. Incidence of BHR was also associated with atopy among bakers and pastry cooks

(OR = 2.37 [1.2–4.7]) and skin sensitization to alkaline persulfates among hairdressers ([OR = 4.3 [0.9–21.4]).

**Conclusion:** We conclude that measurement of FENO is a convenient means for early detection of BHR in occupations at risk of asthma. Studies should be undertaken to assess its usefulness as an early marker of non-occupational asthma.

#### ISEE-0068

##### Modelling Gender Specific Exposure to Air Pollution

Luc Int Panis,\*† Carolien Beckx,\* and Geert Wets,† \*VITO, Mol, Flanders, Belgium; and †University of Hasselt, Diepenbeek, Flanders, Belgium.

**Background and Objective:** Most exposure studies take into account the variation in air quality which is provided by models or by kriging of measurements. The spatial and temporal variation in population density is often ignored and exposure is usually based on address data only.

We present an integrated chain of models that enables us to estimate exposure taking into account temporally and spatially resolved information about people's location and pollutant concentrations. We focus on gender specific differences in NO<sub>2</sub> exposure due to different time-activity patterns.

**Methods:** We used the activity-based model Albatross to model activities and trips for all the individuals within the population in The Netherlands for 4000 population zones. Air quality was modeled with AURORA, a 3-dimensional Eulerian model, at a resolution of 3x3 km. Hourly concentration data resulting from the dispersion modeling were combined with hourly population data derived from the activity-based model to provide detailed dynamic exposure assessments.

**Results:** Neglecting people's travel behaviour in NO<sub>2</sub> exposure analysis will underestimate daily exposure by 4% and hourly exposure up to 30% on average. A disaggregated exposure analysis demonstrates that average exposure concentrations of men are generally higher. Differences of up to 12% occur in the morning when men perform activities at locations with higher concentrations than women. The higher exposure of men in the afternoon is explained by the fact that more men than women have a paid job (more women work part-time jobs) and the workplace exposure concentrations are higher. Differences in pollutant intake rate are more explicit when taking into account gender-specific breathing rates.

**Conclusion:** The most interesting feature of activity-based models is their ability to retain demographic and socio-economic data of the people making trips and performing activities. In this way exposure analysis can be disaggregated by different subgroups in the population.

#### ISEE-0069

##### Socio-Economic Class and Exposure to NO<sub>2</sub> Air Pollution in the Netherlands

Luc Int Panis,\*† Carolien Beckx,\* and Geert Wets,† \*VITO, Mol, Flanders, Belgium; and †University of Hasselt, Hasselt, Flanders, Belgium.

**Background and Objective:** Many studies on air pollution ignore the spatial and temporal variation in population density. Newly developed activity-based transport models have the ability to retain demographic and socio-economic data about the people making trips and performing activities in different locations throughout the day. In this way exposure analysis can be disaggregated by subgroups in the population.

**Methods:** The activity-based model Albatross was used to model activities and trips for all individuals in The Netherlands for 4000 population zones. Air quality was modeled with AURORA, a 3-dimensional Eulerian model, at a resolution of 3 × 3 km. Resulting hourly concentration data were combined with hourly population data derived from the activity-based model to provide detailed dynamic exposure

assessments. We focus on specific differences in NO<sub>2</sub> exposure due to different time-activity patterns in different income groups.

**Results:** People belonging to the lowest socio-economic group (income <average) appear to be exposed to slightly higher concentrations of NO<sub>2</sub> throughout the day compared to the highest socio-economic group (income more than double of average), but there is a large variation within the day. Differences of up to 3% in the early morning are statistically significant. This effect is caused by concentration differences between the residential areas of both groups. The opposite effect was found during the morning rush hour. People belonging to the highest income group have a higher exposure at that time, because they are more likely to be driving to work, exposing themselves to higher concentrations in traffic. This offsets most of the difference between both groups and hence the overall (24h) difference between both socio-economic groups is small (0.84%) and not significant.

**Conclusion:** Low income groups are more likely to suffer higher residential exposure to traffic related air pollution, however this effect is offset by lower exposure during morning trips.

#### ISEE-0072

##### Personal Measurements of Ultrafine Particles Are Associated with Decreased Heart Rate Variability

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**Background:** Heart rate variability (HRV) has been associated with cardiovascular disease. Epidemiological studies showed associations between ambient air pollution and changes in HRV. Personal measurements of air pollutants in this context are rare.

**Methods:** We analysed HRV data of ten volunteers measured over 24 hours in Augsburg, Germany. Subjects were fitted with a HOLTER 7-lead-ECG and portable devices measuring their exposure to particulate matter <2.5µm (PM<sub>2.5</sub>), carbon monoxide (CO) and meteorology. Five of them additionally measured particle number concentrations (PNC). Mixed models were used to analyse the association between heart rate, high and low frequency power (HF and LF), standard deviation of all normal-to-normal (NN) intervals (SDNN), the root mean square of successive NN interval differences (RMSSD) and air pollution. A confounder model was built for each outcome separately adjusting for autocorrelation. 5-minute-ECG-data averages were analyzed in association with 5-minute-pollution-lags preceding ECG (lag0: average of 0–4 minutes up to lag11: 55–59 minutes). Results are presented as %-change from the mean per increase in interquartile range of air pollutant.

**Results:** 2,232 5-minute-segments were available for the analysis of PM<sub>2.5</sub> or CO and 474 for PNC. RMSSD decreased with PNC at lag1 (–2.0%[CI:–3.5;–0.5]) up to lag11 (–3.2%[CI:–4.8;–1.7]). HF reacted similarly, however the decrease started with lag3 (–4.7%[CI:–8.6;–0.6]). Both markers also decreased in association with PM<sub>2.5</sub>, but results were inconsistent. No associations were found for CO or other HRV-markers. Sensitivity analyses limited to the five people with PNC measurements showed similar results for PM<sub>2.5</sub>.

**Conclusion:** The unique feature of this study is the continuous personal air pollution measurement directly related to HRV parameters on a 5-minute-basis. Our results show a decrease in parasympathetic activity in association with particles. The immediate reaction may indicate mediation



by the autonomic nervous system in response to direct reflexes from lung receptors.

#### ISEE-0074

##### Residential Traffic and Pregnancy-Related Outcomes in Mother and Child: The Generation R Study

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**Background and Objective:** The effects of ambient air pollution on pregnancy and its outcomes are under debate. Previous studies have used different methods of assessing exposure to air pollution. The considerable traffic-related spatial variation in air pollutant levels needs to be considered in exposure assessment. Residential proximity to traffic is a proxy for traffic-pollutant exposure that takes into account within-city contrasts. We investigated whether residential proximity to traffic is associated with various birth outcomes and maternal pregnancy complications. Additionally, associations between sociodemographic variables and proximity to traffic were evaluated.

**Methods:** We examined data of 7,339 pregnant women and their children in a population-based cohort study. Residential proximity to traffic was estimated using a geographic information system and was defined as 1) cumulative traffic intensity in a 150 meter (m) buffer around the home address, 2) distance-weighted traffic intensity in a 150m buffer, and 3) proximity to a major road. Using linear and logistic regression analysis, we estimated associations of these exposures with birthweight, and with the risks of low birthweight, preterm birth, and small size for gestational age at birth. We also evaluated associations with pregnancy-induced hypertension, (pre)eclampsia, and gestational diabetes. The associations were adjusted for gestational age, gender, parity, maternal age, maternal education, maternal ethnicity and maternal smoking.

**Results:** There were considerable variations in cumulative traffic intensity and distance-weighted traffic. Fifteen percent of the participants lived within 50m of a major road. Maternal age, ethnicity, parity and smoking habits were significantly associated with higher traffic exposure. Proximity to traffic was not associated with pregnancy-related outcomes in mothers and children.

**Conclusion:** Sociodemographic variables were associated with proximity to traffic. Mothers exposed to residential traffic had no higher risk of adverse birth outcomes or pregnancy complications. Future studies should use more detailed data on temporal and spatial exposure in air pollution.

#### ISEE-0076

##### Personal Care Product Use and Endocrine Disrupting Chemicals in Urban Minority Children

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**Background:** Concern about the effects of endocrine disruptors on early child development has increased as information about widespread use and biological activity becomes available. Urinary phthalate concentrations have been associated with personal care product (PCP) use. Parabens are often contained in PCPs; but associations with urinary paraben concentrations have not been examined.

**Methods:** In a cohort study of Hispanic and Black, New York City children ages 6 to 8 years old, parents/guardians were interviewed in-person about their child's environmental exposures and neighborhood characteristics. Child urine samples were analyzed by the CDC for phthalate and phenol metabolites; these were summed on a molar basis and then expressed as ug/L based on MEP, MEHP or propyl paraben. Biomarkers were compared across groups based on frequency of PCP use over the past year (<1, 1–4, or 5–7 days/week). Models were adjusted for age, race/ethnicity, gender, body size, SES, residence type and creatinine. Analyses include data from 406 girls and 102 boys.

**Results:** Products with the highest frequency of use over the past year were body lotion, shampoo, and chapstick (Mean: 5.5, 2.9, 2.6, days/week, respectively). Perfume use was significantly associated with higher monoethyl phthalate concentrations ( $P < 0.0001$ ; 147.1, 171.2, 257.8 ug/L by frequency category of use, respectively). Additionally, more frequent use of lotion was associated with higher paraben concentrations ( $P = 0.01$ ; 61.7, 108.8, and 116.4 ug/L by frequency category of use, respectively). Shampoo use was associated with low molecular weight phthalates ( $P < 0.01$ ). Product use and biomarker levels were also examined in relation to the children's neighborhood environment.

**Conclusion:** Phthalates and parabens have been widely detected in children and our findings indicate that PCPs may be sources of exposure. Therefore, reducing children's PCP use should be considered as a method for decreasing their exposure to these chemicals.

#### ISEE-0077

##### Prenatal Bisphenol A Exposure and Behavioral Problems In Two Year Old Children

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**Background and Significance:** Bisphenol A (BPA) is an estrogenic monomer used to produce polycarbonate plastics and resins and is used in toys, water supply pipes, and medical tubing. Prenatal BPA exposure causes aggression and hyperactivity in rodent offspring, but there are no published human data.

**Methods:** We examined the association between prenatal BPA exposure and behavioral problems in 249 two-year old children. We measured BPA exposure in urine at 16 and 26 weeks gestation and birth. Behavioral problems were measured by parental report using the Behavioral Assessment System for Children-2 (BASC). We examined the association between log transformed creatinine corrected urinary BPA concentrations and externalizing, internalizing and behavior symptom index (BSI) T-scores using linear regression.

**Results:** Creatinine corrected 16 week urinary BPA concentrations were associated with externalizing behavior problems ( $\beta$ : 2.6; 95% confidence interval [CI]: -0.1, 5.3) after adjustment for maternal age, race, education, income, depression, marital status, child sex, and caregiving environment. Sex modified the effect of 16 week BPA exposure. Higher BPA exposure among females was associated with increased externalizing ( $\beta$ : 5.2; 95% CI: 1.4, 8.9), internalizing ( $\beta$ : 2.9; 95% CI: -0.7, 6.4), and BSI ( $\beta$ : 5.0; 95% CI: 1.7, 8.4) T-scores, but not among male children. BASC T-scores were not associated with BPA concentrations at 26 weeks and only moderately associated with birth BPA concentrations.

**Conclusions:** These data suggest that prenatal BPA exposure may be associated with behavior problems in two year olds, but further studies are necessary to examine this relationship in older children when behavioral measures are more stable.

## ISEE-0083

**The Association Between the Daily Minimum Temperature in Summer Seasons and Hospital Emergency Room Visits for Cardiocerebrovascular Diseases: A Case-Crossover Study**

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**Background and Objective:** Temperature is increasingly being recognized as an important determinant of **cardiocerebrovascular** diseases. This study explores the association between the daily minimum temperature in summer seasons and the hospital emergency room visits for **cardiocerebrovascular** diseases in Beijing, China.

**Methods:** The data of the daily hospital emergency room visits for **cardiocerebrovascular** diseases (ICD-10: I00~I99) from one of Peking University Hospitals, the data of relevant air pollution from the Beijing Municipal Environmental Monitoring Center and the data of meteorological index from China meteorological data sharing service system were collected respectively for statistic analysis with conditional logistic regression model, based on time-stratified case-crossover design.

**Results:** After adjusting the level of SO<sub>2</sub>, NO<sub>2</sub>, and PM<sub>10</sub> in the air, the results showed that each 1°C increase in the daily minimum temperature in the summer was positively associated with the intraday hospital emergency room visits of the total **cardiocerebrovascular** diseases ( $P < 0.05$ ) and the value of ORs is 1.039 (95%CI:1.008~1.071). There were no significant associations between the coronary heart disease, cardiac arrhythmia, heart failure disease, cerebrovascular diseases and the daily minimum temperature in the summer ( $P > 0.05$ ). In multi-factor model, considering relative humidity, 1°C increase in the daily minimum temperature was associated with the coronary heart disease (ORs:1.095, 95%CI:1.001~1.075) and the cerebrovascular diseases (ORs:1.050, 95%CI:1.002~1.100) ( $P < 0.05$ ) respectively.

**Conclusion:** The increase of daily minimum temperature in the summer can raise the hospital emergency room visits of the total **cardiocerebrovascular** diseases, and the coronary heart disease and cerebrovascular diseases together with relative humidity.

## ISEE-0090

**Respiratory Symptoms and Ventilatory Capacity in Metal Polishers**

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**Abstract:** To evaluate the long term effects of metal dusts on the bronchopulmonary system and the synergistic effect of cigarette smoke, a comparative study of spirometric measurements in 104 polishers and 90 unexposed controls was carried out in 25 brass and steelware polishing industries at Moradabad in northern India. The two groups were comparable in terms of age, height, smoking habit and socio-economic status. A total of 58.6% of the polishers had one or more respiratory symptoms, compared to only 25.5% of the controls ( $P < 0.05$ ). Chronic cough was present in 21 polishers (20.2%) as compared to 11.1% of the controls. However, this difference was insignificant. Chronic phlegm was nearly three times as frequent among the polishers as among the controls (17.5% vs 4.4%) ( $P < 0.005$ ). The prevalence of dyspnoea of varying grades was also significantly higher (16.3% as opposed to 4.4%) among the exposed groups. Chronic bronchitis (6.7%) and occupational asthma (4.8%) were found to be confined to polishers. The polishers also experienced acute respiratory symptoms during the work shift. Comparison of the mean values of pulmonary function parameters in the polishers and the controls showed significant differences in the smoking

and non-smoking groups. ( $P < 0.001$ ). The polishers exhibited significantly greater acute reductions in various lung functions over the work shift, particularly for forced expiratory flow over the 25–75% portion of the spirogram (FEF25–75%) FEF25% and FEF50%, than did the controls. Among the exposed group, the acute changes in lung function were found to be significantly larger in the smoking than in the non-smoking polishers. Polishers who were exposed to dusts of various metals for more than 10 years showed a significantly greater acute reduction in all pulmonary function tests ( $P < 0.001$ ) thereby indicating that occupational exposure to multiple metals in the work environment of the polishing industry had deleterious respiratory effects.

## ISEE-0093

**Prenatal Pesticide Exposure as Predictor of Neurobehavioural Deficits and Increased Blood Pressure at School Age: Part of a Silent Pandemic?**

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**Background and Objectives:** Pesticides may be neurotoxic, but the risks caused by prenatal exposures are unclear. The objective of this study was to ascertain neurobehavioral function in children at school age in relation to prenatal pesticide exposure from maternal greenhouse work.

**Methods:** The study was based in Tabacundo in northern Ecuador where floriculture is intensive and the female employment rate is high. We invited 87 children attending the first and second grades in the local public school for clinical testing, which included neurophysiologic (heart rate variability, brainstem evoked potentials) and neuropsychological tests. Maternal interview was conducted to obtain past medical history and occupational history, with emphasis on pesticide exposure during pregnancy. The children's current pesticide exposure was assessed from the urinary excretion of organophosphate metabolites and the erythrocyte cholinesterase activity.

**Results:** Of 85 participants, 35 were exposed to pesticides during pregnancy because of maternal exposure, and 23 had indirect exposure from paternal work. Twenty-two children showed detectable current exposure. Only children with prenatal exposure showed consistent deficits in neuropsychological outcomes after covariate adjustment, which included stunting and socioeconomic variables. Pesticide effects were the strongest on motor speed (Finger Tapping: beta (SD) = -4.7 (2.3)); visual performance (Stanford-Binet Copying: beta (SD) = 0.47 (0.24)); and visual memory (Stanford-Binet Recall: OR (95% CI) = 7.0 (1.1–45)). Among other outcomes studied, only systolic blood pressure (beta (SD) = 4.5 (2.2)) was significantly associated with prenatal pesticide exposure.

**Conclusion:** These findings support the notion that prenatal exposure to pesticides – at levels not causing adverse effects in the mother – can cause lasting adverse effects on brain development. These effects may have long-term health consequences that may include increased risk of cardiovascular disease. Pesticide exposure therefore seems to contribute to a silent pandemic of developmental neurotoxicity.

## ISEE-0095

**Individual Exposure Modelling in an Integrated Decision Support System for Air Quality Management**

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University of Muenster, Muenster, Germany; and §Norwegian Institute for Air Research, Kjeller, Norway.

**Background and Objective:** Air pollution reduction strategies need to be considered on a European level to account for long-range transboundary transport. Health impact assessments have, thus, been based on ambient concentrations. Currently, such assessments do not consider the actual exposure of individuals, i.e. the time-weighted concentration from exposure in all the microenvironments visited by a person. This study estimates the average individual exposure to fine particles (PM<sub>2.5</sub>) for European population in a spatially explicit way using the integrated decision support system EcoSense.

**Methods:** Exposure scaling factors (ESF) were developed per country and subgroup and multiplied by yearly averages of the ambient air pollutant levels to yield a distribution of exposures in the population. Using Monte Carlo methods, distributions of the fractions of time spent in different microenvironments were multiplied by distributions of fine particle infiltration factors from outdoor to indoor micro-environments and summed to produce the ESF. EcoSense applies the ESFs to the ambient air concentration and the population per subgroup in each grid cell (50 x 50 km) within Europe.

**Results:** Preliminary estimates of ESFs indicate that Southern countries are likely to have higher ESFs. Mean (SD) ESFs were e.g. 0.71(0.21) for Helsinki, 0.85(0.17) for Athens, 0.70(0.26) for Oxford, and 0.77(0.19) for Prague. Preliminary individual exposure estimates show that men are exposed more than women in general, elderly people less than the working age population (15–65); highest exposure applies for men 15–65 years, lowest for women 65+. Differences between countries are higher than between subgroups.

**Conclusion:** Population average individual exposure modelling allows for examination of potential changes in exposure due to the implementation of policy measures; and serves as a basis for further research in epidemiology to explore the possibilities of developing exposure response functions based on exposure rather than on ambient concentrations.

#### ISEE-0102

##### Air Pollution and Community Health: Quantifying Acute Cardio-Respiratory Events Attributable to SO<sub>2</sub> and NO<sub>2</sub> Exposure

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**Background and Objective:** Measuring health effects attributable to air pollution is challenging in low-pollution areas. We quantified the community-based burden of acute cardiac and respiratory disease caused by exposure to SO<sub>2</sub> and NO<sub>2</sub> in a non-industrial coastal Mediterranean environment.

**Methods:** Continuous NO<sub>2</sub>, SO<sub>2</sub> and particulate matter concentrations, temperature, precipitation, and wind direction were drawn from 18 regional monitoring stations and pooled by consecutive 12-hour periods for the interval between January 2000 and December 2006. Outcomes included physician-patient encounters due to acute cardiac and respiratory syndromes at 9 primary-care community clinics, and a regional hospital emergency department (ED). For each 12-hour period, pollutants were introduced as independent exposure variables, adjusted for meteorological variables, seasonality, weekday/weekends/holidays, day/night, precipitation and wind speed. The association between exposures and outcomes was analyzed using multivariate Poisson regression models and negative binomial models fitted for over-distributed community data.

**Results:** The data-base included 5,113 half-days, ~700,000 ED records, and ~1,100,000 community clinic visits. Both NO<sub>2</sub> and SO<sub>2</sub> were

associated with increased overall cardio-respiratory ED patient volumes (RR = 1.005 [1.003–1.008] for SO<sub>2</sub>, 1.002 [1.001–1.003] for NO<sub>2</sub>). For community clinics, NO<sub>2</sub> was significantly associated with increased patient load (RR = 1.005 [1.002–1.008]), but SO<sub>2</sub> was not (RR = 1.006 [0.996–1.016]). Population attributable fractions for both pollutants were substantial. Each 10 µg/m<sup>3</sup> increase in SO<sub>2</sub> and NO<sub>2</sub> concentrations increased ED patient volume by 4.76% and 1.96%, respectively; this same increase in NO<sub>2</sub> also increased community visit volume by 4.76%. Weaker associations were observed when a 12hr lag period was introduced. A strong confounding effect was noted for the effect of daytime/nighttime on the association between exposure and outcome, rendering crucial analysis by 12-hour period.

**Conclusion:** The observed association between SO<sub>2</sub> and NO<sub>2</sub> concentrations and increased cardio-respiratory patient load demonstrates these pollutants' substantial impact on population health, even in low-pollution areas.

#### ISEE-0103

##### Long-Term Exposure to Traffic-Related Air Pollution and Mild Cognitive Impairment in the Elderly

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**Background and Objective:** Animal studies have suggested that fine particulate matter (PM) can translocate from the upper respiratory tract to the brain and cause brain inflammation. Brain inflammation is involved in the pathogenesis of neurodegenerative diseases. Hypothesizing therefore that long-term exposure to fine PM might contribute to the development of Alzheimer's disease (AD), the objective of this study is to investigate the association between exposure to fine PM and mild cognitive impairment (MCI) which is associated with a high risk of progression to AD.

**Methods:** A study group of 399 women aged 68–79 years who lived for more than 20 years at the same residential address has been assessed for long-term exposure to PM and tested for MCI. The exposure assessment comprised background concentration of PM<sub>10</sub> and traffic-related air pollution indicated by the distance of the residential address to the next busy road with a traffic density of more than 10,000 cars per day. The women were assessed for MCI by a battery of several neuropsychological tests and a test for their odour identification ability. Current emotional state was tested using CES Depression Scale. Information on other potential confounders (chronic diseases, smoking, indoor sources of air pollution, educational level) was provided by standardized interview.

**Results:** Consistent effects of traffic-related air pollution exposure on test performances were found, but no effects of PM<sub>10</sub> background exposure. The test scores were significantly reduced if the participant's residential address was within a distance range of 50 meters to the next busy road. Also, a dose-response relation between distance to road traffic and test performance was observed. The associations were adjusted for potential confounders using regression analysis.

**Conclusion:** These results indicate that chronic exposure to traffic-related air pollution, essentially fine PM, may be involved in the pathogenesis of AD.

#### ISEE-0104

##### Diurnal Apparent Temperature Range and Socioeconomic Vulnerability in Seoul, Korea

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**Background and Objective:** Rapid temperature changes within a single day may be critical for populations vulnerable to thermal stress who have difficulty adjusting themselves behaviorally and physiologically. We



hypothesized that the diurnal apparent temperature range (DATR) within 1 day was associated with cause-specific mortality, and its association was modified by determinants of vulnerability and season. We examined the association between temperature and cause-specific mortality and effects of season and individual socioeconomic status (SES) on the DATR and mortality in Seoul, Korea, from 2000 to 2005.

**Methods:** We applied generalized adaptive Poisson regression models adjusting for influenza epidemics, day of the week, seasonal trends, PM<sub>10</sub> concentrations, and apparent temperature. A total of 204,126 non-accidental deaths were included.

**Results:** The effects of DATR on cardiovascular mortality were greatest in the spring/fall, while the greatest effects on respiratory mortality were in the spring/fall and winter. One degree Celsius increase in the DATR in the spring/fall corresponded to a 1.19% increase in cardiovascular mortality [95% confidence interval (CI), 0.45%–1.93%] in a time series analysis in Seoul, Korea. Increases in respiratory in the spring/fall and the winter due to DATR were 2.53% (95% CI, 0.24–4.87) and 2.74% (95% CI, 0.21–5.34), respectively. Disadvantaged groups such as the elderly and the less educated were found to be the most vulnerable groups to DATR for both cardiovascular and respiratory mortality.

**Conclusion:** Diurnal apparent temperature range was a strong predictor of mortality, independent of apparent temperature. Furthermore, DATR effects differed by season and individual SES.

#### ISEE-0109

##### Impairment of Infant Behaviour by Polychlorinated Biphenyls (PCBs): Physiologically-Based Pharmacokinetic (PBPK) Modeling Reveals a Critical Time Window for Postnatal Exposure

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**Background and Objectives:** Postnatal exposure to PCBs can impair behavioural processes in animal models at doses within the range of human exposure. To date, no clear conclusion can be drawn from epidemiologic studies regarding the impact of lactational exposure to PCBs on infant development. Discrepancies between studies may be due to the limitations of traditional approaches in estimating postnatal exposure, namely through snapshot measures of breast milk levels and breast-feeding duration. Our study evaluated the impact of postnatal exposure to PCBs on infant activity and attention using simulated early-life toxicokinetic profiles.

**Methods:** A previously validated PBPK model was used to simulate blood PCB-153 levels throughout the first year of life for infants enrolled in a Northern Quebec Inuit longitudinal birth cohort. Monthly area under the curve (AUC) estimates were examined in relation to attention (rate and duration of inattention) and activity (rate and duration of movements) during the 11-month Bayley Scales of Infant Development assessment through multiple regression analysis.

**Results:** We observed significant ( $P < 0.05$ ) dose-dependent increases in infant activity at 11 months in relation to AUC estimates within the 1–7 month time window. Exposure during the 4th month displayed the strongest association with this outcome (adjusted  $\beta = 0.275$ ). No association was detected with indicators of attention. When these two behavioural endpoints were examined in relation to traditional estimates of pre- and postnatal exposure, no association was found.

**Conclusions:** We found a robust dose-dependent association between increased infant activity at 11 months of age and exposure to PCB-153

during a specific time window. To our knowledge, this is the first study to use PBPK modeling to assess the impact of postnatal exposure to persistent organic pollutants on infants' health. These results provide new evidence that postnatal exposure to PCBs may impair infant behaviour.

#### ISEE-0111

##### Which Days of Hot Weather Are Considered Dangerous by Heat-Health Watch Warning Systems?: A Comparison of the Predictive Capacity of Different Systems

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**Background and Objective:** Prompted by growing concerns about global warming, many countries worldwide have introduced Heat Health Warning Systems (HHWS) to minimize the public health impacts of exposure to hot weather. These systems issue alerts in response to forecasts of adverse weather conditions. Fundamentally different approaches are currently in place in the various HHWS systems around the world in terms of setting the thresholds of weather parameters which, when forecast to be breached, are expected to be associated with unacceptable levels of adverse health impacts. We compared the alternate approaches for setting HHWS thresholds as measured by how well they predicted heat-associated mortality in a common set of historical weather and mortality records.

**Methods:** Four different threshold-setting approaches which are currently in operation in HHWS were compared:

- Synoptic classification into air-mass types.
- Epidemiological analysis of retrospective data.
- Physiologic approach based on heat-budget models.
- Empiric set of temperature/humidity indices, e.g. Humidex.

Each approach was calibrated on four 10-year datasets of daily temperature and mortality counts (Chicago, London, Madrid, Montreal) in order to identify the weather conditions associated with adverse health impacts. These parameters were then applied to a further set of 10-year weather only data to provide a ranking of the top 50 most "heat adverse" days occurring in this second dataset as identified by each separate approach. The extent of overlap in the 50 days identified across the approaches was assessed; and temperature, observed mortality, and excess mortality occurring on the identified days was compared.

**Results:** In each of the 4 cities, there was very little agreement in the most "heat adverse" days identified across the four approaches.

**Conclusion:** The identification of "heat adverse" days, and therefore the days on which an alert is called and protection measures initiated, is very dependant on the particular approach used to establish the thresholds.

#### ISEE-0112

##### Environmental Determinants of Diarrhea among Under-Five Children in Nekemte Town, Western Ethiopia

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**Background and Objective:** Though the relationship between environmental risk factors and the occurrence of diarrhea in children has been documented elsewhere, there are limited studies in Ethiopia in general and in Nekemte Town in particular. The present study assessed

the prevalence and environmental determinants of under-five diarrheal morbidity.

**Methods:** A community-based cross-sectional study was conducted in Nekemte town from October 15–November 26, 2007. The study population constituted four hundred and seventy seven mothers/ care takers of index under-five children living in households selected randomly from kebeles in the town. Data was collected using a structured and pre-tested questionnaire, which was then entered onto a computer and edited and analyzed using SPSS for Windows version 12.0.1. The Stepwise logistic regression model was used to calculate the odds ratios and 95% confidence interval for the different risk factors.

**Results:** Out of 477 sampled caretaker-child pairs, 461 participated in the study giving a response rate of 96.6%. The mean ages of the respondents and the index children were 32.4 (+8.8 SD) years and 25.27 (+15.16 SD) months, respectively. Prevalence of diarrheal morbidity over a period of two weeks preceding the study was about 28.9%. In the Bivariate analysis, a number of risk factors including distance from drinking water sources (time taken to-and-from the sources), availability & ownership of the latrine, refuse disposal, the presence of feces around the pit-hole ( $P < 0.001$ ) and presence or absence of pit-hole cover & feces seen in the compound ( $P < 0.05$ ) appeared to be significantly associated with under-five childhood diarrheal morbidity. However, absence of a refuse disposal facility and presence of feces around the pit-hole were the only significant variables on multivariate analyses ( $P < 0.05$ ).

**Conclusion:** As diarrheal morbidity is a major problem among under-five children in Nekemte town, appropriate intervention programs, targeting availability of refuse disposal facilities and care of latrines, should be designed.

#### ISEE-0113

##### Assessing Vulnerability to Heat Stress in Urban Areas. The Example of Greater London

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**Background and Objective:** Increasing mortality related to periods of hot weather is a direct health impact from a warming and more variable climate. Adverse health impacts of heat stress are preventable. To spatially assess vulnerability is useful to prioritize where to take action first. This work aims at developing and testing a vulnerability index to assess hot spots of vulnerability to heat stress in the urban area of Greater London.

**Methods:** A vulnerability index to estimate the vulnerability to heat stress in urban areas has been developed. Therefore, routine data on a high spatial resolution and representing the risk factors as identified in the literature are mapped. With Principal Component Analysis the most relevant of these indicators are composed to a vulnerability index. To test the performance of the vulnerability index, daily data on temperature and spatial data on daily mortality and ambulance callout are used in a Poisson regression model.

**Results:** The comparison of groups of districts with the same level of vulnerability results in an increase in risk of death in summer by 9% for vulnerability score 2 compared to score 1 (lowest vulnerability), 16% for score 3 and constantly increases to 85% increased risk of death for districts with a score of 10 (highest vulnerability). The testing of the vulnerability score with ambulance call data results in an increase of risk from score 1 to 2 is 18%, 24% for score 3, 59% for score 4 and reaches an increase of 165% for score 10.

**Conclusion:** The work shows that it is possible to model hot spots of vulnerability in terms of increased mortality and a higher number of ambulance callouts. The results encourage further work on hot spot

analysis to better target intervention measures, but also to look into risk perception and decomposing inequalities.

#### ISEE-0115

##### Soil Health and Food Production: The Case of Corn Crop Yields in Zapopan, México

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**Background and Objective:** Soil health is the continuous ability of soil to sustain biologic productivity, air and water quality and contribute to human, plant and animal health.

The objective of this study, conducted in Zapopan, Mexico, is to confirm the link between the loss of soil health and loss of the ability to produce food.

**Methods:** Various types of soil degradation were assessed. Once the relevance of each had been determined, as related to the affected area, we considered which type is associated to the loss of soil health as calculated by the reduction in corn yield. 46 samples were taken, both of soil and of corn yield. Correlation and regression analysis were used.

**Results:** The area experiences 31% chemical degradation, 7% water erosion, 10% biological and 36% from physical degradation. Of all types of degradation, aluminum release was the one that showed the highest correlation with corn yield. Acid levels brought on by the excessive use of nitrogenous fertilizers has reduced the pH of the soil from 5.9 to 4.3. Corn yield is affected starting at 1.0 meq of aluminum/100g, which is equivalent to a pH value of 4.7; thus, we can consider that the presence of this metal at such values is an indicator of the loss of health soil. The relation of pH and exchangeable aluminum was  $-0.79$ , with the equation:  $\text{Log } Y = 10.32 (\log x) + 6.91$ ; where:  $Y$  = exchangeable aluminum, and  $x$  = pH. The reduction in corn yield averages from 3.0 tons per hectare on average to 1.7 tons for this effect associated to the loss of health soil.

**Conclusion:** It is important to analyze the subject of food production linked to human welfare as a service of the ecosystem, and that food supply depends on a healthy soil.

#### ISEE-0117

##### Proximity to Wood Factories and Respiratory Health Risks: The Viadana Study

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**Background:** Formaldehyde is an industrial chemical, largely used in wood industry. Both formaldehyde and wood dust are well-known irritants and suspected carcinogens. Few studies have addressed the effects of outdoor exposure to these pollutants in the general population or in children.

**Aims:** To assess the effect of the exposure to pollutants emitted by several local wood factories on respiratory health in children living in the Viadana district (Northern Italy). The exposure was assessed using the residential proximity to the local wood furniture factories, the main source of formaldehyde and wood dust in the area.

**Methods:** All children aged 3–14 attending school in the district were administered a standardized parental questionnaire to determine the prevalence of respiratory and irritation symptoms. 3,854 questionnaires were collected. The minimum distance (km) from each child's home to the closest factory and the number of factories within a 2 km radius were used as proxies of exposure. The association between symptoms and exposure was assessed using logistic regression adjusting for potential confounders.

**Results:** We found a statistically significant association between the reduction in the risk of wheezing (OR = 0.94[0.89, 0.99]), dry cough (OR = 0.96[0.93, 0.99]) and phlegm (OR = 0.91[0.86, 0.97]) with an increased distance from factories. Children living within a 2 km radius around at least one factory, compared to children living far away, have higher prevalence of chest constriction (4% vs. 2%,  $P = 0.03$ ), dry cough (33% vs. 28%,  $P = 0.09$ ), cough (8% vs. 7%,  $P = 0.04$ ) and phlegm (8% vs. 6%,  $P = 0.004$ ) and this risk increased according to the number of factories in a radius of 2 km.

**Conclusion:** Residential proximity is associated with an increasing risk of respiratory symptoms in children.

#### ISEE-0118

##### Characterization of 24-H Exposure to Power Frequency Magnetic Field in Schoolchildren

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**Background and Objective:** Level of agreement between spot or short-term exposure and 24-h exposure to extremely-low-frequency magnetic field (ELF-MF) varies between studies. Also little is known about the inter-correlations between various measures frequently used to summarize ELF-MF exposure measured over a longer period of time. This study aims to characterize schoolchildren's ELF-MF exposure at different time periods during a day, and to assess the inter-correlations among various measures that summarize 24-h exposure.

**Methods:** Data was obtained from 227 elementary schoolchildren who wore a dosimeter for 24-h, and then split into parts according to several predetermined time periods during the day. The arithmetic mean (AM) was calculated for 24-h and for each time period individually. Various 24-h summary measures including geometric means (GM), arithmetic standard deviations (ASD), geometric standard deviations (GSD), coefficient of variation (CV), rate of change metric (RC), and proportions of time >4 mG were also calculated. Spearman correlation coefficient was used to indicate the correlations between summary measures.

**Results:** The average 24-h AM was estimated at  $1.76 \pm 1.77$  mG for the study schoolchildren, with the highest ( $2.52 \pm 3.79$  mG) and lowest ( $1.24 \pm 1.16$  mG) AM noted for after-school care centers and the outdoor area in campus, respectively. Exposure for non-school hours showed stronger associations ( $r = 0.64$ – $0.66$ ) with 24-h exposure. Additionally, AM was highly correlated with GM ( $r = 0.92$ ) and with proportion of time >4 mG ( $r = 0.83$ ), but was weakly correlated with the other summary measures, with a coefficient ranging from  $-0.26$  (CV) to  $0.7$  (ASD).

**Conclusions:** Schoolchildren's exposure to ELF-MF at after-school care centers was high in this urban sample. Additionally, exposure at sleep hours can best predict 24-h exposure. Both intensity and dispersion 24-h summary measures should be calculated simultaneously in order to better characterize schoolchildren's 24-h exposure.

#### ISEE-0126

##### Dioxin Exposure and Puberty Onset Among Russian Boys

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Consulting, Inc., Jasper, GA, United States; and ††Centers for Disease Control and Prevention, Atlanta, GA, United States.

**Background:** Animal models and limited human data suggest associations of exposure to dioxins, furans, and PCBs with altered growth and puberty.

**Objective:** We assessed the association of peri-pubertal dioxin exposures with puberty onset among 482 boys from a longitudinal study of environmental contaminants and male development in Chapaevsk, Russia where environmental dioxin levels are high.

**Methods:** Annual assessments of Tanner staging and testicular volume were conducted between ages 8–12 years. Puberty onset was defined as stages 2 or higher for Genitalia (G2+) or Pubic hair (P2+), or testicular volume (TV) >3 ml. Serum dioxin, furan, and PCB levels at enrollment (8–9 years) were analyzed by the CDC, Atlanta, GA; total TEQ (pg/g lipid) values were log transformed to approximate a normal distribution. Cox proportional hazards models were used to assess risk of puberty onset as a function of exposure adjusted for potential confounders.

**Results:** The median (range) total serum TEQ level at age 8–9 years was 21.1 (4.0 to 174.7) pg/g lipid, about threefold higher than levels among similar aged U.S. and western European children. The boys' mean (SD) birth weight was 3335 (53) gm and Body Mass Index (BMI) at enrollment was 15.9 (2.3) kg/m<sup>2</sup>. At 8 years, 22% had entered puberty by G2+ criteria but only 12% and 4% had entered by respective TV or P2+ criteria. Each log increase in total serum TEQs at age 8 or 9 was associated with a decreased risk of puberty onset for G2+ (hazard ratio (HR) = 0.66, 95% CI 0.45, 0.98), TV (HR = 0.58, 95% CI 0.38, 0.89), and P2+ (HR = 0.76, 95% CI 0.40, 1.45) over three years of follow-up. Effect estimates were attenuated and non-significant after adjustment for baseline growth measures (e.g., BMI) possibly on the causal pathway.

**Conclusion:** These data support a relation of peri-pubertal dioxin exposure with later pubertal onset in boys.

#### ISEE-0128

##### Cumulative Lead Exposure and the Risk of Tooth Loss in Men: The Normative Aging Study

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**Background:** Individuals previously exposed to lead remain at risk due to endogenous release of lead stored in their skeletal compartment. Studies exploring the oral health effects of lead exposure have focused primarily on dental caries and periodontal disease, and it is not known if long-term cumulative lead exposure is a risk factor for tooth loss.

**Objective:** The aim of this study was to examine the association of bone lead concentrations with loss of natural teeth.

**Methods:** We examined 333 men enrolled in the Veterans Affairs Normative Aging Study. We used a validated K-shell X-ray fluorescence method to measure lead concentrations in the tibial midshaft and patella, and lead concentrations in blood were measured using graphite furnace atomic absorption spectroscopy. A dentist recorded the number of teeth remaining, and tooth loss was categorized as 0, 1–8 or >8 missing teeth. We used proportional odds models to estimate the association of bone lead biomarkers with tooth loss, adjusting for age, smoking, diabetes and other putative confounders.

**Results:** Participants with >8 missing teeth had significantly higher bone lead concentrations compared with those who had not experienced tooth



loss. In multivariable-adjusted analyses, men in the highest tertile of tibia lead ( $>23 \mu\text{g/g}$ ) and patella lead ( $>36 \mu\text{g/g}$ ) were approximately three times as likely to have tooth loss ( $>8$  vs  $0-8$ , or  $>0$  vs  $0$  missing teeth) compared with those in the lowest tertile (odds ratio [OR] = 2.99; 95% confidence interval [CI]: 1.58–5.67 and OR = 2.41; 95% CI: 1.30–4.48, respectively). Associations of bone lead biomarkers with tooth loss were similar in magnitude to the increased risk observed in participants who were current smokers. No significant association was observed between blood lead concentrations and tooth loss.

**Conclusion:** Long-term cumulative lead exposure is associated with increased odds of tooth loss.

#### ISEE-0130

##### Air Pollution Causes Oxidative Stress in School Children

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**Background:** Air pollution has been known to contribute to respiratory and cardiovascular mortality and morbidity. Oxidative stress was suggested as one of the main mechanisms. The aim of this study is to analyse the effect of exposure to particulates ( $\text{PM}_{10}$  and  $\text{PM}_{2.5}$ ) and polycyclic aromatic hydrocarbons (PAH) on urinary concentration of MDA in school children.

**Method:** The study population consists of 120 school children. Survey and measurements were conducted in 4 cities in China (Alachan and Beijing) and Korea (Jeju and Seoul) between June 4th and 9th, 2007. In each city, 30 children were recruited for the study. We measured daily ambient level of particulates and their metal components near the schools of the children during the study period. We measured urinary 1-OHP and 2-naphthol to assess PAH exposure, and measured urinary MDA for oxidative stress in the children. Repeated measurements were conducted once a day for 5 days. We constructed linear mixed model after adjusting individual variables to estimate the effects of particulates and PAH on oxidative stress.

**Results:** There were statistically significant positive associations between urinary MDA level and ambient concentrations of particulates from the present day to the 3 lagged days ( $P < 0.001$ ). Urinary 1-OHP level also showed a positive association with urinary MDA level and it was statistically significant with or without particulates in the model ( $P < 0.01$ ). The metal components of  $\text{PM}_{2.5}$  (Al, Cu, As, Sr, Cd, Hg, Mg, Ca, Fe, Zn, Ba, Mo, Pb) and  $\text{PM}_{10}$  (Al, Cu, Zn, As, Sr, Ba, Cd, Mg, Fe, Si, Pb, Hg, Mn) were also found to have significant associations with urinary MDA level. However, there was no significant interaction between exposure to particulates and PAH biomarkers on urinary MDA level.

**Conclusion:** The present study shows that exposures to particulates and PAH independently cause oxidative stress in school children.

#### ISEE-0131

##### The Temporal Pattern of Mortality Responses to Ambient Ozone in the APHEA Project

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**Objective:** We investigated the temporal pattern in health effects of exposure to summertime ozone ( $\text{O}_3$ ) on total, cardiovascular and respiratory mortality in 21 European cities participating in the APHEA-2 project. The temporal pattern of effects is fundamental in assessing the public health importance of the exposure, as it determines whether air pollution has only a transient effect – bringing forward the date of death in a frail individual by a day or two or whether it is responsible for causing death in subjects that would survive if not exposed.

**Methods:** The association was examined using hierarchical models implemented in two stages. In the first stage data from each city were analyzed separately using distributed lag models with up to 21 lags. In the second stage the city specific air pollution estimates were regressed on city specific covariates to obtain overall estimates and to explore sources of possible heterogeneity.

**Results:** We found stronger associations with respiratory mortality that extend to a period of two weeks. A  $10 \mu\text{g/m}^3$  increase in  $\text{O}_3$  was associated with 0.36% (95%CI:  $-0.21, 0.94$ ) increase in respiratory deaths for lag 0 and with 3.35% (95% CI: 1.90, 4.83) for lags 0–20. We also found significant adverse health effects of summer  $\text{O}_3$  (June–August) on total and cardiovascular mortality that persist up to a week, but are counterbalanced by negative effects thereafter. Thus, there was indication of mortality displacement for total and cardiovascular mortality but not for respiratory.

**Conclusion:** Our results indicate that studies on health effects of short term exposure to  $\text{O}_3$  using single day exposures may have found effects on total and cardiovascular mortality largely due to short term harvesting, whereas they probably underestimated effects on respiratory mortality.

#### ISEE-0133

##### Susceptibility Factors to Ozone-Related Mortality—A Population-Based Case-Crossover Analysis

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**Background and Objective:** Acute effects of ozone on mortality have been extensively documented in clinical and epidemiological research. However, few studies have focused on subgroups of the population

especially vulnerable to these effects. The objective of the study is to estimate the association between cause-specific mortality and exposure to ozone, and to evaluate whether individual socio-demographic or chronic conditions present greater susceptibility to adverse effects of ozone.

**Methods:** A case-crossover analysis was conducted in 10 Italian cities to evaluate individual effect modifiers of the ozone-mortality association. Data on mortality and air pollution exposure were collected for the period 2001–2005 (April to September), for 129,026 deceased subjects. Individual information was retrieved on cause of death, socio-demographic characteristics, chronic conditions from previous hospital admissions, and place of death.

**Results:** We estimated a 1.54% (95% confidence interval, CI, 0.92–2.15) increase in total mortality for 10  $\mu\text{g}/\text{m}^3$  increase in ozone (8-hour, lag 0–5). The association had a prolonged lag for total, cardiac and respiratory mortality (lag 0–5), while there was a suggestion of a delayed effect on mortality from cerebrovascular causes (lag 3–5). No important confounding effect of  $\text{PM}_{10}$  or  $\text{NO}_2$  was found. In the subgroup analysis, the effect was more pronounced among the elderly over 85 years of age (3.51%, 95% CI 2.41–4.62), women (2.25%, 95% CI 1.37–3.14), and for people who died outside the hospital (2.10%, 95% CI 1.05–3.17), especially diabetics (5.53%, 95% CI 1.39–9.84).

**Conclusion:** A strong effect of ozone on mortality has been found in Italian cities. Greater vulnerability was confirmed for women and elderly; other subgroups of the population emerged as especially affected, in particular chronically ill house-bound and diabetics.

#### ISEE-0138

##### A Case-Crossover Analysis on the Association of Daily Maximum Temperature with Daily Hospital Emergency Room Visits for Cardiovascular and Cerebrovascular Diseases

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**Background and Objective:** In recent years due to global warming and heatwaves, there is more and more concern by both governments and researchers of most countries, including China, on the potential health consequences. This study explores the association between the daily maximum temperature and hospital emergency room visits for cardiovascular and cerebrovascular disease (ICD-10: I00–I99) in different seasons in Beijing, China.

**Method:** The data of the daily hospital emergency room visits for cardiovascular and cerebrovascular disease (ICD-10: I00–I99) from one of Peking University Hospitals in Haidian District of Beijing, China during 2004–2008, and the corresponding meteorological and air pollution data were collected. The seasonal-stratified case-crossover design, and Logistic multiple regression model was used for the data analysis.

**Results:** After adjusting the influence of relative humidity, wind speed, and atmospheric pressure, it was found that for each 1°C increase in daily maximum temperature, corresponding increases in the hospital emergency room visits for the diseases were 17.3% (OR = 1.173, 95%CI: 1.149–1.197) and 4.2% (OR = 1.042, 95% CI: 1.011–1.074) in spring and summer of the years, respectively ( $P < 0.05$ ); contrarily, there was decrease by 25% in the autumn (OR = 0.75, 95% CI: 0.727–0.773). There was no statistically significant association between both in the winter seasons ( $P \leq 0.05$ ).

**Conclusion:** The increase of daily maximum temperature may be a risk factor of daily hospital emergency room visits for cardiovascular and cerebrovascular diseases in spring and summer. However, it maybe a preventive factor in autumn. It suggests that the impacts of daily maximum temperature may be a two-edged sword on human health.

#### ISEE-0147

##### The Effect of Water Disinfection By-Products on Fetal Growth in Two Southeastern U.S. Communities

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**Background:** A previous study characterized the association between exposure to drinking water disinfection by-products (DBPs) and small-for-gestational-age (SGA), preterm-birth (PTB; <37 weeks gestation), and low birth weight (LBW) among term births in a cohort of women from three southeastern communities (Hoffman et al, 2008). Sensitivity analyses have revealed that women participating in this cohort were more highly educated than the source population, and thus these results may not be generalized to all of the women in these communities.

**Methods:** We linked exposure data ascertained for the study to vital records data to determine if women in Raleigh, NC and Galveston, TX who were exposed to higher concentrations of DBPs during specific periods of gestation have increased risk of adverse birth outcomes, specifically SGA, PTB, and very PTB (<32 weeks gestation). We examined exposure to total trihalomethanes (TTHMs), 5 haloacetic acids (HAA5), and total organic halides (TOX). We used weekly exposure data collected from utilities. The association between DBP concentrations and SGA, PTB and very PTB were assessed using logistic regression.

**Results:** We found no associations in Raleigh, NC between DBPs and fetal growth. In Galveston, TX we found positive associations between higher concentrations of TOX and SGA, PTB and very PTB. The most striking result was a nearly four-fold increase in risk when those with the highest quintile of TOX exposure were compared to those with the lowest (OR 3.79 [95% CI: 1.32, 10.89]).

**Conclusions:** Hoffman et al. (2008) did not find an adverse effect of DBPs on PTB or LBW, but observed an association between TTHMs and SGA only at average residential concentrations above the current regulatory standard. We found similar results, with the exception of the strong association between increased TOX and increased risk of very PTB in Galveston. (This presentation does not necessarily reflect EPA policy.)

#### ISEE-0153

##### Climate Variability and Dengue Fever Infections in Queensland, Australia

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**Background and Objective:** Dengue fever (DF) is one of the most widespread mosquito-borne diseases in the world, especially in tropical and subtropical regions, including Queensland, Australia, which is currently in the midst of the largest DF epidemic in recent history. This study aims to use spatial analysis methods to describe the spatial distribution and clustering of DF cases and explore the possibility of developing a forecast model of DF in Queensland, Australia.

**Method:** We obtained a computerised data set containing numbers of notified DF cases by postal areas (PA) in Queensland for the period of 1<sup>st</sup> January 1993–31<sup>st</sup> December 2004 from the Queensland Department of Health. Data on the Southern Oscillation Index (SOI) and population data were obtained from the Australian Bureau of Meteorology and the

Australian Bureau of Statistics, respectively. Spatial autocorrelation of dengue fever cases in three different periods of 1993–1996, 1997–2000 and 2001–2004 was assessed using Moran's I statistic. Local indicators of spatial association (LISA) maps were used to identify spatial clusters. Seasonal Auto-regressive Integrated Moving Average (SARIMA) model was used to estimate independent contribution of SOI on geographic distribution of DF in this study.

**Results:** The results indicate that the high-high clusters were primarily concentrated in the north of Queensland and low-low clusters moved from north to south during 1993–2004. A decrease in the average SOI during the preceding 3–12 months was significantly associated with an increase in the monthly numbers of PA with DF cases ( $\beta = -0.038$ ;  $P = 0.019$ ).

**Conclusion:** The geographic range of notified DF cases has significantly expanded in Queensland over recent years. Climate variability is directly and/or indirectly associated with dengue transmission and the development of a SOI-based epidemic forecasting system is possible for DF in Queensland, Australia.

#### ISEE-0154

##### Bayesian Spatiotemporal Analysis of Ross River Virus Incidence in Relation to Variation in Socio-Ecologic Factors in Queensland, Australia

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**Background and Objective:** Ross River virus (RRV) infection is the most common mosquito-borne disease in Australia and some Pacific island nations. This study aims to examine the potential impact of socio-ecologic factors on the transmission of RRV infection in Queensland, Australia.

**Methods:** We obtained the computerised data set on the notified Ross River virus (RRV) cases by Local Government Area (LGA) in Queensland for the period of 1<sup>st</sup> January 1999–31<sup>st</sup> December 2001 from the Queensland Department of Health. Weather (maximum temperature and rainfall) and socio-economic index for areas (SEIFA) data were obtained for the same period from the Australian Bureau of Meteorology and the Australian Bureau of Statistics. We used a Bayesian spatiotemporal conditional autoregressive (CAR) model to explore the relationship between monthly variation of RRV incidence and socio-ecologic factors and determine areas prone to social and ecologic-driven epidemics after adjusting for spatiotemporal variation.

**Results:** Our results show the average increase in monthly RRV incidence rates was 2.4% (95% Credible Interval (CrI): 0.08–4.8%) and 2.0% (95% CrI: 1.6–2.3%) for a 1°C increase in monthly average maximum temperature and per 10 millilitre increase in monthly average rainfall, respectively. There appears an interactive effect between temperature and rainfall on the RRV transmission. However, there was no significant association of SEIFA with RRV.

**Conclusion:** The results of spatiotemporal CAR models confirm the previous reports that climate variability may have played a significant role in the transmission of RRV in Queensland, Australia. The interaction between temperature and rainfall may be important in determining the dynamic pattern of RRV transmission.

#### ISEE-0163

##### Urine BPA Level and the Risk of Male Sexual Dysfunction

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**Background:** The human population is widely exposed to Bisphenol A (BPA), a possible human endocrine disruptor. While animal studies have consistently shown its adverse effect, evidence from epidemiological studies is urgently needed.

**Objective:** To determine whether BPA has an effect on male sexual function.

**Methods:** We conducted a study comparing the risk of male sexual dysfunction between 173 BPA-exposed and 386 unexposed workers in four cities in China. Urine BPA was assayed to determine the BPA exposure level. Male sexual function was ascertained through in-person interview using a male sexual function inventory.

**Results:** After adjustment for matching variables and potential confounders, BPA-exposed workers had consistently higher risk of male sexual dysfunction across all domains of measurement, compared to unexposed workers. The exposed workers had greater than three-fold increased risk of reduced sexual desire (odds ratios (OR) = 3.7, 95% confidence interval (CI): 1.5–8.9), a nearly four-fold increased risk of erection difficulties (OR = 3.9, 95% CI: 1.6–9.7), greater than seven-fold increased risk of ejaculation difficulties (OR = 7.4, 2.5–22.0), and greater than two-fold increased risk of reduced overall satisfaction with sex life (OR = 2.4, 1.4–4.3). Among the exposed workers, a higher urine BPA level (> median BPA level) was associated with a higher risk of sexual dysfunction. The trend test for the dose-response relationship was significant for all measures of male sexual dysfunction. The observed associations were generally further strengthened when workers who were also exposed to other chemicals were excluded. Such observations support an argument for an underlying association.

**Conclusions:** Our findings provide the first epidemiologic evidence that exposure to BPA could have an adverse effect on male sexual function in the human population.

#### ISEE-0166

##### Traffic Related Air Pollution Associated with Mild Stroke Hospital Admissions in Copenhagen, Denmark

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**Background and Objective:** We studied the short-term effect of air pollution on stroke separately for ischemic (IS) and hemorrhagic (HS) strokes. To study the effect on IS of primarily embolic origin, IS were separated into IS with and without atrial fibrillation (AF). Finally, we stratified patients by stroke severity into mild and severe strokes.

**Methods:** We applied a time-stratified case-crossover design to evaluate the association between particulate (PM<sub>10</sub>, PM<sub>2.5</sub>, UFP (particles <0.1 µm diameter)) and gaseous (Nitrogen oxides (NO<sub>x</sub>), Carbon Monoxide (CO), ozone (O<sub>3</sub>) air pollution to stroke hospital admissions in Copenhagen (2003–2006). We used conditional logistic regression analysis, adjusting for temperature, relative humidity and wind speed, to examine the air pollution effect for a 0–4 day lag. Computed tomography was used to



differentiate IS and HS. AF was determined by electrocardiography. Admission stroke severity was measured by the Scandinavian Stroke Scale (SSS).

**Results:** Out of 7485 stroke admissions, 6798 were IS and 687 were HS, 3485 were mild and 2248 were severe strokes (1752 missing SSS), and 1278 were with and 5811 were without AF (396 were missing information on AF). We observed a significant positive association between NO<sub>x</sub>, CO and UFPs and IS; NO<sub>x</sub>, CO and UFPs and strokes without AF; and finally UFPs and mild strokes, all at lag 4. No associations were observed between air pollution and HS, IS with AF or with severe strokes. Among 2822 cases with mild IS without AF, the effect of UFPs (per inter-quartile range, 5-day average) was a 21% (95% confidence interval: 4–41%) increase in admissions.

**Conclusion:** We found an air pollution effect on stroke admissions in patients with mild, IS without AF. Traffic related air pollutants, especially UFPs, were most relevant. Our findings indicate that the effect of air pollution is on small IS of thrombotic origin rather than HS and large embolic strokes.

#### ISEE-0167

##### Hospital Admissions and Chemical Composition of Fine Particulate Matter (PM<sub>2.5</sub>) for 106 U.S. Counties

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**Background and Objectives:** The associations between short-term levels of fine particulate matter (PM<sub>2.5</sub>) and human health exhibit spatial and temporal variations that are not fully explained. The hypothesis has been advanced that such differences might be due to heterogeneity in the PM<sub>2.5</sub> chemical composition, but evidence supporting this hypothesis is still lacking. The objectives of this work are to examine whether variation in the relative risks (RR) of hospitalization in an older population associated with ambient exposure to PM<sub>2.5</sub> total mass reflects differences in PM<sub>2.5</sub> chemical composition.

**Methods:** We linked several national datasets for the United States by county and by season: 1) long-term average concentrations of PM<sub>2.5</sub> chemical components for 2000–2005; and 2) RRs of cardiovascular and respiratory hospitalizations for those >65 years associated with a 10 increase in PM<sub>2.5</sub> total mass on the same day for 106 U.S. counties for 1999–2005.

**Results:** We found a positive and statistically significant association between county-specific estimates of the short-term effects of PM<sub>2.5</sub> on cardiovascular and respiratory hospitalizations and county-specific levels of Vanadium, Elemental Carbon (EC), or Nickel PM<sub>2.5</sub> content. In multiple pollutant models, for cardiovascular hospitalizations, the relationship between the PM<sub>2.5</sub> RR and Nickel was robust to adjustment by EC or Vanadium. The unexplained heterogeneity of county- and season-specific PM<sub>2.5</sub> RRs for cardiovascular hospitalization was reduced by 37% when the model accounted for Nickel and Vanadium PM<sub>2.5</sub> content.

**Conclusion:** Communities with higher PM<sub>2.5</sub> content of Nickel, Vanadium, and Elemental Carbon and/or their related sources were found to have higher risk of hospitalizations associated with short-term exposure to PM<sub>2.5</sub>.

#### ISEE-0177

##### Socioeconomic Inequality and Congenital Anomalies: A Small-Area Analysis

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**Background:** The available evidence for a link between socioeconomic status (SES) and congenital anomalies is very limited and is mostly based on individual level SES. Our study aimed to investigate the association between the occurrence of non-chromosomal congenital anomalies and neighborhood SES at fine spatial resolution.

**Methods:** We used population-based registry data on all cases of congenital anomaly arising in the population of Northern England (UK) for the period 1986–2003. Two sub-analyses were performed using the Townsend Deprivation Score (TDS) at Enumeration District level (ED, 1991 census) for the period 1986–1996 and the Index of Multiple Deprivation (IMD) at lower layer super output area level (LSOA, 2001 census) for the period 1997–2003. Congenital anomaly cases occurring in each sub-analysis period were geocoded according to the maternal postcode at delivery and assigned to the corresponding ED/LSOA. The count of cases for anomalies of eight organ systems and the 15 most frequent anomaly subtypes were extracted for each ED/LSOA. Poisson and logistic regression models were developed to abstract risk for quartiles of TDS/IMD at ED/LSOA level for each outcome group in each sub-analysis.

**Results:** There were 6,202 EDs and 1,869 LSOAs with average populations of 454 and 1,513. For most outcome groups there was a trend in congenital anomaly risk with deprivation when assessed by quartiles of TDS/IMD, with a significant increase in risk in the fourth quartile (most deprived) compared with the first quartile (least deprived).

**Conclusion:** The occurrence of congenital anomalies is associated with neighborhood SES. The results of our study are important for epidemiological studies relying on routinely-collected aggregated measures of SES to investigate the non-genetic causes of congenital anomalies. It emphasizes the importance of allowing for the impact of SES in these studies or to proximate the effect of possible confounders for which data are not always available.

#### ISEE-0183

##### Traffic Related Air Pollution and Respiratory Health in Sweden: The Roadside Study

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**Background and Objective:** Few large population studies have been conducted on adverse health effects related to air pollution from road traffic including non-urban populations, using spatially resolved air pollution data. Information on traffic related health risks is important for public health and planning purposes. The objective was to assess if traffic related PM<sub>10</sub> exposure at the home address was associated with respiratory health outcomes in a stratified sample of the Swedish adult population.

**Methods:** The Roadside study was based on a nationwide environmental health survey performed in Sweden in 2007, including 25,935 adults aged 19 to 80. The questionnaire inquired about annoyance from specific sources, respiratory, cardiovascular and allergic symptoms and disease, as well as quality of life. Information on background variables such as smoking, socioeconomic status and home characteristics was also available. Exposure to PM, NO<sub>x</sub> and traffic density at the home addresses of the participants was estimated by dispersion modeling. Associations between traffic related PM<sub>10</sub> exposure and respiratory health outcomes were analyzed using multivariate logistic regression adjusted for gender, age, educational level, smoking, passive smoking, moist/dampness or

mould exposure in the home and country of birth. Results were stratified by seven Swedish regions.

**Results:** PM<sub>10</sub> exposure was significantly positively associated with reporting restricted activity days due to respiratory symptoms in the last 3 months (combined OR 1.44 per 10 µg/m<sup>3</sup>; 95% CI 1.15–1.80). This association was consistent across the different regions. Less consistent significant associations were found for chest tightness/cough in the last 3 months (combined OR 1.30 per 10 µg/m<sup>3</sup>; 95% CI 1.08–1.56), while there were no consistent associations for phlegm, cough and doctor-diagnosed or current/ever COPD.

**Conclusion:** Exposure to traffic related PM<sub>10</sub> exposure consistently increased the risk of restricted activity days due to respiratory symptoms in Swedish adults.

#### ISEE-0185

##### Population Exposure to a Persistent Organic Pollutant (β-HCH) Following Waste Disposal from a Chemical Plant (Sacco River Valley, Italy)

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**Background and Objective:** A chemical plant that manufactures chemicals and pesticides has been operating since the 1950's in the Sacco River Valley (Central Italy). In 2005, high beta-hexachlorocyclohexane (β-HCH) concentrations were found in bovine milk of animals bred in the area along the river south of the facility. The objective of the study was to evaluate contamination levels of the population living in the area.

**Methods:** We defined four residential areas by the distance from the facility and the river, and a random population sample (age 25–64 years) was chosen. Blood samples were taken to analyze α,β,γ-HCH, and other pollutants (HCB, NDL-PCBs, DL-PCBs, p,p'-DDT, p,p'-DDE). We evaluated the association between the area of residence, other potential determinants (sex, age, local food products, well water) and the pollutant serum concentrations using multivariate linear regression models. The results are expressed as geometric mean ratios (GMR) and 95%CI.

**Results:** 246 serum samples were analysed. β-HCH mean concentration was 99.0 ng/g lipid ± 121.3 (GM:60.6). There was a strong association between β-HCH and residence in the area within 1 km of the river (GMR:2.46, 95CI%:1.46–3.16). β-HCH was also associated with age, use of water from private wells (GMR:1.47 95CI%:1.12–4.94) and consumption of local food products (GMR:1.33, 95CI%:0.99–1.79). When the analysis was restricted to 106 people living along the river, the association between β-HCH and consumption of locally produced food (GMR:1.91, 95CI%:1.05–3.48) and privately produced food was even stronger (GMR:2.62, 95CI%:1.42–4.85). No association with the area of residence was found for the other pollutants.

**Conclusion:** These results suggest that chemicals disposed as waste did contaminate the river and the surrounding soil. Population groups living close to the river have high β-HCH levels, most likely due to consuming dairy products and meats from contaminated animals.

#### ISEE-0186

##### Sensitivity of Continuous Performance Test (CPT) to Methylmercury Exposure at Age 14 Years

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**Background and Objectives:** Reaction Time latencies (RT) measured in the Continuous Performance Test (CPT) indicate the speed of information processing. The latencies may be related to different neuropsychological functions depending on the time intervals during the test duration when the responses are assessed: 1–2 minutes with orientation, learning and habituation; the following few minutes with cognitive speed of processing in selective focused attention; and a final period with sustained attention as the dominant demand. Prenatal methylmercury exposure has been associated with increased reaction time latencies at age 7 years in Faroese children. We assessed the association of methylmercury exposure with the average RT in three time intervals at age 14 years.

**Methods:** Exposure levels were determined from mercury concentrations in cord blood, postnatal blood, and hair samples from a Faroese cohort. 878 children completed CPT. RT latencies were recorded during 10 minutes test duration on a task of target stimuli. Regression models were adjusted for confounders.

**Results:** The three sets of CPT-RT outcomes showed different association patterns with methylmercury exposure: the average RT for the first 1–2 minutes was weakly associated with methylmercury (Beta (SE), 2.83 (2.10)); a significant association for the 3–6 minute interval (4.95 (2.23)); and a strongest association for the 7–10 minutes (6.41 (2.45)). This association pattern was unchanged when the scores of Catsys-Reaction Time Test, Finger Tapping Test or CPT-RT (1–2 minutes) were included in the models as confounders to control for simple reaction time and characteristics of learning. No association was found in regard to measures of postnatal exposures.

**Conclusion:** The CPT-RT latencies reflect different functions, as indicated by results separated according to test duration. The findings show that neuropsychological functions related with sustained attention are particularly vulnerable, indicating probable underlying dysfunctions of frontal lobes. This association may be missed, if test results are averaged.

#### ISEE-0189

##### Non-Specific Physical Symptoms and Distance to Powerlines and Base Stations and Underlying Mechanisms

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**Background and Objectives:** Actual and/or perceived exposure to EMF might lead to increased fears and health worries. These fears in turn might increase symptom reporting because people more prone to environmental worries experience more symptoms while looking for explanations for their ill health. The consequence is a vicious circle linking exposure, worries, and symptoms. This pilot study explores the relationship between actual exposure to EMF, perceived proximity to a base station or power line, non-specific symptoms and the role of psychological factors.

**Methods:** Survey-data collected in the Netherlands at neighborhood level in 2006 was matched to individual residence level with maps of power-lines and base stations. The prevalence of non-specific symptoms was related to distance to base stations and power lines. The data allowed for exploring the role of several psychological aspects in the relation between actual and perceived exposure and non-specific symptoms.

**Results:** Three percent of the respondents report an extremely high score on non-specific symptoms and 14% consider themselves extremely sensitive to environmental stressors. Almost half of the residents live within 300 or more meters of a base station, while 3% live within the 0–50 meter zone. The percentage of perceived proximity was 15% and 34% to power lines and a base station respectively. Residents who live very close to power lines and base stations report higher perceived exposure. 11% report to be extremely concerned about possible health

effects of power lines and 13% about impacts of base stations. Full results of the analysis will be presented and discussed.

**Conclusions:** Public concern about EMF exposure increases and that may lead to increased worries about possible impacts on well-being and unspecific physical symptoms. There is a necessity for the development of a model which could define the interaction among the mechanisms that might activate and sustain these symptoms.

#### ISEE-0192

##### PM<sub>2.5</sub>-Bound Organic Compounds and Cardiovascular Symptoms in Myocardial Infarction Survivors

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**Background and Objective:** Exposure to particulate air pollution has been associated with cardiovascular diseases and their aggravation. However, the aerosol components responsible for the adverse health effects have not been conclusively identified, and there is very little information on the role of particulate organic compounds (POC). We evaluated the association between POC and cardiovascular symptoms in myocardial infarction (MI) survivors.

**Methods:** 74 MI survivors from Augsburg, Germany, recorded daily occurrence of chest pain, avoidance of physically demanding activities due to heart problems and shortness of breath between October 2003 and February 2004. Concentrations of hopanes and polycyclic aromatic hydrocarbons (PAH) in the fraction of particulate matter less than 2.5 µm in aerodynamic diameter (PM<sub>2.5</sub>) were quantified. Generalized estimating equations (GEE) models adjusting for meteorological and other time-variant confounders were used to estimate immediate (lag0) and delayed (lag1 to lag3) effects.

**Results:** The average hopane concentration levels ranged from 0.06 to 0.51 ng/m<sup>3</sup>, correlations coefficients among hopanes were moderate to high ( $r > 0.69$ ). The average PAH concentration levels ranged from 0.48 to 3.52 ng/m<sup>3</sup>, and PAH were also highly correlated among each other ( $r > 0.73$ ). No associations were found between air pollution measures and chest pain. The odds for avoidance of activities increased immediately in association with most POC measures (e.g. 10% increase per 1.08 ng/m<sup>3</sup> Benzo[a]anthracene, 95% confidence interval (CI) 2%–19%). The odds for shortness of breath increased consistently associated with lag3 of almost all POC measures (e.g. 10% increase per 0.21 ng/m<sup>3</sup> 17α(H),21β(H)-30-norhopane, CI 2%–19%). However, results also indicated decreases both for avoidance of activities and shortness of breath.

**Conclusions:** For the first time hopanes and PAH, which likely act as indicators for traffic- and combustion-related particles, respectively, were associated with acute cardiovascular health outcomes in MI survivors.

#### ISEE-0194

##### Associations of Endothelial Function and Air Temperature in Diabetic Individuals

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**Background and Objective:** Epidemiological studies consistently show that air temperature is associated with changes in cardiovascular morbidity and mortality. However, the biological mechanisms underlying the association remain largely unknown. As one index of endothelial function, flow-mediated dilatation (FMD) can be viewed as a “barometer” of vascular health. Therefore, the purpose of this study was to analyze the short-term effects air temperature on markers of endothelial function in diabetic patients.

**Methods:** A prospective panel study was conducted on 22 people with diabetes in Chapel Hill, NC, from Nov 2004–Dec 2005. Each subject was studied for four consecutive days. Daily measurements of meteorological data were acquired from the rooftop of the patient exam site. FMD measured by brachial artery ultrasound as well as blood markers on endothelial function were assessed during each patient visit. Data were analyzed using random effects models adjusting for relative humidity, barometric pressure, and particles with an aerodynamic diameter <2.5 µm, and day of the week.

**Results:** FMD decreased in association with a 1°C decrease in temperature on the same day (percent-change in mean level: −4.2% with 95%-confidence interval (CI): [−6.9%; −1.4%]) as well as with a delay of one day (−3.3%; 95%-CI: [−6.5%; −0.1%]), four days (−3.4%; 95%-CI: [−6.3%; −0.5%]) and with the 5-day-average (−4.3%; 95%-CI: [−8.4%; −0.3%]). We also found an increase in intercellular adhesion molecules sICAM-1 in association with the 5-day-average of temperature (7.9%; 95%-CI: [2.0%; 13.8%]). A similar trend was seen for vascular cell adhesion molecules sVCAM-1. Other blood markers representing endothelial function such as von Willebrand factor and endothelial-leukocyte adhesion molecule E-selectin did not show any temperature effect.

**Conclusion:** These data suggest that endothelial function is associated with short-term temperature changes. Endothelial dysfunction might contribute to the increase in cardiovascular morbidity and mortality associated with cold weather.

This abstract of a proposed presentation does not necessarily represent EPA policy.

#### ISEE-0197

##### Qualitative Data in the Study of Environmental Health: An Analysis of the Literature

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**Background and Objective:** Recent journal articles have advocated the use of qualitative methods in environmental health research, even suggesting that qualitative methods, “may become an interdisciplinary companion to epidemiology” (Foster, M.W., & Sharp, R.R. 2005. *Environmental Health Perspectives*, 113(2), 119–122). With few exceptions do such articles include evidence of environmental epidemiologists using qualitative data. This paper presents an analysis of qualitative methods and data used in the study of environmental health and published in peer-reviewed journals.



**Methods:** A primary search on ISI Web of Knowledge/Web of Science included three terms: qualitative, environ\* and health. Timeframe was 1991–2006. Additional searches targeting environmental and public health journals included the phrase “risk perception,” environ\* and qual\*. Inclusion and exclusion criteria are described. Searches resulted in 2639 records combined. Findings of articles were coded and analyzed with the aid of the qualitative analysis software, NVIVO. Content analysis was conducted to determine where and by whom qualitative environmental health research is conducted and published, the types of methods and analyses used in qualitative studies of environmental health, and the types of information qualitative data contribute to environmental health.

**Results:** Sixty-seven articles met inclusion criteria. Twenty-nine articles include one or more authors with specific training in environmental health or epidemiology, with 13 papers including one or more authors from departments of epidemiology. These articles were published in 47 different journals, with the most publications in a single journal totaling seven. This analysis identified a diversity of qualitative techniques, with the majority of studies relying on one-on-one interviews. Approaches to data analysis were equally as diverse, with details absent from a large number of studies.

**Conclusion:** This analysis demonstrates the limited extent to which qualitative data are integrated in traditionally quantitative studies of environmental health, and the demonstrated potential of qualitative data in environmental epidemiology.

#### ISEE-0206

##### Kerosene and Biomass Fuels May Be Risk Factors for Pulmonary Tuberculosis in Developing Countries

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**Background and Objective:** In many countries, including Nepal and India, tuberculosis (TB) is a major problem. A majority of adults are infected with *Mycobacterium tuberculosis*, but only a small proportion of them develop TB. Exposures such as smoking, alcohol consumption, and poor nutrition have been associated with developing active TB. This study was intended primarily to investigate whether smoke from indoor cooking fires using biomass fuels was a risk factor for TB.

**Methods:** This hospital-based case-control study was conducted in the Regional TB Center and Manipal College of Medical Sciences (MCOMS), Pokhara, Nepal. Cases ( $n = 125$ ) were women, aged 20–65 years, with confirmed TB (by chest x-ray and active sputum smear positive or culture positive test). Controls ( $n = 250$ ), frequency matched to cases by age, were female patients without TB attending inpatient and outpatient departments of MCOMS. All participants were administered a standardized questionnaire to obtain information on a wide range of exposures, including tobacco smoking, stove and fuel use, kitchen ventilation, religion, income, house construction, source of lighting, alcohol consumption, and household TB history. Logistic regression was used to identify risk factors.

**Results:** Compared with using a clean-burning-fuel stove (LPG, biogas), the adjusted odds ratio (OR) for using a biomass fuel stove was 2.33 [95% confidence interval (CI) 1.06–5.10], and use of a kerosene fuel stove had an OR of 3.19 (95% CI 1.10–9.30). Exposure to smoke from kerosene lamps had an OR of 15.7 (95% CI 2.92–84.1).

**Conclusion:** The association between biomass fuel use in unflued indoor stoves and TB is consistent with the findings of several previous studies. However, the finding that the risk of TB increases with the use of kerosene, particularly in wick lamps, is new and requires confirmation in other studies. If confirmed, it would strongly justify promoting clean lighting sources, such as solar lamps.

#### ISEE-0209

##### Higher Temperature Increased Eye Infections After Flood in Taiwan

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**Background:** Flood may cause an increased incidence of infectious diseases. Less attention has focused on the infection in eyes from the flood. This study investigated eye infections associated with the floods in Taiwan.

**Methods:** Computerized medical reimbursement data obtained from National Health Insurance and weather data obtained from the Central Weather Bureau were used in this study. Eye infection cases (ICD-9 3720, 3734–3736 and 076) identified for the 1996–2005 period were compared with all non-cases during floods and within 10 days after the floods controlling for covariates.

**Results:** The overall eye infections incidence rate within 10 days after the floods was 64.7/100,000 person-days, higher than that during the floods (53.4/100,000 person-days) and normal days (46.9/100,000 person-days). The multivariate Poisson regression analysis revealed that the relative risk (RR) after the floods was 1.2 (95% confidence interval 1.0–1.3,  $P < 0.05$ ) controlling for covariates. The risk of infection increased as the temperature increased; the RR increased to 1.76 at temperatures greater than 30 degrees C, compared with the temperatures of <15 degrees C. There was a V-shape relation between ages and the infections, with RRs of 2.3 (95% CI 2.3–2.5) for children <10 years of age and 3.4 (95% CI 3.1–3.6) for the elderly, compared with the persons aged 20–49 years.

**Conclusions:** This study demonstrates that flood may increase the eye infection risk during the cleaning period after floods for youngsters and the elderly, particularly when it is warm.

**Key words:** Children, eye infection, flood, temperature variation, the elderly, Taiwan.

#### ISEE-0212

##### Food Security in Impoverished Urban Settlements in South Africa

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**Background and Objective:** Food security is a basic human right. However, approximately one sixth of the developing world do not have sufficient food, impacting on the overall quality of their lives. In this paper we investigate the prevalence and trends in household food insecurity in three impoverished communities in Johannesburg, South Africa.

**Methods:** Annual cross sectional surveys, commencing in 2006, were conducted in three impoverished settlements; Riverlea and Braamfischerville (low-cost housing developments constructed in the early 1960s and early 1990's, respectively), and Hospital Hill (an informal settlement on the outskirts of Johannesburg). A structured questionnaire was used to obtain information on demographic profiles, socio-economic status, and food security. The sample size in 2006, 2007 and 2008 was 327, 354 and 292 households respectively. All statistical analyses were conducted using STATA, version 9.

**Results:** The overall prevalence of food insecurity was 83.5%, 84.2% and 84.9% in 2006, 2007 and 2008 respectively. In Riverlea and Hospital Hill, the poorest sites, the level of food insecurity deteriorated by approximately 8% over the 3 years. Overall food consumption dropped except for the intake of dairy products. Poverty was significantly related to food insecurity ( $P = 0.002$ ). There was no significant difference in food insecurity between male and female headed households. Residing in an area for 10 years or more

had a significant protective effect in 2006 (38.2% of the food insecure;  $P = 0.01$ ). However by 2008 this positive effect decreased and 53.3% of the food insecure had resided in their dwellings for 10 years or longer.

**Conclusion:** Findings from this study indicate that food insecurity is unacceptably high and rising. The urban poor communities appear to be at particular risk in South Africa. Hunger relief and poverty alleviation needs to be more aggressively implemented in order to improve the quality of life in these poor communities.

#### ISEE-0215

##### Traffic-Related Air Pollution and Socioeconomic Status: A Spatial Autocorrelation Study to Assess Environmental Equity on a Small-Area Scale

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**Background and Objective:** Most ecologic studies of environmental equity show that groups with lower socioeconomic status (SES) are more likely to be exposed to higher air pollution levels than groups of higher SES. However, few consider spatial autocorrelation in the data. We investigated the association between traffic-related air pollution and SES on a small-area level in Strasbourg, France, and assessed the impact of spatial autocorrelation on the results.

**Methods:** We used a deprivation index constructed from census data to estimate SES at the block level. Average ambient levels of NO<sub>2</sub>, CO and PM<sub>10</sub> during year 2000 were modeled at the block level by the ADMS-Urban dispersion model. We estimated the associations between traffic-related air pollutants exposure and the deprivation index by using an ordinary least squares model and a simultaneous autoregressive model that controls for spatial autocorrelation. We performed sensitivity analyses on the spatial model specification and the choice of the spatial weight matrix used to define the neighborhood.

**Results:** The associations between the deprivation index and air pollutants levels were positive and nonlinear with both regression models; the midlevel deprivation areas, located near to the principal highways surrounding the urban center, were the most exposed. Control of spatial autocorrelation strongly reduced the strength of the association but clearly improved the model's goodness-of-fit.

**Conclusion:** This study shows in France an uneven spatially distributed burden of environmental hazards according to SES, as showed in other countries. It also demonstrates the need to take spatial autocorrelation into account in ecologic studies, in particular when studying the role of air pollution on social inequalities in health. Failure to do so may lead to biased and unreliable estimates and thus to erroneous conclusions.

#### ISEE-0216

##### Ecological Determinants of Endoscopic Colorectal Cancer Screening Over Time in 11 States

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**Background:** Colorectal cancer (CRC) ranks third among all cancer sites in incidence, and second in cancer-related mortality. CRC screening is essential for early detection of colorectal cancer and both reduced morbidity and increased survival among cancer victims, but screening rates are suboptimal.

**Objective(s):** To study predictors of CRC screening behavior in a cohort of Medicare-enrolled persons over a period during which coverage for

CRC screening increased (2000–2005). The study population includes 272,077 men and women who are age 65+ in 2000 and remain alive through 2005, located in 11 SEER Registry states that span all census regions and exhibit heterogeneous socio-demographics.

**Methods:** We use multilevel logistic regression of a binary probit choice model over two time intervals (2000–2002, 2003–2005) and assess empirically whether predicted effects are different across states and time. Gender, previous cancer diagnosis, disability as the original reason for entitlement, and dual eligibility are key person-specific factors of interest. Social segregation, commuter intensity, availability of CRC screening facilities, availability of oncologists and gastroenterologists, poverty, and income disparity are key environmental variables.

**Results:** The geographic variation in utilization and its associated factors provide insights regarding the heterogeneity of supply-demand systems and realized utilization of CRC services across the landscape. Men are not universally more likely than women to utilize CRC screening; African Americans are not universally less likely to be screened than whites; and disparities between minorities and whites appear to decrease over time.

**Conclusions:** Policy interventions to improve screening rates should tailor interventions to local community characteristics and needs.

#### ISEE-0221

##### Health Impact Assessment of Waste Management Facilities in Three European Countries

Francesco Forastiere,\* Chiara Badaloni,\* Cornelis de Hoogh,† Martin Krayen von Kraus,‡ Marco Martuzzi,§ Francesco Mitis,§ Lubica Palkovicova,¶ Daniela Porta,\* Philipp Preiss,\*\* Andrea Ranzi,†† Carlo Alberto Perucci,\* and David Briggs,† \*Department of Epidemiology Local Health Authority RME, Rome, Italy; †Department of Epidemiology and Public Health, Imperial College, London, United Kingdom; ‡World Health Organization. Regional Office for Europe, Copenhagen, Denmark; §World Health Organization. Regional Office for Europe, Rome, Italy; ¶Department of Environmental Medicine, Slovak Medical University, Bratislava, Slovakia; \*\*Institute of Energy Economics and the Rational Use of Energy, University of Stuttgart, Stuttgart, Germany; and ††Environmental Health Reference Centre, Regional Agency for Environmental Prevention of Emilia Romagna, Modena, Italy.

**Background and Objective:** We conducted a health impact assessment of landfilling and incineration in three European countries (Italy, Slovakia and England) within the EU-funded INTARESE project.

**Methods:** A total of 49 (Italy), 2 (Slovakia), and 11 (England) incinerators were operating in 2001 while the landfills were 118, 121 and 232, respectively. The study population consisted of residents living within 3 km of an incinerator and 2 km of a landfill. Relative risk estimates from epidemiological studies were used, combined with air pollution dispersion modelling for particulate matter (PM) and nitrogen dioxide (NO<sub>2</sub>). For incinerators, we estimated attributable cancer incidence and years of life lost (YoLL), while for landfills we estimated attributable cases of congenital anomalies and low-birth weight infants.

**Results:** The additional contribution to NO<sub>2</sub> within a 3 km radius was 0.228, 0.154, and 0.144 ug/m<sup>3</sup>, respectively. Lower values were found for PM<sub>10</sub>. Assuming that the incinerators continue to operate until 2020, the annual number of cancer cases due to exposure in 2001–2020 will reach 11, 0.07, and 7 in 2020 and then decline to 0 in 2050. By 2050, the attributable impact on the 2001 cohort of residents will be 3,603, 181 and 4,217 YoLL. The annual additional cases of congenital anomalies up to 2030 will be approximately 2, 2, and 3 whereas there will be 42,13, and 59 low-birth newborns, respectively.

**Conclusions:** There are several uncertainties and critical assumptions in the assessment model, but it provides insight into the relative health impact attributable to waste management, which can be characterized as moderate when compared to other sources of environmental pollution that have an impact on public health.

## ISEE-0222

**Effects of Exposure to Metal Rich Air Particles on Histone H3-K4 Dimethylation and H3-K9 Acetylation**

Laura Cantone,\* Valeria Pegoraro,\* Pietro Apostoli,† Matteo Bonzini,§ Angela Cecilia Pesatori,\* Letizia Tarantini,\* Valentina Bollati,\* Joel Schwartz,‡ Pietro Alberto Bertazzi,\* and Andrea Baccarelli,\* \*University of Milan and IRCCS Maggiore Hospital, Milan, Italy; †University of Brescia, Brescia, Italy; ‡Harvard School of Public Health, Boston, United States; and §University of Insubria, Varese, Italy.

**Background and Objectives:** Alteration in epigenetic regulation of gene expression is a frequent event in human cancer. The detrimental effects of inhalation of ambient and occupational air particles on respiratory and cardiovascular disease have been linked to systemic deregulation of gene expression. In vitro studies have shown that metal components of air particles, such as Cr and Ni, may determine histone acetylation or methylation, a main epigenetic mechanism for chromatin remodelling, and chronic exposure to these metal compounds could increase cancer incidence. Whether inhalation of metal particle components could modify histone modifications in humans is unresolved. We investigated whether metal components of air particles determine histone modifications in workers in an electric-furnace steel plant with well-characterized exposure to air particles and related metal components.

**Methods:** We extracted total histones from blood collected from 63 workers on the last day of a workweek following three consecutive work days. Individual exposure to particulate matter with aerodynamic diameter  $<10\mu\text{m}$  ( $\text{PM}_{10}$ ) or  $<1\mu\text{m}$  ( $\text{PM}_1$ ), and metals (Cr, Pb, Cd, As, Ni, Mn) was estimated using work area measurements and time-activity records. We determined histone H3-K4 dimethylation and H3-K9 acetylation using PathScan Sandwich ELISA kits (Cell Signaling Technology).

**Results:** H3-K4 dimethylation and H3-K9 acetylation were not associated with levels of PM mass (H3K4m2:  $\beta = 0.03$ ,  $P = 0.34$  for  $\text{PM}_{10}$ ,  $\beta = 0.02$ ,  $P = 0.56$  for  $\text{PM}_1$ ; H3K9ac:  $\beta = -0.07$ ,  $P = 0.23$  for  $\text{PM}_{10}$ ,  $\beta = -0.03$ ,  $P = 0.70$  for  $\text{PM}_1$ ). H3-K4 dimethylation increased in association with air levels of Cr ( $\beta = 0.18$ ;  $P = 0.005$ ), Pb ( $\beta = 0.18$ ;  $P = 0.01$ ), As ( $\beta = 0.16$ ;  $P = 0.03$ ) and Ni ( $\beta = 0.15$ ;  $P = 0.04$ ). H3-K9 acetylation showed a borderline negative association with airborne cadmium ( $\beta = -0.26$ ;  $P = 0.06$ ).

**Conclusions:** Our results indicate histone modifications as a novel epigenetic mechanism induced by metal components of air particles in human subjects.

## ISEE-0226

**Exposure to Air Pollution During 1st Year of Life and Development of Allergic Diseases up to 8 Years of Age**

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**Background and Objective:** Epidemiological studies that have investigated the association between traffic-related air pollution and long-term effects on the development of childhood respiratory disease and allergic sensitization have found inconsistent results. The objective was to assess the association between the exposure to residential outdoor levels of air pollution from traffic during the 1st year of life and respiratory symptoms and sensitization in children up to 8 years.

**Methods:** The spatial distribution of nitrogen oxides from traffic (traffic- $\text{NO}_x$ ) and inhalable particulate matter from traffic (traffic- $\text{PM}_{10}$ ) in the study area was assessed with emission databases and dispersion modelling. Estimated levels were used to assign first-year exposure levels for children in a prospective birth cohort BAMSE ( $n = 4089$ ) by linking to geocoded home addresses. Parents in four Swedish municipalities

provided questionnaire data on symptoms and exposures when the children were 2 months and 1, 2, 4 and 8-year-old. At 8 years of age, 65% of the children attended clinical examination which included a lung function test (PEF) and blood test (specific IgE measurements).

**Results:** Exposure to air pollution from traffic during the first year of life was associated with an excess risk of sensitization to pollen at 8 years (odds ratio (OR) for 5th-95th percentile difference in traffic- $\text{NO}_x = 1.53$ ; 95% confidence interval (CI) = 1.08–2.18). Association with persistent wheezing tended to be positive, although non-significant (OR for traffic- $\text{NO}_x = 1.41$ ; 95% CI = 0.86–2.31). However, ORs were found to be elevated for atopic wheeze (combination of persistent wheeze and sensitization at 8 years of age = 1.93 (1.04–3.61)). Results were quite similar using traffic- $\text{NO}_x$  and traffic- $\text{PM}_{10}$  as indicators.

**Conclusion:** Exposure to moderate levels of locally emitted air pollution from traffic during the first year of life enhances the development of sensitization and atopic respiratory disease in 8-year-old children.

## ISEE-0228

**Traffic-Related Air Pollution and the Development of Asthma During the First 8 Years of Life—The PIAMA Study**

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**Background and Objectives:** The role of air pollution exposure in the development of asthma and related symptoms remains unclear. We assessed the association between traffic-related air pollution, asthma and related symptoms during the first 8 years of life in a prospective birth cohort study.

**Methods:** We estimated exposure to nitrogen dioxide ( $\text{NO}_2$ ), particulate matter ( $\text{PM}_{2.5}$ ) and soot at the birth address by land-use regression models. Associations between air pollution exposures and annual questionnaire reports of (symptoms of) asthma were assessed in a repeated-measures logistic regression analysis in 3,866 children from the PIAMA birth cohort. Effects are presented for an interquartile range increase in exposure, after adjusting for covariates (sex, study type, parental allergies, parental education, maternal smoking during pregnancy, breastfeeding, use of gas stoves and unvented water heaters, presence of siblings, smoking at home, signs of dampness, presence of pets, and nationality).

**Results:** Overall associations [adjusted odds ratio (95% confidence interval)] with air pollution were statistically significant for ever-reporting asthma [i.e. 1.26 (1.07–1.49) per 3.23  $\mu\text{g}\cdot\text{m}^{-3}$  change in  $\text{PM}_{2.5}$ ], asthma symptoms [wheeze and/or shortness of breath and/or prescription of inhalation steroids, 1.13 (1.01–1.27)], wheeze [1.21 (1.09–1.34)], and nocturnal dry cough [1.12 (1.02–1.22)] during the past 12 months. The associations with asthma ever and asthma symptoms during the past 12 months increased slightly with age; associations with wheeze did not change with age. Associations were somewhat stronger for children who lived at the same home during the entire follow-up.

**Conclusions:** Exposure to traffic-related air pollution based on exposure estimated for birth address is positively associated with the development of asthma during the first 8 years of life.



## ISEE-0229

## Urinary Phthalates and Breast Cancer Risk in Mexico

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**Background and Objective:** Phthalates are ubiquitous environmental contaminants that disrupt the endocrine system. Phthalates are mainly used as plasticizers in PVC plastics and as additives in personal care products. We assessed the urinary concentrations of nine phthalate metabolites and breast cancer (BC) incidence in an ongoing population based case-control study in northern Mexico.

**Methods:** Histological confirmed BC cases (233) were aged matched with 221 women living in the same area of the index cases. Information about reproductive and dietary history, and potential sources of phthalates was obtained by direct interviews. The following phthalate metabolites were determined by HPLC-MS/MS at the CDC: monoethyl phthalate (MEP), monobenzyl phthalate (MBzP), mono-n-butyl phthalate (MBP), mono-isobutyl phthalate (MiBP), mono-2-ethylhexyl phthalate (MEHP), mono-2-ethyl-5-oxohexyl phthalate (MEOHP), mono-2-ethyl-5-hydroxyhexyl phthalate (MEHHP), mono-2-ethyl-5-carboxypentyl phthalate (MECPP), and mono-3-carboxypropyl phthalate (MCPP).

**Results:** Detectable concentrations of phthalate metabolites varied from 83% (MEHP) to 100% (MEP, MBP, MEOHP, MEHHP, MECPP). Cases had significantly higher geometric mean concentrations of MEP (169.58 vs. 106.78 mcg/g creatinine) than controls. In contrast, controls presented significantly higher concentrations of MBP, MEOHP and MCPP. After adjusting for known BC risk factors, a significant trend in the increase of BC risk was observed in relation to MEP (OR T3 vs. T1 = 1.75 CI95% 1.07–2.86,  $P$  for trend = 0.020) that remained significant and became stronger only in premenopausal women (OR T3 vs. T1 = 3.06 CI95% 1.27–7.35,  $P$  for trend = 0.009). Anti-androgenic phthalates (MBzP, MBP, MiBP) and MCPP were significantly negative associated with BC risk. No significant associations with BC were detected for the rest of phthalates.

**Conclusion:** MEP is a metabolite of diethyl phthalate, which is mainly used in cosmetics and fragrances. Further estimation of dermal and inhalation exposure to DEP by specific products is warranted. Biological mechanisms of its potential effect on BC should be clearly defined. This first report needs to be replicated.

## ISEE-0230

Acute Effects of PM<sub>2.5</sub> on Ventricular Repolarization

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**Background and Objective:** Studies have implicated an effect of PM on ventricular repolarization as a potential mechanism for PM-cardiac disease relationship. However, the time course of PM effects has not been established. Thus, we carried out a population-based Air Pollution and Cardiac Risk study to investigate the time-course of PM effects on ventricular repolarization.

**Methods:** We recruited 79 community-dwelling individuals  $\geq 45$  years. We obtained 24-hour ECG using a high resolution 12-lead Holter (1000 Hz). We visually identified and removed all artifacts and ectopy and

calculated beat-to-beat QT intervals for each 30-minute segment. We then calculated the average HR-corrected QT indices, including QT Prolongation Index (QTI), Bazett's (QTcB) and Fridericia's (QTcF) HR-corrected QT intervals, and as time-specific measures of ventricular repolarization. We used a personal PM<sub>2.5</sub> monitor to measure 24-hour individual-level real-time PM<sub>2.5</sub> exposures and calculated 30-minute time-specific average PM<sub>2.5</sub> exposure. We used linear mixed-effects models to calculate autocorrelation- and other confounders-corrected regression coefficients ( $\beta$ ) for relating PM<sub>2.5</sub> to QTI. We sequentially put lagged-terms into a single model until the last entered term was no longer significant ( $P > 0.05$ , type I sums of squares).

**Results:** The mean (SD) age was 56 (7.8), with 53% female and 68% white. Most of the adverse ventricular repolarization effects from PM<sub>2.5</sub> occurred around 3–3.5 hours. The  $\beta$ s (SE,  $P$ -value) due to a 10  $\mu\text{g}/\text{m}^3$  increase in lag7 PM<sub>2.5</sub> on QTI, QTcF, and QTcB were 0.11 (0.05,  $P = 0.04$ ), 0.13 (0.06,  $P = 0.03$ ), and 0.21 (0.10,  $P = 0.05$ ), respectively. The lag6 PM<sub>2.5</sub> on QTcB was 0.23 (0.11,  $P = 0.03$ ).

**Conclusion:** Elevated PM<sub>2.5</sub> is associated with longer ventricular repolarization, and the time to effects is about 3–3.5 hours, which may contribute to increased risk of acute cardiac events, such as sudden cardiac death.

## ISEE-0231

## Vulnerability to Heat-Related Morbidity and Mortality in Copenhagen, Denmark

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**Background and Objectives:** Climate change has potentially grave implications for human health. The association between the daily 3-hr maximum apparent temperature (Tappmax) and respiratory, cardio- or cerebrovascular (RD, CVD, CBD) hospital admissions/non-accidental deaths was investigated during the period 1 Jan 2002 to 31 Dec 2006.

**Methods:** Health outcome data for Greater Copenhagen were retrieved from the Danish Hospital and Cause of Death registers. The meteorological (temperature and relative humidity) and air pollution (CO, NO<sub>2</sub>, PM<sub>10</sub>) data were collected at a fixed urban background monitor by the Danish National Environmental Research Institute. Data on % weekly general practitioner (GP) visits due to influenza were provided by the Statens Serum Institute. The associations between Tappmax and health outcomes were studied in a case-crossover design, with every 2nd day as a control day, in the same month and year as the case day. Associations are expressed as hazard ratios (HR) and 95 confidence intervals (CI), per inter-quartile range (IQR) increase in Tappmax. Models were adjusted for day of the week, public holidays, % weekly GP visits due to influenza. The admission models were also adjusted for PM<sub>10</sub>. Different lags and moving averages of Tappmax, NO<sub>2</sub>, CO and PM<sub>10</sub> were investigated. Effect modification was investigated by stratification and interaction terms: Warm/cold periods, age, socio-economic status, existing diabetes and/or hypertension, previous RD and CVD hospital admissions and distance between household and fixed urban background air pollution monitor. Various sensitivity analyses were conducted.

**Results and Conclusion:** For an IQR (8°C) increase in the 5-day lag of Tappmax, a 20% increase in the RD mortality rate was observed in the warm period (Apr–Sep) (HR 1.201, 95% CI 1.059–1.361). Significant associations were observed between CVD hospital admissions and Tappmax in the cold (HR 1.048, 95% CI 1.025–1.073) and warm periods (HR 0.950, 95% CI 0.920–0.981).

## ISEE-0234

**Traffic Exposure and Mortality in Rome: Results of a Large Cohort Study**

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**Background and Objective:** There are few investigations on the long-term effects of traffic-related pollutants and mortality. We analyzed the association between different proxy measures of exposure to traffic air pollution and mortality in the Rome Longitudinal Study (RoLS).

**Methods:** We selected all 684,204 city residents (October 21, 2001) aged 45–80 years who had not changed their address in the previous five years. Different GIS indicators were available for each subject's residence: distance from high traffic roads (HTR) (>10,000 vehicles per day), traffic density within 150m from home (number of vehicles \* meters of street in the buffer of 150m from home/area of the buffer), meters and daily traffic count of HTR within 150m of home. Data on individual education and area-based socioeconomic position (SEP) were also available. We followed the participants until December 31, 2006. Cox regression models were used to study traffic indicators and mortality taking into account gender, age, education, and area-based SEP.

**Results:** During the study period, 45,006 natural deaths occurred (mortality was 13.4% per year, 96% of all deaths). All GIS indicators had a statistically significant association ( $P$  for trend <0.03) with mortality. Subjects who lived fewer than 50m from a HTR had a higher risk of dying (HR = 1.05, 95%CI:1.02–1.08) than those more than 250m away. Traffic density showed the strongest association with an 8% (95%CI = 4–11%) higher risk for those in the greatest traffic density quartile than those with zero traffic density. The results were stronger for cardiovascular diseases and diabetes. No effect modification was seen for age, education and area based SEP.

**Conclusion:** An association between traffic variables and mortality was detected, especially for cardiovascular diseases and diabetes.

## ISEE-0235

**Personal Care Products' Use and Its Association with Urine Concentrations of Phthalate Metabolites**

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**Background and Objective:** Sources of phthalates other than PVC related products are scarcely documented in Mexico. The aim of this study was to explore the association between urinary levels of nine phthalate metabolites and use of personal care products as well as other potential environmental sources.

**Methods:** Subjects included 108 women who participated as controls in an ongoing population based case-control study of environmental factors and genetic susceptibility to Breast Cancer in northern Mexico. Direct interviews were performed to inquire about reproductive history, use of personal care products and diet. The following phthalate metabolites were measured in urine by HPLC-MS/MS at the CDC: monoethyl phthalate (MEP), monobenzyl phthalate (MBzP), mono-n-butyl phthalate (MBP), mono-isobutyl phthalate (MiBP), mono-2-ethylhexyl phthalate (MEHP), mono-2-ethyl-5-

oxohexyl phthalate (MEOHP), mono-2-ethyl-5-hydroxyhexyl phthalate (MEHHP), mono-2-ethyl-5-carboxypentyl phthalate (MECPP) and, mono-3-carboxypropyl phthalate (MCP).

**Results:** Detectable urinary concentrations of phthalate metabolites varied from 75% (MEHP) to 100% (MEP, MBP, MEOHP, MEHHP, MECPP). Setting a cut off point of  $P < 0.05$ , linear regression models showed that anti-age creams' use was significantly associated with concentrations of MEP ( $\beta = 0.84$ ) and MCP ( $\beta = 0.51$ ), perfume use significantly predicted increasing concentrations of MBP ( $\beta = 0.36$ ) and MiBP ( $\beta = 0.5$ ). MBzP concentration was related to the use of hair conditioner ( $\beta = 0.58$ ) while DEHP metabolites concentrations were significantly associated to deodorant (MEHP  $\beta = 0.49$ ) and body cream use (MECPP, MEHHP,  $\beta = 0.4$  and  $0.47$ ). Bottled water consumption was associated to concentrations of MCP, MEOHP, MEHHP and MECPP ( $\beta = 0.39, 0.39, 0.39$  and  $0.33$  respectively).

**Conclusion:** The results of this study suggest that using personal care products contributes to phthalates body burden. Further estimation of dermal and inhalation exposure by specific products is warranted. "The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention."

## ISEE-0244

**Estimating Local Health Impacts Using Fine-Scale Air Quality Estimates and Baseline Incidence Rates**

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**Background and Objective:** Health impact assessments have historically been relied upon to characterize the national or regional public health burden associated with exposure to ambient pollutants. The U.S. EPA and environmental scientists in cities such as New York and Seattle have recently shown interest in assessing health impacts at a local scale. We demonstrate how best to combine regional and fine scale air quality modeling with local health information to develop an emissions control strategy that maximizes air quality benefits.

**Methods:** We first estimated fine-scale (1km) PM<sub>2.5</sub> air quality changes in the Detroit metropolitan area for two alternate air quality strategies. The first aimed to improve air quality level to a certain level; the second used information regarding the distribution of populations and their susceptibility to maximize health benefits while attaining that air quality level. We estimated health impacts using the environmental Benefits Mapping and Analysis program (BenMAP), which we configured to utilize ZIP-code level hospitalization rates for key health endpoints, including chronic bronchitis and respiratory hospitalizations. We ran the model with and without these local incidence rates and assessed the influence of local rates on estimates of health impacts.

**Results:** The total health benefits were greater under the emission control strategy that utilized local air quality and health data. The population-weighted air quality change was greater for susceptible populations. Local incidence rates more accurately represented the health status of key populations than did national incidence rates. The estimated cases of chronic bronchitis, myocardial infarctions and respiratory hospitalizations were significantly different using local rates.

**Conclusions:** Joint consideration of fine-scale air quality modeling and local-scale health data produced an emission control strategy that delivered (1) highly resolved estimates of health impacts across key sub-populations; (2) valuable information regarding the efficacy of emission controls; (3) an improved estimate of total health benefits.

## ISEE-0249

**Diet Contributes Significantly to the Body Burden of PBDEs in the General U.S. Population**

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**Background and Objective:** Exposure of the US population to polybrominated diphenyl ethers (PBDEs) is thought to be via exposure to dust and diet. However, little work has been done to empirically link body burdens of these compounds to either route of exposure. The primary goal of this research was to evaluate the dietary contribution of PBDE body burdens in the US by linking serum levels to food intake.

**Methods:** We used two dietary instruments--a 24-hour food recall and a 1-year food frequency questionnaire--to examine food intake in participants of the 2003–2004 National Health and Nutrition Examination Survey (NHANES). We regressed serum concentrations of five PBDEs (BDE-28, 47, 99, 100 and 153), and their sum ( $\Sigma$ PBDE), against diet variables while adjusting for age, sex, race/ethnicity, income and BMI.

**Results:**  $\Sigma$ PBDE serum concentrations among vegetarians were 23%–27% lower than among omnivores ( $P < 0.01$ ), a result that was consistent for individual congeners. Serum levels of five PBDE congeners were significantly associated with consumption of poultry fat: low, medium and high intake corresponded to geometric mean  $\Sigma$ PBDE concentrations of 40.6, 41.9 and 48.3 ng/g lipid, respectively ( $P < 0.01$ ). Similar trends were observed for red meat fat, which were statistically significant for BDE-100, BDE-153 and  $\Sigma$ PBDE. No association was observed between serum PBDEs and consumption of dairy or fish. Results were similar for both dietary instruments, but were more robust using the 24-hour food recall.

**Conclusion:** Intake of contaminated poultry and red meat contribute significantly to PBDE body burdens in the United States.

## ISEE-0254

**Acute Radiation Exposure and Risk of Second Primary Cancers in Atomic Bomb Survivors**

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**Background and Objective:** Studies of the Japanese Atomic Bomb Survivors provide some of the most comprehensive evidence to date of the impact of ionizing radiation exposure on cancer risk. Radiation-associated risks for first primary cancers have been characterized extensively in A-bomb survivors, and this research has guided risk assessment for radiation exposure in environmental, occupational, and medical settings. Since comparatively little is known about the risk of subsequent primary cancers, we investigated the risk of second primary solid cancer and leukemia among survivors of a first primary cancer in the Life Span Study of Atomic Bomb Survivors.

**Methods:** Second primary cancer incidence data for 1958–2001 was provided by the Hiroshima and Nagasaki population-based cancer registries. Poisson regression analysis was used to examine risks of second primary cancer, among survivors of a first cancer, in relation to radiation dose to the colon ( $\gamma$ -ray dose plus 10 times the neutron dose, estimated from the DS02 dosimetry system).

**Results:** Of 13786 A-Bomb survivors with a first primary cancer, 1331 developed second solid cancers, and 33 developed leukemia. Compared to survivors with radiation dose  $<0.005$  gray (Gy), survivors exposed to  $\geq 2.00$  Gy were at significantly elevated risk of developing second primary solid cancers (RR = 2.3; 95% CI: 1.7, 3.1) and second primary

leukemia (RR = 7.8; 95% CI: 2.2–28.0) in analyses adjusted for sex, city, exposure age, attained age, and age at first diagnosis. For linear dose response models, the excess RRs/Gy were 0.5 (95% CI: 0.3, 0.7) and 3.2 (95%CI: 1.0, 8.3) for second primary solid cancers and leukemia, respectively.

**Conclusion:** While further research is necessary, we observed significantly elevated risks of second primary cancers associated with exposure to ionizing radiation in Atomic Bomb Survivors with a first primary cancer, providing further evidence of the long-term risks associated with exposure.

## ISEE-0261

**German Environmental Survey for Children (Geres IV): Phenanthrene Trans-9,10-dihydrodiol as a Biomarker for ETS-Exposure of Children**

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**Background and Objective:** Samples of GerES IV were used to analyse the concentrations of the PAH metabolites phenanthrene trans-1,2-dihydrodiol (1,2-DI-OH-PHEN), phenanthrene trans-9,10-dihydrodiol (9,10-DI-OH-PHEN) and 1,2,3,4-phenanthrene-tetrol (1,2,3,4-PHEN-tetrol) for the first time in children.

**Methods:** 150 morning urines had been randomly chosen from the stored 1800 samples of GerES IV (3 to 14 year old German children). Chemical analysis comprises an enzymatic cleavage of the conjugates with subsequent clean up followed by derivatisation and final quantification with gas chromatography-mass spectrometry.

**Results:** The metabolites were detectable in all samples analysed and in higher concentrations than the already in GerES measured metabolites (1-OH-PYR, MONO-OH-PHEN). The mean concentrations were 0.92  $\mu$ g/l (1,2-DI-OH-PHEN), 0.51  $\mu$ g/l (9,10-DI-OH-PHEN) and 1.06  $\mu$ g/l (1,2,3,4-PHEN-tetrol). 9,10-DI-OH-PHEN was the best biomarker to show ETS exposure of children. The concentration was 0.43  $\mu$ g/l for those children living in households with no smoker, 0.57  $\mu$ g/l for those living with one smoker and 0.74  $\mu$ g/l for children living with more than one smoker.

**Conclusion:** 9,10-DI-OH-PHEN was the best indicator to show ETS exposure of children. It was suggested that the ratio between 1,2,3,4-PHEN-tetrol and the sum of the five MONO-OH-PHEN is an indicator for the individual metabolic phenotype (Hecht, 2005). The ratio between 1,2,3,4-PHEN-tetrol and the sum of the MONO-OH-PHEN was 2.8. It was not different between boys and girls or in the different age groups of the children. However, the ratio seems to be higher in children than in adults which indicates that children excrete relatively more 1,2,3,4-PHEN-tetrol than adults and might suggest that children form in general more biological active PAH diol epoxides compared to adults.

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## ISEE-0264

**Prenatal Exposure to Gas Cooking and Neurodevelopment at 14 Months**

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**Background and Objective:** Concerns are emerging for neurodevelopmental effects of exposure to air pollutants during pregnancy or early life. Gas cookers are a main source of indoor air pollutants, in particular NO<sub>2</sub>. A recent study was the first to associate exposure to gas appliances and indoor NO<sub>2</sub> with adverse neurodevelopmental outcomes and this requires replication. We examine the relationship between use of gas cookers during pregnancy and neurodevelopment at month 14, and assess potential modification of this relationship by *GSTP1* polymorphisms.

**Methods:** A prospective population-based birth cohort in Sabadell (Spain) enrolled 657 pregnant mothers between 2004 and 2006. Children were assessed for mental and psychomotor development at age 14 months with the Bayley Scales of Infant Development. In the 3<sup>rd</sup> trimester of pregnancy, information about the presence of gas cookers at home was obtained through questionnaires (n = 557). Cord blood was genotyped for the coding variant Ile105Val in *GSTP1*; analyses by genotype were restricted to children from Spanish and white ethnic origin (n = 356).

**Results:** Gas cookers were present in 61% of homes. The presence of a gas cooker was associated with a decrease in the mental development index of 3.10 points (95%CI -5.51, -0.70) independent of social class, education, maternal IQ and other potential confounders. There was no association with the psychomotor index ( $\beta = 0.18$ ; 95%CI -2.33, 2.69). The negative effect of gas cooking on neurodevelopment was greatest in a small group of children (N = 39) homozygous for the Val105 allele, but tests for interaction were not statistically significant.

**Conclusion:** This study suggests an early neurodevelopmental effect of gas cooking exposure and supports the findings of one previous study. Given the common use of gas cookers, any small effect could have large public health implications. Larger studies are needed to confirm suspicions of a *GSTP1*-mediated oxidative stress mechanism.

#### ISEE-0276

##### Blood Lead Levels and Major Depressive Disorder, Panic Disorder, and Generalized Anxiety Disorder in U.S. Young Adults

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**Background and Objective:** Lead is a ubiquitous neurotoxicant, and adverse cognitive and behavioral effects of exposure are well documented in children and occupationally exposed adults, but not in adults with low environmental exposure. We sought to investigate the association of current blood lead levels (BLL) with three common psychiatric diagnoses among young U.S. adults.

**Methods:** We used data from the National Health Nutrition Examination Survey (1999–2004), a cross-sectional survey of a representative sample of the non-institutionalized U.S. population. Twelve-month DSM-IV criteria-based diagnoses of major depressive disorder, panic disorder, and generalized anxiety disorder were assessed by the Composite International Diagnostic Interview. A total of 1,987 respondents age 20–39 years with data on BLL, the three disorders, and all covariates were included in the analyses.

**Results:** The BLL geometric mean was 1.24  $\mu\text{g}/\text{dL}$  (SD 1.72, range 0.3–37.3  $\mu\text{g}/\text{dL}$ ). Increasing quintiles of BLL was associated with higher odds of major depressive disorder (*P* for trend 0.05) and panic disorder (*P* for trend 0.02), but not generalized anxiety disorder (*P* for trend 0.75), after adjustment for sex, age, race/ethnicity, education, and poverty-income ratio. Persons with BLL in the highest quintile had 2.3 times the odds of major depressive disorder (95% confidence interval [CI]: 1.13–4.75) and 4.9 times the odds of panic disorder (95% CI: 1.32–18.48) as those in the lowest quintile. Cigarette smoking was associated with higher BLL and the outcomes, but models excluding current smokers also resulted in

statistically significant associations for major depression (*P* for trend = 0.03) and panic disorder (*P* for trend = 0.01).

**Conclusion:** In this sample of young adults with low levels of environmental lead exposure, higher BLL was associated with increased odds of major depression and panic disorder. Exposure to lead at levels generally considered safe could result in adverse mental health outcomes.

#### ISEE-0278

##### Environmental Health and Risk Perception in Practice: A Review of Case Studies

Paolo Luria, and Mary Lyons, Liverpool John Moores University, England, United Kingdom.

**Background and Objectives:** Today, risk perception and communication appear to be of fundamental importance to risk management. In 2007–2008, the authors undertook a desk study on environmental health risk perception, in cooperation with the Health Protection Agency North West. The work aimed to provide public health practitioners with a useful tool to assist in the practical management of public concerns in relation to potential environmental hazards.

**Method:** 30 public health experts in the North West of England were asked to submit case studies on main areas of public concern. Seventeen cases were received. A content analysis was carried out to identify and explore the perception of the most common environmental health hazards in the region. The public perception of the level of risk posed from those hazards was then compared with best evidence available about known health risks associated with them. 84 documents were reviewed.

**Results:** Community anxiety and stress were significant factors of the risk associated with the cases. Public reaction to a hazard did not necessarily relate to the likelihood of exposure but to the feared consequences. Most of the concerns related to land and air contamination, often focusing on cancer fear. In about 50% of the cases there was a public dissatisfaction with the authorities' response, which did not meet people's expectations. In particular:

- investigation timescale did not conform to the desire of the public for a prompt response;
- the investigation was often limited to the quantification of environmental or health risks, neglecting other intangible factors, more important to the general public;
- the outcomes were usually communicated in a very technical manner.

**Conclusions:** The work concluded that risk perception may be more important in determining priorities for health promotion and intervention than calculated risk, although regulators have legally to focus on the latter.

#### ISEE-0280

##### The Future of Environmental Health, an Integrated Approach

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**Abstract:** Health can be considered as one of the most important constituents of quality of life. To explore how future health will evolve, the population & health model PHOENIX has been refined and further developed. The main purpose of it is to describe future health status using of the concept of the health transition, given changes in socio-economic and environmental conditions. Based on the review of existing integrated approaches to health modelling, a health module has been developed and describes various population health outcomes. The additional value of this approach is the integration with other sustainability domains (economic and environment) while preserving the linkage with the empirical data and concepts (e.g. the disability-adjusted life years). The most relevant health

risk factors and the associated diseases have been included, with a special focus on environmental risks. Food and hunger, Water supply and sanitation, climate change and malaria, energy supply and indoor / outdoor air pollution are amongst the risk factors included, covering already a substantial part of the health-related Millennium Development Goals (MDG). Explorations of existing consistent socio-economic and environmental scenarios show that many of the health-MDGs will not be achieved, given current MDG-policy targets. Policy analyses have been performed to explore how approximate these targets. The use of such an integrated approach enables to have a sound analysis of the economic and social feasibility of these policy options. Especially the integration of health with various (in)equality facets, by the distinction of gender issues in access to food, a close inter-linkage with educational processes, in which gender issues are also playing a vital role, but also placing health in a broader perspective of poverty, make that the future unfolding of these health scenarios could be very valuable for policy makers, within but also outside the health field.

#### ISEE-0284

##### Air Pollution and Risk of Congenital Anomalies in England, 1991–99

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**Background and Objectives:** There is growing epidemiological evidence for the adverse effects on the fetus and newborn of maternal exposure to air pollution. This paper investigates the association between risk of non-chromosomal congenital anomaly and annual ward level exposure to air pollution in England during the 1990s.

**Methods:** A geographical study was conducted across four regions of England with population-based congenital anomaly registers, 1991–99. Exposure was measured as 1996 annual mean background SO<sub>2</sub>, PM<sub>10</sub> and NO<sub>2</sub> concentrations at census ward level (n = 1474). Poisson regression, controlling for maternal age, area socio-economic deprivation, and hospital catchment area was used to estimate relative risk for an increase in pollution from the 10<sup>th</sup> to the 90<sup>th</sup> centile, for 23 non-chromosomal congenital anomaly subtypes.

**Results:** For non-chromosomal anomalies combined, relative risks were 0.99 (95%CI 0.93–1.05) for SO<sub>2</sub>, 0.97 (95%CI 0.84–1.11) for NO<sub>2</sub>, 0.89 (95%CI 0.75–1.07) for PM<sub>10</sub>. For congenital anomaly subtypes, two statistically significant associations were found, of which the raised risk for Tetralogy of Fallot and SO<sub>2</sub> (RR = 1.38, 95%CI 1.07–1.79) is of interest in the light of previously reported associations between this cardiac anomaly and other air pollutants.

**Conclusions:** While air pollution in the 1990s did not lead to sustained geographical differences in overall congenital anomaly rate in England, further research regarding specific anomalies is indicated.

#### ISEE-0287

##### Evaluating Geographic Imputation Approaches for Zip Code Level Data: An Application to a Study of Pediatric Diabetes

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Research Institute, Seattle, WA, United States; and ¶University of Colorado, Denver, CO, United States.

**Background and Objective:** There is increasing interest in the study of place effects on health, facilitated in part by geographic information systems. Incomplete or missing address information reduces geocoding success. Several geographic imputation methods have been suggested to overcome this limitation. Accuracy evaluation of these methods can be focused at the level of individuals, and at higher group-levels (e.g., spatial distribution).

**Methods:** We evaluated four geo-imputation methods for address allocation from ZIP codes to Census tracts at the individual and group level. Two fixed (deterministic) and two random allocation methods were evaluated, using land area or population under age 20 as weighting factors. Data included 2,126 geocoded cases of incident diabetes mellitus among youth aged 0–19 between 2002 and 2003 in four U.S. regions. The imputed distribution of cases across tracts was compared to the true distribution using a chi-squared statistic.

**Results:** At the individual level, population-weighted fixed allocation showed the greatest level of accuracy, with correct census tract assignments averaged 30.45% across all regions, followed by the populated-weighted random method; 21.07%. Distribution of cases across Census tracts was: 58.2% of tracts exhibited no cases, 26.2% had one case, 9.5% had two cases, and less than 3% had three or more. True distribution was best captured by random allocation methods, with no significant differences (*P*-value > 0.90). However, significant differences in distributions based on fixed allocation methods were found (*P*-value < 0.0003).

**Conclusion:** Results indicate fixed imputation methods yield greatest accuracy at the individual level, thus indicating their use for studies focusing on distances to exposure sites. Fixed methods result in artificial clusters in single Census tracts. For studies focusing on spatial distribution of disease, random methods seemed superior, as they most closely replicated the true spatial distribution. When selecting an imputation approach, researchers should consider carefully the study aims.

#### ISEE-0288

##### Noise and Cardiovascular Mortality in Switzerland—A Cohort Study

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**Background and Objective:** Exposures to noise and to air pollution have both been associated with cardiovascular mortality. The aim of this study was to examine the association of acute myocardial infarction, atherosclerosis related mortality, heart failure and selected control outcomes (lung cancer, alcoholic liver disease) with residential exposure to noise, taking air pollution levels into account.

**Methods:** We analysed data from the Swiss National Cohort, which is based on the linkage of census 2000 data with mortality records from 2000–2005. The data base includes information on place of residence, sex, age, civil status, education, date and cause of death. A GIS was used to assess exposure at place of residence to noise from roads, trains and aircrafts from geospatial noise models, exposure to PM<sub>10</sub> and distance to major roads. Data of 4.58 mio persons were analysed using Cox proportional hazard models.

**Results:** For persons with high exposure to aircraft noise (>60dB), increased heart failure mortality (HR = 1.63, 95%-CI 1.07–2.48) and myocardial infarction mortality (HR = 1.15, 95%-CI 0.81–1.65) was observed compared to persons with exposure under 45dB. With respect to road and train noise exposure, neither acute myocardial infarction, atherosclerosis related heart disease nor heart failure mortality were increased in highly exposed individuals. Adjustment of the analyses for PM<sub>10</sub> levels or for distance to roads did not noticeably change the risk estimates for noise effects.

Interestingly, alcoholic liver disease mortality was increased in the highest exposure category of all three types of noise exposure.

**Conclusion:** We observed an association between aircraft noise and heart failure mortality. Alcohol abuse might play a role as either intermediate or confounding factor for the observed associations with noise exposure.

#### ISEE-0292

##### Saharan Dust Transport and Daily Mortality

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**Background and Objective:** A recent study in Barcelona evaluated the effects of Saharan dust on mortality. In this study, the authors showed that increases of both fine and coarse particles were associated with greater effects on mortality in Saharan dust days than in non Saharan dust ones. We study this relationship in Emilia-Romagna, a region in the north-east of Italy. In this region the meteorological and air quality station of Mt. Cimone (2165 a.s.l.) is located, one of the first high mountains that is passed by the Saharan air masses and where measurements of their chemical composition has been regularly carried out since 2002.

**Methods:** The identification of Saharan dust episodes was done analysing the hourly number concentration of coarse particles at Mt. Cimone. Additional information on dust episodes was obtained from the analysis of background trajectories and satellite images. Exposure of study population to particulate matter was defined through the monitored level of PM<sub>10</sub> in urban areas. We studied all subjects at least 75 years of age who died of natural causes in the main cities of the region from 2002 to 2006. The association of daily concentrations of PM<sub>10</sub> with daily mortality was investigated using a case-crossover design. Conditional logistic regression was used to estimate percent increase in the risk of dying for an increase of 10 µg/m<sup>3</sup> in PM<sub>10</sub> (lag 1). Chemical composition of particles was also analyzed.

**Results:** Natural mortality risk increased by 3.8% (95% Confidence Intervals, CI, 0.2–7.5) during non Saharan dust days and by 5.7% (CI, –3.0–15.2%) during Saharan dust days in summer period. Other analyses have been done by age, sex and cause of death.

**Conclusion:** The apparent increase in mortality associated with Saharan dust raises concern over possible underestimation of toxicity from coarse particles when they come from desert sources.

#### ISEE-0294

##### Comparing Risk Factors of Atopic and Non-Atopic Asthma May Lead to Misleading Conclusions

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**Background and Objective:** It has become commonplace to analyze separately atopic and non-atopic asthma in studies on genetic, environmental, and immunological characteristics of asthma. Atopic asthma is in most studies defined simply based on presence of both asthma and positive skin prick test or specific IgE antibodies. We here illustrate the problems introduced by using atopic and non-atopic asthma as endpoint in analyses exploring characteristics associated with asthma/atopy.

**Methods:** Analyses of the 31 year follow-up of the Northern Finland 1966 birth cohort (n = 5417). Asthma was defined as doctor-diagnosed asthma ever and atopy as any skin prick test reaction >3 mm to common

allergens at age 31. Atopic and non-atopic asthma were defined as asthma with and without atopy, respectively.

**Results:** The prevalence of asthma was 7.8% and of atopy 30%. Having a cat in childhood was associated with decreased risk of atopy at age 31 years (OR 0.59, 95% CI 0.52–0.66). This created a spurious protective association with atopic asthma (OR 0.69, 95% CI 0.53–0.88) and an opposite association with non-atopic asthma (OR 1.27, 95% CI 0.93–1.75). There was no association between cat ownership and asthma, when analysis was stratified by atopy or in a multivariate model adjusted for atopy (OR 1.05, 95% CI 0.85–1.29). Similar spurious associations were seen for gender. Findings were confirmed with simulated datasets.

**Conclusion:** If a characteristic is associated with atopy, this will produce a similar association with atopic asthma and a reverse association with non-atopic asthma, even if the characteristic has no association with asthma. Therefore, before better methods become available to define phenotypes of asthma, asthma and atopy should be analyzed as separate end points.

#### ISEE-0296

##### Concentration Response Functions for Ultrafine Particles and All-Cause Mortality and Hospital Admissions: Results of an European Expert Panel Elicitation

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**Background:** Toxicological studies have provided evidence of the toxicity of ultrafine particles (UFP), but epidemiological evidence for health effects of UFP is limited. No quantitative summary currently exists of concentration response functions for UFP, that can be used in health impact assessment.

**Objective:** To specify concentration response functions for ultrafine particles in urban air including its uncertainty through an expert panel elicitation.

**Methods:** Fourteen European experts from the disciplines of epidemiology, toxicology and clinical medicine were selected using a systematic peer-nomination procedure, of whom eleven participated in the workshop. Using individual ratings supplemented with group discussion, probability distributions of effect estimates were obtained for all-cause mortality and cardiovascular and respiratory hospital admissions.



**Results:** Experts were willing to quantify effects of UFP on all-cause mortality and to a lesser extent hospital admissions. Between experts substantial differences in the estimated UFP health effect and its uncertainty were found. The mean of the central estimate of the percentage decrease in all-cause mortality with a 1,000 p/cm<sup>3</sup> permanent decrease in UFP concentration was 0.43%. The lack of studies on long-term exposure was rated as the most important factor contributing to the overall uncertainty. Most experts felt that toxicity of UFP differed depending on source and/or composition. Effects on cardiovascular and respiratory hospital admissions were considered more uncertain.

**Conclusion:** This expert elicitation provides the first estimate of quantitative summary concentration response functions between urban air ultrafine particles and all cause mortality and hospital admissions, along with explicit estimates of their uncertainty.

#### ISEE-0297

##### Modelling Children's Exposure to Lead in Hoboken, Belgium

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**Background and Objective:** Since the 19<sup>th</sup> century, Hoboken, Belgium has harbored a non-ferrous smelting industry resulting in considerable lead pollution. In the 1970's, a twice-yearly biomonitoring program for children in the adjoining district of Moretusburg was established, resulting in an increased awareness and the introduction of lead reduction measures. To assess the current situation in the broader area, biomonitoring and environmental measuring campaigns were set up for 593 young children aged from 2.5–7 years old in the wider surroundings of the plant.

This contribution looks at how biomonitoring and environmental measurement data were used to build and validate an integrated exposure model describing the dynamics of children's exposure to lead.

**Methods:** The exposure model was built around US-EPA's IEUBK model, extending it with a wrapper model component allowing for a more accurate modelling of children's whereabouts and activities. Based on environmental measurements, the model predicts blood lead levels (BLL). Model validation was performed by comparing predictions with measured BLL, both for individual children and for pooled groups based on home location and school frequented.

**Results:** Average BLL in the area are relatively low and consequently, individual child behaviour introduces significant variations unaccounted for in the model. While model validation shows that predictions are in the same order of magnitude as measurements (approximately 18% over-prediction), the trend reproduction is poor. A model-based comparison shows food consumption and soil and dust ingestion to be the major contributors to the overall lead exposure. Both home and school locations have an influence on the BLL.

**Conclusion:** Model validation shows that variations and specifics of individual children's behaviour remain a challenge in obtaining adequate predictions.

Food consumption and soil and dust ingestion are the major contributing exposure pathways, and home and school locations are determining factors for the observed BLL.

#### ISEE-0298

##### Dampness and Moulds in Relation to Asthma Symptoms in Children: Results from Phase Two of the International Study of Asthma and Allergies in Childhood (Isaac Phase Two)

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**Introduction:** Dampness and mould are thought to negatively affect respiratory health in children. We investigated the relation to asthma symptoms and possible effect modifiers in a large international study.

**Methods:** A cross-sectional study of approximately 25000 children was carried out in 22 centres in 17 countries worldwide. Random samples (n = 1000) of 8 to 12 year old children were studied using standardized parental questionnaires with detailed questions on asthma symptoms and potential risk factors including "damp spots" and "visible moulds or fungus" on the walls or ceiling. In addition, standardized protocols were applied for skin prick testing to assess atopic sensitization. Odds ratios (OR) for each centre and combined estimates from meta-analysis random effects models were calculated.

**Results:** "Damp spots" and "moulds" in the first year of life and at present were significantly associated with wheeze in the past year (combined crude and adjusted ORs from 1.60 to 1.79). The effect did not vary by skin prick test positivity or parental allergic disease. The crude OR for damp spots but not for moulds was significantly higher (P = 0.028) among children that used feather bedding in their first year of life (OR: 2.64; 95%CI: 1.81 to 3.86) compared to children using blankets only (OR: 1.68; 95%CI: 1.38 to 1.85). After adjustment for age, sex, parental allergic disease and maternal education, significance was lost (P = 0.17; ORs of 2.23 and 1.60, respectively). The presence of double glazing compared to single glazing did not influence the effect of either moulds or damp spots.

**Conclusions:** These results confirm that self reported dampness and moulds are associated with an increased risk of asthma symptoms. Atopy, parental allergic disease and type of window did not modify the observed associations. Initially observed differences between types of bedding might be confounded by parental disease and maternal education.

#### ISEE-0300

##### Three Different Models to Estimate Long-Term Exposure to Traffic Related Air Pollution in Amsterdam, the Netherlands

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**Abstract:** In the north-western part of the Netherlands, several health effects studies on traffic related air pollution are planned in the future. To estimate exposure, separate land use regression (LUR) models are developed for the full region (model1) and the greater city of Amsterdam (model2). The full region consists of rural, suburban and urban areas including Amsterdam. For Amsterdam, more detailed information is available. The aim of this study was to compare both models and a dispersion model with measurements in Amsterdam, to see whether the city-specific model for Amsterdam improves exposure estimation.

Model1 is based on widely available land use data (100m grid), model2 on more detailed landuse data (5m grid). The same detailed traffic information is used. Separate NO<sub>2</sub> monitoring campaigns were performed for model1 (Ogawa badges, n = 60) and model2 (Palmer tubes, n = 62). Both models were developed using the same supervised stepwise regression procedure.

Next, NO<sub>2</sub> concentrations were estimated using both LUR models and the dispersion model, and compared to the measured concentrations at 75 sites (62 Palmes, 13 Ogawa) in Amsterdam.

Model1 predicts NO<sub>2</sub>-concentrations from background concentration, traffic volume at the nearest road, distance to the nearest busy road and residential land use in a 5km buffer (model-specific cross-validated R<sup>2</sup>: 85%). The prediction variables in model2 are: traffic volume at the nearest busy road within 50m, distance to the nearest main road, green space in a 250m buffer and water in a 100m buffer (model-specific cross-validated R<sup>2</sup>: 70%).

Correlation between concentrations measured in Amsterdam (n = 75) and the prediction of city specific model2 (r = 0.82) is higher than of model1 (r = 0.70) or the dispersion model (r = 0.76).

In Amsterdam, a city-specific LUR model based on detailed land use data results in a better NO<sub>2</sub>-exposure estimation than a regional LUR model or a dispersion model.

### ISEE-0303

#### Long-Term Traffic Related Air Pollution and Diabetes Prevalence in a Semi-Rural Area in the Netherlands

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**Abstract:** In recent studies an association between long term exposure to air pollution and type 2 Diabetes Mellitus (T2DM) is suggested. The present study aims to investigate this relationship using data from a Diabetes Screening study conducted between 1998 and 2000 among nearly 12000 inhabitants, aged 50–75, of a semi-rural area in the Netherlands.

Over 9000 men and women participated in a stepwise screening procedure, consisting of the diabetes symptom risk questionnaire, followed by fasting capillary blood glucose measurement and an oral glucose tolerance test in selected high risk individuals. WHO 2006 diagnostic criteria were used for the definition of DM.

Long term exposure to NO<sub>2</sub>, a proxy for traffic related air pollution, was estimated using a land use regression model incorporating the predictor variables; background concentration, traffic volume at the nearest road, distance to the nearest busy road and residential land use in a 5km buffer. Exposure was estimated at the postcode-centroid, in the Netherlands about 20 addresses share one postcode. Logistic regression was performed to estimate diabetes risk associated with NO<sub>2</sub> exposure.

Of the 8150 participants (70% of those invited), 417 had T2DM and 217 patients with T2DM were detected. Annual exposure to NO<sub>2</sub> at the postcode of the study population ranged from 9.0 to 37.8 µg/m<sup>3</sup>, with a mean of 15.8 µg/m<sup>3</sup>. First crude analysis shows an Odds Ratio for T2DM of 1.39 (95% Confidence Interval: 1.00–1.94) per 10 µg/m<sup>3</sup> increment in NO<sub>2</sub>.

First crude results from this study indicate that long-term exposure to traffic related NO<sub>2</sub> exposure is associated with T2DM risk. Additional exploration of the data and adjusted analyses are necessary and will be performed.

### ISEE-0308

#### Estimating Cancer Incidence Attributable to Incinerators: A Tool for Health Impact Assessment

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**Background and Objectives:** The health impact of incinerators remains a controversial issue because of lack of appropriate exposure assessment. It is likely that the excess risk due to incinerators varies over time, according to the characteristics of the plants and the surrounding community. Under INTARESE EU-project, we have developed a flexible tool for health impact assessment that estimates the number of cases of cancer attributable to an incinerator at a specified time period.

**Methods:** We developed a formula to estimate the excess risk (ER) of cancer. Let's assume that:

- 3.5% (95%CI: 3–4%) (Elliott et al, 1996) is the reference excess risk (RER) in a population living within 3 km from a plant and exposed for 20 years (period 1960–1980);
- exposure levels change with time;
- for a given age, cumulative exposure (CE<sub>a,i</sub>) is the sum of the exposures levels across time;
- latency from first exposure modifies the ER with a carcinogenic response described as a sigmoid function (Ls). ER declines with time from cessation of exposure (Lc);
- population and age distribution do not change over time.

**Results:** Using experimental data, we defined a coefficient Ey(t) for exposure levels that varies from 1 during 1960–1980 to 0.05 after 2000. Thus, for each age a<sub>i</sub>, CE<sub>a,i</sub> is the sum of the exposures over time (Ey(t)). The excess risk (ER<sub>a,i</sub>) is then:

$$ER_{a,i} = RER * (CE_{a,i} / 20) * Ls * Lc.$$

The estimated ER may reach values up to 4.0% for old people living close to a plant operating since the sixties while it never exceed 0.5% for more recent plants operating after the nineties.

**Conclusion:** The proposed method may be used, as the first approximation, to estimate the attributable burden of cancer cases for population living near incinerator. The tool is flexible, but the underlying assumptions and their uncertainties should be transparent.

### ISEE-0309

#### Investigation of the Immuno-Modulatory Effects of Aflatoxin B<sub>1</sub>, B<sub>2</sub> and G<sub>1</sub>

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**Background and Objective:** Mycotoxins are a diverse group of compounds that are produced by fungi of the *Penicillium*, *Fusarium*, and *Aspergillus* species. They occur in food and feed products which have fungal contamination. Mycotoxins can have severe detrimental effects on both human and animal health, including liver damage, cancer, and immunosuppression. It has been postulated that chronic aflatoxin exposure affects disease progression in individuals infected with HIV. The aim of this project was to investigate immunomodulatory effects of aflatoxins, in an effort to gain a better understanding of the mechanisms through which these compounds exert their immunosuppressive effects.

**Methods:** Murine macrophages (cell line J774) were cultured in the presence of AFB1, AFB2, AFG1, singly or in combination, for up to 72 hours. Cells were treated with lipopolysaccharide (LPS) for 24 hours to induce a cytokine response. The effect of these aflatoxins on the secretion of the pro-inflammatory cytokines interleukin 1 $\beta$  (IL-1 $\beta$ ), IL-12p40, IL-6 and Tumour Necrosis Factor- $\alpha$  (TNF- $\alpha$ ), and the anti-inflammatory cytokine IL-10, were determined by Enzyme Linked Immuno-Sorbent Assay (ELISA).

**Results:** There was a varied effect on the cytokine profile depending on the type of aflatoxin. All three aflatoxins tested had significant, dose-specific effect on levels of IL-12p40 after 24 hours treatment. AFG1 induced a significant increase in IL-6 secretion at low doses. Treatment with aflatoxin for 72 hours resulted in a statistically significant, dose-dependent increase in the secretion of the pro-inflammatory cytokine IL-6, and a decrease in the secretion of the anti-inflammatory cytokine IL-10.

**Conclusions:** The data clearly show that the aflatoxins have immunomodulatory effects on macrophages. The effect of the aflatoxins on IL-6 and IL-10 highlight the pro-inflammatory nature of these compounds. These results help explain the effects of aflatoxin exposure such as cancer, liver damage, and vaccine failure.

#### ISEE-0317

##### The Effect of Environmental Exposure to Pesticides on Birth-Weight

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**Background and Objective:** The impact of exposure to environmental contaminants on the intrauterine development is still uncertain for pesticides. In the literature conflicting results are reported, mainly due to the difficulty of exposure assessment and therefore to the presence of measurement error. We propose a Bayesian hierarchical model that aims to characterise the underlying latent exposure and compare it with the standard regression methods commonly used in epidemiology.

**Methods:** The study is a mother-child cohort conducted in Brittany (France). A total of 3421 pregnant women were enrolled between 2002 and 2005 by gynaecologists at their initial visit, before 19 weeks amenorrhea. For this analysis the pregnancy outcome investigated is birth-weight. Environmental exposure to pesticides during pregnancy is assessed from a questionnaire (household use), environmental measures (agricultural activities, pesticide emission in air) and urinary samples collected at the beginning of pregnancy for a subset of women. In this presentation, we focus on analysing the air emission measures and propose a Bayesian model that combines information from 69 measured molecule of pesticide using a latent factor structure, to characterise the global exposure by air pesticides in a flexible fashion together with its link to birth-weight.

**Results:** A negative association is found between birth-weight and pesticide exposure in air characterised by the latent factor ( $-4.4$  CI95% =  $[-24.0;15.0]$ ). Investigating the role of groups of molecules we found that fungicides have the largest negative effect on birth-weight. These results are in accordance but lower than the ones obtained by the linear regression using the observed global exposure ( $-8.0$  CI95% =  $[-20.9;4.9]$ ).

**Conclusion:** The Bayesian model allows to integrate uncertainty in the exposure estimates and to identify exposure profiles based on prior information or on similar behavior. The preliminary results will be extended to include the other sources of exposure (agricultural and household use) in a Bayesian integrated framework.

#### ISEE-0321

##### Air Pollution by Pesticides and Maternal Urinary Biomarkers in Association with Head Circumference at Birth

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**Background:** The role of the environmental exposure to pesticides during pregnancy on intrauterine growth is still uncertain but recent studies have suggested an adverse impact on head circumference at birth. Our objective is to measure the impact of pesticide exposure during pregnancy assessed through estimates of atmospheric concentrations and urinary biomarkers, on head circumference among newborns.

**Methods:** This study is based on a mother-child cohort conducted in Brittany (France). A total of 3421 pregnant women were enrolled before 19 weeks amenorrhea between 2002 and 2005. Data from self-administered questionnaires and urine samples were collected at the inclusion. Among liveborn singletons ( $n = 3322$ ), 105 infants with head circumference small for their sex and gestational age (SHC: 3.2%) were identified using the 5th percentile of reference curves for head circumference at birth. Exposure to pesticides in air was assessed at geographical level from estimated quantities of pesticide compounds used in agricultural activities in 2003 and known to be volatile, and then related to the place of residence at the beginning of pregnancy. Dialkylphosphate metabolites (DAP) of organophosphorous insecticides were measured in maternal urines for the SHC group and a control group ( $n = 601$ ) randomly selected from the liveborn singleton cohort. Logistic regression models were fitted adjusting for numerous risk factors using backward selection.

**Results:** Risks of having babies with SHC increased with levels of air exposure to pesticides (OR[1<sup>st</sup> tertile] = ref; OR[2<sup>nd</sup> tertile] = 1.8 [1.1,3.1]; OR[3<sup>rd</sup> tertile] = 1.7 [1.0,2.9]). An increase in risks of SHC was observed with increasing levels of urinary DAP metabolites (OR[not quantified] = ref; OR[1<sup>st</sup> tertile] = 1.6 [0.8,3.3]; OR[2<sup>nd</sup> tertile] = 1.9 [0.9,4.0]; OR[3<sup>rd</sup> tertile] = 2.1 [1.0,4.4]). Levels of air exposure to pesticides were significantly correlated with levels of DAP metabolites, especially dimethyl metabolites.

**Conclusion:** Using two distinct exposure assessments, this prospective study provides additional evidence of possible impact of environmental exposure to pesticides during pregnancy on head circumference, in particular atmospheric exposure to pesticides.

#### ISEE-0325

##### Particle Pollution in Accra Neighborhoods: Spatial and Socioeconomic Patterns

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**Background and Objective:** Despite rapid urbanization, there has been very limited systematic measurement and monitoring of urban air pollution in sub-Saharan Africa (SSA). More than three quarters of the region's population, including a large fraction of the urban population, use biomass fuels for cooking and heating. Therefore, sources of urban air pollution in Africa are biomass combustion as well as transportation, industrial pollution, and non-combustion sources which are the common sources in more industrialized countries. Within each city, the levels of air pollution, and the contributions of combustion and non-combustion sources, may vary by a neighborhood's socioeconomic characteristics and



the location of the neighborhood. The objective of the study was to understand the spatial and socioeconomic patterns of particulate matter (PM) pollution in Accra, Ghana.

**Methods:** Over a two year period, we measured 48-hour integrated and continuous PM<sub>10</sub> and PM<sub>2.5</sub> concentrations at a total of 11 rooftop sites in four neighborhoods. Measurement sites in each neighborhood were located either on a main road or in a residential area.

**Results:** Annual PM<sub>10</sub> concentrations (excluding the harmattan period) at traffic sites ranged from 90–110  $\mu\text{g}/\text{m}^3$  and at residential sites 60–110  $\mu\text{g}/\text{m}^3$ ; the corresponding ranges for PM<sub>2.5</sub> were 40–55  $\mu\text{g}/\text{m}^3$  at traffic sites and 30–70  $\mu\text{g}/\text{m}^3$  at residential sites, with distinct seasonal patterns. Neighborhoods of higher socioeconomic status consistently had lower levels of PM pollution than lower socioeconomic ones. Time-patterns of continuous PM pollution were also different at traffic sites compared to those in residential areas.

**Conclusion:** PM pollution in these Accra neighborhoods is slightly lower than large cities in Asia but substantially higher than those in Latin America and high-income nations. There is evidence for the contributions from biomass and traffic sources, and from geological and marine non-combustion sources to PM pollution.

#### ISEE-0327

##### Joint Effects of BMI, Diet, and Urinary Biomarkers of Environmental Exposures in Relation to Female Pubertal Maturation

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**Background:** Environmental exposures may alter timing of puberty, a factor related to later reproductive function, breast cancer, and other chronic diseases. The Breast Cancer and Environment Research Centers (BCERCs) are investigating environmental exposures and puberty in females. We hypothesize that hormonally active exposures because of their weak biologic activity may alter age at pubertal onset, although their effects may be modified by adiposity (the major source of prepubertal estrogen).

**Methods:** A multi-ethnic cohort of 6–8 year old girls was established at three national BCERC sites. At baseline, urine specimens from 1151 girls were analyzed for biomarker panels of hormonally active chemicals (9 phthalate, 8 phenol, and 3 phytoestrogen metabolites). Breast development stages from physical examination, and covariate information including body mass index (BMI), diet, and selected characteristics were collected. We calculated multivariate adjusted prevalence ratios (aPR) for the association of baseline biomarker measurements with breast stage (stage B2+ [any] vs. B1 [none]) at first annual follow-up (N = 948).

**Results:** Breast development (B2+) was present in 25% of girls. Three biomarkers had small but significant effects on breast stage in BMI-biomarker interaction models. For example, the likelihood of being B2+ decreased monotonically across quintiles of enterolactone (aPR = 0.92 [0.83–0.98] vs 1<sup>st</sup> [reference]) among girls with BMI-percentile  $\geq$

median. BP-3 showed an inverse association and 2,5-dichlorophenol a positive association among high BMI-percentile girls; there was no association in low-BMI girls. Modification of the biomarker-B2+ association was observed with selected dietary factors that may be related to hormonal mechanism of the exposures.

**Conclusion:** Preliminary results from this longitudinal study suggest that environmental exposures may be associated with pubertal developmental if considered jointly with body size distribution or dietary factors. Longer follow-up may provide further insight on effects of weak hormonal agents in relation to female puberty.

#### ISEE-0330

##### Within-Neighborhood Variation of Particle Pollution in Developing Country Cities: Mobile Monitoring and GIS Analysis in Four Neighborhoods in Accra

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**Background and Objective:** In sub-Saharan Africa there has been limited systematic measurement and monitoring of urban air pollution. Common sources of pollution include transportation, industrial pollution, and non-combustion sources, similar to industrialized countries. In addition, use of biomass fuels for cooking and heating is a significant factor. Within each city, levels of air pollution and contributions of combustion and non-combustion sources may vary between neighborhoods and within neighborhoods based on varying distributions of emission sources. The objective of the study was to understand the within-neighborhood variation of particulate matter (PM) pollution in four neighborhoods in Accra, Ghana.

**Methods:** Over a two year period, we used mobile monitors to measure ground level PM<sub>2.5</sub> and PM<sub>10</sub> along a set walking path for seven consecutive days in each of four neighborhoods. All data were georeferenced. We also collected data on pollution sources and other variables that may affect local PM levels. All statistical analyses were corrected for serial correlation of continuous PM data using autoregressive models.

**Results:** GIS analysis of ground level mobile monitoring data identified large within-neighborhood variations in PM<sub>2.5</sub> and PM<sub>10</sub> levels, with evidence of hotspots in each neighborhood. Over the seven measurement days, the inter-quartile range of PM<sub>2.5</sub> concentrations in the four neighborhoods were: 26–102; 18–58; 23–63; and 16–28  $\mu\text{g}/\text{m}^3$ . Corresponding inter-quartile ranges for PM<sub>10</sub> in each neighborhood were: 50–160; 49–144; 31–95; and 29–63  $\mu\text{g}/\text{m}^3$ . Statistical analysis showed that higher local PM pollution was associated with presence of biomass stoves (wood followed by charcoal), trash burning, road surface (dirt or paved), and traffic congestion.

**Conclusion:** Ground level PM pollution varies significantly within-neighborhood in Accra, with large influence from local sources. These findings indicate that sparse fixed site monitoring may be inadequate for assessing human exposure in complex urban environments.

#### ISEE-0331

##### A Method of Identifying Residual Confounding and Other Violations of Model Assumptions

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**Background and Objective:** Valid model-based estimation typically requires several assumptions including no residual confounding, correct model specification and no measurement error. Here, we present a method for assessing whether these assumptions hold. It depends on availability of an evaluation factor that meets the criterion: it is independent of the outcome conditional on measured exposures in the absence of confounding, misspecification and correlated measurement errors.

**Methods:** Using directed acyclic graphs, we show one can identify violations of model assumptions using an evaluation factor  $F$  that satisfies the stated criterion. Validity to partially correct estimates follows from probability arguments in a simple situation when the only violation is residual confounding. We apply the method to a time-series study of emergency department visits for asthma and ozone levels over the preceding 2 days in Atlanta.

**Results:** When  $F$  was the ozone level two days following ED visits, its association with ED visits was weak and non-significant in the base model. However, when several variables judged *a priori* to be confounders were excluded,  $F$  was strongly associated with ED visits—correctly indicating the presence of a violation of an assumption, here residual confounding. In contrast, the AIC incorrectly suggested these variables might be omitted.

**Conclusion:** This method provides a potentially useful way to identify important sources of bias—residual confounding, model mis-specification or correlated measurement error. Its sensitivity and performance will differ by context. The example illustrates that use of some statistical approaches, such as AIC, can be misleading. Pollution levels or emissions after the outcome has occurred may be suitable evaluation factors in some situations.

#### ISEE-0332

##### Prolonged Exposure to Particulate Air Pollution and Decreased DNA Methylation

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**Background and Objective:** Acute and chronic exposure to particulate air pollution is associated with increased cardiovascular morbidity and mortality. Epigenetic mechanisms are a potential pathway linking environmental exposures to disease. Lower blood DNA methylation, an epigenetic mechanism, has been found in processes related to cardiovascular disease. Recently, acute air pollution exposure has been associated with changes in DNA methylation in heavily methylated sequences with high representation throughout the human genome. We hypothesized that prolonged exposure to particulate pollution might also modify DNA methylation and be a potential mechanism by which chronic air pollution exposure adversely affects health.

**Methods:** We measured DNA methylation of LINE-1 and Alu repetitive elements by quantitative PCR-Pyrosequencing of 985 blood samples from 680 elderly participants in the Boston Normative Aging Study. We used covariate-adjusted mixed models to account for repeated measures. We estimated effects on DNA methylation of ambient pollutants (black carbon,  $PM_{2.5}$ , and sulfate) in multiple exposure windows (ranging from 1 month to 1 year) prior to the examination.

**Results:** We found that a  $1\mu g/m^3$  increase in black carbon over a 60-day period was associated with a 0.8% (95% CI: 0.004%, 1.6%) decrease in methylation of LINE-1 repetitive elements. A  $1\mu g/m^3$  increase in black carbon over a 90-day period was associated with a 0.6% (0.001%, 1.1%)

decrease in Alu repetitive elements. A  $1\mu g/m^3$  increase in sulfate over a 90-day period was associated with 0.3% (0.02%, 0.6%) decrease in LINE-1 repetitive elements. The association with longer exposure windows persisted when we fit models simultaneously adjusting for 1-week moving averages of pollutant exposure. There was no association with  $PM_{2.5}$ .

**Conclusion:** Exposure to particulates over 2 to 3 months is associated with decreased repetitive element methylation. This may be a mechanism by which chronic exposure to air pollution increases risk of morbidity and mortality.

#### ISEE-0333

##### Pesticides and Autism: Incorporating Temporal Vulnerability as an Unknown Parameter

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**Background and Objectives:** Investigators have suggested that exposure to diverse pesticides during gestation could be associated with development of autism spectrum disorders (ASD) in childhood. Because little is known about ASD pathophysiology, investigation of this possibility requires *a priori* specification of hypothesized temporal periods of vulnerability of the embryo/fetus. This necessity may decrease the sensitivity of hypothesis tests, require unwieldy numbers of tests, or underestimate parameter variances for associations. We formulated day-specific vulnerability as a vector in a hierarchical Bayesian model to examine temporal patterns of associations of maternal residential proximity to agricultural applications of several pesticides with ASD in children.

**Methods:** 465 children with ASD born in California's Central Valley were matched with 6975 controls based on date of mother's last menstrual period. Day-specific agricultural pesticide applications within 500 meters of mother's residence at time of birth were quantified from 10 months preconception to the postnatal period. The conditional logistic regression model was specified as having coefficients normally distributed about a locally weighted temporal average with variance described using a non-informative prior. The structure of the local weighting function was selected by minimizing the Deviance Information Criterion. Significance was ascertained through Monte Carlo simulations.

**Results:** Residential proximity to organochlorine pesticide applications was associated with ASD risk during the first trimester (postconception days 27–60 [ $P < 0.01$ ] or 14–77 [ $P < 0.05$ ]). A period of association during the second trimester (days 108–165) only intermittently attained significance. Averaging coefficients over each time period yielded odds ratios for ASD comparing proximity to 50 pounds of pesticide to no exposure of 1.54, 1.47, and 1.18, respectively.

**Conclusions:** This approach allowed us to incorporate uncertainty regarding temporal periods of vulnerability into our estimates of associations. This method may be broadly applicable to the environmental epidemiology of conditions for which little is known about temporal vulnerability.

#### ISEE-0336

##### Community Engagement Benefits Environmental Health Research

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**Background and Objective:** Community participation can enhance research through improved participant recruitment and retention; allow community input about relevant environmental health issues; improve trust between researchers and the community; and provide more effective dissemination of research findings. The National Institute of

Environmental Health Sciences (NIEHS) supports many research activities through the Partnerships for Environmental Public Health (PEPH) program that effectively engages communities, and in turn, benefits the research process.

**Methods:** In this presentation we will elucidate benefits of community engagement by highlighting approaches, strategies and positive outcomes from several NIEHS-sponsored research programs: Breast Cancer and the Environment Research Centers (BCERC), Environmental Justice (EJ), and Superfund Basic Research Program (SBRP). We also will present research gaps and opportunities identified at a recent NIEHS-sponsored workshop.

**Results:** Community engagement has benefited NIEHS-sponsored research in several ways. Inclusion of community volunteers has helped with participant recruitment and retention in the BCERC program, and the BCERC Community Outreach and Translation Cores have played a vital role in ensuring appropriate dissemination and risk communication when significantly elevated exposure to perfluorochemicals was identified among a subset of participants. The establishment of community-researcher partnerships and research capacity building has improved trust and access to vulnerable populations in the EJ program. Finally, the creation of community advisory boards for research projects in the SBRP program has led to increased awareness of environmental issues in the community. Major gaps identified include the need to develop evaluation metrics for community-researcher partnership effectiveness, increase training opportunities for researchers and community members on how to engage in researcher-community partnerships, and establish best practices for research dissemination and risk communication in environmental health research in general.

**Conclusion:** The PEPH program demonstrates the NIEHS commitment to coordinate and support both ongoing and future environmental health research activities that actively engage community members in research, dissemination, and evaluation.

#### ISEE-0339

##### Spatial Analysis of Rheumatoid Arthritis in the Nurses' Health Study

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**Background and Objective:** The etiology of rheumatoid arthritis (RA) remains largely unknown although epidemiologic studies suggest genetic and environmental factors may play a role. Geographic variation in incident RA has been observed at the regional level. To explore further the association between location and RA risk, we analyzed individual level data from U.S. women in the Nurses' Health Study. Spatial analyses are a useful tool for generating new exposure hypotheses.

**Methods:** The spatial analyses included 456 incident RA cases and 9,108 controls with geocoded addresses for 1988–2002. Spatial variation was examined using (1) 1988 addresses (baseline) and (2) last reported addresses (at diagnosis or censoring). We applied generalized additive models to predict a continuous risk surface, smoothing on longitude and latitude while adjusting for confounders including age, race, parity, menopausal status, body mass index, smoking, and socioeconomic status. Permutation tests were conducted to test for the overall importance of location and identify areas of statistically significant risk. We did not predict risk for geographic areas with low participant density.

**Results:** Maps generated using baseline addresses were essentially flat based on the global statistic for location ( $P$ -value = 0.14). However, when we examined the nurses' last reported address, we found a highly significant association with geography ( $P$ -value = 0.005). Large areas of increased risk were identified in the northeast and southwest United States. There was little evidence of spatial confounding when the crude and fully adjusted models were compared.

**Conclusions:** The results of our spatial analyses suggest that RA incidence is associated with location at time of diagnosis or censoring, but not with baseline addresses in 1988. The mean number of years between the two time points was 12 years, with over 40% of the nurses having moved. Geographic differences of RA risk may be due variation in environmental exposures, climate, or behavioral factors.

#### ISEE-0340

##### The Long-Term Mortality Effects of Flooding in England and Wales, 1994 to 2005

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**Objective:** To quantify the long-term effect on mortality of flood events in England and Wales, 1994 to 2005.

**Methods:** Observational study based on high-resolution linkage of post-coded mortality data to a national Geographical Information System database on the timing and distribution of flood events, 1994 to 2005. Mortality in each flooded area in the year after the flood onset was compared with mortality in the year before the flood. Such change was compared with the similarly calculated change in mortality in non-flooded areas within 5 km of a flooded area. Comparisons were stratified by sex, age group (0–14, 15–64, 65–74, 75–84, 85+), region, the year of flood onset, and socio-economic deprivation.

**Results:** Between 1994 to 2005, the national database recorded 319 flood events (1,680 km<sup>2</sup> in total area), affecting 4,814 post-codes (237,000 residents). Within flooded areas, there were 720 deaths in the year after flooding. The ratio of pre-flood to post-flood deaths in the flooded areas to that in the comparison areas varied from region to region and by flood event. Overall, the majority of areas and flood events seem to be associated with a relative reduction in mortality in the year after flooding, but in some there was a relative rise. There was no clear evidence of variation in the relative change in mortality by age or socio-economic group.

**Conclusion:** Our preliminary results do not support the conclusion that floods in England and Wales have been associated with a rise in mortality in the year after flooding. However, further analysis is needed of the circumstances of different flood events, and as yet it remains unclear to what degree the results may have been influenced by recording artefact relating to the relocation of people to new residential addresses.

#### ISEE-0342

##### Seasonal Difference of Ambient Temperature Effect on Blood Pressure Change

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**Background:** Blood pressure levels and cardiovascular disease rates have been known to decrease in warmer temperature. However, it is not clear whether the relationship is linear or varies depending on the season.

**Methods:** We recruited 44,406 adults who visited a health checkup clinic from 1995 to 2008. We used multiple regression models to estimate the effects of temperature (mean, maximum and minimum) on systolic and diastolic blood pressure. For 7,714 subjects who had the examination



more than once, we used repeated measurement analysis with data of the first and the last visit.

**Results:** Systolic blood pressure decreased most in August (0.45 mmHg for increase of 1 C degree) and diastolic blood pressure decreased most in January (0.26 mmHg for increase of 1 C degree). When minimum temperature was cold (less than -10 C degree) or hot (more than 20 C degree), the effect of temperature on blood pressure reduction was greater than the effect during moderate range of temperature (-10 C to 20 C degree). The repeated measurement analysis validated the findings and showed minimum temperature was more associated with reduction of blood pressure than mean or maximum temperature.

**Conclusion:** These study results suggest that ambient temperature is a significant effector of blood pressure change, particularly in hot and cold seasons. Blood pressure decreased with higher temperature and increased with colder temperature.

#### ISEE-0352

##### Association Between High Selenium Intake and Subsequent Increased Risk of Type 2 Diabetes in an Italian Population

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**Background and Objective:** Considerable interest exists about the health effects in humans of environmental selenium, but several uncertainties remain about such effects and the amounts of exposure involved. Recently, two trials carried out in the US showed an excess risk of type 2 diabetes in subjects on a long-term supplementation with selenium. We analyzed the association between selenium intake from foods and diabetes risk within a cohort study carried out in Italy.

**Methods:** We investigated the association between dietary intake of selenium and subsequent risk of type 2 diabetes within the cohort ORDET, a sample of 7,288 women from northern Italy enrolled in a prospective study on relation between diet and breast cancer. Dietary selenium intake was measured at baseline (1987–1992) through a semi-quantitative food-frequency questionnaire. During a 16-years follow-up, 253 women developed type 2 diabetes (as defined on the basis of a) self-reported physician diagnosis, b) use of anti-diabetic medication—self-reported or by linkage with regional prescription drug database, and c) linkage with medical discharge records). We calculated in a logistic regression model the risk of diabetes according to quintile of baseline selenium intake, while adjusting for several demographic, anthropometric and lifestyle variables.

**Results:** Average intake of selenium in the cohort was lower than that estimated in the US population. In multivariate analysis, risk of diabetes was directly associated with baseline selenium intake (*P* trend 0.026), with a relative risk of 2.01 (95% confidence interval 1.11, 3.64) in the highest quintile of dietary selenium intake compared to the lowest one.

**Conclusion:** Higher dietary intakes of selenium increased the risk of type 2 diabetes in this female population. Consistent with recent studies, these findings raise additional concerns about the possibility of sub-clinical metabolic toxicity induced by selenium at lower levels of exposure than previously thought.

#### ISEE-0353

##### Health Vulnerability of Aboriginal Community in Canada and Possible Sustainable Solutions

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**Background and Objective:** The Aboriginal population in Canada has faced an unprecedented environmental health crisis during the last several decades. Due to pollution of ocean, lakes and rivers, and atmosphere, the aquatic and terrestrial animals are getting contaminated with heavy metals and persistent organic pollutants. These animals are the traditional source of regular diet and thus the Aboriginal populations have been exposed to contaminants. Also, on account of changing lifestyle (high fat content food, smoking, alcohol and poor physical exercise), the same populations have developed newer adverse health outcomes, such as cancer and obesity related diseases. The purpose of the study is to explore the various factors, responsible for the current epidemiological trend of environmental health burden of the Aboriginal population.

**Methods:** The study analyzes the major published research and policy documents on Aboriginal health and its determinants. Various leaders of the Aboriginal communities and the physicians responsible for the Aboriginal health services have been contacted and informally interviewed.

**Results:** Apart from the contamination of traditional food sources and the changing lifestyle, a long history of deprivation, inaccessible health services, poor representation of Aboriginal population in health care and a communication gap between health care providers and the community, are mostly responsible for their high morbidity and mortality. A sense of alienation and hesitance to use the existing health care facilities has further deteriorated their health status. Poor surveillance and late detection are responsible for high mortality due to various types of cancers.

**Conclusion:** Despite the evidence for the role of multiple risk factors, there is lack of systematic effort to integrate them in the health policy for the Aboriginal population. Hence, there is need to incorporate the social, cultural, economic perspectives in the health services and research. Community based initiatives to promote healthy lifestyle and macro level initiative to curb environmental pollution would ensure sustainable development.

#### ISEE-0356

##### The German Environmental Survey for Children (GerES IV): Irritation of Eyes and the Respiratory System Correlate with Pollutants in Indoor Air and Other Environmental Factors

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**Background and Objectives:** The German Environmental Survey for Children (GerES IV) is a large-scale population study conducted 2003–06. Main objectives were to generate representative data on the environment-related exposure and on linked health outcomes. GerES IV was performed jointly with the National Health Interview and Examination Survey for Children and Adolescents (KiGGS), conducted by the Robert Koch Institute (RKI).

**Methods:** 1,790 children aged 3 to 14 years from 150 locations in Germany participated in GerES IV. The investigation comprised i.e. interviews on irritation symptoms (excluding those caused by infections) and various exposure factors. More than 70 volatile organic compounds (VOC) in indoor air were quantified in a sub-sample of 600 participants. Data evaluation reported here was conducted for non-smoking, non-pollinotic children only.

**Results:** More than 20% of the children suffered from irritation of eyes, nose or throat within the last year. Significantly higher concentrations of

benzene and toluene were quantified in rooms of children who suffered from nasal irritation at least once in their life. In multivariate logistic regressions, elevated ( $>0.3 \text{ mg/m}^3$ ) indoor TVOC concentrations (OR = 4.4 [1.6–11.9]) and living on a busy road (OR = 2.9 [1.2–7.2]) were significantly associated with the occurrence of frequent irritation symptoms.

**Conclusions:** Irritation symptoms in German children are more frequent than previously thought. Several environmental factors influencing these symptoms have been identified. Although our findings need to be substantiated by further studies including larger collectives, they advocate the reduction of indoor air pollution in order to improve health outcomes in children.

**Acknowledgements:** We thank all children and parents who have participated in this study. The financial support of the Federal Ministries for the Environment, Nature Conservation and Nuclear Safety and of Education and Research is gratefully acknowledged. GerES IV field work was conducted by the RKI.

#### ISEE-0361

##### Increased Asthma Severity among Children Exposed to Outdoor NO<sub>2</sub>

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**Background and Objectives:** Recent literature suggests that outdoor concentrations of NO<sub>2</sub> (primarily associated with motor vehicles) or living close to highways may be associated with asthma exacerbation (increase in symptoms, medication use and health care utilization) in asthmatic children.

**Methods:** In CT and MA, 1400 children with active asthma (age 5–10) were enrolled in a prospective study. Palmes tubes measured NO<sub>2</sub> outside their homes for 4 weeks. Parents used daily calendars to record symptom and medication use, to report to a research assistant at the end of the monitoring period. These data were used to classify asthma severity using the Global Initiative for Asthma (GINA, 2002) criteria, as mild intermittent, mild persistent, moderate, or severe. The analysis was stratified by season to control for the differing time spent outdoors and ordered logistic regression models controlled for ethnicity, mother's age and education, and housing type (single vs. multi-family).

**Results:** Mean (SD) NO<sub>2</sub> concentrations were 10.7 ppb (3.8) in the winter months, 8.7 ppb (3.4) in the spring, 9.8 ppb (3.1) in the summer and 12.6 ppb (3.7) in the fall. No increased asthma severity was associated with NO<sub>2</sub> exposure during the cooler months. Among 227 children measured during the summer, 145 played outdoors at least half of the days during the monitoring period. Among these children, an increase of 5 ppb in NO<sub>2</sub> was associated with an increased risk (odds ratio = 2.0, 95% CI 1.2–3.5) for a one category increase in GINA asthma severity (e.g. moderate to severe). No increased risk was associated with NO<sub>2</sub> exposure for children who did not play outdoors half of the days (odds ratio = 1.2, 95% CI 0.6–2.4).

**Conclusion:** Exposure to outdoor NO<sub>2</sub>, at levels well below the US Environmental Protection Agency standard (53 ppb), is associated with significant risk for increased asthma severity in children who spend time outdoors.

#### ISEE-0366

##### Association of Traffic and Railway Noise with Blood Pressure in the Swiss Air Pollution and Lung Disease in Adults Cohort (SAPALDIA)

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**Background:** Noise exposure has been associated with cardiovascular morbidity. Studies on noise and hypertension are inconsistent, and potential confounding by air pollution remains unclear.

**Objective:** To examine the association of traffic and railway noise exposure by day and night with blood pressure adjusting for ambient air pollution.

**Methods:** Blood pressure was measured in 6450 SAPALDIA participants, aged 29–73. Estimates of annual average street and railway noise levels at residential addresses during day- and night-time were obtained from a model developed by the Swiss Federal Office of the Environment. Annual average outdoor air pollution exposure to PM<sub>10</sub> and NO<sub>2</sub> at the address of residence was predicted by dispersion/land-use regression models. Associations of systolic and diastolic blood pressure with traffic and railway noise were estimated using multivariable linear regression. Interactions were tested for age, gender, hypertension and time of residency.

**Results:** Traffic and railway noise exposure ranged from 0–73 dBA and 0–66 dBA, respectively. Railway noise was positively associated with systolic pressure: daytime (0.060 mmHg/dBA, 95%CI 0.002–0.116), night-time (0.064, 0.003–0.131); and with diastolic pressure: daytime: (0.02, –0.0016–0.053), night-time (0.030, –0.012–0.070). Adjusting for NO<sub>2</sub> resulted in slightly stronger associations. Interactions, with higher effect estimates, were present in elderly, men and hypertensive participants, and lower effects in participants with longer time of residency. Regression analyses on traffic noise and blood pressure yielded non-significant results.

**Conclusion:** We found a significant association between railway noise and blood pressure after adjusting for exposure to outdoor air pollution. Contrarily to prior studies, traffic noise had no-significant impact. Adjusting for NO<sub>2</sub> resulted in a slightly increased association. Larger noise-related increase in blood pressure was observed in men, elderly and hypertensive patients. Effect modification by time of residency may be due to natural selection of noise in-sensitive individuals or adaptation to the exposure.

#### ISEE-0374

##### ENNS: The French Nutrition & Health Survey–Blood Lead Levels in the French Adult Population

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**Background and Objectives:** The French Nutrition & Health Survey (ENNS) was carried out by the French Institute for Public Health Surveillance in 2006–2007. The main objectives were to explore food consumption and levels of various biomarkers in the general population. The aim of the present study was to assess blood lead levels (BLL) in the French adult population.

**Methods:** ENNS is a cross-sectional study in the general population. Participants (18 to 74 years of age) were sampled using a three-stage

probability design stratified by geographical areas and degrees of urbanization. Data on individual characteristics, eating habits, occupational and environmental exposure were collected through interviews and self-administered questionnaires. Blood samples were collected and analysed using standardized procedures.

Sample weights and complex sample design were taken into account in statistical analyses to produce unbiased and representative estimates.

**Results:** The blood lead geometric mean in the French population was 25.7  $\mu\text{g/L}$  [CI95: 24.9–26.5]. The overall prevalence of elevated BLL ( $>100 \mu\text{g/L}$ ) was 1.6% [CI95: 1.1%–2.1%]. The median was 25  $\mu\text{g/L}$  and the 95th percentile was 73  $\mu\text{g/L}$ . Comparison with results from previous studies show that the geometric mean of BLL (in male young adults) dropped by 50% in 10 years.

In 2006, levels were significantly higher ( $P < 0.0001$ ) for males than for females, and increased ( $P < 0.0001$ ) with age, tobacco or alcohol consumption. Others factors associated with BLL were identified including leisure activities, socio-professional status, age of housing, birth country and shellfish consumption.

**Conclusion:** The findings from the ENNS-lead study demonstrate that BLL in the French population has declined during recent years, and is still influenced by age, sex, smoking habits, and alcohol consumption. The distribution of BLL in France was quite similar to that observed in other European countries (Germany and Czech Republic).

#### ISEE-0376

##### A Study of Heat-Wave Related Mortality in 107 United States Communities

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**Background and Objective:** Both the possible increase in frequency and intensity of heatwaves from climate change and the occurrence of major heat-wave events like the 2003 European heatwave have increased interest in the health effects of heatwaves. No uniformly applied definition of a heatwave exists. Further, many heat-wave studies are limited to the effects of either one major heatwave or of heatwaves within a single city. This study estimates the health effects of heatwaves for 107 U.S. communities over a 14-year period and analyzes geographical variation.

**Methods:** Heatwaves were defined by several categorizations relating to their intensity and duration. Heat-wave effects on mortality were estimated by comparing mortality rates during heatwaves to those of non-heat-wave days for each community. Results were then combined, accounting for statistical uncertainty, using Bayesian hierarchical modeling to generate overall estimates. Effects by cause of death and age were considered. Second-stage analysis was used to relate heat-wave effects to community-specific characteristics, including central air-conditioning (AC) prevalence.

**Results:** Results indicate that mortality risk increases with heatwaves' intensity or duration. Under one of the heat-wave definitions considered, mortality risk increased 6.08% (posterior interval (P.I.): 4.02%, 8.18%) during heatwaves compared to effects at normal temperature. Spatial heterogeneity in effects indicates that heat-wave-mortality effect estimates from one community may not be applicable in another. Heatwaves had significant effects on all age groups, particularly those 75 and older (8.24% increase in mortality risk; P.I.: 5.31%, 11.25%). Heatwaves were also found to have a greater effect on cardiovascular deaths (8.80%; P.I.: 5.47%, 12.22%) versus other causes of death. Heat-wave effects were generally higher in communities with greater unemployment, a higher percentage of African Americans, and greater urbanicity.

**Conclusions:** Findings have implications for community efforts and scientific research on weather-related mortality and the potential health impact of climate change.

#### ISEE-0379

##### Urinary Arsenic Species, Toenail Arsenic, and Estimates of Arsenic Intake in Southeastern Michigan Population with Low-To-Moderate Exposure to Arsenic in Drinking Water

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**Background and Objectives:** Positive correlations have been found in populations exposed to low-to-moderate concentrations of arsenic in drinking water. However, a significant percent of variation remains unexplained by drinking-water concentration alone. This study aims to evaluate the impact of possible predictors, in addition to arsenic in drinking water, on the ability of urinary arsenic to reflect exposure.

**Methods:** Urine samples were collected from a subsample ( $n = 343$ ) of a population enrolled in a case-control study in Southeastern Michigan. Samples were analyzed using an HPLC-ICPMS system for six different arsenic species: arsenobetaine (AsB), As[III], As[V], MMA[V], and DMA[V]. The sum of As[III], As[V], MMA[V], and DMA[V] was used to denote total arsenic (ToxAs). Dietary information was obtained through a self-reported food frequency questionnaire.

Log-transformed drinking-water arsenic concentration at home was a significant ( $P = 0.05$ ) predictor of urinary arsenic ( $R^2 = 0.17$ ). Associations improved ( $R^2 = 0.24$ ) when individuals with less than 1  $\mu\text{g/L}$  of arsenic in drinking water were removed, and improved more when analyses were applied to individuals who consumed an above average amount of home drinking water ( $R^2 = 0.39$ ). This population excreted more AsB than a recent sample assessed by NHANES. However this population did not consume higher amounts of seafood/fish products. After categorizing the exposure by arsenic concentrations in water and water intake, ToxAs ( $R^2 = 0.44$ ) explained more variability than toenail arsenic concentrations ( $R^2 = 0.29$ ).

**Conclusions:** Results presented here suggest that categorical estimates of water consumption better characterize intake, potentially attributed to misclassification in self-reported water consumption. Mushroom and chicken consumption was correlated with AsB, suggesting that these are other sources of organoarsenicals. These results show that arsenic exposure from drinking water consumption is an important determinant of urinary arsenic concentrations, even in populations exposed to low-levels of arsenic in drinking water.

#### ISEE-0384

##### Exposure-Response Relationship Between Particulate Air Pollution and Short-Term Mortality in Four Chinese Cities

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**Background and Objective:** Numerous epidemiologic studies have reported the association between particulate air pollution and short-term mortality in China and other countries. In most of these studies, a linear non-threshold relationship was assumed without taking into account the exposure-response characteristics between particulate matter and daily mortality. Several studies have reported the exposure-response curves between particulate matter and daily mortality in developed countries and suggest that the linear non-threshold model is appropriate to assess the health effects of particulate air pollution on daily mortality. However, the characteristics of the exposure-response relationship should be further investigated.

**Methods:** We collected data on the concentration of air pollutants, weather and daily cause-specific death counts for Beijing, Shanghai, Tianjin and Guangzhou. We then constructed generalized additive models



for the exposure-response relationship adjusting for the confounding effect of the long-term trend, seasonality, temperature and relative humidity. We then estimated the relative risk for daily death per 10  $\mu\text{g}/\text{m}^3$  increase in  $\text{PM}_{10}$ .

**Results:** The threshold linear models can be used to assess the health effects of concurrent particulate matter concentrations on daily mortality in the range of 15–200  $\mu\text{g}/\text{m}^3$ . For all-cause mortality, circulatory mortality and respiratory mortality, the threshold concentrations are 60  $\mu\text{g}/\text{m}^3$ , 60  $\mu\text{g}/\text{m}^3$ , and 50  $\mu\text{g}/\text{m}^3$ , respectively. In the range of threshold concentrations to 200  $\mu\text{g}/\text{m}^3$ , the estimated effect of  $\text{PM}_{10}$  on total mortality was 0.35% (95%CI: 0.22–0.48%) increase per 10  $\mu\text{g}/\text{m}^3$  increase in  $\text{PM}_{10}$ , and the estimated effect of  $\text{PM}_{10}$  on circulatory mortality and respiratory mortality was 0.41% (95% CI: 0.21–0.62%) and 0.53% (95%CI: 0.23%–0.83%), respectively.

**Conclusion:** There is a significant association between particulate matter concentrations and daily mortality, a threshold for the effect of particulate matter on daily mortality may exist in four Chinese cities.

#### ISEE-0385

##### The Social Epidemiology of Bisphenol A Exposure

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**Background and Objective:** Socioeconomic disparities in exposure to endocrine-disrupting chemicals such as bisphenol A (BPA) have not been well characterized, nor has the complex relationship between socioeconomic position (SEP) and race/ethnicity. Studying these differences may reveal that certain groups bear a disproportionate burden of exposure and may generate useful hypotheses about sources of exposure.

**Methods:** We conducted a cross-sectional study of 2,517 participants in the 2003–2004 National Health and Nutrition Examination Survey with urinary BPA measurements. Using multiple regression models and controlling for age, gender, and creatinine, we investigated the association between log-transformed BPA levels and numerous self-reported socioeconomic indicators, which capture slightly different aspects of social stratification. We attempted to disentangle effects of race/ethnicity and SEP.

**Results:** Measuring SEP by income, education, and occupation revealed somewhat similar inverse relationships with BPA levels. Income showed the strongest association; people with poverty income ratios (PIR) less than one had BPA levels 23% (95% CI 11–37%) higher than those with PIRs greater than three. Income measures incorporating household size were better predictors, as was education compared to occupation. Education effects remained after controlling for income. Other indicators such as food security also had residual effects. In models not adjusted for SEP, Non-Hispanic Blacks had BPA levels that were 10% higher than Non-Hispanic Whites. With SEP adjustment, this difference dropped to 5%. Mexican Americans, on the other hand, had lower BPA levels than Non-Hispanic Whites, a difference that increased from 21 to 27% with control for SEP.

**Conclusion:** Lower SEP, measured in different ways, was associated with higher urinary BPA levels. Dietary patterns, known to differ by SEP, may contribute to this disparity. For Non-Hispanic Blacks, SEP appeared to mediate some of the observed difference by race/ethnicity, but not for Mexican Americans, indicating possibly different sources of exposure in these two groups.

#### ISEE-0386

##### Certain Polyfluoroalkyl Chemicals Associated with Higher Cholesterol in the General U.S. Population

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**Background and Objective:** Polyfluoroalkyl chemicals (PFCs) are used commonly in commercial applications and are detected in humans and the environment world-wide. Concern has been raised that they may disrupt lipid regulation, though conflicting results have been found in human versus animal studies. We investigated the relationship between exposure to PFCs and lipid outcomes in a large publicly-available dataset.

**Methods:** We analyzed data from the 2003–2004 National Health and Nutrition Examination Survey (NHANES) for 2,094 participants aged 12 and older. Using multiple linear regression and controlling for numerous covariates, we studied the association between serum concentrations of perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), perfluorooctane sulfonic acid (PFOS), and perfluorohexane sulfonic acid (PFHS), and measures of cholesterol.

**Results:** We found a positive association between exposure to PFOS, PFOA, and PFNA and total and non-HDL-cholesterol (“bad” cholesterol) among adults. Those in the highest quartile of PFOS exposure had total cholesterol levels 12.6 mg/dL higher than those in the lowest. For PFOA, levels were 9.8 mg/dL higher, and for PFNA, 13.9 mg/dL. Results for PFHS revealed an opposite trend, with a 7.0 mg/dL decrease.

**Conclusion:** This exploratory study is consistent with certain occupational health studies in finding a positive association between PFOS and PFOA and cholesterol, despite much lower exposures among the general population in NHANES. Results for PFNA and PFHS are novel and may be important. While these findings do not prove a causal association, they contribute to the literature suggesting that PFC exposure may disrupt cholesterol metabolism in humans, and may do so through different mechanisms than are present in animals. These results also emphasize the need to study PFCs other than PFOS and PFOA.

#### ISEE-0391

##### Community Health Assessment Pilot Study in La Pita, Nicaragua

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**Background:** In developing nations, the impact of disease-oriented health services on community health is relatively small compared to structural interventions designed to improve living conditions, including nutrition, sanitation, housing, education, and access to health care. La Pita is an isolated coffee-growing cooperative of 143 inhabitants and 150 day-laborers in Matagalpa, Nicaragua. A community health assessment was conducted to evaluate community needs through community-based participatory research, and to design interventions that integrate engineering and public health components.

**Methods:** The cross-sectional survey was conducted by the Engineers without Borders–University of Hawaii chapter (EWB-UH), using standardized demographic household surveys, key informant interviews, and focus-group meetings. Data was collected on health outcomes and socio-demographic population characteristics, including nutrition, sanitation, housing, education, and access to health care. Data analysis was performed using SAS 9.1.

**Results:** The response rate for the household surveys was 95.5%. Chronic respiratory symptoms due to poor ventilation and indoor air quality; diarrhea resulting from poor sanitation and personal hygiene; severe injuries; lack of health education; and limited access to health services were identified as the most important community concerns. The prevalence of chronic difficulty breathing was 21, dry cough was 14.9, and persistent wheezing was 6.4 per 100 persons in the last year. Evident

socioeconomic disparities and barriers to community participation were identified among households with the least active participation.

**Conclusions:** Interventions were proposed to target the need for increased access to health services and improved indoor air quality. The following intervention programs were developed for implementation in 2009/2010: a “train the trainer” capacity building program of first aid and general health education; ventilation and asthma prevention program; and improved access to health care services through building new bridges. Standardized program evaluation procedures will be used to evaluate the longitudinal effect of the proposed interventions.

#### ISEE-0392

##### Mercury Concentrations in First Hair Cuts as a Predictor for Autism

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**Background and Objective:** Because mercury is known to target the central nervous system, considerable interest has focused on this metal as a possible contributor to autism development. Nevertheless, little research has addressed total environmental mercury and much controversy surrounds the topic. In this study, we (1) addressed the relationship between sources of external mercury exposures and hair mercury levels in first baby haircuts and (2) determined if there is an association between baby hair mercury levels and autism development.

**Methods:** The Childhood Autism Risks from Genetics and the Environment (CHARGE) study is a comprehensive, population-based case-control study with participants sampled from three strata: children with autism, children with developmental delay but not autism, and typically developing children. Autism and ASD diagnoses were confirmed using established instruments, namely the ADI-R and ADOS. The child's first hair cut was collected from the mothers and mercury levels were determined using Laser Ablation coupled to ICP-MS (Inductively Coupled Plasma Mass Spectrometry). To predict hair mercury levels, we fit a multiple linear regression model including three levels of fish consumption and Rho D immunoglobulin. A multiple logistic regression model was fit to assess the relationship between log hair mercury levels and developmental outcome (autism versus typical development) in the presence of potential confounders including mother's fish consumption during the index period, duration of breastfeeding, and mother's education level.

**Results:** Although none of the variables significantly predicted log hair mercury levels, there was a trend showing that increased levels of fish consumption predict higher hair mercury levels. The odds ratio for log hair mercury predicting developmental outcome was 0.98 (0.83, 1.16).

**Conclusion:** There does not appear to be a relationship between hair mercury levels in first baby haircuts and the development of autism, although further investigation of gene-environment interactions might identify vulnerable subsets.

#### ISEE-0393

##### The Impact of Portable Air Filters on Indoor Air Pollution and Microvascular Function in a Woodsmoke-Impacted Community

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**Background and Objective:** Residential wood burning has been linked to respiratory morbidity and is a significant pollution source in many locations. However, little is known about the cardiovascular effects of air pollution in woodsmoke-impacted communities.

**Methods:** Using portable high efficiency particulate air (HEPA) filters in an intervention study, we investigated air pollution and microvascular function among approximately 50 healthy adults in a woodsmoke-impacted community in British Columbia, Canada. In a single-blind randomized crossover design, each home was monitored for two consecutive seven-day periods, and two HEPA units were operated indoors with the filters removed for one of the two periods. Air pollution was measured indoors and outdoors using nephelometers for continuous PM<sub>2.5</sub> mass concentration and Harvard Impactors for both PM<sub>2.5</sub> mass concentration and the woodsmoke tracer levoglucosan. Microvascular function was measured at the end of each seven-day period using the portable Endo-PAT. In addition, inflammatory markers in blood (C-reactive protein and interleukin-6) and urinary oxidative stress markers (isoprostanes and malondialdehyde) were also quantified, and participants completed a respiratory symptoms questionnaire and time-location diary.

**Results:** Based on preliminary monitoring results from 14 homes, the average outdoor PM<sub>2.5</sub> concentration was  $11.3 \pm 5.4 \mu\text{g}/\text{m}^3$  and was not related to HEPA filter status. As expected, indoor concentrations were significantly lower during HEPA filtration periods ( $3.5 \pm 2.1 \mu\text{g}/\text{m}^3$ ) than during non-HEPA periods ( $9.8 \pm 6.2 \mu\text{g}/\text{m}^3$ ). The indoor PM<sub>2.5</sub> reduction in individual homes ranged between 0.4 and  $15.8 \mu\text{g}/\text{m}^3$  (median reduction:  $5.2 \mu\text{g}/\text{m}^3$ ), with a greater reduction in the indoor-generated PM<sub>2.5</sub> component (median reduction:  $3.6 \mu\text{g}/\text{m}^3$ ) than the outdoor-generated component (median reduction:  $1.4 \mu\text{g}/\text{m}^3$ ). Levoglucosan will allow us to evaluate the role of woodsmoke in these PM<sub>2.5</sub> reductions.

**Conclusion:** These preliminary results indicate that HEPA filters reduce indoor PM<sub>2.5</sub> and introduce modest exposure gradients from which to evaluate woodsmoke-influenced PM<sub>2.5</sub> and cardiovascular health.

#### ISEE-0399

##### Impact of Pre- and Postnatal Exposure to Environmental Tobacco Smoke (ETS) on Sudden Infant Death Syndrome (SIDS)

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**Background and Objective:** The aim of this review is to critically evaluate the impact of prenatal and postnatal exposure to environmental tobacco smoke (ETS) on the sudden infant death syndrome (SIDS) separately. The main challenge of this analysis is a possible correlation between maternal smoking during pregnancy and postnatal ETS exposure.

**Methods:** We identified eligible studies by means of a systematic literature search. For prenatal exposure we included studies with information about maternal smoking during pregnancy. For postnatal exposure we restricted our evaluation to studies that quantified the risk for postnatal exposure either by adjusting their analysis for maternal smoking during pregnancy or by conducting stratified analysis in non-smoking mothers. Pooled relative risks were obtained by meta-analysis.

**Results:** From 736 potentially eligible studies, 13 studies on maternal smoking during pregnancy were identified and seven case-control studies on postnatal exposure. The pooled relative risk associated with paternal smoking after birth was  $\text{RR} = 1.62$  (95% Confidence Interval: 1.34–1.94). For maternal smoking after pregnancy, the pooled relative risk for SIDS adjusted for smoking during pregnancy was 2.28 (95% CI: 1.41–3.69). The relative risk of maternal smoking during pregnancy on SIDS was 2.49 (95% CI: 1.84–3.38) based on 5 studies with prospective exposure assessment and 2.72 (95% CI: 2.28–3.23) based on eight studies with retrospective exposure assessment. Only two studies on prenatal exposure adjusted their analysis for postnatal ETS exposure: their pooled RR was 3.21 (2.42, 4.26).

**Conclusion:** We found evidence that postnatal ETS exposure is a risk factor for SIDS independent of maternal smoking behaviour during pregnancy. Nevertheless, maternal smoking during pregnancy seems to be

a somewhat higher risk factor. Interestingly, separate analyses of prospective and retrospective studies do not indicate the presence of recall bias in these studies.

#### ISEE-0404

##### Effects of Radio Frequency Electromagnetic Field Exposure on Sleep Quality: A Cross-Sectional Study

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**Background and Objective:** There is public concern about the effects of exposure to radio frequency electromagnetic fields (RF-EMF) on health-related quality of life. The aim of this cross-sectional study was to investigate the association between levels of exposure to RF-EMF and sleep quality.

**Methods:** We sent questionnaires to 4000 individuals who were randomly selected from the inhabitants of the city of Basel (Switzerland) and the surroundings. We assessed day-time sleepiness using the Epworth Sleepiness Scale (ESS) and subjective sleep quality score (SQS) using questions from the Swiss Health Survey 2007. In addition, we asked about RF-EMF exposure relevant behaviours, lifestyle factors and socio-demographic factors. We used a prediction model to assess exposure to environmental RF-EMF including modelled exposure from fixed site transmitter at home. Two exposure categories were built (below and above the 90th percentile). Analyses were stratified for individuals reporting to be electromagnetic hypersensitive (EHS) and non-EHS individuals. Multivariable models were adjusted for relevant confounders (e.g. age, gender and self-reported distress).

**Results:** Response rate was 37%. Considering all responders, 21% reported to be EHS. Mean predicted exposure to all RF-EMF sources was 0.19 V/m. The cut-off point (90th percentile) was 0.25 V/m. In the multivariable models the ESS score was neither in the EHS collective (OR = 1.08, 95% CI [0.41–2.81] for 10% highest exposed) nor in the non-EHS collective (OR = 0.81, 95% CI [0.49–1.34] for 10% highest exposed) significantly associated with personal RF-EMF exposure. Similarly, SQS was not associated in both collectives with personal RF-EMF exposure. In addition, we found no indication that self-reported duration of mobile phone use, objective operator data or self-reported cordless phone use influence ESS or SQS.

**Conclusion:** Preliminary analyses suggest that exposure to RF-EMF is not associated with day-time sleepiness or subjective sleep quality of non-EHS and EHS individuals.

#### ISEE-0412

##### Assessment of Morbidity of the Population of the Kyrgyz Republic Under Climate Change Scenarios

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**Abstract:** The aim was to assess infectious and noninfectious morbidity in the population of Kyrgyz Republic under climate change scenarios.

Acute intestinal infections (AII) were examined using data of the Bishkek Centre for State Sanitary-Epidemiologic Surveillance for 2005 and 2006 as a baseline. Circulatory diseases were examined using data of the Republican Medical Information Centre for 1996–2005. We used

meteorological parameters such as monthly average air temperature, relative air humidity, monthly and annual precipitation, with annual data of Kyrgyzhydromet for 1961–1990 serving as a baseline. For the estimation of predicted indices of population health under two scenarios of A2-ASF and B2-MES release in individual regions we used predicted values of air temperature of observation stations prepared by G.A. Desyatkov and O.N. Katkova (2007).

On the basis of greenhouse gas release scenarios and possible climatic changes, prediction tables on the morbidity of the population of the Kyrgyz Republic were developed. As a result of calculations, ranges of seasonal variation in acute intestinal infections and circulatory diseases were produced. By 2100 rates of AII are expected to be increased under the two scenarios. Expected rates of AII are higher under scenario A, which may increase up to 57000 cases per 100000 population with the basal 2005 model and somewhat lower with the 2006 basal model—up to 47000. The highest rates are expected in July in the two scenarios.

The highest annual and monthly rates of circulatory diseases are expected in 2100 for Chui Region (Tokmok–1735.6 and Karabalta–1675.0 cases per 100000 population), Issyk-Kul Region (Cholponata–1243.6 and Kyzylsuu–666.8), Jalalabat Region (Jalalabat–1147.6).

This work was carried in the framework of the GEF/UNDP project “Assistance to the Kyrgyz Republic in preparation of the Second National Communication under the UN Framework Convention on Climate Change”.

#### ISEE-0413

##### Changes in Markers of Genotoxicity in Relation to Exposure to Disinfection By-Products in Swimming Pools

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**Background and Objective:** Exposure to disinfection by-products (DBPs) has been associated with cancer risk, but the mechanisms of action are poorly understood. A recent study found increased bladder cancer risk among subjects attending swimming pools, where uptake of DBPs, such as trihalomethanes (THMs) can be particularly high through dermal absorption and inhalation. We evaluated in an experimental study whether swimming in pools was associated with markers of genotoxicity.

**Methods:** Fifty non-smoking adult volunteers, after signing informed consent, swam for 40 minutes in a chlorinated pool. We determined THM levels in pool air and water, water mutagenicity, total and specific THM levels in exhaled air, micronuclei and the comet assay in peripheral blood lymphocytes, urine mutagenicity, and administered an extensive questionnaire on lifestyle factors. In addition, gas chromatography (GC)/mass spectrometry (MS) was used to comprehensively identify DBPs in pool waters. Blood, urine and exhaled air samples were collected before and after swimming. We used Generalized Estimating Equations (GEE) to assess associations between THM exposure and changes in genotoxicity markers before and after swimming.

**Results:** Total THM levels in pool water were around 60 µg/L. On average, a threefold increase was observed for total THM levels in exhaled air before and after swimming. A statistically significant increase ( $P$ -value = 0.009) was found for micronucleated binucleate cells (BNMN) in relation to changes in exhaled air total THMs and for the 4 specific THMs. This increase was more pronounced for brominated compounds. No changes were found for the Comet assay. We found only minor increases in urine mutagenicity, with more pronounced changes observed



only for exposure to bromoform. Adjustment for several potentially confounding factors did not modify results.

**Conclusion:** We identified increases in markers of genotoxicity associated with exposure to THMs in swimming pools. These increases were modest, and findings should be verified in larger studies.

#### ISEE-0416

##### Mass Psychogenic Illness: Can Experts Agree When It Occurs and How Often?

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**Background & Objective:** Mass Psychogenic Illness, sometimes known as mass hysteria, can be defined as: "widespread, subjective symptoms thought to be associated with environmental exposure to a toxic substance in the absence of objective evidence of an environmental cause" [1]. Over 200 case reports have been published on such episodes, but rarely does the literature go beyond that of the simple case study. The aim of this research was to test consensus criteria on how to define this intriguing phenomenon and to determine its frequency.

**Methods:** Three independent experts in toxicology were asked to rate 280 chemical incidents against consensus criteria for Mass Psychogenic Illness. The criteria have been developed by our group for practical and research use. The incidents were selected sequentially and prospectively from a surveillance system run by the Chemical Hazards and Poisons Division of the Health Protection Agency, UK. Incidents for which the independent toxicologists agreed met all our criteria were designated as being due to Mass Psychogenic Illness. The prevalence and predictors of these incidents were then estimated.

**Results:** Using our criteria, toxicologists were able to agree on which incidents were Mass Psychogenic in origin. Preliminary results show that 13 (4.6%) of incidents were likely to be examples of Mass Psychogenic Illness. Such incidents were more likely to be associated with an odour, OR = 5.0 (95%CI 2.4–10.4), and with high use of emergency health resources e.g. receiving large number of casualties, OR = 4.8 (95%CI 1.8–12.9), and activation of hospital major incident plans.

**Conclusion:** Operational criteria for the definition of Mass Psychogenic Illness enable toxicologists to identify such episodes from a brief case description. These episodes are not uncommon and are likely to be associated with high costs to health and emergency services. Further work on early identification and successful management of these incidents is required.

#### ISEE-0426

##### Influence of Built Environment and Socioeconomic Position on Children's Physical Activity During Leisure Time and due to Mode of Travel

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**Background:** Environmental factors are suggested to play a major role in physical activity. For example, characteristics of the neighbourhood such as accessibility of green space and sidewalk availability may increase likelihood of walking.

**Objective:** To assess the relationship between children's built environment, socioeconomic position, physical activity during leisure time and due to mode of travel.

**Methods:** Cross-sectional data on 11453 children (48% girls) aged 5–7 years in Germany were analysed by logistic regression. Living in an adverse built environment was defined as experiencing at least 4 out of 6

characteristics (crowded flat, main road, frequent heavy traffic, no accessible green space, no nearby playground, neighbourhood perceived unsafe with regard to road traffic). Definition of physical activity during leisure time was based on frequency of climbing, playing with a ball, playing tag, cycling and skating. Children's mode of travel to kindergarten and to friends/relatives was assessed as active if mainly by foot/bicycle versus motorised if exclusively by car/bus. Household equivalent income was used as indicator of socioeconomic position (SEP).

**Results:** Socially disadvantaged children were more likely to live in an adverse built environment (9.3% versus 3.2%), to walk or cycle to kindergarten (62.2% versus 52.2%) and less likely to be physically active during leisure time (34.0% versus 41.6%) and to walk or cycle to friends (60.4% versus 62.0%). Accounting for gender, SEP, and study region in multivariate analysis, an adverse built environment was inversely associated with children's physical activity during leisure time (OR 0.74 [95% CI 0.60–0.91]) and with active mode of travel to friends (0.62 [0.51–0.76]). In contrast, a low SEP (1.50 [1.26–1.78]) but not an adverse built environment (1.20 [0.97–1.48]) was associated with walking or cycling to kindergarten.

**Conclusion:** Public health promotion of children's physical activity needs to consider the contribution of built environment as well as socioeconomic influences.

#### ISEE-0427

##### Modeling Human Exposure to Cadmium and Arsenic in a Zinc Smelter Area—A Belgian Case Study

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**Background and Objective:** The Northern Campine region in the north-east of Belgium has a long history harboring polluting zinc industry. A recent study showed a significant correlation between cadmium exposure and lung cancer incidence in the area. During the last decades, increasing concerns lead to various measures to limit or eliminate the pollution. In order to assess the present situation concerning cadmium and arsenic pollution and human exposure, a campaign was set up including questionnaires and biomonitoring for 1217 adults and environmental measurements in 100 homes. Based on these data, we developed, implemented and validated a human exposure model, linking external exposure to internal dose using PBPK modelling.

**Methods:** The model included all relevant exposure pathways (inhalation, purchased and homegrown food, water consumption, soil ingestion, smoking). The pharmacokinetic models of Nordberg-Kjellström and Walker and Griffin were used to model the contaminant distribution throughout the human body. Since urinary cadmium is a marker for lifetime exposure, historical exposure was taken into account.

**Results:** Model validation shows good predictive capabilities for cadmium, but less for arsenic. Nowadays, food consumption is a defining exposure pathway for cadmium and arsenic. Inhalation and soil ingestion are of minor importance, but gain importance when taking into account historical exposure. Age, smoking behaviour and consumption of homegrown vegetables correlate with cadmium levels in the human body. Model simulations show that residents younger than 50 have only a small risk of exceeding health-based urinary cadmium limits in the future. We expect marginal health risks for people born nowadays in the exposed area and residing there for life.

**Conclusion:** Historical exposure clearly contributes to urinary cadmium levels, but measures to limit or eliminate the cadmium pollution reduced the current health risks for residents. Consumption of (homegrown) food is a major exposure pathway for cadmium and arsenic.

#### ISEE-0430

##### Ambient Air Pollution and Birth Weight in Full-Term Infants in Atlanta, 1994–2004

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**Background and Objective:** An emerging body of evidence suggests ambient levels of air pollution during pregnancy are associated with fetal growth.

**Methods:** We used vital records data to construct a retrospective cohort of 406,627 full-term births occurring between 1994 and 2004 in five central counties of metropolitan Atlanta, USA. We examined the relationship between birth weight and temporal variation in ambient levels of carbon monoxide (CO), nitrogen dioxide (NO<sub>2</sub>), sulfur dioxide (SO<sub>2</sub>), ozone (O<sub>3</sub>), PM<sub>10</sub> (particulate matter <10 µm in diameter), PM<sub>2.5</sub> (particulate matter <2.5 µm in diameter) and speciated PM<sub>2.5</sub> measurements. Daily pollutant levels in five-county Atlanta were characterized using a population-weighted spatial average of air quality monitors in the study area. Daily concentrations were then averaged over the time period corresponding to each infant's third trimester. We also conducted capture-area analyses limited to mothers residing within four miles (6.4 km) of each air quality monitoring station. Linear regression models included control for seasonal and long-term time trends, gestational week, maternal education, maternal marital status, maternal age, maternal tobacco use, race and ethnicity, and parity.

**Results:** In the five-county analysis, ambient levels of NO<sub>2</sub>, SO<sub>2</sub>, PM<sub>2.5</sub> elemental carbon and PM<sub>2.5</sub> water-soluble metals were significantly associated with small reductions in birth weight in full-term infants (–4 to –16 grams per interquartile range [IQR] increase in pollutant concentrations). The capture-area analyses provided little evidence of harmful effects of air pollution, but confidence intervals were wide.

**Conclusion:** Results provide limited support for an effect of ambient air pollution in the third trimester on birth weight in full-term infants.

#### ISEE-0431

##### Association of Heart Rate Variability with Average Exposure to NO<sub>2</sub> and Noise in a Population-Based Sample of Adults

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**Background:** Low Heart Rate Variability (HRV) is known to be associated with cardiovascular morbidity and mortality. In the SAPALDIA cohort study, long term exposure to NO<sub>2</sub> was found to be inversely associated with HRV in women but not in men. Furthermore, although other studies have shown cardiovascular effects of noise, little is known about its association with HRV.

**Objective:** To disentangle effects of traffic noise and NO<sub>2</sub> on HRV.

**Methods:** 24-hour electrocardiograms were recorded in randomly selected SAPALDIA participants aged >50 years. Noise annoyance and general health were investigated by interviews. Annual exposure to NO<sub>2</sub> at the address of residence was predicted by hybrid land use/dispersion models. Estimates of street and railway noise levels at residential addresses during day and night were obtained from a model developed by the Federal Office of the Environment (FOEN). Associations of HRV parameters with NO<sub>2</sub> and noise were estimated using multivariable mixed linear regression models adjusting for further potential confounders.

**Results:** Street and railway noise showed a significant positive association with 24-h and night-time HRV (SDNN, total power, high and low frequency power), in men (n = 683) but not in women (n = 724). In men, 10 dB increments in street noise and railway noise, during the night, were each associated with an increase in SDNN by 4% (CI95% = [1; 7]).

The previously observed gender difference in the NO<sub>2</sub> effect disappeared after controlling for noise exposure. A 10 µg/m<sup>3</sup> increment in 1-year average NO<sub>2</sub> level was associated with a decrement in SDNN by 2% (CI95% = [–4; 0]). Replacing objective noise data by noise annoyance perception provided qualitatively similar results.

**Conclusion:** The gender difference in the effect of NO<sub>2</sub> on HRV could be largely explained after controlling for noise exposure due to traffic. The unexpected positive association between noise exposure and HRV in men needs further investigation.

#### ISEE-0432

##### Air Pollution and Inflammation: Gene-Environment Interactions in Myocardial Infarction Survivors

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**Background and Objective:** There is evidence suggesting that cardiovascular effects of air pollution are mediated by systemic inflammation which is regulated by genes involved in these pathways. We had earlier shown that the air pollution-fibrinogen response is modified by a promoter single nucleotide polymorphism (SNP) in the promoter region of FGB and intended to find further SNPs with a similar effect in other genes.

**Methods:** In 895 myocardial infarction survivors from five European cities repeated plasma fibrinogen levels (N = 5327) and genetic information were determined. We tested a two stage approach. We applied a screening step for 136 SNPs located in 24 genes from inflammatory and detoxification pathways on the mean fibrinogen level and its variability. We took statistically significant SNPs (adjusted for multiple comparisons)

to the second stage in which we assessed the modification of the air pollution-fibrinogen response by these selected SNPs.

City-specific analyses were conducted using additive mixed models adjusting for patient characteristics, time trend and meteorology to assess the impact of air pollutants on plasma fibrinogen levels modified by the selected SNPs. City-specific estimates were pooled using meta-analysis methodology.

**Results:** We identified 39 SNPs in 14 gene loci associated with increased variability of fibrinogen levels. Testing for gene-environment interactions, for subjects being homozygous for the minor allele of TLR4 rs2770150 a 2.4% percent increase in fibrinogen mean per 13.5  $\mu\text{g}/\text{m}^3$  increase in the 5-day-average of particles with a diameter  $<10 \mu\text{m}$  (95%-confidence-interval (CI): 1.2–3.7%) was found, whereas for subjects being homozygous for the major allele no change (0.1%; 95%CI: –0.6–0.7%) in fibrinogen was seen ( $P$ -value for interaction 0.0015).

**Conclusion:** Through a two-stage analysis of five independent study samples we identified new potential pathways of genetic modulation of the air pollution-fibrinogen response in myocardial infarction survivors.

#### ISEE-0437

##### **Incorporating Individual-Level Uncertainties in Exposure Into Epidemiologic Analyses: An Application Using Arsenic in Drinking Water and Bladder Cancer**

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**Background and Objective:** Epidemiologic analyses traditionally rely on precise estimates of exposure for assessing risk. In reality, however, exposure is characterized with uncertainty that can vary across individuals. Methods which incorporate uncertainty in exposure into epidemiologic analyses will yield a greater degree of confidence in estimates of risk.

**Methods:** In this report we demonstrate a method using SAS (SAS Institute, Inc., Cary, NC) that uses Monte Carlo simulation to pull estimates of exposure from a normal distribution specified by a mean and uncertainty estimate that can vary for each individual. After the exposure estimate is pulled, the relationship between exposure and disease is evaluated using logistic regression. This process is repeated 999 times producing a distribution of odds ratios and confidence intervals.

**Results:** This method will be demonstrated in a case-control study of bladder cancer using estimates of exposure to arsenic in drinking water over the life-course and its associated uncertainty. Among statistically significant findings from analyses that do not incorporate uncertainty in exposure, less than 50% of simulated results were statistically significant.

**Conclusions:** The resulting distribution of odds ratios and confidence intervals yields a more realistic depiction of risk from the exposure by incorporating uncertainty in exposure. Given the ease of implementation, this approach can be readily adopted by epidemiologists who possess quantitative measures of exposure and its associated uncertainty.

#### ISEE-0442

##### **Buildings and Population Density in Intra-Urban Air Pollution Epidemiology: The New York City Community Air Survey (NYCCAS)**

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**Background and Objective:** Land-use regression (LUR) studies have used Census-based population density to indicate non-traffic related emissions (e.g., home heating). Censuses, however, capture where the population lives, poorly reflecting daytime source activity. Remotely

sensed data indicating daytime and nighttime population suggests that these patterns differ in NYC and elsewhere. Further, for epidemiology, exposure estimates based on population density may produce unknown biases in exposure distributions, if cohorts reflect overall population patterns.

**Methods:** The New York City Community Air Survey (NYCCAS) examines year-round intra-urban variability in multiple air pollutants, at 150 sites selected using stratified random sampling by borough, traffic and buildings density, with purposeful monitors at locations of interest. We collect seasonal 2-week integrated fine particles ( $\text{PM}_{2.5}$ ), elemental carbon (EC), nitrous oxides ( $\text{NO}_x$ ), sulfur dioxide ( $\text{SO}_2$ ), and ozone ( $\text{O}_3$ ). LUR models will be produced to examine fine-scale pollutant variability, improve source identification, and provide guidance for health policy.

**Results:** Preliminary analyses suggest that  $\text{NO}_2$  and built space correlate better with daytime than nighttime population within 300 m ( $r = 0.62$  vs  $0.28$  for  $\text{NO}_2$ ;  $0.90$  vs.  $0.30$  for built space).  $\text{NO}_2$  variability is better predicted by built space ( $R^2 = 0.42$ ) or daytime population density ( $R^2 = 0.39$ ) than by nighttime ( $R^2 = 0.08$ ) or Census population ( $R^2 = 0.07$ ).

Adding buildings density to temporally-adjusted  $\text{NO}_2$  models with daytime population adds minimal predictive power ( $R^2 = 0.60$  to  $0.63$ ), and indicates that buildings may account for 50% of variability attributable to daytime population. Further investigation will examine buildings effects on multiple pollutants, comparing models using buildings and population terms.

**Conclusion:** Buildings density, a marker for heating fuel emissions, significantly explains intra-urban pollution variability. Further disaggregation of population density effects should improve epidemiological exposure estimates.

#### ISEE-0449

##### **Social Stress and Susceptibility to Concentrated Particulate Air Pollution (CAPs) in Rats**

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**Introduction:** Epidemiological evidence suggests that social stressors may influence susceptibility to environmental pollution. Epidemiologic methods alone, however, can not fully disentangle effects of spatially-correlated social and physical stressors (e.g., traffic-related noise and pollution). Spatial auto-correlation may lead to residual confounding, and physiologic mechanisms for stress-related pollution susceptibility remain unknown.

**Methods:** Twenty-four 12-week old male Sprague-Dawley rats were randomly assigned to four exposure groups (Stress/CAPs; Stress/Filtered Air (FA); Non-stress/CAPs; Non-stress/ FA). Stress group animals were individually introduced into the home cage of a larger male 20 minutes twice weekly. Fine CAPs exposures were generated using the Harvard particle concentrator. Ambient fine particles concentrated approximately 30 times. Test animals were exposed to CAPs or FA in single-animal phethysmographs 5 hours/day for 10 days. Three rats per group were exposed daily, at the same time each day, to account for  $\text{PM}_{2.5}$  variability.

Continuous respiratory data was collected using a Buxco system. Circulating blood was drawn at sacrifice on the day following final CAPs/FA exposure, and analyzed for serum corticosterone, C-reactive protein (CRP), and stress and inflammatory markers. Lungs were fixed at constant pressure and random slices obtained for histology. Continuous  $\text{PM}_{2.5}$  was measured by TEOM, and black carbon (BC) by aethelometer. Integrated filters provided gravimetric  $\text{PM}_{2.5}$  and reflectance analysis for BC.

**Results:** CRP was significantly elevated only with both chronic stress and CAPs. Linear models adjusted for age indicate that, only among stressed animals, higher PM concentrations conferred significantly increased



respiratory frequency (F), and decreased end expiratory pause (EEP), end inspiratory pause (EIP), peak expiratory flow (PEF), expiratory time (Te), inspiratory time (Ti), and tidal volume (TV).

**Discussion:** Our findings suggest that chronic stress may alter respiratory response to air pollution in animals. Further investigation of biomarkers is needed to clarify physiological pathways for this effect.

#### ISEE-0453

##### Changes in Levels of Polychlorinated Dibenzodioxins and Dibenzofurans (PCDD/Fs) and Dioxin-Like PCBs in the General Population Living Near to an Urban Waste Treatment Plant in Bilbao (Spain)

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**Background and Objective:** In 2005, a new urban waste treatment plant started its activity in Bilbao. The emissions from such plants include PCDD/Fs. This study aims to estimate the evolution of the blood levels of PCDD/Fs and dioxin-like PCBs in the population around the plant after two years of follow-up.

**Methods:** Two cross-sectional studies were carried out to measure the blood levels of PCDD/Fs, dioxin-like PCBs and Total Substances with Dioxin Activity (TSDA) in volunteers in 2006 (baseline study) and 2008. We recruited at least 80 people per zone, 20 for each sex and age group (20–44 years and 45–69 years). We selected two nearby areas most exposed to the incinerator, according to the Environmental Impact Study (Alonsotegi (A) and Rekalde (B)) and two control areas (Santutxu (C) and Balmaseda (D)). The serum samples were grouped by sex and age to produce four pooled samples per zone, resulting in a total of 16 pooled-samples per year.

**Results:** Serum samples were obtained from 322 individuals in 2006 and from 326 in 2008. At baseline, mean (SD) PCDD/Fs, dioxin-like PCBs and TSDA values, in pg/g lipid, were: 23.45 (8.51), 15.56 (7.97) and 39.01 (14.98), respectively. In 2008, these values increased by 0.15 (−7.29~7.58), 8.04 (0.31 ~ 15.78) and 8.19 (−6.73~23.11), respectively. Only the increase in PCBs was statistically significant. Linear regression models, adjusting for age and gender, showed increased levels in the second year in the control areas (C/D), whereas no increases were observed for the exposed areas (A/B); beta-coefficients: −12.28 (−26.06~1.50), −10.15 (−23.73~3.43) and −22.43 (−49.14~4.28), respectively.

**Conclusion:** The exposed areas showed no significant differences in the levels of PCDD/Fs and PCBs over time. The data therefore suggest that variations in the levels of PCDD/Fs and PCBs are not attributable to the incinerator.

#### ISEE-0456

##### Particulate Air Pollution, Metabolic Syndrome and Heart Rate Variability: The Multi-Ethnic Study of Atherosclerosis

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**Background and Objective:** Numerous epidemiologic studies have shown an association of cardiovascular disease (CVD) with fine particulate air pollution (PM<sub>2.5</sub>); altered cardiac autonomic balance has been suggested as a possible biological pathway. Metabolic diseases, such as type-2 diabetes, have been suggested to confer susceptibility to particle toxicity on CVD. We examined the associations of PM<sub>2.5</sub> with heart rate variability (HRV), a marker of cardiac autonomic function, and whether metabolic syndrome (MetS) modified these associations.

**Methods:** Standard deviation of NN intervals (SDNN) and the root mean square of successive differences in NN intervals (rMSSD) were measured in 5,465 persons aged 45–84 years who were free of cardiovascular disease at the Multi-Ethnic Study of Atherosclerosis baseline exam (2000–2002). Data from U.S. Environmental Protection Agency monitors were used to estimate ambient PM<sub>2.5</sub> concentrations (averages up to 60 days prior to the HRV measurement) at participant residences. MetS was defined as having three or more of the following criteria: abdominal obesity, hypertriglyceridemia, low high-density lipoprotein cholesterol, high blood pressure, and high fasting glucose.

**Results:** After controlling for confounders, an interquartile range increase in 2-day average PM<sub>2.5</sub> (10.2 µg/m<sup>3</sup>) was marginally associated with a 1.7% decrease in SDNN (95% confidence interval (CI), −3.5%, 0.2%; *P* = 0.08) and a 1.8% decrease in rMSSD (95% CI, −3.9%, 0.2%; *P* = 0.08). Associations were stronger among individuals with MetS than those without MetS: an interquartile range elevation in 2-day PM<sub>2.5</sub> was associated with a 5.7% decrease in rMSSD (95% CI, −8.9%, −2.4%) among subjects with MetS, whereas almost no change was found among subjects without MetS (*P*-interaction = 0.005). Similar effect modification was observed in SDNN. No significant effect modification by individual components of MetS was found.

**Conclusion:** These findings suggest an association of PM<sub>2.5</sub> with HRV, particularly among persons with MetS.

#### ISEE-0457

##### Development of a Spatial Vulnerability Assessment for Heat-Related Illness

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**Background and Objective:** The adverse effect of extreme heat events on health in urban communities is of major concern. There is a need to identify populations who are vulnerable to the health impacts of heat so that targeted public health interventions may be more appropriately developed. Our primary objective was to develop recommendations for a Toronto-specific, spatially explicit vulnerability assessment for heat-related illness.

**Methods:** This study was divided into four key phases: (i) a scan of methods and case examples of jurisdictions where a heat vulnerability assessment was carried out, (ii) the identification of suitable and available datasets for a Toronto-specific heat vulnerability assessment, (iii) the development of recommendations for the assessment, and (iv) the production of prototype maps that reflect these recommendations. The recommendations and prototype maps are organized by the three components of vulnerability: exposure, sensitivity, and adaptation. The project was initiated by and

completed in partnership with Toronto Public Health, to develop a tool for practical intervention.

**Results:** There are several intra-urban heat vulnerability assessments in progress for metropolitan areas across the globe. In consideration of the available information on the methodological approaches of these case examples, and the availability of spatial data as indicators of heat vulnerability, we propose three elements for the vulnerability assessment: (i) spatial patterns of heat vulnerability indicators, (ii) spatial patterns of composite indices of heat vulnerability, and (iii) clusters of vulnerable neighbourhoods. Prototype maps of each of these approaches will be presented to illustrate their potential utility in identifying vulnerable populations, such as the elderly and socially isolated.

**Conclusions:** Developing a spatial vulnerability assessment for heat has the potential to identify areas that are characterized by one or more risk factors for heat-related illness. This approach will enable public health decision-makers to more effectively target populations that are vulnerable to heat.

#### ISEE-0459

##### Development of Health-Relevant Indicators of Climate Change for Europe

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**Background and Objective:** WHO is implementing a project aimed at evaluating the impacts of policy options related to climate change from public health perspective. One objective is the development of tools for monitoring and assessment of environmental health (EH) issues related to climate change through the use of EH information system methods in particular indicators.

**Methods:** The climate change related EH issues to be measured by indicators were identified through a critical review of the relevant scientific literature. A working group coordinated by WHO developed methodological proposals for indicators, including rationale and definitions, calculation methods, data sources, interpretation and policy relevance. After evaluation of the proposals, selected indicators underwent a feasibility study.

**Results:** The following climate change related EH issues were selected to ensure a balanced and comprehensive overview of common and widespread public health problems related to climate change in Europe: flooding; extreme temperatures; vector-borne diseases; water- and food-borne diseases; air quality; asthma, allergies and pollens. Policy actions, in particular adaptation measures, were added as a cross-cutting issue. The DPSEEA model was adapted to climate change and environmental health linkages. The indicators developed measure either population exposures, such as direct (flooding and temperature extremes) or indirect (through ecological factors and vectors) ones, or climate change-sensitive health outcomes. They use as much as possible existing information from observations, monitoring and surveillance, while identifying gap areas for further development.

**Conclusion:** Based on the feasibility study and in consultation with the Member States, a set of policy-relevant indicators will be selected to extend the ENHIS system. Quality and sensitivity of existing surveillance, particularly of drinking water- and food-related outbreaks, need improvement. Further advances of GIS techniques are required, especially for population-relevant assessments.

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#### ISEE-0460

##### High Manganese Levels in Food Crops Cultivated in the Vicinity of Ferro-Manganese Alloy Plant in the Great Salvador Area, Brazil

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**Background:** Manganese (Mn) is an important essential micronutrient involved in bone mineralization, especially for growing children. However, it can also be a neurotoxin if high exposure levels surpass the body homeostatic mechanisms.

**Objective:** Measure Mn levels in food crops grown in the vicinity of a ferro-alloy plant in order to evaluate the quality of products cultivated in such impacted area.

**Methods:** Mn levels in banana (*Musa paradisiaca* L.), acerola (*Malpighia puniceifolia*) and fermented manioc (*Manihot utilissima*) flour were determined by electrothermal atomic absorption spectrometry. Food crops were sampled (n = 20 of each) in two areas between 2007–2008: Cotegipe de Baixo (CB) close to the plant (avg. distance 1.5 km) and Cotegipe de Cima (CC) a hill area a little bit further and not in the wind direction (avg. distance 2.5 km).

**Results:** Mean Mn levels in acerola were  $18.69 \pm 8.79$  mg.kg<sup>-1</sup> and  $28.13 \pm 13.57$  mg.kg<sup>-1</sup>, for CC and CB, respectively. In banana, mean Mn levels were  $93.60 \pm 41.03$  mg.kg<sup>-1</sup> and  $66.73 \pm 62.23$  mg.kg<sup>-1</sup> for CC and CB, respectively. In manioc flour, locally known as “puba”, mean Mn levels were  $2.26 \pm 1.29$  mg.kg<sup>-1</sup> and  $2.64 \pm 1.51$  mg.kg<sup>-1</sup> in CC and CB, respectively. Mn contents in fruits grown in Cotegipe Village are very high when compared to literature values (0.7 mg.kg<sup>-1</sup> for acerola and 4.2–6.7 mg.kg<sup>-1</sup> for banana). It is also approximately 4 to 5 times higher in manioc flour when compared to reported values (0.5 mg.kg<sup>-1</sup>). Statistical difference in mean Mn levels between products from the two localities was only observed for acerola ( $P = 0.015$ ).

**Conclusion:** Results show that the Mn levels in food product grown in the vicinity of a ferro-alloy plant are very high, reaching Mn contents that surpass the estimated safe daily ingestion (2–5 mg/day).

#### ISEE-0461

##### Association of Prenatal Exposure to Methylmercury and Fatty Acids with Neurobehavioral Test Performance at Ages 7 Years and 10 Years

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**Background and Objective:** Methylmercury, a neurotoxic seafood contaminant, can have serious adverse effects on the developing brain. However, seafood nutrients such as the long-chain polyunsaturated fatty acids (docosahexaenoic acid, DHA, arachidonic acid, AA) provide beneficial effects on brain development. Because they occur in the same food items, underestimation of the effects of both mercury toxicity and nutrient benefits may occur from the lack of mutual adjustment. We assessed the associations of prenatal exposures to methylmercury and fatty acids with neurobehavioral test performance in a Faroese birth cohort, where increased methylmercury exposure mainly originates from pilot whale meat.

**Methods:** The cohort consisted of 182 singleton term births in 1994–1995. We measured cord serum phospholipid fatty acids, umbilical cord blood and maternal hair mercury. Blood and hair mercury samples were obtained from the participants at age 7 and 14 years. The DHA

concentration was used as the main nutrient parameter. Multiple regression analysis was carried out with adjustment for confounders. These analyses were supplemented with structural equation analyses to avoid problems with multiple comparisons.

**Results:** Indicators of prenatal methylmercury exposure were significantly associated with deficits in cued naming and verbal learning. The association strengthened after adjustment for DHA. Although the associations between DHA and the outcomes were not statistically significant, the effects became stronger after adjustment for mercury. Similar results (but weaker associations) were obtained using the DHA/AA ratio. Likewise, the number of fish dinners per week during pregnancy was less clearly associated with improved test results.

**Conclusion:** In a small Faroese birth cohort, prenatal exposure to methylmercury was associated with deficits at school age in domains known to be sensitive to this neurotoxicant. The results support the notion that negative confounding is present and results in underestimation of the true effects of both methylmercury toxicity and seafood nutrients, unless mutual adjustment is included.

#### ISEE-0466

##### Proximity to Industrial Polluting Sources and Socioeconomic Status-An Environmental Equity Study on A Small-Area Scale

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**Background & Objective:** Territorial disparities in exposure to environmental hazards according to socioeconomic status (SES) contradict the principle of environmental justice, which states that no population group should suffer a disproportionate burden of exposure. In this work, which is the first phase of an epidemiological study on environmental risk factors of perinatal mortality, we investigated the association between proximity to industrial pollution sources and SES at small-area level and assessed the impact of different proximity indicators on the measure of the association.

**Methods:** An ecological study was conducted in the Lille Metropolitan Area (LMA). We used a validated deprivation index, constructed from 1999 census data, to estimate SES at the French census block level ( $n = 453$ ; 1,100,000 inhabitants). Information on industrial air emissions in 2006 was drawn from the French database of the European Pollutants Emission Register. Several industrial proximity indicators were estimated and sensitivity analysis was performed to investigate their influence on the association with SES while controlling for spatial autocorrelation in the data. We present here results using a Multi-Site Proximity Index (MSPI), a cumulative distance measure between census block centroids and each facility.

**Results:** Significant spatial autocorrelation was detected in SES and location of industries. Spatial distributions of industries show a clear pattern, with a higher number located in the most deprived areas, near the LMA center. The MSPI differ significantly between deprivation categories ( $P < 0.001$ ), with the lowest MPSI in the most disadvantaged blocks (geometric mean: 499,286 km [95%CI = 482,959–516,166] in category 5) and the greatest in the wealthiest ones (559,083 km [95%CI = 533,197; 588,225] in category 1). Inclusion of emission levels in the MSPI sharpens the contrasts.

**Conclusion:** Deprived populations experience a greater exposure to industrial pollution. Substantial exposure misclassification may result from a poor choice of proximity metrics in environmental equity analyses and may lead to erroneous conclusions.

#### ISEE-0468

##### Plasma Homocysteine, Particulate Air Pollution, and Oxidative Stress-Related Genes—A Gene-Environment Interaction

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**Background and Objective:** High total plasma homocysteine (tHcy) is a risk factor for human health. Ambient particulate matter is also associated with cardiovascular events and, recently, with tHcy. However, the biological mechanisms are not fully understood. One of the putative pathways is through oxidative stress. We used repeated measures data from the Normative Aging Study to examine whether the associations of  $PM_{2.5}$  and black carbon (BC) with tHcy were modified by a broad set of genetic polymorphisms related to oxidative stress, including HFE H63D, C282Y, CAT (rs480575, rs1001179, rs2284367 and rs2300181), NQO1 (rs1800566), GSTP1 (wild vs non-wild), GSTM1, GSTT1 (deletion vs non-deletion) and HMOX-1 (any short vs both long) genotypes.

**Methods:**  $PM_{2.5}$ , BC, tHcy and other covariates were repeatedly measured between 1995 and 2006. We fit mixed models in R to examine the association of pollution with tHcy and the effect modifications by individual genotypes adjusting for covariates.

**Results:** Interquartile ranges (IQR) increases in  $PM_{2.5}$  and BC of 7-day moving averages were associated with 1.05% (95% confidence interval (CI): -0.01%, 2.11%) ( $P = 0.089$ ) and 2.40% (95% CI: 1.00%, 3.83%) ( $P = 0.007$ ) increases in tHcy (natural log), respectively. GSTT1 and HFE C282Y significantly modified effects of BC on tHcy, and HFE C282Y and CAT (rs2300181) significantly modified effects of  $PM_{2.5}$  on tHcy. Several gene polymorphisms marginally modified effects of  $PM_{2.5}$  and BC. All genes with significant interactions with particulate air pollution had marginally significant main effects on tHcy.

**Conclusion:** Effects of  $PM_{2.5}$  and BC on tHcy appeared to be mediated by genes related to oxidative stress pathways.

#### ISEE-0471

##### The Relationship of Incident Diabetes with Chronic Particulate Matter Exposures

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**Background and Objective:** Information is lacking as to whether Diabetes Mellitus (DM) merely modifies the impact of air pollution exposures on cardiovascular outcomes or whether it is also an air pollution associated outcome. Using two prospective cohorts, the Nurses' Health Study (NHS) and the Health Professionals Follow-Up Study (HPFS), we investigated the relationship of incident DM with chronic exposures to  $PM_{10}$  (particulate matter less than 10 microns in diameter),



PM<sub>2.5</sub> (particulate matter less than 2.5 microns in diameter), and PM<sub>10-2.5</sub> (particulate matter between 2.5 and 10 microns in diameter).

**Methods:** Cases were initially reported through biennial questionnaires and confirmed by supplemental questionnaire. During the follow-up from 1992 to 2002, questionnaires also provided information on time-varying covariates and updated addresses which were geocoded and used to assign air pollution exposures that were estimated with GIS-based spatial statistical models.

**Results:** Among participants living in metropolitan areas of the northeastern and midwestern US, there were 4,073 incident cases of DM in the NHS, and 646 cases in the HPFS. Among women, DM was significantly associated with increases in each size fraction of PM averaged over the 12 months prior to diagnosis in single pollutant time and age adjusted models. Risk of DM was also elevated for men. The greatest risk was related to PM<sub>2.5</sub> exposure (HR for women: 1.32; 95%CI: 1.14–1.51; HR for men: 1.36; 95%CI: 0.98, 1.87). After adjustment for known risk factors for DM, risks remained elevated but were considerably attenuated.

**Conclusion:** Using time-varying measures of covariates and long-term exposures, we found particulates were associated with increased risks of DM among women and men living in the northeastern and midwestern US. This relationship was confounded by known risk factors for DM.

#### ISEE-0475

##### High Dietary Zn Intake Mitigates the Effect of Pb on Height in a Cohort of 12 to 60 Month-Old Children in Mexico City

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**Background and Objective:** A widely described lead effect is impaired physical growth. Zinc is essential for growth and its interaction with lead has not been thoroughly studied. In animal models, lead increases zinc excretion, which may lead to zinc deficiencies. Zinc deficiencies may enhance lead absorption, further increasing blood lead levels, triggering a vicious cycle that further impairs linear growth. The objective was to estimate the interaction between blood lead concentrations and dietary zinc intake and its effect on children's height.

**Methods:** Blood lead and anthropometry were measured at 12, 18, 24, 30, 36, 48 and 60 months of age in 647 children residing in Mexico City. Blood lead was measured by atomic absorption spectrometry except at 18 and 30 months when measured by anodic stripping voltammetry. Children's usual dietary zinc intake was estimated with a FFQ at each time point. Linear regression with robust standard errors was performed to estimate the lead-zinc interaction.

**Results:** After adjusting for maternal height, child age, sex, caloric and protein intake, high zinc intake was protective against the effect of lead in children above 36 months. There was a significant effect of lead in children with reported Zn intake below the RDA (5 mg/d); at the lowest reported Zn intake (1.6 mg/d) height was in average 0.1 cm lower per 1 mg of Pb increase ( $P = 0.031$ ). This effect, however, was non-significant at Zn intakes equal to or greater than 5 mg/d ( $b = -0.069$ ,  $P = 0.065$ ). No significant interaction was observed in children below 36 months of age.

**Conclusion:** Our results suggest that the effect of lead on growth can be partially offset by dietary zinc intakes above 5 mg/d in children above 36 months of age, highlighting the importance of adequate nutrition in preventing the effects of lead exposure on child stature.

#### ISEE-0476

##### Assessment of Health Impacts of Heatwaves in Brisbane, Australia: How to Best Define A Heatwave?

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**Background and Objective:** As global warming continues, the frequency, intensity and duration of heatwaves are likely to increase. However, a heatwave is unlikely to be defined uniformly because acclimatisation plays a significant role in determining the heat-related impact. This study investigated how to best define a heatwave in Brisbane, Australia.

**Methods:** Computerised datasets on daily weather, air pollution and health outcomes between 1996 and 2005 were obtained from pertinent government agencies. Paired t-tests and case-crossover analyses were performed to assess the relationship between heatwaves and health outcomes using different heatwave definitions.

**Results:** The maximum temperature was as high as 41.5°C with a mean maximum daily temperature of 26.3°C. None of the five commonly-used heatwave definitions suited Brisbane well on the basis of the health effects of heatwaves. Additionally, there were pros and cons when locally-defined definitions were attempted using either a relative or absolute definition for extreme temperatures.

**Conclusion:** The issue of how to best define a heatwave is complex. It is important to identify an appropriate definition of heatwave locally and to understand its health effects.

#### ISEE-0480

##### The Association Between Arsenic Exposure and Cerebrovascular Disease—A Study in the Blackfoot Disease Endemic Area in Taiwan

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**Background and Objective:** Epidemiological studies have demonstrated that chronic arsenic exposure may cause various health effects, but previous studies on the association between arsenic exposure from drinking water and cerebrovascular diseases (CVD) in different regions in Taiwan yielded inconsistent results. The objective of this study is to evaluate the possible association between arsenic exposure and mortality of CVD in Taiwan with the data from the whole country, trying to solve the problem with a more complete database.

**Methods:** We analyzed the national death registry data of Taiwan from 1971 to 2005. Two areas were defined as the exposed group: one is the blackfoot disease (BFD) endemic area, and the other is the Lan-Yang Basin (LYB) area. The arsenic levels in the drinking water in the BFD area were generally higher than those in the LYB area. Standardized mortality ratios (SMRs) adjusted for gender and age were calculated using the whole population in Taiwan and the population in the Chiayi-Tainan area as the reference populations respectively.

**Results:** The standardized mortality rate of CVD in Taiwan decreased from  $2.46/10^3$  in 1971 to  $0.63/10^3$  in 2005. Women had lower rates than men, with  $SMR = 0.80$ . The exposure group had higher SMRs of CVD in comparison with the reference populations, with SMRs from 1.06 to 1.09 in men and 1.12 to 1.14 in women. The BFD endemic area had higher mortality rates of CVD than the LYB area, with  $SMR = 1.05$  in men and  $SMR = 1.04$  in women.

**Conclusion:** In Taiwan, women had lower mortality rates of CVD, and the rate has been constantly decreasing in both genders from 1971 to 2005. Exposure to arsenic in drinking water is associated with a higher risk of CVD.

## ISEE-0487

**Quantification of Short Term Effects of Pollen Counts and Sentinel Botanic Garden Observations on Pollinosis Symptoms: A French Panel Study**

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**Background and Objective:** In recent decades, numerous epidemiological studies investigating the change of prevalence of pollinosis showed an increase in the occurrence of this disease all over the world. In order to explain this phenomenon and to build a specific prevention tool, a sentinel botanic garden was realized in Nantes city (France). The objective of this study was to explore short term relationships between pollinosis symptoms and either grass pollen counts or pollen observations in this garden.

**Methods:** 81 volunteers suffering from pollinosis and living in Nantes metropolis area were recruited by allergy physicians. The panel took place while the grass pollen season (March to July 2007). Daily number of plants in flower was collected by botanists and daily pollen counts were measured by a central stationary sampler. Daily symptoms of rhinoconjunctivitis (eye, nose, throat, respiration) were reported in a diary by volunteers as well as pollinosis treatment intake.

Marginal (GEE) and mixed models were realized to explore short term effects of pollen covariates on pollinosis symptoms and treatment intake. Models were adjusted for confounding variables (time trend, meteorology, pollution levels) and took lags and autocorrelation into account.

**Results:** The response rate was excellent: 97%. Most of the volunteers were treated by antihistaminic and immunotherapy. A positive and significant association between prevalent pollinosis symptoms and grass pollen counts was shown for nose (OR = 1.043; 95%CI [1.026–1.060]) and eyes (OR = 1.035; 95%CI [1.018–1.052]) symptoms. Short term effects of pollen observations were also observed in the period before the pollen grass peak for total symptoms (OR = 1.02; 95%CI [1.00–1.05]).

**Conclusion:** Short term effects of grass pollen on pollinosis symptoms were clearly showed and quantified. Those results provide information for better prevention and care of pollinosis and have contributed to the establishment of a new panel study realized in 2009.

## ISEE-0491

**Characterization of Jet Fuel Inhalation Exposure and Urinary Metabolites in U.S. Air Force Personnel**

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**Background and Objective:** Jet propulsion fuel-8 (JP-8) is the primary jet fuel used by the U.S. military, collectively consuming about 2.53 billion gallons annually. Previous reports suggest that JP-8 is potentially toxic to the immune, respiratory, and nervous systems. The objectives of this study were to evaluate inhalation exposure to JP-8 as well as absorption of JP-8 constituents among U.S. Air Force (USAF) personnel while performing job-related tasks.

**Methods:** Seventy-three full-time USAF personnel from three active bases were categorized a priori as having low (n = 35) or high (n = 38) exposure to JP-8 based on job title and tasks. Personal air samples were

collected from each participant during four consecutive workdays using air pumps and sorbent tubes.

Using gas chromatography/mass spectrometry, charcoal sorbent tubes were analyzed for benzene, ethylbenzene, toluene, xylenes, and total hydrocarbons (THC) while Chromosorb® tubes were analyzed for naphthalene. Pre- and post-shift urine samples were also collected from each worker each day and analyzed for 1- and 2- naphthols, 2-, 3-, and 9-hydroxyfluorene, 1-, 2-, 3-, and 4-hydroxyphenanthrene, and 1-hydroxypyrene. Linear mixed-effects models were used to explore the association between inhalation exposure and post-shift urinary metabolites, adjusting for creatinine and pre-shift urinary concentrations.

**Results:** THC air concentrations were significantly different between the exposure groups (2.6 vs. 0.5 mg/m<sup>3</sup>,  $P < 0.0001$ ). Similar differences were observed for the other analytes measured in air. Among the high exposure group, post-shift urinary 1- and 2-naphthol levels were significantly higher than pre-shift levels (both  $P < 0.05$ ). Inhalation exposure to THC was significantly associated with post-shift urinary 1-naphthol ( $\beta = 0.21$ ,  $P < 0.0001$ ), 2-naphthol ( $\beta = 0.11$ ,  $P = 0.0006$ ) and 2-hydroxyfluorene levels ( $\beta = 0.08$ ,  $P = 0.005$ ). Naphthalene air concentrations displayed similar significant associations with post-shift urinary 1-naphthol ( $\beta = 0.26$ ,  $P < 0.0001$ ) and 2-naphthol levels ( $\beta = 0.13$ ,  $P < 0.0001$ ).

**Conclusion:** USAF personnel experience inhalation exposure to JP-8 which is associated with absorption of JP-8 constituents while performing normal job-related tasks.

## ISEE-0498

**A Panel Study on Epigenetics, Markers of Oxidative Stress, and Lung Function Among Children with Respiratory Disease Exposed to Industrial Air Pollution**

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**Objectives:** To study DNA methylation, exhaled nitric oxide (FeNO), lung function (FEV<sub>1</sub>) in children with respiratory symptoms exposed to industrial air pollution.

**Methods:** A panel study of 39 children aged 8–11 years followed on 2007/12–2008/4 was conducted in Valle-del-Mela (Sicily-Italy), a High Risk Area (55504 inhabitants) with oil refineries and energy plants. Symptomatic children were screened by modified ISAAC questionnaire (2506, 89.5% responders). The 39 selected children were divided into 9 groups matched by school, monitored for 7 consecutive days. DNA Methylation was measured on nasal mucosa cells collected by swab, twice per subject on day fourth and seventh of the same week. Personal PM<sub>2.5</sub> active, NO<sub>2</sub>, SO<sub>2</sub> passive sampling were done on one child witness of a 4-child group. Ambient PM<sub>2.5</sub> monitor, meteo station, passive NO<sub>2</sub> SO<sub>2</sub> samplers in 21 schoolyards were used. Diaries filled in by parents recorded symptoms, therapy, indoor sources. Data were analyzed with mixed models controlling for confounders.

**Results:** Average daily ambient PM<sub>2.5</sub> was 23.0 µg/m<sup>3</sup>, weekly ambient SO<sub>2</sub> over 20 µg/m<sup>3</sup> in three locations. Average daily (90 percentile) personal PM<sub>2.5</sub> was 44.5 (86.6), SO<sub>2</sub> 17.7 (32.8). Effect measures were expressed for 10 µg/m<sup>3</sup> increase of pollutant concentration.

We found FEV<sub>1</sub> reduction –4.3% (90% Confidence Interval –6.1; –2.6%) for SO<sub>2</sub> lag2 ( $P < 0.01$ ), FeNO increment 10.8% (3.2–18.4%) for SO<sub>2</sub> lag01 ( $P = 0.022$ ); a decrease –1.0% of global DNA Methylation (Alu elements 90% CI –2.0; –0.6%) and –4.1% of iNOS (–7.8; –0.4%) for SO<sub>2</sub> lag12; –1.8% (–3.0; –0.6%) of iNOS for PM<sub>2.5</sub> lag12. DNA Methylation of interleukin 6 position was reduced when FEV<sub>1</sub> was

below median ( $P = 0.028$ ) and when FeNO was below median ( $P = 0.048$ ); consistently iNOS was reduced ( $P < 0.001$ ).

**Conclusion:** Short-term exposure to industrial pollutants was associated with changes in DNA methylation, bronchial inflammation and lung function in children with respiratory symptoms.

#### ISEE-0501

##### The Effect of Prenatal Exposure to Urban Air Pollution on Fetal Growth Assessed by Ultrasound Measurements

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**Background and Objective:** We aimed to assess the relationship between prenatal exposure to traffic-related air pollution and fetal growth assessed by ultrasound measurements in a cohort of 576 pregnant women from Sabadell, Spain.

**Methods:** Fetal characteristics measured were femur length, head circumference, abdominal circumference and biparietal diameter. Linear mixed models were used to obtain longitudinal growth curves for each fetal parameter. Models were adjusted for gestational age, sex, maternal age, pre-pregnancy weight and height and paternal height. Growth models were applied to calculate unconditional and conditional standard deviation scores for 12, 20, and 32 weeks of gestation and for intervals between weeks 12–20, 20–32 and 12–32.

Exposure to NO<sub>2</sub> and Volatile Organic Compounds (VOCs) was assessed by using Land-Use Regression (LUR) modelling. Air pollution estimates from LUR models were temporally-adjusted using daily levels of NO<sub>2</sub> measured at a fixed monitor. For each woman we obtained mean exposures to air pollution from the last menstrual period until 12, 20 and 32 weeks of gestation and between 12–20, 20–32, and 12–32 weeks of gestation. Associations were estimated for a 10 µg/m<sup>3</sup> increase in exposure to air pollutants and were adjusted by season of conception and maternal education.

**Results:** Exposure to VOCs between weeks 12 and 20 of pregnancy was inversely associated with the standard deviation score for femur length during the same period ( $\beta = -0.106$ ,  $P$ -value = 0.06). Similarly, growth in biparietal diameter between weeks 20 and 32 of pregnancy was inversely associated with exposure to NO<sub>2</sub> and VOCs from the last menstrual period until 20 weeks of pregnancy ( $\beta = -0.066$ ,  $P$ -value = 0.06 for NO<sub>2</sub> and  $\beta = -0.104$ ,  $P$ -value = 0.08 for VOCs).

**Conclusion:** Results suggest that negative effects of traffic-related air pollution on fetal growth may already manifest at the beginning of the second trimester of pregnancy.

#### ISEE-0504

##### Dietary Cadmium Exposure—A Review of Recent Risk Assessments

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**Abstract:** Cadmium is a toxic metal, commonly used in various industrial products, such as rechargeable batteries. It is also a common pollutant in fertilizers. Food is the main source of cadmium intake in the non-smoking population. The bioavailability, retention and toxicity are affected by several factors including nutritional status, low iron status in particular. Cadmium is efficiently retained in the kidney (half-life 10–30 years), the concentration being proportional to that in urine (U-Cd). Cadmium is nephrotoxic, initially causing renal tubular damage and can also cause bone damage, either via a direct effect on bone tissue or indirectly as a result of renal dysfunction. After prolonged and/or high exposure the tubular injury may progress to glomerular damage and eventually to renal failure. Recent data also suggest increased cancer risks and increased

mortality in environmentally exposed populations. Early effects on kidneys and bone have been detected at U-Cd levels between 0.5 and 3 µg Cd/g creatinine. A large proportion of the non-smoking adult population has urinary cadmium concentrations of 0.5 µg/g creatinine or higher in areas with no specific source of cadmium exposure. For smokers this proportion is considerably higher.

**Conclusion:** There is thus no margin of safety at current exposure/dose levels in the general population. Therefore, measures should be put in place to reduce exposure to a minimum. This is reflected in the recent lowering of the tolerable weekly intake by the European Food Safety Agency to 2.5 micrograms per kilogram of body weight, based on a urinary excretion of 1.0 µg/g creatinine.

#### ISEE-0505

##### Association Between Air Pollution and Stroke Mortality Differs According to Socioeconomic Position

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**Introduction:** Studies link air pollution with increased mortality; however, susceptibility factors are less understood. We investigated the short-term effects of PM<sub>10</sub> and O<sub>3</sub> on stroke mortality in the Metropolitan Area of Mexico City, according to Socioeconomic Position (SEP).

**Methods:** We used a time-series approach to model the relationship between mortality and ambient levels of PM<sub>10</sub> and O<sub>3</sub> (8 hours maximum moving average) on days prior to death over a 9 year period (1997–2005). SEP of the deceased was defined using an index constructed at the municipality level based on three dimensions: appliance ownership, income per capita and housing quality. Codes 430–8 from ICD-9 and 160–9 from ICD-10 were used to define stroke mortality.

**Results:** Single-lag models for stroke mortality showed for each increase of 10 µg/m<sup>3</sup> of PM<sub>10</sub> in medium SEP, a daily mortality increase of 1.80% (lag1; 95%CI: 0.82%–2.78%) for all ages and of 2.38% (lag1; 95%CI: 1.23%–3.53%) for individuals >65 years. For high SEP, daily mortality increased by 1.29% (lag1; 95%CI: 0.42%–2.16%) for all ages and by 1.32% (lag2; 95%CI: 0.40%–2.24%) for individuals >65 years old. For each increase of 10 µg/m<sup>3</sup> of O<sub>3</sub> for medium SEP, the results indicated a significant mortality increase of 0.66% (lag1; 95%CI: 0.154%–1.16%) for individuals >65 years old only. For high SEP, significant daily mortality increases were found for all ages (0.53% on lag2; 95%CI: 0.20%–0.86%), and for individuals >65 years (0.62% on lag2; 95%CI: 0.24%–0.99%). No significant association was found in low income SEP.

**Conclusions:** Our findings confirm the association of air pollution with stroke mortality, however the association was only found in areas with medium and high income.

#### ISEE-0506

##### Air Pollution and Asthma Control in the Epidemiological Study on Genetics and Environment of Asthma (EGEA)

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Necker, Paris, France; ‡‡CIC, Marseille, France; and §§CREAL, IMIM-Hospital del Mar, CIBER, ICREA, Barcelona, Spain.

**Introduction:** Asthma control reflects the disease activity in the past months and has been underlined in the updated asthma guidelines. Its association with air pollution is not well known. The objective is to assess the association between modelled PM<sub>10</sub>, NO<sub>2</sub> and O<sub>3</sub> concentrations and asthma control in the EGEA2 study (2003–2007).

**Methods:** Modelled outdoor PM<sub>10</sub>, NO<sub>2</sub> and O<sub>3</sub> estimates were linked to each residential address using the 4-km grid air pollutant surface developed by the French Institute of Environment for 2004. Asthma control was defined in three classes based on questions from the current GINA guidelines (symptom frequency and Beta-2 agonist intake in the last 3 months, lung function (FEV<sub>1</sub>), and exacerbations in the past year) in 501 subjects with current asthma. Multinomial logistic regressions were conducted adjusted on sex, age, body mass index, education, smoking and use of inhaled corticosteroids. Odds ratios (OR) are reported per inter quartile range (IQR).

**Results:** Medians concentrations (μg.m<sup>-3</sup>) were 32 (IQR 25–38) for NO<sub>2</sub> (n = 465), 46 (41–52) for O<sub>3</sub> (n = 481) and 21 (18–21) for PM<sub>10</sub> (n = 481). 44%, 29% and 27% had controlled, partly-controlled and uncontrolled asthma respectively. The association of PM<sub>10</sub> with partly-controlled asthma was not significant (OR 1.14 (95%CI 0.91–1.43)) but reached significance for uncontrolled asthma (OR 1.58 (1.23–2.03)). For O<sub>3</sub>, the pattern was less consistent with a stronger association for partly-controlled than uncontrolled asthma (OR 1.29 (0.96–1.76) and 1.19 (0.86–1.66) respectively). When including both pollutants in the same model, the pattern persisted, as well as in never-smokers and those not exposed to environmental tobacco smoke. No associations were found for NO<sub>2</sub>.

**Conclusions:** The results suggest that PM<sub>10</sub> and O<sub>3</sub> are associated with partly-controlled and uncontrolled asthma, however the interpretation of the results require some caution and more analysis are needed to better understand and their implication.

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#### ISEE-0507

##### A Novel Approach to Estimate Distributed Lag Model Between Hospital Admissions and Ozone: A Multi-City Time Series Analysis

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**Background and Objective:** Time series analyses have been extensively used to examine the short-term effects of air pollution on health. Standard methods have been used to eliminate confounding by long term and seasonal trends. Distributed lag models have been used to examine whether the exposure effect persists for some time. This creates two issues; first ozone concentrations are serially correlated over time, leading to oscillations in the effect size from lag to lag. Second, from a causal modeling viewpoint, it is preferable to have the exposure as close as possible to randomly assigned. Haugh and Box proposed filtering exposure to remove all autocorrelation, resulting in random fluctuations in differences from expected exposure over time. We apply this approach to season specific analyses to examine the distributed lag between ozone and cardiovascular and respiratory hospital admissions in 92 US cities for the years 1985–2003, for the months May to September.

**Methods:** We fit a city-specific quasi Poisson regression model controlling for seasonality, temperature, and day of the week. We used ARIMA models to pre-filter the ozone series and its lags.

**Results:** We found a 0.14% increase (95% CI: 0.05–0.23) and a 0.10% increase (95% CI: 0.01–0.20) in CVD admissions for 10 ppb increase in the same day 8-hour mean ozone when using the original and pre-filtered ozone respectively. The sum of the six day distributed lag increased from

–0.23% (95% CI: –0.46 –0.01) to 0.53% (95% CI: 0.23–0.81) for CVD and from 2.11% (95% CI: 1.67–2.54) to 4.4% (95% CI: 3.8–4.9) for respiratory disease when using the pre-filtered ozone vs. the original series.

**Conclusions:** This study presents a new approach to examine distributed lag models and shows that the collinearity between lags could underestimate the exposure health effects.

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#### ISEE-0508

##### Delivery Hospitalization Complicated by Preeclampsia in Relation to Ambient Particulate Matter Exposure Prior to Admission in the United States, 1999–2005

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**Background and Objectives:** Ambient air pollution has been associated with preterm delivery and restricted fetal growth but relatively little attention has been focused on intermediate endpoints that may reflect the underlying biologic mechanisms. Particulate matter (PM) exposure has been associated with hypertension and cardiovascular events. Preeclampsia is a serious hypertensive disorder of pregnancy that can occur on the pathway to preterm birth. This analysis evaluates the acute impact of PM exposure on preeclampsia complicating delivery in the United States (US).

**Methods:** EPA air quality data has been linked to the National Hospital Discharge Survey (NHDS) for 1999–2005. The NHDS is a national probability survey representing inpatient hospitalizations from non-Federal short-stay hospitals in the US. Approximately 33% of delivery hospitalizations (unweighted 83,164/251,957) have air monitoring data for at least one pollutant within a five-mile radius based on zip code of residence. For the acute time-period before delivery, we calculated both a seven-day and six-week average PM<sub>10</sub> and PM<sub>2.5</sub> exposure for each delivery admission. Quartiles of exposure were based on the distribution for deliveries without preeclampsia.

**Results:** No significant associations were observed between 6-week average PM<sub>10</sub> or PM<sub>2.5</sub> and risk of preeclampsia. No dose-response was observed but third quartile 7-day average exposure was significantly elevated for both PM<sub>10</sub> (Odds Ratio [OR] = 1.16, 95% Confidence Interval [CI]: 1.03–1.30) and PM<sub>2.5</sub> (OR = 1.15, CI: 1.04–1.28). These results were essentially unchanged after adjustment for maternal age, race and region of the country.

**Conclusions:** Preeclampsia risk may be increased by ambient PM exposure in the week preceding delivery but the lack of a dose-response suggests other unmeasured factors may be important. The NHDS has limited demographic data so we plan to evaluate this further by linking to contextual data on income and other factors that may vary with geography.

#### ISEE-0509

##### Environmental Exposure to Dioxins from Living Near Industrial Combustion Sources and Risk of Non-Hodgkin Lymphoma

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States; \*\*University of Iowa, Iowa City, IA, United States; ††Department of Family Medicine and Karmanos Cancer Institute, Wayne State University, Detroit, MI, United States; and ‡‡National Center for Environmental Assessment, Office of Research and Development, U.S. Environmental Protection Agency, Washington, DC, United States.

**Background and Objective:** Occupational exposure to dioxins and dioxin-like chemicals has been associated with an increased risk of non-Hodgkin lymphoma (NHL). The objective was to assess if environmental exposure to dioxins from living near industrial combustion sources is associated with NHL.

**Methods:** We conducted a population-based case-control study of NHL (1998–2000). The residential locations of 792 cases and 624 controls during the 20-year period before the date of diagnosis (similar date for controls) were linked to a spatial database of eight types of dioxin-emitting facilities operating in the United States in 1995. The residential proximity to these facilities was assessed. We used unconditional logistic regression to compute odds ratios (OR) and 95% confidence intervals (CI) of NHL associated with living within 5 km of a source and for the duration of residence within 5 km.

**Results:** A total of 311 (39%) cases and 251 (40%) controls lived within 5 km of a dioxin-emitting facility (OR: 1.0, 95% CI: 0.8–1.3). The duration of residence within 5 km was not significantly associated with NHL (ORs: 1.3, 1.1 and 0.9 for 1–13, 14–19 and 20 years, respectively,  $P > 0.05$ ). The most common sources were medical waste incinerators, coal-fired electric generating facilities, and sewage sludge incinerators. For these specific sources separately, we observed no significant association with risk for ever living within 5 km or for duration of residence (data not shown).

**Conclusion:** Preliminary analyses show that NHL risk was not associated with living within 5 km of a dioxin-emitting source based on the 1995 locations. Extrapolation of the locations over 20 years and not taking into account the emission levels likely resulted in misclassification of exposure. We are currently developing an additional database for 1987, which we will use to create more accurate exposure indices incorporating distance, emission levels, predominant wind speed and topography.

#### ISEE-0512

##### pH in Exhaled Breath and Ozone Exposure: Interaction with GSTM1 and GSTP1

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**Background and Objective:** Ozone exposure can trigger oxidative stress responses. Functional polymorphisms in glutathione S-transferases GSTM1 and GSTP1 appear to condition responses to oxidative stress. We hypothesized that children with the GSTM1 null genotype and children with the GSTP1 val/val genotype (at codon105) would be more susceptible to ozone as assessed by a lower pH (a marker of inflammatory response) in exhaled breath after exposure.

**Methods:** We collected 465 exhaled breath (EB) samples from 92 asthmatic children for whom we had health and ozone exposure information, and GSTM1 and GSTP1 genotyping. We determined the effect of ozone exposure (8-hr moving average) on pH in EB using general estimating equations adjusting for potential confounding factors and evaluated interaction with genotype.

**Results:** Among the 37% of children who were GSTM1 null, ozone level was inversely related to EB pH (beta =  $-0.09$ ,  $P = 0.009$ , change for a 10 ppm increase in  $O_3$ ) while for GSTM1 positive children, ozone was not significantly related to pH EB (beta =  $-0.02$ ,  $P = 0.273$ ). The

interaction between ozone and GSTM1 genotype was marginally significant ( $P = 0.127$ ). For GSTP1 genotype, in children with the Val/Val genotype (29% of total), ozone was significantly related to pH in EB (beta =  $-0.08$ ,  $P = 0.015$ ), in children with the Ile/Val variant (46%), ozone was less strongly related to pH EB (beta =  $-0.05$ ,  $P = 0.048$ ), while in children with the Ile/Ile (25%) genotype, ozone was not significantly related to pH in EB. The interaction between ozone and GSTP1 genotype was marginally significant ( $P = 0.182$ ).

**Conclusion:** In asthmatic children, GSTM1 and GSTP1 genotypes may influence susceptibility to ozone exposure as measured by pH in exhaled breath, a marker of airway inflammation.

#### ISEE-0514

##### Comparison of Methods for Estimation of Exposure to Traffic Related $NO_2$

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**Background & Objective:** We compared land use regression (LUR) modelling, interpolation, and dispersion modelling as methods for assigning levels of exposure to  $NO_2$  to individual participants in an epidemiological study investigating a traffic intervention in Sydney, Australia.

**Methods:** For the development of the LUR and interpolation models, we deployed 38 passive  $NO_2$  samplers in strategic positions in the study area (50 km<sup>2</sup>), three times each year over 2 years. Inputs to the LUR models (eg land use, population and traffic data) were obtained using GIS software. The LUR model incorporated a temporal component by including air quality data from four continuous monitors in the study area. A mixed model was used to account for correlation between sampling periods. Interpolation of  $NO_2$  estimates between the passive sampler locations was performed using kriging. Dispersion modelling used TAPM-CTM to model  $NO_2$  concentrations on a 1 km grid while the Langrangian Wall Model (LWM) was used to model concentrations to a resolution of 10 m. The exposure estimation methods were assessed for their agreement with the passive sampler measurements.

**Results:** Validation of the LUR model using leave-one out cross validation demonstrated good temporal and spatial predictions of  $NO_2$  concentrations (ICC = 0.87) and explained a high degree of the variability in  $NO_2$  ( $R^2 = 0.70$ ). Predictor variables included traffic density, population density, commercial land use, and data from the fixed site continuous monitors. The dispersion models were found to have poorer agreement with the passive sampler  $NO_2$  readings (ICC = 0.35) than the LUR model. The interpolation method was found to be unreliable, probably due to the lack of spatial autocorrelation in the data.

**Conclusion:** LUR modelling was the most accurate method for predicting  $NO_2$  levels and was simpler to implement than dispersion modelling.

#### ISEE-0517

##### Low Birth Weight and Exposure to Disinfection By-Products in Pregnant Women in Crete (Rhea Study)

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Research (IMIM), Epidemiologia y Salud Pública (CIBERESP), Barcelona, Spain.

**Background and Objective:** Exposure to disinfection by-products (DBPs) during pregnancy has been associated with adverse birth outcomes. We evaluated exposure to DBPs through ingestion, inhalation and dermal absorption among women, in relation to birth weight and other reproductive outcomes.

**Methods:** The mother-child birth cohort in Crete ("Rhea" study) enrolled 1500 pregnant women at the third month of pregnancy (2007–2008) who were residents in the prefecture of Heraklion. Exposures were assessed through 2 general and 2 Food Frequency questionnaires during pregnancy, requesting extensive information on personal water related habits. Tap water samples were collected in the homes of the representative mothers on the basis of detailed water distribution patterns, and were analysed for major DBPs including trihalomethanes (THMs). Logistic and linear regression models were applied.

**Results:** Pregnant women reported a high consumption of bottled water at home (76%), and work (96%). About a third of the women reported water consumption of more than 1.5 L/day. More than half the women (59%) washed dishes by hand whereas only 12% used a dishwasher, nearly all women (94%) took showers rather than baths (1%), and only 2% attended a swimming pool. THM levels were low (<20 micrograms/L) with a relatively high proportion of brominated compounds. After adjusting for educational status, smoking during pregnancy and ethnicity, birth weight was found to be lower among women drinking tap water (beta coefficient = -132 gr, 95%CI -251 to -14) and those drinking bottled water (beta = -96 gr, -202 to 11) as compared to women drinking water from springs. No statistically significant results were found for other reproductive outcomes. An analysis incorporating home specific modelled total THM and specific THM values is ongoing and is taking into account all routes of exposure.

**Conclusion:** These results provide some evidence of differences in birth weight in relation to source of drinking water.

#### ISEE-0523

##### Preterm Birth and Ambient Air Pollution in Volta Redonda, Rio de Janeiro, Brazil

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**Background and Objective:** Preterm birth (PTB) is related to some health outcomes such as pulmonary, ophthalmologic and neurologic morbidity, delayed psychomotor development and death. In recent years, several studies have examined the relationship between PTB and air pollution. This study investigated the association between prematurity and air pollution in Volta Redonda, an industrialized city in Rio de Janeiro/Brazil.

**Methods:** In this population-based study we examined prematurity in relation to maternal exposure to outdoor air pollution, among 13,366 singleton births in Volta Redonda from 2003 to 2006. Birth and air monitoring data were obtained from governmental offices. We estimated maternal exposure to particulate matter with an aerodynamic diameter of  $\leq 10 \mu\text{m}$  ( $\text{PM}_{10}$ ), sulfur dioxide ( $\text{SO}_2$ ) and ozone ( $\text{O}_3$ ) considering their daily arithmetic means concentrations. Date of birth was used to estimate maternal exposure to pollutants over each trimester of pregnancy. We estimated crude and adjusted effects of air pollution exposure on the risk of PTB using logistic regression models. Analyses were performed to single and multiple pollutants models to assess the robustness of each contaminant in the association. We adjusted models for potential confounders of preterm birth.

**Results:** Statistical significant crude and adjusted odds ratios (OR) for PTB was observed to maternal exposure to  $\text{SO}_2$  during each trimester of pregnancy. Multiple pollutants model indicates the robustness of the relationship between maternal exposure to  $\text{SO}_2$  and PTB OR<sub>First trimester</sub> = 1.304; 95% CI: 1.145, 1.487; OR<sub>Second trimester</sub> = 1.310; 95% CI: 1.187, 1.446; OR<sub>Third trimester</sub> = 1.252; 95% CI: 1.1152, 1.360). Dose-response patterns were also observed for interquartile range in all three trimesters of pregnancy in their relation to maternal exposure to  $\text{SO}_2$ .

**Conclusion:** Results show that maternal exposure to sulfur dioxide may increase risk of preterm birth.

#### ISEE-0527

##### Temperature and the Risk of Acute Ischemic Stroke: Results from the Registry of the Canadian Stroke Network

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**Background and Objective:** Weather conditions have been reported to affect the onset of acute ischemic stroke, however prior studies have been limited and have not yielded consistent results.

**Methods:** We evaluated the association between ambient temperature and the risk of ischemic stroke among patients admitted to Regional Stroke Centers participating in the Registry of the Canadian Stroke Network in 8 metropolitan areas across Ontario, Canada. First, we applied the time-stratified case-crossover design to estimate the effect of mean ambient temperature in each city 0–5 days prior to the time of stroke symptom onset, controlling for dew point and pressure. Each lag was considered in a separate model and the results were verified using unconstrained distributed lag models. We used random-effects meta-analytic techniques to combine the city-specific effect estimates. Warm (April–September) and cool (October–March) months were considered separately. We repeated the analyses additionally controlling for  $\text{PM}_{2.5}$ .

**Results:** Between 2003 and 2007, 8882 patients were hospitalized for neurologist-confirmed acute ischemic stroke, had data on date and time of symptom onset, and resided  $\leq 50$  km from an ambient pollution monitor. During warm months, mean ambient temperature was inversely associated with risk of ischemic stroke 0–23 hr later (OR for a  $5^\circ\text{C}$  increment 0.88; 95% CI: 0.81, 0.95;  $P = 0.001$ ). Temperature was not associated with altered risk at longer lags. During cool months, mean ambient temperature was associated with risk of ischemic stroke 24–47 hr later (OR: 0.90; 95% CI: 0.79, 1.02;  $P = 0.09$ ). Results were not materially different in models controlling for ambient  $\text{PM}_{2.5}$  or when unconstrained distributed lag models were considered.

**Conclusion:** These results suggest that even after controlling for seasonal trends at the monthly level, daily variability in ambient temperature influences the risk of acute ischemic stroke. These effects do not appear to be confounded by  $\text{PM}_{2.5}$ .

#### ISEE-0528

##### A Novel GIS Method for Modelling 1 km $\text{NO}_2$ Concentrations across Europe

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**Background and Objectives:** There is a need for consistent, high-resolution air pollution exposure information across large areas to support policy and epidemiological studies at the European level. As current air pollution monitoring networks are sparse, modelling methods are needed. A GIS-based moving window approach was thus developed to model



annual average NO<sub>2</sub> concentrations for the EU-15 (excluding Sweden) at the 1 km level.

**Methods:** Models were developed on the basis of emissions, meteorological and monitored data. Models were built using monitoring data from 714 background NO<sub>2</sub> sites for 2001 and validated by comparing predicted with observed NO<sub>2</sub> concentrations at a set of 228 independent background sites. Modelled NO<sub>x</sub> emissions for the EU-15 were first derived on the basis of proxies (population and road density, traffic statistics and land cover) to disaggregate national emissions estimates, by source category, to a 1 km grid. A set of annuli of varying radii were passed over this grid, using a focalsum function, to derive a calibration between measured concentrations at each monitoring site and distance-weighted sum of emissions in the surrounding area. The calibration equation was then used to convert the emissions grid to a 1 km grid of annual average NO<sub>2</sub> concentrations.

**Results and Conclusion:** The model was used to predict concentrations at the validation sites, and several measures of performance were obtained. Results indicated that the focalsum model ( $R^2 = 0.61$ , RMSE = 6.59  $\mu\text{g}/\text{m}^3$ ) was at least as reliable as geostatistical and land use regression models developed using the same data.

#### ISEE-0529

##### Diabetes Mellitus Modifies the Association Between Particulate Air Pollution and Acute Ischemic Stroke: Results from the Registry of the Canadian Stroke Network

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**Background and Objective:** Previous studies have reported an association between short-term exposure to ambient fine particulate matter (PM<sub>2.5</sub>) and the risk of hospitalization for ischemic stroke. Patients with diabetes mellitus have been shown to have enhanced sensitivity to the vascular effects of ambient particles and thus may be at increased risk of ischemic stroke, but this hypothesis has not been previously evaluated.

**Methods:** We analyzed data from 8882 patients hospitalized between 2003 and 2008 with acute ischemic stroke, having a documented date and time of stroke symptom onset, and residing  $\leq 50$  km from a PM<sub>2.5</sub> monitor in one of 8 major metropolitan regions in Ontario, Canada. All patients were admitted to a Regional Stroke Center participating in the Registry of the Canadian Stroke Network. We applied the time-stratified case-crossover design to estimate the effect of mean PM<sub>2.5</sub> in each city 0–47 hr prior to time of stroke symptom onset, controlling for meteorological variables, and used random-effects meta-analytic techniques to combine the city-specific estimates. Separate analyses were performed according to the presence or absence of a history of diabetes mellitus, atrial fibrillation, and hypertension.

**Results:** Overall, there was no consistent association between PM<sub>2.5</sub> levels and risk of ischemic stroke 0–47 hr later. However, we found significant effect modification by diabetes mellitus ( $P = 0.033$ ). Among patients with diabetes we observed a 9.5% (95% CI: –0.1%, 20.1%;  $P = 0.052$ ) increased risk of ischemic stroke per 10  $\mu\text{g}/\text{m}^3$  increase in PM<sub>2.5</sub>. We did not find evidence of statistically significant effect modification by a history of hypertension ( $P = 0.82$ ) or atrial fibrillation ( $P = 0.73$ ).

**Conclusion:** Patients with diabetes mellitus may be especially susceptible to the cerebrovascular effects of particulate air pollution. This observation is consistent with prior studies suggesting that patients with diabetes may be at greater risk of particulate-related cardiac events.

#### ISEE-0531

##### Association of Air Pollution with Sleep Disordered Breathing

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**Background and Objective:** Sleep-disordered breathing (SDB), the recurrent episodic disruption of normal breathing during sleep, affects as much as 17 percent of US adults, and may be more prevalent in poor urban environments. SDB and air pollution have been linked to increased cardiovascular diseases and mortality, but the influence of pollution on SDB is poorly understood. We used data from the Sleep Heart Health Study (SHHS), a US multi-center cohort study assessing cardiovascular and other consequences of SDB, to examine whether PM<sub>10</sub> was associated with SDB among persons 40 years and older.

**Methods:** Using baseline data from SHHS urban sites, outcomes included: the respiratory disturbance index (RDI; number of apneas plus hypopneas per hour of sleep); percent of sleep time <90% O<sub>2</sub> saturation; and sleep efficiency (percentage of recording time asleep) measured using overnight in-home polysomnography. We applied a mixed effect model with a random city effect, controlling for seasonality, mean temperature, age, body mass index, gender, education and an age by gender interaction, to examine the annual and daily effect of EPA-measured PM<sub>10</sub>.

**Results:** In the summer, but not in other seasons, elevated PM<sub>10</sub> in the previous 24 hours was associated with increases in the RDI with a 11.5% (95% CI: 2.1–21.8) increase in RDI for an inter-quartile (IQR; 14  $\mu\text{g}/\text{m}^3$ ) increase in PM<sub>10</sub>. We also found a 15.8% (95% CI: 1.2–32.7) increase in percent of sleep time <90% O<sub>2</sub> sat, and 1.2% (95% CI: –2.3–0.05) reduction in sleep efficiency.

**Conclusions:** This study suggests that air pollution is associated with acute increases in indices of SDB and thus, suggest a mechanism for prior observations of increased SDB severity in individuals from poor urban environments.

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#### ISEE-0538

##### Accumulation of DBPs in Human Breast Milk

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**Background and Objectives:** All over the world the authorities are challenged to balance the risk presented by microbial pathogens and DBPs resulted from the disinfectant used to destroy them from drinking water. Unfortunately these toxic DBPs can be transferred from mother to infant via breastfeeding. The aim of this study was to determine these DBPs in water from distribution systems and its accumulation in human milk.

**Methods:** DBPs such as THMs and HAAs from water were analyzed over the last 3 years on GC-ECD using HS-extraction. Starting with 2008, milk samples from 58 nursing mothers were collected and analyzed for these DBPs on GC-ECD-MS after separating the lipid content from milk. An interview was held with each of the mother based on a standard WHO questionnaire. A comparison study were performed between mother living in urban area using disinfected water and mothers living in rural area using untreated water from house well.

**Results:** The most commonly determined DBPs from water were THMs with an average of TTHMs between  $85 \mu\text{g} \times \text{l}^{-1}$ – $21 \mu\text{g} \times \text{l}^{-1}$ , higher values being measured in summer seasons. The HAAs concentration was notably lower, with an average of THAAs at  $13 \mu\text{g} \times \text{l}^{-1}$ . In breast milk collected from women living in urban area we detected DBPs, with an average at 23 pg/lipid for  $\Sigma\text{THMs}$  and 1.8 pg/lipid for  $\Sigma\text{HAAs}$ . The value of daily intake of these DBPs from mother's milk by children was calculated based on the formula of USEPA.

**Conclusions:** It was observed that in the case of women from rural area the concentration of DBPs was extremely low, almost nonexistent but considerable amounts of DDT were detected in their case. The following results have been obtained of daily intake of these compounds: 0.0008–0.0011 for  $\Sigma\text{HAAs}$  ( $\text{mg} \times \text{kg}^{-1}$ ), 0.09–0.0021  $\Sigma\text{THMs}$  ( $\text{mg} \times \text{kg}^{-1}$ ) and 0.072–0.0095 for  $\Sigma\text{DDT}$  ( $\text{mg} \times \text{kg}^{-1}$ ).

#### ISEE-0539

##### Long-Term Exposure to Road Traffic Noise and Myocardial Infarction

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**Background and Objective:** An association has been reported between long-term exposure to road traffic noise and the risk of myocardial infarction (MI), but the evidence is limited and inconclusive. No previous study has simultaneously analyzed the role of exposure to noise and air pollution from road traffic in the risk of MI. Our objective was to assess the association between long-term exposure to road traffic noise and risk of MI adjusted for air pollution.

**Methods:** A population-based case-control study on MI was conducted 1992–1994 in Stockholm County. Participants answered a questionnaire and underwent a physical examination. Residential exposure to noise and air pollution from road traffic between 1970 and 1992–1994 was assessed for 3666 participants (1571 cases of MI and 2095 controls), based on residential history combined with information on traffic intensity and distance to nearby roads. Information was also obtained on factors potentially affecting the relationship between noise exposure and MI, such as noise annoyance.

**Results:** The correlation between long-term individual exposure to noise and air pollution from traffic was high ( $r$  0.6). The adjusted odds ratio for MI associated with long-term road traffic noise exposure of 50 dBA or higher was 1.12 (95% confidence interval 0.95–1.33). In a subsample, defined by excluding persons with hearing loss or exposure to noise from other sources, the corresponding odds ratio was 1.38 (1.11–1.71), with a positive exposure-response trend. No strong effect modification was apparent by sex or cardiovascular risk factors, including air pollution from road traffic.

**Conclusions:** The results lend some support to the hypothesis that long-term exposure to road traffic noise increases the risk for MI.

#### ISEE-0540

##### Uptake of Persistent Organic Pollutants by Vegetables Grown in Contaminated Soil in Cluj District, Romania

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**Background and Objectives:** Persistent organic pollutants (POPs) such as PAHs and organochlorinated compounds are chemical substances that persist in the environment due to their physical and chemical properties. Unfortunately they could be bioaccumulated through the food web posing

a risk for human health. The aim of this study was to determine whether POPs present in contaminated soils along Somes river, are transferred to edible parts of basic vegetables for human or domestic animal consumes such as maize, wheat and potato. From this reasons five agricultural sites and seven private gardens were monitored during the study.

**Methods:** Several water, soil and vegetables samples were collected from different agricultural sites near Somes river between the periods of March 2007–March 2009. The analyses of POPs included sixteen PAH compounds and twenty chlorinated POPs were performed on GC-MS and GC-ECD-FID using Soxhlet and LLE extraction. A simulation experiments was conducted to determine the residual levels and bioaccumulation of most founded POPs compounds on maize and potato.

**Results:** Higher values of POPs were found in soil samples than in river water samples (below with 35% for PAHs and 47% for chlorinated POPs). The concentrations of this POPs were lower in vegetables samples (with 62% for chlorinated POPs and 75% for PAHs) than in corresponding soil samples. Based on simulation experiment considerable concentration of PAHs was measured in leaf, fact that could be attributed to possible air pollution.

**Conclusions:** POPs concentration intake by the selected vegetables was lower than concentration from corresponding soils, higher values of this pollutants were found in roots and leaf excepting the potato where in tubers the concentration were higher than in leaf or roots. The bioconcentration factors values based on dry weight were below 1.2 and in some POPs cases that values decreased with increasing concentrations in soil.

#### ISEE-0541

##### Effect of Saharan Dust on the Association Between Particulate Matter and Daily Mortality in Rome, Italy

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**Background and Objectives:** Outbreaks of Saharan-Sahel dust over the Euro-Mediterranean areas frequently induce exceedances of the  $50 \mu\text{g}/\text{m}^3$ –EU 24h standard. Public concern about the health adverse effects of these natural events on mortality has increased. This study evaluated the effect modification of Saharan dust on the association between different PM sizes (fine, coarse and  $\text{PM}_{10}$ ) and total and cause-specific mortality.

**Materials and Methods:** 80,423 residents aged 35+ who died in Rome between 2001–2004 were selected. A time series analysis was performed to explore the effects of different ( $\text{PM}_{2.5}$ ,  $\text{PM}_{2.5-10}$ ,  $\text{PM}_{10}$ ) on natural, cardiac, cerebrovascular, and respiratory daily mortality. We then added a Saharan dust-PM interaction term to test the hypothesis that the effect of PM, especially coarse and  $\text{PM}_{10}$ , on mortality would be higher in dust affected days.

**Results:** Coarse particles ( $\text{PM}_{2.5-10}$ , IQR:  $10.8 \mu\text{g}/\text{m}^3$ ) and  $\text{PM}_{10}$  (IQR:  $19.8 \mu\text{g}/\text{m}^3$ ) were associated with natural (lag 0–2, 2.96%, 95%CI = 1.23, 4.72 and 3.00%, 95%CI 1.51, 4.51), cardiac (lag 0, 3.72%, 95%CI = 0.78, 6.73 and 3.62%, 95%CI = 1.11, 6.18), cerebrovascular (5.41%, 95%CI = 1.74, 9.22 and 3.01, 95%CI = –0.84, 7.02) and respiratory mortality (lag 0–5, 12.65%, 95%CI = 1.18, 25.42 and 4.57%, 95%CI = –2.46, 12.09). Statistically significant effect modification ( $P < 0.01$ ) was seen for cardiac mortality with stronger  $\text{PM}_{2.5-10}$  and  $\text{PM}_{10}$  effects in Saharan dust days compared to dust free days (9.73% vs 0.86% and 9.44% vs 1.83%). An effect modification was also suggested for  $\text{PM}_{2.5-10}$  and respiratory mortality. The results were stable after adjustment for ozone.

**Conclusions:** Saharan dust outbreaks should not be considered as harmless events. Even if the toxicological capacity of particles coming

from desert sources needs to be further investigated, anthropogenic contribution to coarse PM should be controlled and limited particularly in areas frequently advected by desert dust episodes.

#### ISEE-0542

##### Short Term Effects of Nitrogen Dioxide Exposure on Mortality and Susceptibility Factors

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**Background and Objective:** Several studies have shown an association between daily variation in the nitrogen dioxide (NO<sub>2</sub>) concentration and daily deaths. Given this growing evidence, we investigated whether particular conditions may increase the individual susceptibility to this pollutant. We investigated the NO<sub>2</sub>-mortality relationship, for specific causes of death, considering individual socio-demographic features and chronic or acute medical conditions as potential effect modifiers.

**Methods:** We studied 271,111 subjects aged over 35 years, resident in 10 Italian cities and deceased from natural causes between 2001 and 2005. A time-stratified case-crossover analysis was chosen to evaluate the short term effects of NO<sub>2</sub> on natural, respiratory and cardiac mortality at different lags (from 0 to 5 and cumulative). To study susceptibility factors individual information on socio-demographic features and hospital admissions in the previous two years was collected via record-linkage.

**Results:** For an increase of 10 µg/m<sup>3</sup> NO<sub>2</sub>, we found a statistically significant excess risk for natural mortality of 2.09% (lag 0–5, 95CI% = 0.96; 3.24), 2.63% for cardiac mortality (lag 0–5, 95CI% = 1.53; 3.75) and 3.48% for respiratory mortality (lag 1–5, 95CI% = 0.75; 6.29). These effects were independent from those of PM<sub>10</sub>. Greater effects on total mortality were estimated among people aged 85 and over (3.41%) with a clear effect modification for subjects with at least one hospital admission in the two years preceding the death (2.86%) and for subjects who had three or more specific chronic conditions (3.62%). Changes in pulmonary circulation and heart conduction disorders were the conditions that conferred the highest susceptibility.

**Conclusion:** Strong and homogeneous increased risks of mortality for exposure to current levels of NO<sub>2</sub> were detected, with prolonged effects. Higher susceptibility was found for the elderly and for subgroups of the population characterized by specific chronic conditions.

#### ISEE-0545

##### Exposure to Disinfection By-Products and Adverse Birth Outcomes Related to Fetal Growth and Prematurity – A Systematic Review and Meta-Analysis

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Mark Nieuwenhuijsen,\*‡ \*Imperial College London, London, United Kingdom; †University of Crete, Heraklion, Greece; and ‡Center for Research in Environmental Epidemiology, Barcelona, Spain.

**Background and Objective:** We aimed to provide quantitative estimates of exposure-response relationships between total trihalomethanes in drinking water and several adverse birth outcomes relating to fetal growth and prematurity, suitable for use in health impact/risk assessment.

**Methods:** We carried out a systematic review and meta-analysis of epidemiological studies featuring original peer-reviewed data on the association of total trihalomethane exposure and at least one outcome related to fetal growth.

**Results:** A comprehensive literature search yielded 37 studies for further consideration. Following the application of eligibility criteria based on study characteristics, we selected fifteen independent studies for the extraction of relative risks of several adverse birth outcomes. Sufficient data were available for meta-analyses to be carried out for four adverse birth outcomes: low birth weight (LBW), term low birth weight (TLBW), preterm delivery (PTD) and small for gestational age (SGA) (including intra uterine growth retardation (IUGR)). Small, positive statistically significant summary measures were found for SGA, but not for LBW, TLBW or PTD.

**Conclusion:** We found small, statistically significant, positive associations for SGA associated with TTHM exposure under various exposure timings. We investigated and discussed uncertainties relating particularly to exposure.

#### ISEE-0548

##### Effects of Cold Weather on Hospital Admissions: Results from 12 European Cities Within the PHEWE Project

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**Background and Objectives:** Low temperatures have been associated with increases in mortality showing a geographical variability. The objective of this study was to estimate the impact of low temperatures on cardiovascular, cerebrovascular and respiratory hospital admissions, during the cold period (October-March) in twelve European cities included in the PHEWE project.

**Methods:** For each city, time series analysis was used to model the relationship between minimum temperature (lag 0–15 days) and daily hospital admissions by cause and age group (all ages, 0–14, 15–64, 65–74, 75+) in the period 1990–2000. The effect was expressed as percent variation (decrease) in hospital admissions for a 1°C increase in temperature. The model was adjusted for: holidays, day of the week and month, pressure, wind speed, NO<sub>2</sub>, time trends and indicator for influenza epidemics. Pooled estimates were obtained applying a random effects meta-analysis. Estimates were pooled in two groups (Mediterranean and Northern-Continental cities) on the basis of meteorological and geographical criteria.

**Results:** City-specific results for respiratory causes showed an increase in admissions as temperatures decrease in all cities, with a stronger association in the elderly. Similar results for cardiovascular admissions have been found only in Barcelona, Dublin and London. For cerebrovascular causes no significant association was observed. Pooled results show an increase for both cardiovascular and cerebrovascular admissions, although not significant, for all ages and the elderly. For



respiratory admissions, a significant effect of low temperatures is observed for all ages in the North-Continental cities ( $-2.5\%$ ; 95%CI:  $-3.6$ ;  $-1.3$ ) and Mediterranean cities ( $-1.6\%$ ; 95%CI:  $-2.5$ ;  $-0.6$ ) with the greatest percent change in the 75+ age group ( $-4.1\%$ , 95%CI:  $-5.7$ ;  $-2.5$  and  $-2.7\%$ ; 95%CI:  $-3.3$ ;  $-2.1$ , respectively in the North-Continental and Mediterranean cities).

**Conclusions:** The impact of low temperatures and hospital admissions confirm findings from the PHEWE cold-related mortality analysis with the strongest impact on respiratory admissions, especially in North-Continental cities. Results suggest that cold-related hospital admissions are an important public health problem across Europe.

#### ISEE-0550

##### The Attributed Effect of Climate Extremes, Climate Related Epidemics or Outbreaks on Health Is Largely Dependent on the Choice of Approach – A Case Study Comparing Four Approaches for Estimating Excess Hospital Admissions During a Record Warm Summer in South Sweden

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**Background:** One effect of global warming is an increasing number of extreme weather events, such as floods, storms and heat waves. We aim to compare approaches for the estimation of excess number of cases associated with an extreme episode, exemplifying with a case study of hospital admissions during the extremely warm summer 2006 in southern Sweden.

**Method:** Hospital admissions were collected for 6 hospitals in the Skåne (Scania) region of Southern Sweden, 1998–2006, from the Swedish National Board of Health and Welfare. Temperature data in the region was collected from the meteorological station in the city of Malmö.

We used four established approaches to estimate the excess numbers associated with extreme heat. Time series of daily frequencies of hospital admissions were assumed to follow a Poisson distribution. Standardized mortality ratios and generalized additive models were used to estimate the health risks attributed to the extreme heat.

**Results:** The four approaches yield vastly different results that are not reflected in the confidence limits of the specific estimates. The excess numbers can be largely biased if time trends are not accounted for when estimating the observed from previous years' data. Moreover, modeling the effect of temperature (including lagged effect) fails to describe the risks induced by the extreme heat, possibly due to not incorporating the duration of exposure.

**Conclusion:** The estimated excess frequencies may be largely dependent on the choice of approach. Estimating relative risks of temperature or other determinants of disease may fail to incorporate the specific characteristics of the particular weather event, e.g. the duration. This means such estimates may be less appropriate to use when predicting the future burden of such event on human health, and in particular the burden of future heat waves.

#### ISEE-0556

##### Heat Related Mortality among High Risk Elderly in Rome. Summer 2008

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**Background and Objectives:** High temperature does not affect the entire population but specific subgroups are more susceptible to heat effects. We analysed the impact of heat waves on mortality during

summer 2008 among elderly ( $\geq 65$  years) residing in Rome, classified according to an indicator of susceptibility to heat.

**Methods:** At the beginning of summer people 65+ year old were classified in four groups at increasing risk of dying during heat waves (low, medium-low, medium-high, high). The indicator attributes a score to subjects according to age, gender, civil-status and pre-existing pathologies. People identified at medium-high and high risk were included in an active surveillance program.

Heat mortality by level of risk was evaluated using a cubic regression spline; relative and attributable risks of dying during heat wave days by risk level were computed.

**Results:** The maximum apparent temperature-mortality relationship show different pattern in the four risk groups, with a clear dose-response relationship only in the medium-high risk group. The RRs of dying during heat wave increase by increasing risk up to the medium-high level, while in the highest risk group the RR was lower and not significant (RR<sub>low</sub> 1.18, 95CI%: 1.10–1.27; RR<sub>medium-high</sub> 1.40, 95CI%: 1.08–1.86; RR<sub>high</sub> 1.10, 95CI%: 0.88–1.37). The attributable risk ranges from 0.99 per 100,000 (95CI%: 0.83–1.16) in the low risk group to 11.39 in the medium-high (95CI%: 7.66–15.97) and declines to 4.24 in the high risk group (95CI%: 0.72–8.60).

**Conclusions:** Results show an effect of heat on mortality which increase according to susceptibility level. However the highest risk group showed a lower RR of dying during heat waves, and this might be due to their high overall mortality rate as well as to the effectiveness of the prevention program.

#### ISEE-0558

##### Expert Elicitation on Health Effects Related to Exposure to Ultrafine Particles: Likelihood of Causality and Causal Pathways

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**Background and Objective:** Exposure to fine ambient particulate matter (PM) has consistently been associated with morbidity and mortality. However, the association of health effects from exposure to ambient ultrafine particles (UFP) is still under debate. Therefore, we organized an expert elicitation workshop to assess the evidence for a causal relationship between exposure to UFP and health endpoints.

**Methods:** The workshop focused on: 1) the likelihood of causal relationships with key health endpoints, and 2) the likelihood of causal pathways for cardiac events. Selected through a systematic peer-nomination procedure, twelve European experts (epidemiologists, toxicologists and clinicians) attended the workshop. Individual expert

judgments in the form of ratings of the likelihood of causal relationships and pathways were obtained using a confidence scheme adapted from the Intergovernmental Panel on Climate Change.

**Results:** The likelihood of an independent causal relationship between increased short-term UFP exposure and increased all-cause mortality, cardiovascular and respiratory hospital admissions, aggravation of asthma symptoms and lung function decrements was rated medium to high by most experts.

The likelihood for long-term UFP exposure to be causally related to all cause mortality, cardiovascular and respiratory morbidity and lung cancer was rated slightly lower, mostly medium.

The experts rated the highest likelihood for the pathway involving respiratory inflammation and subsequent thrombotic effects; translocation of particles to the blood and subsequent effects on the autonomic nervous system and cardiac rhythm was considered the least likely pathway towards cardiac events.

**Conclusion:** Overall the results of the expert elicitation indicated that there is medium to high likelihood of health effects associated to UFP exposure, most likely through respiratory inflammation and subsequent thrombotic effects. The results stresses the importance of considering UFP in future Health Impact Assessments of (transport-related) air pollution, and the need for further research on health effects of UFP exposure.

#### ISEE-0562

##### Effect of Air Pollution Control on Mortality in County Cork, Ireland

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**Background and Objective:** Previously, we reported reductions in black smoke concentration ( $-36 \mu\text{g}/\text{m}^3$ ) and 6–16% reductions in total non-trauma, cardiovascular, and respiratory mortality rates following a 1990 ban on the marketing, sale, and distribution of coal in Dublin, Ireland. We have now evaluated changes in mortality rates in County Cork following a similar coal ban in 1995, where a similar  $16.5 \mu\text{g}/\text{m}^3$  reduction in black smoke concentration was observed.

**Methods:** Using Poisson regression, we regressed weekly age/gender standardized mortality rates against an indicator of the post- versus pre-ban period (before and after October 1, 1995) adjusting for influenza epidemics, weekly mean temperature, and the Irish standardized mortality rates in the areas not affected by the 1990, 1995, 1998, or 2000 local bans on coal sales.

**Results:** Compared to the pre-ban period, we found a significant reduction in the total, non-trauma mortality rate ( $-6\%$  95% CI =  $-9\%$ ,  $-5\%$ ) with larger reductions in the younger ( $<75$  yrs) subjects ( $-14\%$ ; 95% CI =  $-16\%$ ,  $-11\%$ ), compared to those  $75+$  yrs ( $-5\%$ ; 95% CI =  $-7\%$ ,  $-3\%$ ). In analyses of broad ICD9 categories, we found significant reductions in the cardiovascular ( $-13\%$ ), respiratory ( $-8\%$ ), and 'other cause' ( $-7\%$ ) mortality rates. We also found significant 7–25% reductions in specific cardio-respiratory mortality rates including ischemic heart disease, ischemic stroke, pneumonia, COPD, and lung cancer.

**Conclusion:** These reductions in cardio-respiratory mortality rates were similar in size to those seen in Dublin following the 1990 ban.

#### ISEE-0564

##### Extrapolation of Land-Use Regression Models in Time

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**Background and Objective:** Land-use regression (LUR) modelling has become a popular method to assess exposure levels for individual study subjects in large epidemiological studies. Stochastic modelling is used to determine which predictor variables best explain the pollution concentrations measured at a number of network locations. Because of the lack of spatially sufficiently resolved data, epidemiological studies often use recent air pollution exposure data and link those to health data collected before the exposure data. This is only valid if spatial contrasts are stable over a long period of time. We tested the stability of measured and modelled spatial contrasts across the Netherlands over an approximately 10-year period.

**Methods:** The TRAPCA study conducted  $\text{NO}_2$  measurements at 40 locations in the Netherlands in 1999–2000. A land-use regression model was developed to estimate individual exposures for a cohort of 4146 children. A new land-use regression model was constructed around  $\text{NO}_2$  measurements taking place in 144 locations respectively in 2007, of which 35 locations were the same as in 1999–2000. This enabled us to compare both measurements and model predictions between the both years.

**Results:** Results from  $\text{NO}_2$  measurements conducted in 2007 correlated well with  $\text{NO}_2$  measurements taken in 1999–2000 ( $R^2 = 0.86$ ). When both 1999–2000 and 2007 land-use regression models were applied to predict concentrations for the measuring sites using leave-one-out validation, these also agreed very well ( $R^2 = 0.81$ ). Interestingly, our 2007 land-use regression model was able to explain 66% of spatial variability in 1999–2000 measurements and the 1999–2000 model explained 80% of variability as measured in 2007.

**Conclusion:** Our study found that the spatial contrasts which applied in 1999–2000, still applied to a large extent in 2007. Apart from that, we found convincing evidence that it is acceptable to use recent models to estimate exposure variability for correlation with historical health outcomes.

#### ISEE-0566

##### $\text{PM}_{2.5}$ and Heavy Metals Outdoor Concentrations at a School Near to an Industrial Zone in Cali, Colombia

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**Background and Objective:** High levels of particulate matter (PM) were previously found in northern Cali. The area limits with an industrial zone with main emissions coming from metals smelting and batteries production factories. As part of the exposure assessment in a prevalence study of respiratory symptoms in children, we determined outdoors levels of  $\text{PM}_{2.5}$  and heavy metals in a school located 2.5 km down-wind of the industrial zone.

**Methods:** Twenty-four hours samples of  $\text{PM}_{2.5}$  were collected from January–March 2009 with a low-volume sampler on Teflon filters. Samples were gravimetrically analyzed for mass concentration and via EDXRF to determine presence and mass concentration of heavy metals (Cu, Cr, As, Cd, Pb). Pair wise correlation coefficients were estimated for  $\text{PM}_{2.5}$  and metals, and also between all metals. Additionally, linear regression analysis was performed for  $\text{PM}_{2.5}$  and Pb.

**Results:** Mean concentration of  $\text{PM}_{2.5}$  was  $43.38 \mu\text{g}/\text{m}^3$ . Among all samples 73% were found with Cr at a mean concentration of  $0.005 \mu\text{g}/\text{m}^3$ ; 31% with As at  $0.010 \mu\text{g}/\text{m}^3$ ; 82% with Cd at  $0.057 \mu\text{g}/\text{m}^3$ ; 71% with Cu at  $0.024 \mu\text{g}/\text{m}^3$ ; and 100% with Pb at  $0.814 \mu\text{g}/\text{m}^3$ . We only found a significant correlation between Pb and As levels ( $r = 0.90$ ,  $P < 0.001$ ). Regression analysis demonstrated a statistically significant association between Pb and  $\text{PM}_{2.5}$  ( $P = 0.05$ ) although it only explained 8% of the PM variation.

**Conclusion:** Although levels of  $\text{PM}_{2.5}$  did not exceed daily limits, there was a trend to exceed annual limits. Heavy metals concentrations, mainly Pb, represent a threat for human health, and the correlation observed between Pb and As suggests that main potential sources are local factories.

Based on these results, we will conduct indoor and personal exposure assessments and blood-lead testing in these school children.

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**ISEE-0572****Annual Ambient Black Carbon Associated with Shorter Telomeres in the Greater Boston Area**

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**Background and Objective:** Leukocyte telomere length varies between individuals and decreases with age. Telomere length is inversely associated with cardiovascular disease (CVD) risk and is decreased by several risk factors for CVD, such as hypertension and obesity. No epidemiological study has been reported on the association between telomere length and ambient air pollution. We used longitudinal data from the Normative Aging Study (NAS) to investigate whether ambient black carbon concentration near homes is associated with decreased telomere length.

**Methods:** We measured telomere length repeatedly, approximately every 4 years from 1999 to 2007 using quantitative PCR. Here we analyze this outcome among 177 never-smoking men from the NAS cohort. Black carbon (BC) concentrations at each subject's home during the year prior to telomere measures were predicted based on a previously validated spatio-temporal model. Natural log-transformed telomere length was the dependent variable in linear mixed effects models with random subjects intercepts, adjusting for several potential confounders.

**Results:** The mean (IQR) annual black carbon concentration was 301 (168 to 449) ng/m<sup>3</sup>. Over the 1 to 3 (median = 2) repeated measures per subject, telomere length, expressed as the ratio of telomere repeat copy number to single-copy gene copy number (T/S ratio), had geometric mean (geometric standard deviation) of 1.25 (1.32). Relatively wide temporal variability in telomere length was suggested by the intraclass correlation among repeated measures within subjects ( $r = 0.11$ ), much smaller than expected due to random measurement error alone. We found that an interquartile range increase in BC was associated with a 5.7% decrease (95% CI -10.9, -0.2) in telomere length.

**Conclusion:** Shortening of telomeres may play an important role in the health effects of ambient particles, particularly those rich in black carbon, which are primarily related to automobile traffic.

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**ISEE-0579****Exposure to Polyfluoroalkyl Chemicals and Attention Deficit Hyperactivity Disorder in U.S. Children Aged 12–15 Years**

Kate Hoffman, Veronica Vieira, Thomas Webster, and Roberta White, Department of Environmental Health, Boston University School of Public Health, Boston, MA, United States.

**Background and Objective:** Polyfluoroalkyl chemicals (PFCs) have been widely used in consumer products. Exposures in the U.S. and world populations are widespread. Associations between exposures to four common PFCs and parental report of diagnosis of Attention Deficit Hyperactivity Disorder (ADHD) were evaluated.

**Methods:** Data were obtained from the National Health and Nutrition Examination Survey (NHANES) 1999–2000 and 2003–2004 for children aged 12–15. Parental report of a previous diagnosis by a doctor or healthcare professional of ADHD in the child was the outcome measure. PFOA, PFOS, PFNA, and PFHS levels were measured in serum samples from each child. The association between each PFC and ADHD was examined using smoothing, categories, and linear models. All analyses

were adjusted for age, sex, race, maternal smoking during pregnancy, and environmental tobacco smoke. Confounding by variables such as lead and socioeconomic status was also assessed but associations were not altered.

**Results:** Of the 586 children aged 12 to 15 in the sample, 51 were reported by their parents to have been diagnosed with ADHD. When PFOS was entered into analyses as a continuous predictor, a 1.22 fold increased odds was observed for each 10  $\mu\text{g/L}$  increase (95% CI 1.03–1.45). Similarly, compared to the first quartile of PFOS exposure, individuals in the fourth quartile were 1.92 times more likely to have ADHD (95% CI 0.82–4.51;  $P$ -value for trend = 0.039). There were also significant dose response relationships between PFHS and PFOA exposures and ADHD. For each  $\mu\text{g/L}$  increase, the odds of ADHD increased 1.06 and 1.09 times respectively (95% CI 1.02–1.11 and 1.00–1.18). Similarly, children with higher PFNA levels were more likely to have ADHD (OR = 1.33 for  $\mu\text{g/L}$  increase; 95% CI 0.91–1.95).

**Conclusions:** These results are consistent with an affect of PFCs on ADHD risk. Follow-up of these cross-sectional data with cohort studies is needed.

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**ISEE-0587****Asthma Phenotypes Modify the Impact of Environmental Factors on Children's Lung Function**

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**Background:** Previous studies have examined the role of childhood asthma phenotypes based on clinical history on asthma severity and symptom aggravation by environmental risk factors. The current study focuses on the associations between lung function in childhood and environmental factors and the modification of these factors by asthma phenotypes.

**Methods:** From a case-cohort sample of inner-city children aged 7 to 13 years selected from the administrative records of a large health maintenance organization, we obtained acceptable pulmonary function and exhaled nitric oxide measurements from 615 children who were divided into three phenotypes: 349 children who had never had asthma (never asthma), 189 children who had an asthma-related clinical visit in the last 2 years (current asthma), and 77 children who had some prior history of asthma, but who had no asthma-related clinical visit in the last 2 years (former asthma).

**Results:** The former asthma children showed strong decrements in forced expiratory flow at one second (FEV1) associated with early-life exposures to tobacco smoke: smoking during pregnancy (-7.2%, 95% CI -13.7%, -0.1%) and environmental tobacco smoke before age two (-8.0%, 95% CI -14.1, -0.2%). The current asthma children showed FEV1 decrements associated with indoor combustion sources: gas stoves with pilot lights (-4.9%, 95% CI -10.1, 0.03) and non-gas/non-electric heat (-12.4%, 95% CI -20.9, -0.4%). In both cases, these environmental factors were not significantly associated with pulmonary function decrements among the other two phenotypes.

**Conclusion:** The delineation of distinct asthma phenotypes is essential to the assessment of the physiologic impact of environmental risk factors in childhood asthma.

This is an abstract of a proposed presentation and does not necessarily represent the policy of EPA.

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**ISEE-0590****Short-Term Fine Particulate Matter Air Pollution and Vascular Reactivity in Diabetic Patients**

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**Background:** Fine particulate matter (PM<sub>2.5</sub>) has been associated with physiologic and inflammatory changes related to vascular dysfunction. People with diabetes might be more vulnerable to the cardiovascular effects of air pollution. We examined whether short-term exposure to fine particles is associated with vascular endothelial function and arterial stiffness in subjects with type 2 diabetes mellitus (T2DM).

**Methods:** We conducted a repeated measures study in 37 subjects with T2DM in Boston, Massachusetts, from September 2006 until December 2008. Hourly central site measurements of PM<sub>2.5</sub>, sulfate, black carbon (BC), organic carbon (OC), particle number and meteorological variables were performed. We applied linear mixed models with random participant intercepts to investigate the association of different short-term lags and averaging times of air pollutants with ultrasound-derived brachial artery diameter, flow-mediated dilation (FMD), a measure of endothelial function, and augmentation index (AI), a measure of arterial stiffness assessed by pulse-wave analysis.

**Results:** PM<sub>2.5</sub> and OC were consistently associated with a decrease in baseline arterial diameter. A 1.45  $\mu\text{g}/\text{m}^3$  increase (inter-quartile range) in OC and a 3.97  $\mu\text{g}/\text{m}^3$  increase in PM<sub>2.5</sub> in the 3-day mean prior to the examination were associated with a  $-0.091$  mm (95% CI  $-0.169$  to  $-0.014$  mm) and a  $-0.073$  mm (95% CI  $-0.120$  to  $-0.025$  mm) decrease, respectively, in baseline diameter. AI increased with 3-day mean BC and particle number exposure. FMD changes were less consistently associated with PM.

**Conclusions:** Levels of ambient fine PM air pollution commonly encountered in urban areas are associated with vasoconstriction and an increase in augmentation index in subjects with T2DM.

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## ISEE-0591

### Temperature Effects on the Hydration Status

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**Background and Objective:** Extreme hot or cold temperature was found to be related with cause-specific morbidity and mortality in previous studies, but few studies examined the pathway of temperature-related health. In the present study, we hypothesized that with temperature changes below or above the threshold level, higher concentrations of BUN/Creatinine ratio and urine specific gravity were produced as a result of keeping the adequate hydration status.

**Methods:** The generalized linear models (GLM) were used to examine the association between the temperature and the hydration status after controlling for gender, age, and season. Blood chemistry data for 44,442 individuals were collected from Seoul National University Hospital, Seoul, Korea, based on the physical examinations occurred between May 1, 1995 and December 31, 2006 in Seoul. Meteorological data on temperature were acquired from the Korea Meteorological Administration (KMA). Akaike's information criterion (AIC) value was used to estimate the threshold of temperature where the effects of temperature on the hydration status were the lowest.

**Results:** V-shape associations between the temperature and the hydration status were found. The threshold temperature levels were 21.6°C and 22.2°C for BUN/Creatinine ratio and urine specific gravity, respectively. BUN/Creatinine level decreased as temperature increased from the coldest days to the threshold temperature ( $\beta = -0.03059$ ,  $P$ -value =  $1.42\text{E-}10$ ) and increased above the threshold temperature ( $\beta = 0.091998$ ,  $P$ -value =  $3.78\text{E-}07$ ). Similarly, the urine specific gravity level decreased below the threshold temperature ( $\beta = -7.68\text{E-}05$ ,  $P$ -value =  $8.18\text{E-}36$ ) and increased above the threshold temperature ( $\beta = 0.0001866$ ,  $P$ -value =  $1.22\text{E-}13$ ).

**Conclusion:** The study provided the evidence of temperature effects on the hydration status and may suggest a pathway of temperature-related health outcomes under the extreme weather conditions.

## ISEE-0594

### Long- and Short-Term Residential Exposure to Urban Air Pollution and Blood Markers of Systemic Inflammation and Coagulation

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**Background and Objective:** Short-term exposure to elevated levels of fine particulate matter (PM) has been linked to systemic inflammation and coagulation. It is unclear whether chronic PM exposure effects inflammatory mechanisms and might thereby contribute to air pollution-induced atherogenesis. We examined the independent association of chronic PM exposure with several blood markers of inflammation and coagulation, taking small-scale variations in short-term air pollution into account.

**Methods:** We used baseline data (2000–2003) from the Heinz Nixdorf Recall Study, a German population-based prospective cohort of 4814 participants. A chemistry transport model was applied to model daily surface concentrations of air pollutants on a grid of 1 km<sup>2</sup>. Applying multiple linear regression, we analyzed sex-specific associations of long-term PM<sub>2.5</sub> (mean of 365 days prior to blood draw) at each participant's residence with high-sensitivity C-reactive protein (hs-CRP), fibrinogen, white blood cell count (WBC), platelet count, and plasminogen activator inhibitor-1 (PAI-1), adjusting for personal characteristics, season, temperature, ozone and daily PM<sub>2.5</sub> exposure, modeled on a 1 km<sup>2</sup> grid.

**Results:** We found associations of long-term PM<sub>2.5</sub> with several blood markers in men. A 2.4  $\mu\text{g}/\text{m}^3$  (interquartile range) increase in the 365-day average PM<sub>2.5</sub> prior to the day of examination was associated with an adjusted increase in hs-CRP of 3.3% (95% CI 5.5% to 21.6%), in fibrinogen (2.5%; 95% CI 1.0% to 4.0%), and in platelet count ( $4.8 \times 10^9/\text{L}$ ; 95% CI  $0.9 \times 10^9/\text{L}$  to  $8.7 \times 10^9/\text{L}$ ). Associations in women were inconsistent. Short-term PM<sub>2.5</sub> (4-day moving average) was not associated with blood markers. Short-term ozone exposure (3-day moving average) was associated with hs-CRP, PAI-1, and WBC.

**Discussion:** This study indicates that long-term residential exposure to high levels of PM<sub>2.5</sub> is independently of short-term exposures associated with markers of systemic inflammation and thrombotic activity in men. This could contribute to the development and progression of air pollution-related atherosclerosis.

## ISEE-0632

### Parkinson's Disease, Gender, and Occupational Exposure to Armed Forces Environments

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**Background and Objective:** The increased proportional mortality due to Parkinson's disease (PD) observed for veterans suggests that factors associated with exposure to armed forces environments may play a role in the etiology of PD. This analysis was conducted to examine the relative importance of occupational exposure to armed forces environments, occupational herbicide exposure, smoking, family history of PD, and head trauma as risk factors for PD.

**Methods:** The data were collected in 1989 in a population-based case-control study of PD in Calgary, Canada. Non-demented cases (75 men, 55 women) were selected from a case register of Calgary residents with neurologist-confirmed PD. For each case, two matched (sex and age + or - 2.5 years) community controls were selected by random digit dialing. Cases and controls were interviewed using a structured questionnaire. The data were analyzed using conditional logistic regression analysis.

**Results:** Ninety-nine men (30 cases, 68 controls) and 11 women (7 cases, 4 controls) gave a history of exposure to armed forces environments. For men, with adjustment for occupational herbicide exposure, smoking, family history of PD, and head trauma, which were significant predictors of PD risk, the odd ratio was 0.77 (95% CI: 0.33–1.79) for occupational exposure to armed forces environments. For women, with adjustment for family history of PD, the only other significant predictor of PD risk, the odds ratio was 4.77 (95% CI: 1.09–20.87) for occupational exposure to armed forces environments.

**Conclusion:** The results suggest the hypothesis of a positive association between occupational exposure to armed forces environments and Parkinson's disease risk. Larger studies are needed to test the hypothesis and determine if there is a gender difference.

#### ISEE-0639

##### Potential Sources of Phthalate Exposure in a Vancouver, BC Birth Cohort at Three Months of Age

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**Background:** Phthalates are ubiquitous contaminants in humans and are of concern due to reproductive and respiratory effects. Food is considered a major source of phthalates. However, by three months infants exhibit a range of phthalate levels, unlikely to be explained exclusively by breast milk or formula intake. This pilot study uses urinary biomarkers for five major phthalates in infants from Vancouver, BC, at three-months of age to evaluate exposure from baby products and home furnishings.

**Methods:** The cohort of 150 infants and their families was recruited as part of a pilot for the Canadian Healthy Infant Longitudinal Development cohort (CHILD). A home and phthalate intake assessment (questionnaire, visual inspection, floor dust sample), and urine sample was conducted at three months old. Urine was analyzed for the monoester metabolites of di(2-ethylhexyl) phthalate (DEHP), benzyl butyl phthalate (BBzP), di-n-butyl phthalate (DnBP), di-methyl and di-ethyl phthalate (DMP, DEP) using automated on-line solid phase extraction and separation with HPLC and isotope-dilution tandem mass spectrometry.

**Results:** The first 48 urine samples showed a range of exposure for the metabolites of DEHP, BBzP, DnBP, DMP and DEP. 3.6–5.9-fold differences were found in mean values of the interquartile range (25<sup>th</sup>–75<sup>th</sup> percentile). In preliminary analyses, use of a plastic pacifier, skin products, laminate or vinyl flooring, and presence of a household member working with hazardous materials was more common in the highest exposure quartile, except for mono- (2-ethyl-5-oxohexyl) phthalate one of three metabolites of DEHP. The type of diaper, diaper creams or use of diaper wipes, was not associated with the upper quartile of any phthalates. Phthalates levels in house dust are pending.

**Conclusion:** These preliminary results from a pilot study of the CHILD birth cohort suggest that phthalate exposures in these three-month-old infants are associated with behavioural and home indoor environmental characteristics.

#### ISEE-0641

##### Pilot Study of Household Drinking Water Quality in Remote Rural Communities, Baja California Sur, Mexico

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**Background and Objectives:** The infant mortality rate in Mexico is still four times higher than in the US, with rates even double the Mexican average among rural and indigenous communities. Water related illnesses are a leading cause of infant death in these rural areas. The objective of this pilot study was an assessment of water quality and usage pattern in remote rural households in Baja California Sur as basis for the development of a participatory community based intervention module.

**Methods:** Microbial water quality was assessed in 192 households located in remote rural communities lacking access to a piped water system. Samples were taken from the main water source and the storage container. Screening for arsenic was conducted in 415 water sources in the same rural area. Sampling and testing was conducted by a trained research team, involving measurements of *E.coli*, arsenic, salinity, turbidity using field kits; water sources were geocoded. Information on usage pattern and contextual factors was recorded.

**Results:** The family water sources included shallow open wells, springs, or standing water in dry river beds, with 41.1% testing positive for *E.coli*. Drinking water measured in the main storage container (n = 102), tested positive for *E.coli* in 42%; 24.4% of tested sources had values >10 µg/L of arsenic. Parameters were identified supporting the development of a culturally targeted participatory intervention module to be implemented.

**Conclusions:** Although worldwide the water related Millennium Development Goal is likely to be achieved in many countries, there are within country disparities that may disproportionately affect rural and indigenous communities. Our pilot findings in Baja California Sur, Mexico, underscore the need for the development and implementation of culturally appropriate household based, user friendly and integrative water intervention approaches where there continues to be no access to piped water, aiming at the reduction of environmental health disparities.

#### ISEE-0645

##### Multi-Pollutant Analysis of Reproductive Outcomes and Air Pollution Using the CMAQ Model

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**Background and Objective:** A growing body of research has reported associations between exposure to ambient air pollution and adverse reproductive outcomes. We previously reported associations in a population-based cohort between small for gestational age (SGA) and pre-term birth with regulatory monitor-based and land use regression model exposure estimates. Here we present findings using estimates from the Community Multi-scale Air Quality (CMAQ) modeling system for additional air pollution metrics in the region of Vancouver, Canada.

**Methods:** We identified 70,249 singleton births born between 1999 and 2002 with complete covariate and residential history data. We estimated risk of mean pregnancy exposures on SGA and preterm birth in logistic regression models. We obtained daily average CMAQ model estimates from May 30, 2004 to May 29, 2005, at a grid resolution of 4 x 4 km<sup>2</sup>; these were linked by month and day to the residential (6-digit postal code) histories of mothers during pregnancy with the actual birth year being

retained as a covariate. CMAQ estimates for 20 particle components and 7 gaseous species were included in analyses.

**Results:** For SGA, elevated ORs were observed for NO/NO<sub>2</sub>, CO, NH<sub>3</sub> and particulate NH<sub>4</sub> (accumulation mode). Other particle species associated with elevated ORs were soil and coarse mass, elemental carbon, accumulation mode nitrate and sulfate and primary (but not secondary) organic mass. Although the number of cases was small (N = 241) we observed consistent associations with pre-term birth <30 weeks for unspecified anthropogenic accumulation mode mass, coarse mass, and ammonia.

**Conclusion:** Exposure estimates derived from the CMAQ model showed associations with birth outcomes that generally were consistent with previous observations based upon monitoring network data and land use regression models. Associations with preterm births <30 weeks were also consistent with prior findings of an association with PM<sub>2.5</sub> mass, but also suggest a non-traffic source for this relationship.

#### ISEE-0647

##### The Relationship among Maternal Fish Consumption, Mercury Level, and Health Effects from Fetus to Infant Using a Structural Equation Model: Mothers and Children's Environmental Health (MOCEH)

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**Background and Objective:** Prenatal exposure to high levels of mercury have been associated with adverse reproductive outcomes. We examined the relationship among maternal fish consumption, mercury level, and health effects from fetus to infant using a structural equation model.

**Methods:** The collaborating multi-centers for a prospective cohort study of Mothers and Children's Environmental Health (MOCEH) have been built up in 2006 and we enrolled 1,286 women before the second trimester of their pregnancy and their spouses between 2006–2009. A trained nurse interviewed participants to record general information on demographic and socioeconomic factors, health behaviors, and environmental factors. We collected blood and urine samples to measure biomarkers for environmental exposures including heavy metals. We measured the mercury level in blood using atomic absorption spectrophotometry. A structural equation model was used to describe the sequential relationships between environmental factors, mercury level and health effects from fetus to infant. We used AMOS 6.0 (SPSS Inc.) for the structural equation model analysis.

**Results:** Overall, pre-pregnant fish consumption was associated with birth weight and the weight of infants at 6 months of age. Amongst women who consumed blue-backed fish, *Trichiurus lepturus* and bluefin tuna, the weight of the fetus and the infant was lower in the group with a greater than 50 percentile level of mercury in blood and having higher fish consumption compared to those fetus' and infants whose mothers were in

the lower 50 percentile for mercury blood level and having lower levels of fish consumption.

The path in the model showed that mercury levels in blood directly affected birth weight. After considering environmental factors, we considered that fish consumption might cause increased levels of mercury in blood. Birth weight was indirectly decreased by fish consumption through blood mercury level.

**Conclusion:** More detailed evaluation of the potential adverse effects of pre-pregnant fish consumption may be warranted. Pregnant woman should be cautious of consuming some types of fish due to potential mercury contamination.

#### ISEE-0648

##### Exposure to Bisphenol A Affects Liver Function in Urban Adults

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**Background and Objective:** Health effect of Bisphenol A (4,4'-isopropylidenediphenol, BPA) has been emphasized mostly on reproductive system, but very little is known whether BPA affects other organs. We evaluated the relationship between exposure to BPA and liver function, and the genetic modification on the relationship by the status of GSTM1 and GSTT1.

**Methods:** A total of 1,131 adults dwelling in urban areas were evaluated from April to December, 2005 and 1,105 participants left after excluding whose liver function was compromised by liver diseases. Besides urinary BPA, informations for environmental and occupational exposure histories were collected through a systemized questionnaire.

**Results:** A significant dose-response relationship was found between urinary BPA levels and liver enzyme concentrations in simple regression analysis ( $P < 0.05$ ). Regression coefficients of these liver enzyme concentrations on urinary BPA levels stayed significant in the multiple regression models after controlling for sex, age, smoking, drinking, exercise, total caloric intake and BMI ( $P < 0.05$ ). In condition of presence of GSTT1 and absence of GSTM1, regression coefficients not only remained significant but also got stronger.

**Conclusion:** This study indicated that BPA exposure is associated with elevated liver enzyme concentration and presentation of certain genotype (GSTM1 or GSTT1) can enhance the effect.

#### ISEE-0650

##### Environmental Geochemistry and Drinking Water Resources in the Pannonian Basin (Western Romania)

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**Background, Objectives and Methods:** A multidisciplinary study has been achieved in Western Romania. This area is known for its high concentrations of geogenic arsenic in its artesian aquifers, many of those used as drinking water (DW) supplies. Therefore we have studied the geochemistry of these aquifers and the quality of the DW that the population has access to. The main concern is the availability of DW with as contents below the EU parametric value of 10 mg/L. Moreover, the study has also focused on the amount of humic substances (HS) in those waters, in regard with the known ability of HS to extract as from the bedrock and transport and concentrate it into the aquifers.

**Results:** The results showed a wide range of geochemical conditions and frequently high concentration of arsenic ranged from 0.12 and 223 µg/L; pH values varied from 6.26 to 8.81; redox potentials from -246 and



+140 mV and O<sub>2</sub> concentrations from 0 to 7.1 mg/L. It has been demonstrated in the study that those water supplies with a more yellowish color have a higher concentration of HS.

**Conclusion:** Up to 56% of all the investigated villages use public artesian wells as their only source of DW. Furthermore, 26% of villages have their only source of DW artesian wells that have >10 mg/L of arsenic. Higher HS concentrations have been found in wells with low-medium concentration of arsenic, a fact that increases the concern about the quality of DW resources in the area. Arsenic is known for its deleterious effects on human health; exposure to inorganic arsenic may induce irritation of the stomach, intestines, bone marrow toxicity, and may contribute to the development of certain cancers (skin, lung, liver and hematopoietic system).

We acknowledge funding from the European Commission (AquaTRAIN MRTN-CT-2006-035420).

#### ISEE-0660

##### Interaction Between Black Smoke and Neighbourhood Socio-Economic Status and Their Association with Birth Weight

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**Background and Objective:** An accumulating body of evidence suggests that exposure to ambient air pollutants can adversely affect birth weight. However, the effect of socio-economic status (SES) on this relationship is less well described. We investigated whether the association between black smoke (BS) and birth weight is modified by neighbourhood SES.

**Methods:** We used the Particulate Matter and Perinatal Events Research (PAMPER) dataset of singleton births (N = 109,086) in Newcastle upon Tyne during 1961–1992, which contained information on birth weight, gestational age, infant sex, maternal age, parity and neighbourhood SES. Weekly BS exposures for each individual pregnancy were estimated using a two-stage statistical modelling strategy, incorporating temporally and spatially varying covariates. Weekly estimates were averaged over the whole pregnancy and the three trimesters. Neighbourhood SES was based on the Townsend deprivation score (TDS), which was calculated using four major UK census indicators – unemployment, car ownership, house ownership and overcrowding. TDS was grouped into quintiles. Linear regression with fractional polynomials was used to model the relationship between BS and birth weight.

**Results:** Birth weight was significantly associated with BS and TDS individually, and an interaction term was also significant for whole pregnancy ( $P = 0.003$ ), second trimester ( $P < 0.001$ ) and third trimester ( $P = 0.001$ ) exposures. BS and birth weight were significantly associated for each of the quintiles of TDS. For the whole pregnancy exposure, at the 25<sup>th</sup> percentile (17.2  $\mu\text{g}/\text{m}^3$ ) compared to the 1<sup>st</sup> percentile (7.4  $\mu\text{g}/\text{m}^3$ ) the estimated reduction in birth weight was 15g, 23g, 41g, 27g and 9g for the 1<sup>st</sup> (most affluent) to the 5<sup>th</sup> quintile (most deprived) of TDS respectively. The reduction in birth weight increased with higher BS exposures.

**Conclusion:** We found a significant interaction between neighbourhood SES and BS in their association with birth weight suggesting a modifying effect of SES on the relationship between ambient air pollution and birth weight.

#### ISEE-0662

##### Water Consumption and Use, Trihalomethane Exposure and the Risk of Hypospadias

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**Background and Objective:** Hypospadias is a common urogenital congenital anomaly affecting up to 90 per 10,000 males. Exposure to trihalomethanes (THMs) has been associated with other congenital anomalies such as urinary tract and neural tube defects. We examined the relation between exposure to THMs and hypospadias in a large case-control study.

**Methods:** 471 cases of hypospadias and 490 randomly selected population-based controls in the south east of England were interviewed by telephone. Questions included demographics of the mother and father, family history of disease, pregnancy history, diet, including vitamin intake, smoking, alcohol use, occupation, water consumption, bathing, showering, dish washing and swimming. Information on THM concentrations at residence was obtained from the water companies and linked using a Geographical Information System (GIS).

**Results:** Our results suggest that water consumption may be associated with increased risk of hypospadias. THM concentrations in tap water and duration of showering, bathing and dishwashing did not show associations with hypospadias.

**Conclusion:** Water consumption may be associated with risk of hypospadias, but there was little evidence for an association with THMs. Further work is needed to investigate maternal exposure to other DBPs.

#### ISEE-0665

##### Effects of Tap Water Processing on the Concentration of Disinfection By-Products in Water People Drink

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**Background and Objective:** Concentration of disinfection by-products (DBP) in water varies depending on the way water is processed before consumption. The aim of this study was to examine the effects on DBP concentration of a range of common water processing methods used in daily consumption of drinking water from a public water supply system (tap water).

**Methods:** We conducted a cross-sectional survey of DBP concentrations in tap water samples in Sydney, Australia, and investigated the effects of refrigerator storage, jug filtering, boiling in an electric kettle, and supply from an instant boiling water unit with or without filtering on DBP concentrations in water ready for consumption. Four species of trihalomethanes (THMs) and nine species of haloacetic acids (HAAs) were analyzed in each sample collected. Water samples were processed in such a way as to simulate real life conditions for drinking filtered water or hot water drinks prepared from tap water.

**Results:** There was a large reduction in total THMs in kettle-boiled water, instant boiled water, jug-filtered water and instant boiled-filtered water (reductions to 14.2%, 6.5%, 7.4% and 12.2% of tap water respectively). Fridge storage did not show any significant effect on THMs or HAAs. Jug-filtering and instant boil-filtered water resulted in large decreases (reductions to between 6% and 23%) in all species of HAAs. However refrigerator storage showed only a minimal decrease in HAAs (reduced to 90%).

**Conclusion:** This study suggests that filtering tap water can significantly reduce the concentration of all species of DBPs, and that boiling tap water significantly reduces THMs but only some HAAs. Further research in this area using larger sample sizes is warranted to investigate explanatory factors affecting DBP concentration after various water handling strategies.

## ISEE-0669

**Commuters' Air Pollution Exposure Is Affected by Vehicle and Fuel Type**

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**Background and Objective:** The TRAVEL study was designed to study the exposure to air pollution and related health effects in different groups of commuters. We were specifically interested in differences in exposure between new diesel and petrol cars; electric and diesel buses; bicycle routes along busy and minor roads.

**Methods:** Exposure to PM<sub>10</sub>, soot and particle number count (PNC) was measured during morning traffic in the city of Arnhem. On one day measurements were taken in either the two types of buses or the two types of cars or along the two different bicycle routes and at an urban background location. PM<sub>10</sub> concentrations were measured using Harvard Impactors. Soot content was determined using a smoke stain reflectometer. PNC was measured using portable condensation particle counters (TSI CPC3007).

**Results:** On 16 bicycle days, median PM<sub>10</sub> levels were 37 and 40 µg/m<sup>3</sup> on minor and busy roads, respectively. Median soot levels were 5.3 and 6.7 × 10<sup>-5</sup>/m. Median PNCs were 22,000 and 32,000 particles/cm<sup>3</sup>.

On 16 days, PM<sub>10</sub> levels were 32 and 30 µg/m<sup>3</sup> in a petrol and diesel car, respectively. Soot levels were 8.9 and 8.1 × 10<sup>-5</sup>/m. PNCs were 34,000 and 30,000 particles/cm<sup>3</sup>.

On 15 days, PM<sub>10</sub> levels were 43 and 48 µg/m<sup>3</sup> in an electric powered bus and diesel bus, respectively. Soot levels were 5.1 and 7.0 × 10<sup>-5</sup>/m. PNCs were 24,000 and 34,000 particles/cm<sup>3</sup>.

Because of different meteorological circumstances, exposure levels of the different transport modes cannot be directly compared.

**Conclusion:** Exposure levels in petrol and diesel cars were comparable. On bicycle routes along minor roads exposure to soot and PNC was 30% lower than along major roads. Exposure to PM<sub>10</sub>, soot and PNC in electric powered buses was considerably lower than in diesel buses.

## ISEE-0673

**Heat Health Effect Prevention: Evaluation of the Active Surveillance Program of High Risk Elderly in Rome, Summer 2008**

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**Background and Objective:** A key component of the heat prevention program in Rome is the active surveillance of high risk patients by General Practitioners (GPs) and has been active since 2006. The objective of this study is to describe the characteristics of the program and to evaluate the impact of GPs' prevention activities during summer 2008.

**Methods:** Elderly subjects (≥65 years) were classified in four risk categories (from low to high) on the basis of demographic and health characteristics retrieved from population registries and health information systems. GPs had to include medium-high/high risk patients in the program and to increase active surveillance during heat waves. GPs' activities included: phone calls and home visits, changes in pharmacological treatment, home-based treatments, facilitated access to hospitals, nursing and residential homes. The impact of GPs prevention activity was evaluated by comparing the rate of mortality during heat

wave versus non-heat wave days (period: May-September) for patients included/not included in the program.

**Results:** Out of 2535 GPs in Rome, 315 participated in the program. Among the 60045 elderly residents, 13072 (2.2%) were classified at medium-high/high risk. Patients included in the surveillance programme were 6431, of these 22.1% were classified at medium-high/high risk. Only 37.1% of patients included in the program received home visits; during heat waves, a three-fold increase in the average number of daily home visits was observed. Comparing heat-wave days vs other days, an excess mortality was observed only in patients not included in the programme (RR = 1.20, 95%CI: 1.14–1.27 vs RR = 0.95, 95%CI: 0.65–1.34).

**Conclusion:** GP participation and the rate of inclusion of high risk patients in the program was low. Nevertheless, results suggest that surveillance activities provided by GPs might reduce the impact of heat waves on patients under surveillance. Involvement of GPs and their compliance with the protocol need to be improved in the future.

## ISEE-0683

**Association of Temperature at Residence Vs Central Site Temperature with Mortality in Eastern Massachusetts—A Case Crossover Analysis**

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**Background and Objective:** Studies reported increased mortality during heat waves worldwide. While these studies used daily central site temperature as the exposure variable, temperature is spatially variable, and housing and landscape characteristics affect exposure.

To investigate acute and chronic effects of temperature on mortality we developed a spatio-temporal model for temperature in Eastern Massachusetts for 2000 to 2004 and applied it to a case-crossover study.

**Methods:** We obtained Massachusetts daily temperature data from 397 different sites resulting in 50 to 190 daily measurements, from four different data sources: NCDC, EPA, Weatherbug, and Weatherunderground. Land use, elevation and census data were obtained from the National Land Cover Database 2001 provided by USGS and the Massachusetts Geographic Information System. The prediction model for daily temperature at an address included daily intercepts and smooth functions of space, season specific smooth functions of space, distance to coastline, elevation and landuse.

Mortality data was obtained from Department of Public Health for Eastern Massachusetts. Residences of the 125,409 out-of-hospital-deaths were geocoded.

A time stratified case-crossover analysis was conducted with estimated temperatures at place of residence as exposure variable. We examined individual and contextual covariates as modifiers of the effect of temperature, to examine questions of susceptibility. We compared our results using temperature at Logan airport as exposure variable.

**Results:** For daily maximum summer temperature at place of residence we estimated an increase of 2% (95% CI 0.1–3.8%) deaths per 7°C. Compared to this the association of mortality with temperature at Logan airport of 3% (95% CI 1.1–5.6) was somewhat larger. After stratifying by location specific average temperature level we observed higher effects for subjects with residence at locations with more moderate temperatures.

**Conclusion:** A rise in summer temperature was associated with a higher risk in mortality, which may be modified by mean temperature level.

## ISEE-0690

**Exposure to Ambient NO<sub>2</sub> During Pregnancy and Head Circumference in the INMA Cohort in Valencia, Spain**

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**Objective:** To assess the association between residential exposure to outdoor NO<sub>2</sub> during pregnancy with head circumference at birth in the INMA cohort in Valencia, Spain.

**Methods:** Study participants were 782 pregnant women and their children at birth. Ambient NO<sub>2</sub> was estimated by means of Land Use Regression techniques using a grid of 93 sites plus GIS data. Using daily information from the monitoring network, NO<sub>2</sub> spatial estimations were adjusted to correspond to the pregnancy period for each woman. NO<sub>2</sub> exposure was introduced both, in continuous in 2 categories, <40, and >40 µg/m<sup>3</sup>. Outcome variables were birth head circumference (HC) standardized for gestational age; and fetal growth restriction (FGR) in HC based on constitutional growth potential models. We classified as FGR-HC those newborns whose HC was below the lower limit of the confidence interval for such prediction at 90%. Association between exposure to residential outdoor NO<sub>2</sub> and HC measures was assessed by linear regression for HC and by logistic regression for FGR controlling for potential confounders.

**Results:** NO<sub>2</sub> mean level corresponding to the 782 pregnancy periods was 36.9 µg/m<sup>3</sup>, being 43.1% of them above 40 µg/m<sup>3</sup>. In multivariate analysis an increase of 10 µg/m<sup>3</sup> in NO<sub>2</sub> levels during the first trimester of pregnancy was related with a decrease in HC of -0.07 cm (95%CI -0.14 to 0.01) and OR of being FGR-HC: 1.22(95%CI 0.89–1.67) for exposure at third trimester. HC decreased 0.17 cm (95%CI -0.34 to -0.003) and OR for FGR-HC was 2.08 (95%CI 1.04–4.19) for NO<sub>2</sub> exposure above 40 µg/m<sup>3</sup> during the whole pregnancy.

**Conclusion:** Our results suggest an association between maternal exposure to outdoor air pollution and birth head circumference. Exposure thorough the whole pregnancy seems to be relevant for an increased risk of being FGR for HC.

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## ISEE-0701

**Exposure Assessment of Allergens and Endotoxin in Vacuum Dust Samples Collected from Homes in an Agricultural Region with Industrial Dairy Operations**

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**Background and Objective:** The impact of industrial food animal production facilities (IFAP) on the exposure and health of communities proximal to these facilities is poorly characterized and understood. Communities close to IFAP may be subject to high level acute exposures and low-level chronic exposures of particulate matter, gases, and biological agents from the distribution of solid and liquid manure. One study objective was to compare the levels of indoor and outdoor allergens in settled dust from homes in close proximity to IFAP, <3 miles (proximal n = 24), to homes >3 miles distant (distal n = 16) from IFAP in the Yakima Valley WA where 64 industrial scale dairies operate.

**Methods:** Indoor and outdoor settled dust samples were collected by vacuum using standardized home collection methods. Analysis of settled dust was conducted by ELISA for allergens, Der p 1, Der f 1, Mus m 1, and Bos d 2 (a cow allergen). Endotoxin was analyzed for by LAL.

**Results:** Bos d 2 was found in the indoor dust samples of 75% of sampled homes. Indoor and outdoor concentrations of Bos d 2 in proximal homes were significantly higher than distal home environments,  $P = 0.03$  and  $P = 0.002$  respectively. Mus m 1 and Der p 1 allergen concentrations were significantly higher only in the indoor environments of proximal homes,  $P = 0.03$  and  $P = 0.05$ . Der f 1, and endotoxin were not significantly different either by location or group.

**Conclusion:** Our study reports novel findings of Bos d 2 allergen detection inside homes in this agricultural region. Allergens at concentrations found in this study are clinically significant contributors to respiratory health effects. This study provides evidence to support health effects studies to investigate the impact of IFAP contaminants on the health of communities living in close proximity to these facilities.

## ISEE-0703

**A Land Use Regression Model for Ultrafine Particles in Amsterdam**

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**Background and Objective:** Studies have suggested acute health effects related to short-term exposure to ultrafine particles (UFP). There are currently no epidemiological studies on health effects of long-term exposure to UFP, largely because of the lack of spatially resolved exposure data for UFP. The objective of this study was to develop a land use regression model for UFP in the city of Amsterdam.

**Methods:** Total particle number was measured from October 2002 until March 2004 directly outside 50 homes spread over the city of Amsterdam, using condensation particle counters (TSI CPC3022a). Each home was measured during one week. Simultaneously measurements were made at one urban background site in the city center. The average difference of the home outdoor and the reference site measurements per home was used to develop the land use regression model. Predictor variables were obtained using geographic information systems.

**Results:** Valid data were available for 48 sites, of which 22 were traffic sites. The mean difference with the reference site was 7644 cm<sup>-3</sup> (interquartile range 2210–21081 cm<sup>-3</sup>). A linear regression model with indicator variables defining whether or not the site was a traffic site, in a street canyon, in the city center and the sampling height of the site explained 51% of the variance in concentrations. Traffic was the most important predictor.

**Conclusion:** For the first time a land use regression model for UFP in Amsterdam has been developed, with similar validity as previously published models for more commonly measured pollutants such as NO<sub>2</sub>.

## ISEE-0707

**Reducing Air Pollution Exposure from Biomass Fuel Has More Impact on Severe Than Non-Severe Child Pneumonia: Findings From the Respire (Guatemala) RCT**

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**Background and Objective:** The RESPIRE RCT studied the effect of reducing woodfuel smoke pollution on child pneumonia. Greater risk reduction was found for severe compared to non-severe cases. This is important as severe cases have higher case-fatality. Our objective is to



establish whether this finding is robust, or an artefact deriving from severe outcomes representing more specific pneumonia definitions.

**Methods:** 518 homes with pregnant women or children <4 months were randomised to use a chimney stove or the traditional open fire. Surveillance to age 18 months combined exposure assessment, weekly home visits by fieldworkers (FW), physician examination, pulse oximetry (PO), direct antigen test for respiratory syncytial virus (RSV), and chest X-ray (CXR).

**Results:** For new FW-assessed episodes, in multinomial logistic regression, while there was no effect on acute upper respiratory infections (AURI) [RRR = 0.99 (0.87, 1.13) and a modest reduction of non-severe cases [RRR = 0.89 (0.69, 1.14), there was a 50% reduction in severe cases [RRR = 0.51 (0.27, 0.95)]. The RR for all weeks with FW-pneumonia was 0.85 (0.73, 0.98), implying longer episodes among controls. Physician-assessed clinical features of severe pneumonia were significantly more frequent in severe FW cases, providing independent validation of severity criteria. For new physician-assessed pneumonia episodes, impact increased from all cases [RR = 0.78 (0.56, 1.05)], through hypoxaemic and CXR positive, to RR = 0.55 (0.34, 0.88) for hypoxaemic RSV negative. Overall, fewer intervention cases had crepitations ( $P = 0.02$ ), the RR for these cases being 0.76 (0.58, 0.99). For hypoxemic cases clinical features did not differ between intervention and control.

**Conclusion:** Some FW-defined cases will be AURI, but many fewer physician-diagnosed cases will be. The larger risk-reduction among severe vs. non-severe physician-diagnosed cases, together with finding that hypoxaemic intervention and control cases were clinically indistinguishable, leads us to conclude that wood smoke exposure reduction impacted more on severe pneumonia, potentially more so among RSV-negative cases.

#### ISEE-0715

##### Urban Air Pollution and Acute Otitis Media in a Population-Based Birth Cohort

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**Background and Objective:** Middle ear infection is the main reason children under five years receive antibiotics and a leading reason for physician visits. Recent European studies have identified an association between urban air pollution and these infections. We present findings from the first North American study to investigate the role of traffic-related air pollution and wood burning as preventable risk factors for middle ear infection.

**Methods:** Middle ear infection was identified during the first two years of life using ICD9 coding of outpatient physician visits linked with antibiotic prescription data for all children born in southwestern British Columbia during 1999–2000. Exposure to traffic-related air pollution (NO, NO<sub>2</sub>, PM<sub>2.5</sub>) and wood burning was assessed using land-use regression models derived from detailed monitoring and geographic variables. Potential confounding variables were collected from the Perinatal Database Registry (older siblings, maternal smoking, maternal age, breastfeeding, birth weight, gestational age), hospitalizations (First Nations status), Vital Statistics (gender, birth season) and the 2001 Census (neighborhood income, female education, rural residence). Generalized estimating equations were used to model the impact of air pollution, modeled at the home address, during a 2-month window prior to middle ear infection.

**Results:** Full follow-up and risk factor information was available for 39,827 children. Adjusted risk ratios and 95% confidence intervals for an inter-quartile range increase in NO and NO<sub>2</sub> were 1.20 (1.18–1.22) and 1.19 (1.17–1.21), respectively. Results for PM<sub>2.5</sub> were not significant. The adjusted risk ratio for wood burning prior to infection was 1.58 (1.54–1.62).

**Conclusion:** The association between air pollution and middle ear infection suggests that pollution abatement strategies could successfully reduce the impact of this common and costly childhood disease.

#### ISEE-0716

##### Estimation of Heavy Metals Concentrations in Outdoor Air Using Mosses\*

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**Introduction and Objectives:** Long-term monitoring of local traffic-related pollution is a challenge in health research. We tested the use of mosses (*Hylacomium Splendens*) as active monitors. Mosses' uptake capacity is independent of climatic and physiological conditions therefore can be deployed for several months. Heavy metals (HM) in outdoor environments were measured to characterize their spatial distribution in Girona-Spain and determine their main predictor variables. HM relationship with traffic intensity, heavy traffic, bus lines and stops, distance to traffic and type of urbanization was investigated.

**Methods:** Moss bags were exposed in 23 houses during two months, following internationally approved methods. Metal concentrations were detected by ICP-SFMS. In parallel, NO<sub>2</sub> was monitored with Palmes tubes. Stepwise linear regression was conducted to derive the best-fit model.

**Results:** Regression models using traffic variables explained 61–85% of variability of Cu, Cr, Mo, Pb, Sb, Sn, and Zn. HM concentrations were strongly associated with the number of bus lines in front of the house. This variable alone explained 73–85% of Cu, Cr, Mo, Sb, Sn variability. In comparison, covariates explained 53% of NO<sub>2</sub> variability, mainly captured by the *characterization of the site's surroundings*. NO<sub>2</sub> was not highly correlated with any HM (highest correlation: 0.57 with Sb). Metals were more associated with bus and general traffic than NO<sub>2</sub>.

**Conclusion:** The strong association of HM with bus lines in Girona, a city dominated by street canyons, may indicate a key role of diesel engines. Given its higher source specificity, known toxicity and stronger association with traffic, HM are more specific indicators of local traffic than NO<sub>2</sub>. HM biomonitoring is thus an attractive alternative to NO<sub>x</sub> passive sampling used as a marker of traffic-related pollution, in particular in studies on long-term exposure, as deployment can remain many months without maintenance needs.

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#### ISEE-0720

##### Lead Exposure, Hemoglobin and Intelligence Quotient: Effect Modification by Dopamine Receptor D2 Taq IA Polymorphism Among Children in Chennai, India

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**Background and Objective:** Anemia and lead exposure remain significant public health issues in many parts of the world, often occurring together. Considerable evidence from animal literature suggests that variation in the Dopamine D2 receptor (DRD2) gene mediates the effects of lead and iron on cognition and behavior. We tested the hypothesis that the Taq IA polymorphism in the DRD2 gene modifies the effects of lead and hemoglobin on IQ among children.

**Methods:** Children aged 3–7 (n = 756) were enrolled into the study from 12 schools nested in four different traffic and industry zones in Chennai, India. The Binet-Kamat scales of intelligence were administered to ascertain Intelligence Quotient (IQ). Venous blood was analyzed for lead and hemoglobin levels. Genotyping for the DRD2 polymorphism was carried out using a MassARRAY iPLEX™ platform. Stratified analyses and interaction models, using generalized estimating equations (GEE), were examined to explore interactions between lead, hemoglobin and DRD2 Taq IA categories (homozygous variant vs presence of wild type allele).

**Results:** A one unit increase in log blood lead was associated with a decrease of 9 IQ points in the variant homozygous group in comparison to a decrease of 4 IQ points in the children who carried the wild type allele. Higher hemoglobin levels were associated with higher IQ in the children who carried wild type variants of the DRD2 receptor, but within the subpopulation that was homozygous for the variant allele, a 1 g/dl higher hemoglobin was associated with a slight decrease in IQ (0.7 points,  $P = 0.02$ ).

**Conclusion:** Children who are homozygous for the DRD2 Taq IA polymorphism, as compared to the rest of the study population, were more susceptible to the effects of higher lead exposure and higher hemoglobin was associated with lower IQ, suggesting an increased neurotoxic effect.

#### ISEE-0731

##### Forest Fires and Mortality in Athens, Greece

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**Background and Objective:** The Greek capital, Athens, lies in a valley surrounded by four mountains and the sea and has a population of more than 4 million. The urban green area per inhabitant is small (2 m<sup>2</sup>), hence the peri-urban green areas on the surrounding mountains are of great importance. The climate of the area as well as the observed increase in temperature makes forest fires a real threat to the environment during the summer.

We investigated the effects of forest fires on the total and cause-specific mortality on the population of Athens, during 1998–2004.

**Methods:** We used Poisson regression to investigate the effect of forest fires on mortality. Three dummy variables for forest fires were included in the model: one indicating the days with a major forest fire (>30,001,000 m<sup>2</sup> burnt), a second indicating relatively smaller forest fires (1,001,000–30,000,000 m<sup>2</sup> burnt) and a third for small fires (10,000–1,000,000 m<sup>2</sup> burnt). We also controlled for air pollution, temperature (plus heat-waves), wind speed and direction, week day and time trend.

**Results:** Small fires do not appear to have an effect on mortality. Medium sized fires are consistently associated with an increase in mortality but this does not reach the nominal level of statistical significance in most cases.

Large fires are associated with a 60% (95%CI: 46%–77%) increase in the daily total number of deaths, 68% (95%CI: 48%–92%) increase in the cardiovascular number of deaths and 102% (95%CI: 48%–175%) increase in the respiratory number of deaths, over and above the effect of temperatures, heat-waves, and ambient particles.

**Conclusion:** Forest fires are not only a threat to human health as an environmental disaster. They have also an effect on mortality, not associated with accidental deaths, which appears to be proportional to the size of the fire.

#### ISEE-0742

##### The Impact of Outdoor NO<sub>2</sub> Exposure on Fetal Growth Assessed by Ultrasounds During Pregnancy

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**Background and Objective:** Our aim was to assess the association between prenatal exposure to NO<sub>2</sub> and fetal growth in different periods of pregnancy in a cohort of pregnant women from Valencia, Spain.

**Methods:** Ultrasounds were performed around 12, 20, 32 weeks of pregnancy for all women (n = 787) and at week 38 for a sub-sample (n=100). Measurements of biparietal diameter, abdominal circumference and femur length were used to estimate fetal weight (EFW) by means of Hadlock algorithm. A longitudinal growth curve for EFW, adjusted for maternal height, weight, age, parity and ethnicity, was fitted using linear mixed models. Unconditional z-scores at 12, 20, 32 and 38 weeks of gestation were used as size indicators and conditional z-scores were used as growth indicators in 12–20, 20–32 and 32–38 gestational age intervals. Outdoor NO<sub>2</sub> exposure was assessed by using a GIS-based approach (land-use regression models). Air pollution estimates from land-use regression models were temporally-adjusted using daily levels registered by the monitoring network of the city. We considered the full pregnancy and its two first trimesters as critical exposure windows. Associations were evaluated using generalized additive models (gam), adjusted by socioeconomic and lifestyle variables and season of conception. We considered NO<sub>2</sub> as a categorical (cut-off: median @ 37 µg/m<sup>3</sup>) variable.

**Results:** NO<sub>2</sub> exposure during the first trimester was inversely associated with size at 32 weeks ( $P = 0.009$ ), and with growth between 32 and 38 weeks ( $P = 0.004$ ). NO<sub>2</sub> exposure during the second trimester was inversely associated with size at 32 and 38 weeks ( $P = 0.011$  and  $P = 0.051$ ) and with growth between 20 and 32 ( $P = 0.014$ ) and 32 and 38 weeks ( $P = 0.031$ ). Weaker associations were found for exposure during the whole pregnancy.

**Conclusion:** Results from this study suggest that early prenatal exposure to outdoor NO<sub>2</sub> is associated with reduced fetal weight.

**Funding:** Ministry of Health, Spain: FIS-FEDER 06/1213.

#### ISEE-0744

##### Evaluation of Alternative Exposure Metrics for Assessing Mortality Risk from Lung Cancer and Mesothelioma among an Occupational Cohort Exposed to Amphibole Asbestos from Vermiculite Mining Operations in Libby, Montana

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**Background and Objective:** In Libby, MT, the mining and milling of vermiculite, which was contaminated with amphibole asbestos, exposed workers and residents to asbestos fibers for decades. Several million homes in the United States and Canada may have vermiculite attic insulation from the Libby, MT mine. USEPA is conducting its cancer risk assessment based on epidemiologic analysis of the occupational cohort assembled by NIOSH.

**Methods:** This analysis was based on 880 workers hired in 1960 or later when fiber concentrations were lower and believed to be more consistent with potential environmental exposure. We used extended Cox proportional hazards models to assess the effects of Libby amphibole asbestos on lung cancer mortality and a Poisson model of absolute risk of mesothelioma mortality. Sensitivity analyses used multiple lags for cancer latency and multiple exposure metrics including cumulative exposure, residency-time weighted exposure, and metrics allowing for fiber clearance, translocation or biologic sequestration. We compared results using AIC weights which assign probabilities of each model being the best fit.

**Results:** The best fitting class of models in these analyses for lung cancer mortality used 10-year lags and allowed for simulated clearance over time. These models had 2.6–3.8 times the probability of being the best model compared to cumulative exposure. The best fitting model for mesothelioma mortality had 15-year lag and also allowed for clearance. The two best fitting metrics had 56–167 times the probability of being the best model compared to cumulative exposure. We found that residency-time weighted exposure models had low relative probability for both lung cancer and mesothelioma mortality.

**Conclusions:** The adverse effects of Libby amphibole exposure on cancer mortality in this cohort are clear. Models that mathematically allow for fiber clearance over time provide clearly superior fit to these cancer mortality data.

**Disclaimer:** This abstract does not necessarily reflect EPA policy.

## ISEE-0752

### Maternal Exposure to NO<sub>2</sub> During Pregnancy and Fetal Growth: A Comparison of Two Exposure Models

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**Background and Objective:** We have previously reported that nitrogen dioxide (NO<sub>2</sub>) exposures, as estimated by a geostatistical model and the closest monitoring station approach, showed little to moderate agreement. Here, our aim was to compare these two exposure models in terms of association with fetal growth.

**Methods:** We focused on 428 women from the Eden cohort recruited in two French maternity hospitals, living less than 2 km away from a permanent monitoring station. NO<sub>2</sub> levels during each trimester of pregnancy were estimated using a geostatistical model built by combining measures from measurement campaigns with a fine resolution and, to seasonalize these estimates, from permanent monitoring stations.

Additionally, we report associations with the more classical approach relying only on the permanent monitoring station closest from the home address. Ultrasound measurements of biparietal diameter (BPD) were performed during each trimester of pregnancy. Associations between exposure and BPD or birth weight (BW) were assessed by linear regression adjusted for potential confounders and gestational age.

**Results:** Compared to the lowest exposure tertile, NO<sub>2</sub> levels in the highest tertile were associated with a mean BW lowered by 150 g (95% confidence interval, CI, −266; −34 g) as estimated by the geostatistical model and 110 g (95% CI, −203; −17 g) as estimated by the nearest permanent monitoring station. No clear association was found between NO<sub>2</sub> levels estimated by both exposure models and BPD throughout the different trimesters of pregnancy.

**Conclusion:** In spite of their moderate agreement in terms of exposure estimates, both exposure models were consistent in terms of association between estimated NO<sub>2</sub> levels and fetal growth. In particular, first trimester exposure levels were more strongly associated with BW than second and third trimester exposures for both models. There was no evidence for an effect of exposure on early BPD measurements.

## ISEE-0760

### Exposure Assessment of Newborn Babies Near Incinerators: A Geographical Approach

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**Background and Objectives:** The relationship between exposure to emissions from incinerators and adverse birth outcomes is controversial. In the Emilia Romagna region (northern Italy), a multisite project (the MONITER project) is focusing on the environmental and health impact of eight incinerators (municipal solid waste, MSW). The relationship between pollution attributable to these plants and birth outcomes is under investigation. The aim of the first stage of the project is the characterization of the exposure of the population, including newborn babies.

**Methods:** Study areas were defined as the 4 km zones around the eight MSW incinerators. We collected data on all newborn residents in the study areas for the period 2003–2006 from Registry Offices. Pollution maps from the incinerators were provided by ADMS dispersion model outputs of NO<sub>x</sub> and PM<sub>10</sub>. Simulations of pollutant dispersion were also performed for all other sources in the areas (traffic, heating, industries, and agriculture). Exposure estimates at home location were made using G.I.S.

**Results:** A total of 13251 births were included in the eight areas. We considered yearly simulations data and for each incinerator we made 5 yearly simulations (2002–2006). These models considered monthly activity of the plants within the considered time period. By means of GIS analyses, we constructed an individual-based database with 5 yearly concentration values for incinerator, and average concentration values for all the other sectors. We calculated a weighted exposure value for each first trimester and 9-month pregnancy period. The mean weighted exposure values of pollution due to incinerator during pregnancy periods are 0.57 nanograms/m<sup>3</sup> (s.d. 0.93) for PM<sub>10</sub> and 0.052 micrograms/m<sup>3</sup> (s.d. 0.045) for NO<sub>x</sub>. The corresponding values for traffic pollution are 23.10 (s.d. 38.23) and 39.32 (s.d. 30.29) micrograms/m<sup>3</sup>.



**Conclusion:** We proposed a geographical approach to exposure assessment for a population of newborn near incinerators. Collected information is the basis for exposure indicators and subsequent epidemiological analysis.

#### ISEE-0761

##### Assessment of Ambient Air Pollutant Measurement Error Associated with Instrument Precision and Spatial Heterogeneity

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**Background and Objective:** In time-series studies of ambient air pollution and health in large urban areas, measurement errors associated with instrument precision and spatial heterogeneity can affect risk estimates. Here, these errors are characterized and modeled.

**Methods:** Daily measures of 12 air pollutants were obtained from three ambient monitoring networks operating in Atlanta, USA during 1999–2004. Instrument precision was characterized using observations from collocated monitors. Spatial heterogeneity was assessed using data from multiple monitors in the study area to estimate population-weighted semivariograms that represent ratios of spatial variance to temporal variance. Monte Carlo simulations of both error types were generated for each pollutant, modeled as a function of the measured concentrations and including temporal autocorrelation.

**Results:** Instrument error was small; relative to the total temporal variability, variance due to error ranged from 1% to 2% for continuously monitored pollutant gases (NO<sub>2</sub>, NO<sub>x</sub>, CO, SO<sub>2</sub>, O<sub>3</sub>) and 2% to 9% for particulate matter measures requiring laboratory analyses (PM<sub>10</sub>, PM<sub>2.5</sub>, and PM<sub>2.5</sub> components sulfate, nitrate, ammonium, elemental carbon, organic carbon). In contrast, error due to spatial heterogeneity ranged from 4% to 12% for secondary air pollutants (O<sub>3</sub>, nitrate, sulfate, ammonium) and 28% to 59% for primary pollutants (NO<sub>2</sub>, NO<sub>x</sub>, SO<sub>2</sub>, CO, elemental carbon). Pollutants with substantial contributions from both primary and secondary sources (PM<sub>10</sub>, PM<sub>2.5</sub>, organic carbon) had intermediate levels of error. Time-series simulations with modeled error added to central monitor data were generated maintaining similar lognormal distribution features. For instrument error only, correlations between simulations closely matched the observed correlation between collocated monitor data. For spatial error, the semivariograms between simulations closely matched the population-weighted semivariogram.

**Conclusion:** Measurement error associated with instrument precision and spatial heterogeneity can be modeled and simulations can be produced for the assessment of the impact of ambient pollutant measurement error on health risk estimates.

#### ISEE-0763

##### Perfluorooctanoic Acid (PFOA) and Pubertal Maturation in Young Girls

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**Background:** Polyfluoroalkyl compounds (PFCs) and their salts, such as perfluorooctanoic acid (PFOA), have been reported to change mammary gland structure and function in laboratory animals. We explored the relationship between serum PFOA concentration and timing of pubertal maturation in young girls.

**Methods:** Within the NIH Breast Cancer and the Environment Research Centers (BCERC), we conducted a study of multiple environmental biomarkers, including PFOA and other PFCs in serum of young girls (age 6–7 years at entry) from two sites (N = 689 girls). Pubertal staging (breast (B) and pubic hair (PH)) has been conducted by clinicians or trained research staff, every year or more frequently, for as long as four years. After calculating adjusted geometric means for all PFCs, we examined the relationship between PFOA serum concentration at the beginning of the study with body mass index (BMI) and pubertal Stage 2 at baseline and one year follow-up.

**Results:** Detectable serum levels of five PFCs, including PFOA, were found in >95% of the girls. The PFOA median was 6.4 ng/ml (range < LOD 0.1 to 55.9 ng/ml), with 24.9% having values above the 95<sup>th</sup> percentile for children 12–19 years (NHANES 2003–2004 population (8.6 ng/ml)). At the follow-up visit, 28.3% of girls had reached Tanner stage B2+, 19.2% were PH2+ and 30.3% had a BMI percentile for age >85. In analyses where serum PFOA was modeled as a continuous variable, we found a direct relationship with pubertal breast status and an inverse relationship with BMI percentile at the follow-up visit, with adjustment for age, race, site and caregiver education.

**Conclusions:** It appears that PFOA acts as an endocrine disruptor although perhaps not by the usual mechanism. Although the relationship with BMI was inverse, there was a direct relationship with breast maturation. We continue to explore these complex relationships in models including other covariates.

#### ISEE-0764

##### Ischemic Heart Disease Mortality Associations with Long-Term Exposure to PM<sub>2.5</sub> Components

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**Background and Objective:** Numerous epidemiological studies have now documented that long-term exposure to fine particulate matter air pollution mass (PM<sub>2.5</sub>) is associated with an increased risk of mortality. In particular, Pope and collaborators have noted elevated risks in deaths, especially due to cardiac causes in the U.S. nationwide American Cancer Society (ACS) CP-II cohort (Pope et al., 2004). However, the types of particles that are most responsible for these associations are not yet known.

**Methods:** Using the ACS cohort (extended through 2004), and the U.S. EPA PM<sub>2.5</sub> speciation data, we evaluated associations between various composition and source components of PM<sub>2.5</sub> in 80 U.S. metropolitan areas. Source apportionments were conducted using methods by Thurston and Spengler (1982). Individual elements were also considered as exposure indices. Mortality analyses employed Cox Proportional Hazards modeling. The focus of this new research was to determine which components of PM<sub>2.5</sub> were most explanatory of the previously reported PM<sub>2.5</sub> association with Ischemic Heart Disease (IHD) mortality.

**Results:** The major U.S. PM<sub>2.5</sub> sources identified, their key tracer elements, and their mean nationwide PM<sub>2.5</sub> impacts were: Soil (Ca, Si) 0.8 ug/m<sup>3</sup>; Metals (Pb, Zn) 0.2 ug/m<sup>3</sup>; Traffic (OC, EC, NO<sub>2</sub>) 4.6 ug/m<sup>3</sup>; Steel (Fe, Mn) <0.1 ug/m<sup>3</sup>; Coal Combustion (As, Se) 1.1 ug/m<sup>3</sup>; Oil

Combustion (V, Ni) 0.9  $\mu\text{g}/\text{m}^3$ ; Salt (Na, Cl) 0.1  $\mu\text{g}/\text{m}^3$ ; Biomass burning 1.3  $\mu\text{g}/\text{m}^3$ ; Other Sulfates (S) 4.3  $\mu\text{g}/\text{m}^3$ ; Other Nitrates ( $\text{NO}_3$ ) 0.6  $\mu\text{g}/\text{m}^3$ ; and, Other Organic Carbon (OC) 0.5  $\mu\text{g}/\text{m}^3$ . While most industrial and fossil fuel combustion categories had relative risk (RR) estimates above 1.0 for IHD deaths, coal combustion and traffic emission-related particles were among the largest and strongest  $\text{PM}_{2.5}$ -mortality associations.

**Conclusion:** Particles resulting from industrial and fossil fuel combustion sources are most associated with increased risk of Ischemic Heart Disease mortality from long-term  $\text{PM}_{2.5}$  exposure.

#### ISEE-0767

##### Advanced Communication Tools and a Qualitative Research to Complement Epidemiological Study

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**Background and Objective:** A qualitative research through advanced communication tools have been included in an epidemiological human biomonitoring (HBM) study in 16 municipalities of Campania Region, Italy (SEBIOREC), the area is experiencing a waste crisis and a diffuse pollution due to illegal dumping since '90.

**Objectives:** Contribute qualitative insights for interpreting epidemiological data; facilitate stakeholders comprehension of meaning and implication of HBM and of environment-health relationships.

**Methods:** A field research based on narrative interviews was developed focusing on: perception of pollution and its consequences on people; trust towards authorities and scientists; food consumption, change of habits and occupational and environmental exposure profile.

The study questionnaire prepared to interpret HBM included a section on risk perception and information sources (section 11).

Seminars and focus groups are in progress for supporting interpretation of HBM results and preparing communication tools, involving the SEBIOREC researchers. Monitoring of communication activities by a specific experts group is in progress.

**Results:** SEBIOREC analysis of 910 blood and breast milk samples to detect dioxins and metals is ongoing. Questionnaire-section 11 analysis showed that the most dangerous perceived problems for individual exposure were: air and waste pollution (84% and 83%), industries (77%), earthquake (67%); information resulted mainly covered by National (31%) and Local TV (14%) among six multiple answers; low trust towards institutions and associations was identified.

Eighty interviews to selected representatives, for 120 recorded hours, were carried out. The results show a complex picture, where people are experiencing difficulties in establishing connections between people and environment, are losing trust in the future, are building relationships at a local level based on affectivity, are often consuming local food and water.

**Conclusion:** Understanding risk perception and knowledge of residents in a highly polluted area, including one where illegal waste dumping is common, is crucial to properly interpret and release results of HBM studies to donors, administrators and the community.

#### ISEE-0769

##### Elevated Blood Lead Levels Negatively Impact Kindergarten Reading Readiness

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**Background and Objective:** Despite important lowering of blood lead levels in the US, many children living in urban areas continue to be

affected by early and ongoing exposures to lead. Lead exposure effects on IQ are well known, and the detrimental impact of lead exposure on reading and math school progress has been described. Our objective was to evaluate the relationship between blood lead levels and kindergarten reading readiness, an earlier marker of school performance, in a diverse urban school population.

**Methods:** Kindergarten reading readiness test scores and school administrative data for 3,652 children attending public school kindergarten in Providence, Rhode Island were linked to State Health Department records of blood lead testing using individual identifiers. Children having at least one blood lead test and reading readiness test scores in both the fall and spring were included ( $N = 3,364$ ). 58% were Hispanic and 34% spoke Spanish as their first language. On average, each child had 3 available blood lead tests. For each child, the geometric mean blood lead level was estimated.

**Results:** The median geometric mean blood lead level was 4.2 (IQR 2.8–6.0)  $\mu\text{g}/\text{dL}$ . After adjustment for sex, race, age, child language, and free/reduced lunch status, children in the 4<sup>th</sup> quartile of blood lead level were over 2 times more likely to score below national benchmark standards for reading readiness in the fall (OR 2.06; 95%CI 1.66, 2.57) as compared to the lowest quartile. On average, the fall reading readiness score was decreased by over 8 points in the highest versus lowest quartile (–8.4 points (95%CI –10.7, –6.2)).

**Conclusions:** Elevated lead exposure may contribute to decreased reading readiness at kindergarten entry. Additional lead exposure remediation and educational programs during or before kindergarten could reduce the gap in reading readiness before children begin basic primary school education.

#### ISEE-0772

##### Biomass Burning as a Driver of Human Exposure to Particulate Matter in the Amazon Region

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**Background and Objective:** The Amazon region has experienced a large number of forest fires in the past years; mainly in the peak of the dry season, during July to October, with a considerable increase of particulate matter loading. In the past the Southern Amazon was the main forest burning region due to the deforestation process. Nowadays the expansion of cattle ranching and the extensive soil beans in the western Amazon region has increased the atmospheric aerosol loading. The aim of this study is to evaluate the environmental and health indicators associated with particulate matter from biomass burning in susceptible age groups in the western Amazon region.

**Methods:** The study was carried out in the municipality of Porto Velho/Rondônia using as health indicator the daily hospital admissions due to respiratory conditions in children under 10 years old and elderly people. An ecological time series study using generalized additive models was carried out using daily levels of  $\text{PM}_{2.5}$  obtained from the CATT-BRAMS Model for the period of 2005. The results showed a high concentration of particles  $\leq 2.5 \mu\text{m}$  in the atmosphere of Amazon region during the dry season reaching levels of 580  $\mu\text{g}/\text{m}^3$ .

**Results:** For  $\text{PM}_{2.5}$  an increase of 10  $\mu\text{g}/\text{m}^3$  was associated with an increment of 1.0%; 1.5%; 1.6% and 1.3% of hospitalization due to respiratory diseases in children since the current day until three days after exposure. For elderly people the associations were not statistically significant, this could be explained partially by the small number of elderly from remote areas that get to reach the hospital in an urban area.

**Conclusion:** These results show that the exposure to fine particles from biomass burning may generate health problems for some age groups.

However, the distance from hospitals to the most affected burning areas should be carefully examined.

#### ISEE-0776

##### Effective Spatial Smoothing of Disease: A Tool for Epidemiologists

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**Background and Objective:** The availability of routinely collected geocoded data on health, population distribution and environmental pollutants, in conjunction with improved statistical and geographical information science methods, offers an opportunity to assess environmental health risks quickly, at relatively low cost to rapidly address public concerns about perceived environmental health risks. Visualising mortality or morbidity rates and spatial patterns of health outcomes can highlight areas of good or poor health event ascertainment and possibly identify important public health problems.

**Methods:** An application for disease mapping and risk analysis, the Rapid Inquiry Facility (RIF) has been developed by the Small Area Health Statistics Unit (SAHSU) at Imperial College London, in collaboration with the US CDC Environmental Public Health Tracking Program and the EUROHEIS project. Disease mapping is a valuable method for exploring spatial patterns of health outcomes, however, when dealing with low population numbers and/or rare diseases such methods can be problematic. Both rates and SMRs become numerically unstable and typically the less populated areas will show the highest risks. One way of addressing these problems is using Bayesian smoothing methods.

**Results:** The RIF allows users to carry out Empirical Bayes smoothing and to automatically link to WinBUGs to run a number of other smoothing models. We will outline four different smoothing models that can be used with the RIF for: Empirical Bayes, heterogeneity, conditional autoregressive modelling (CAR) and the Besag, York and Mollie (BYM) model and discuss, with examples, advantages of each approach.

**Conclusion:** We will demonstrate that a number of different models should always be run for more accurate interpretation. Furthermore, when adopting the Bayesian approach we will outline the key issues that should be included for the choice of prior distributions of the parameters, in particular for variance parameters and the checking of the convergence.

#### ISEE-0777

##### Association Between Low Birthweight and Air Pollution in an Industrial Brazilian City

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**Introduction and Background:** Vitória is a Brazilian industrial city by the seashore, which has faced an increase in the automotive fleet in the last decade and, consequently, air pollution levels. The exposure of pregnant women and children to environmental toxic agents has been a more frequent concern. Some studies have been carried out to both identifying and preventing the effects of these agents in the human being. Among these studies, a considerable part has focused on alterations that these exposures can cause on fetal development and growth. This study aims to investigate the association between birth weight and atmospheric pollution from January 2001 to December 2004, in the city of Vitória.

**Methods:** This is a historical cohort study of pregnant women. Birth weight and information on mother and pregnancy were obtained at the Brazilian "Born Alive National Information System" (SINASC, in Portuguese). Daily records of air pollutants (PM<sub>10</sub>, NO<sub>2</sub>, SO<sub>2</sub> and O<sub>3</sub>), temperature and relative humidity of air for the study period were obtained from the São Paulo State Environmental Agency (CETESB).

Associations between birth weight and air pollutants mean levels at each gestational trimester were investigated using both linear and logistic regression models.

**Results:** 16,316 births were registered in the period and in 91% of them newborns presented weight above 2,500 grams. An increase of 10 µg/m<sup>3</sup> in the mean level of PM<sub>10</sub> in the third trimester of pregnancy was associated with a decrease of 50.7 grams in birth weight. The effect of PM<sub>10</sub> was robust, remaining significant in a logistic regression model, OR=1.32 (CI95%: 1.01; 1.71), showing a dose-dependent behavior (PM<sub>10</sub> quartiles).

**Conclusion:** Our findings suggest that even at concentrations below the standards of air quality, there is an association between variations of PM<sub>10</sub> and low birth weight.

#### ISEE-0780

##### Three Measures of Forest Fire Smoke Exposure and Their Association with Respiratory and Cardiovascular Physician Visits and Hospital Admissions

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**Background and Objective:** Assessment of forest fire smoke health effects is challenging because fires are spatially and temporally sporadic. Exposure estimates can be based on air quality measurements when smoke affects urban areas, but fires often burn in remote areas with sparsely distributed populations. During the summer of 2003 numerous fires burned in a 150000 km<sup>2</sup> region of British Columbia, Canada potentially affecting ~640000 residents. We investigated whether respiratory and cardiovascular health outcomes were associated with three measures of smoke exposure over a 92-day study period.

**Methods:** A cohort of 281711 residents was identified from administrative data. Individual daily exposure estimates were assigned to each subject based on (1) data from six TEOM air quality monitors, (2) SMOKE plumes visible in satellite images and (3) output from a CALPUFF dispersion model. Longitudinal logistic regressions (adjusted for sex, socioeconomic status and day-of-week) were used to examine the effects of exposure on respiratory and cardiovascular physician visits and hospitalizations for subjects living within 50 km of a fire. Analyses were stratified by age and by potential sensitivity to smoke based on the number of physician visits in the previous year.

**Results:** A 10 µg/m<sup>3</sup> increase in two-day mean (t and t-1) TEOM-measured PM<sub>10</sub> was associated with odds ratios of 1.02 (1.01–1.03) and 1.06 (1.00–1.13) for respiratory physician visits and hospitalizations, respectively. Effect estimates were highest in the 30–50 age categories, but did not differ by potential sensitivity to smoke. Coefficients for the SMOKE and CALPUFF metrics showed similar trends but were non-significant. No effects were detected for cardiovascular outcomes.

**Conclusion:** Effects of TEOM-measured PM<sub>10</sub> on respiratory outcomes are consistent with those reported in other studies. General agreement of the SMOKE metric demonstrates the potential usefulness of purely satellite-derived exposure estimates in areas with no air quality monitoring.

#### ISEE-0781

##### A Prospective Study of Arsenic Induced Respiratory Symptoms and Chronic Obstructive Pulmonary Disease (COPD): Findings from Health Effects of Arsenic Exposure Longitudinal Study (HEALS) in Bangladesh

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**Background:** The dose-response relationship between arsenic (As) exposure and lung disorder is not clear, particularly for exposure at low-to-moderate levels. We conducted a prospective cohort study to evaluate the effect of As exposure on respiratory symptoms in the HEALS cohort in Araihaazar, Bangladesh who are exposed to a wide range of water As concentration (0.1 µg/L to 864 µg/L). We also conducted a case-control study with 144 cases of COPD and 5 age- and gender-matched controls selected per case from HEALS.

**Methods:** We used Cox regression models to estimate hazard rate ratios (RRs) for respiratory symptoms during follow-up period in relation to levels of As exposure at baseline, adjusting for age, gender, smoking, body mass index, education, and arsenic-related skin lesion status.

**Results:** A total of 9.10%, 13.09%, and 2.48% of the 11,746 participants completing four years of active follow-up reported having a chronic cough, breathing problem, or blood in their sputum, respectively, assessed by trained physicians. The RRs for respiratory symptoms were: 1.00 (ref), 1.24 (95% CI: 1.08–1.42), 1.39 (95% CI: 1.21–1.60), 1.46 (95% CI: 1.27–1.68), and 1.48 (95% CI: 1.28–1.70) for quintiles of baseline water As concentration ( $\leq 7$ , 7–40, 40–90, 90–178,  $>178$  µg/L), respectively. Similarly, the RRs for respiratory symptoms were 1.16 (95% CI: 1.01–1.32), 1.13 (95% CI: 0.99–1.30), 1.31 (95% CI: 1.15–1.50), and 1.36 (95% CI: 1.19–1.55), comparing the 2<sup>nd</sup>–5<sup>th</sup> quintiles to the bottom quintile of urinary arsenic, respectively. In the case-control analyses, the Odds ratios (ORs) of COPD were 1.00 (ref), 1.85 (95% CI: 0.99–3.43) and 2.07 (95% CI: 1.13–3.79) for water As concentration  $\leq 25$ , 26–120 and  $>120$  µg/L, respectively.

**Conclusion:** Our findings suggest an adverse respiratory effect of As exposure at low levels. A large proportion of the country's population may be at risk of lung diseases due to As exposure.

#### ISEE-0787

##### Water, the Mid-East Conflict and Public Health: from Zero-Sum to Win-Win

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**Background and Objectives:** Current severe water shortages in the Mideast result mainly from growing populations, increasing negative supply-demand ratios, contamination by toxics from industrial and agricultural effluent, desertification and salting of aquifers.

**Objectives:** We (1) examine water needs and resources in the region; (2) identify role of toxic effluents in destruction of these resources; (3) present a region-wide inventory of water resources and technologies and (4) outline the components of a region wide win win strategy keyed to climate change.

**Methods:** We summarize existing inventories and information on toxic effluents, based on available information, and present win-win options for meeting needs.

**Results:** Data show that water sources in Turkey more than meet the needs of Syria, Israel, the Palestinian Authority and Jordan combined, even with trends associated with climate change. Within individual countries, water shortages and contamination by microbials and toxins have resulted from regional and local mismanagement, waste, poor conservation policies, and aquifers contaminated with toxins.

Improvements in microbial water quality from chlorination and filtration have been offset by contamination from industrial sources, pesticides, metals, and solvents.

**Conclusion:** A comprehensive regional strategy addresses needs for public health, agriculture, recreation and industry, and ensures water supply and quality. This strategy requires measures at the national and regional level, including conservation, more use of waste water for irrigation and reuse, removal of toxics at the source (Zero Emissions), filtration and chlorination and reversing the shift to bottled water. Desalination plants, the Med-Dead Canal and a Turkish pipeline are capital options, but require assessments of environmental and public health impacts. These measures should more than offset draughts from rainfall shortages associated with climate change. Water shortages are a consequence, not cause of zero-sum regional conflicts, and the costs of prevention are a fraction of those of the arms race.

#### ISEE-0794

##### Uncertainty in Bias Estimation: Implication for Health Impact Assessment. An Analysis within the Intarese Project

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**Background and Objective:** Conventional analysis of observational data involves many assumptions which may be grossly violated but are not testable with the data under analysis. While random error decreases with increasing sample size, systematic error remains. Quantitative methods, such as sensitivity analysis, Monte Carlo risk analysis and Bayesian uncertainty assessment are useful tools for a valuable insight into the importance of various sources of bias in epidemiological studies. In the absence of adequate information from humans, results from animal studies serve as an indirect way for the estimation of the potential carcinogenic hazards of different agents and environmental pollutants. Uncertainties in the extrapolation from animal to human or from low to high doses arise in this case. The objectives of this study are:

1. Evaluate the most important sources of bias in individual studies investigating the carcinogenic risk of exposure to diesel exhaust, and.
2. Combine the bias-adjusted effect estimates into a common measure.

**Methods:** Different approaches were adopted in order to assess the uncertainty in individual study results. Sensitivity analysis was applied to the selected epidemiological studies whereas results from toxicological studies were analyzed through a benchmark dose (BMD) approach. Through the BMD approach we defined a point of departure (POD) and extrapolated from the POD to low environmentally-relevant exposure levels. Adjusted estimates were finally combined in a pooled estimate through meta-analysis.

**Results:** Adjustment for the main sources of uncertainty in epidemiological studies produced lower risk estimates showing that ignoring bias leads to risk estimates potentially biased upwards. Extrapolation from animal to human via BMD analysis produced similar estimates.

**Conclusion:** When evidence from epidemiological and toxicological studies is either contradictory or ambiguous, combining bias-adjusted effect estimates into a common measure could strengthen evidence for the characterization of pollutant-specific risks for human health.

#### ISEE-0797

##### Weekly Levels of Air Pollution During Pregnancy and Risk of Low Birth Weight

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**Background:** In the past decade several publications have reported on the associations between air pollution (mostly particulates) and adverse pregnancy outcomes (preterm births, low birth weight, spontaneous abortion etc.). However, a lot of questions have remained to be elucidated before a causal link would be widely accepted, therefore further studies are needed.

**Methods:** Face-to-face interviews were carried out by the district nurses among 2,827 pregnant women in 3 towns in Hungary (Győr, Veszprém and Dorog). The questionnaires collected information on the past and present health status and medical findings, occupation, housing environment, smoking and other life-style and socio-economic factors. Air pollution levels were assessed by continuous monitors of the National Air Quality Monitoring Network. All the weeks of the individual pregnancies were characterised by the weekly mean. The maximum levels of air pollutants and their associations with birth weight were evaluated by logistic regression and by Mann-Whitney test. Adjustments were made for age, smoking and number of previous pregnancies.

**Results:** After excluding miscarriages and multiple pregnancies, 2,651 pregnancies were evaluated. The number of newborns with low birth weight (<2500g) was 161 (6.07%). The most obvious association was found between low birth weight (LBW) and increased CO levels during the end of the second trimester and the first half of the third trimester. SO<sub>2</sub> and particulate levels in the second half of the third trimester showed a tendency to be associated with low birth weight. Not only LBW but birth weight, too, was significantly associated with weekly mean of daily maximum CO levels.

**Conclusions:** Increased levels of certain air pollutants during different periods of pregnancy may increase the risk of low birth weight.

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#### ISEE-0805

##### Influence of Prenatal Lead Exposure on Genomic Methylation of Cord Blood DNA

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**Background:** Fetal lead exposure is associated with adverse pregnancy outcomes and developmental and cognitive deficits; however, the mechanism(s) by which lead-induced toxicity occurs remains unknown. Epigenetic fetal programming via DNA methylation may provide a pathway by which environmental lead exposure can influence disease susceptibility. The objective of this study was to determine if prenatal lead exposure is associated with alterations in genomic methylation of leukocyte DNA levels from umbilical cord samples.

**Methods:** Genomic DNA methylation, as assessed by Alu and LINE-1 methylation via pyrosequencing, was measured on 103 umbilical cord blood samples from the biorepository of the Early Life Exposures in Mexico to Environmental Toxicants (ELEMENT) study group. Prenatal

lead exposure had been assessed by measuring maternal bone lead levels at the mid-tibial shaft and the patella using a spot source <sup>109</sup>Cd K-XRF instrument.

**Results:** An inverse dose-response relationship existed between quartiles of patella and tibia lead and cord LINE-1 methylation (*P* for trend = 0.01) and Alu methylation (*P* for trend = 0.05), respectively. In mixed effects regression models, maternal tibia lead was negatively associated with umbilical cord genomic DNA methylation of Alu ( $\beta = -0.027$ ; *P* = 0.01). No associations were found between cord blood lead and cord genomic DNA methylation.

**Conclusions:** Prenatal lead exposure is inversely associated with genomic DNA methylation in cord blood. These data suggest that the epigenome of the developing fetus can be influenced by maternal cumulative lead burden and may influence long-term epigenetic programming and disease susceptibility throughout the life-course.

#### ISEE-0807

##### Excess Mortality During Heat Waves in Ireland

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**Background:** Ireland is not known for having extreme high temperatures, with values above 30°C uncommon. Ireland has significant excess winter mortality compared to summer. The objective of this study is to estimate the impact of nation-wide heat waves on the total, cardiovascular and respiratory relationship, for the period 1981–2003, to determine if there are any periods of excess summer mortality.

**Method:** A time series model was developed to estimate the temperature-mortality relationship. Temperatures were averaged across all stations to create a national daily indicator. Heat waves were characterized by their intensity, duration and their geographical coverage. The excess mortality attributed to the heat waves was estimated comparing the predicted mortality from observed temperatures and the predicted mortality from reference temperatures.

**Results:** The best model for total mortality includes time, day of the week, minimal temperature at lag 0, 2, and maximal temperatures at lag 1, dummy variables for influenza and day of week were also included. Four heat waves periods were identified: July 1983, July 1989, July–August 1995, and August 2003. A significant mortality impact for total mortality, respiratory and cardiovascular was observed during all these summers (+69.6% in 1983, +61.7% in 1989, +126.6% in 1995, +9.3% in 2003). The impact was largest for the oldest age group and for respiratory mortality.

**Conclusions:** Even the relatively low maximum temperatures seen in Ireland have an effect on mortality. The largest cities being on coastal areas, they are less exposed to heat, and showed the least signal. The use of a nation-wide model allows capturing the effect of heat on the population. Facing the risk of climate change, it is necessary to gain a better understanding of the potential health impact of increased periods of hot weather, and to identify prevention strategies.

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#### ISEE-0809

##### Gender Differences in Occupational Exposure Assessment for a National Surveillance Project

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**Background and Objective:** The Finnish CAREX system is a useful tool for estimating numbers of workers exposed to carcinogens. It has been

adapted for Canadian use and a new goal is to examine differences in occupational exposure by sex. Our objective is to identify circumstances where women may be underrepresented in original estimates.

**Methods:** Population data was obtained from Statistics Canada. Finnish and US estimates of proportions of workers exposed to 9 carcinogens by industry and occupation were adapted for Canada with additional input from Canadian assessors (wood dust, benzene, silica, formaldehyde, diesel exhaust, PAH, chromium, lead, tetrachloroethylene). Numbers exposed were calculated by industry, occupation, province and sex. Descriptive statistics examining sex differences in industrial and/or occupational groups were prepared.

**Results:** The proportion of men exposed ranged from 58% (tetrachloroethylene) to 94% (silica). There were only 3 carcinogens where men constituted <90% of workers exposed. In addition, the top industrial and occupational groups for men and women were different. For diesel exhaust, the largest industrial group for men was truck transportation, and the largest occupational group was truck drivers. For women, the largest industry was school bus transport, although this was only the 4<sup>th</sup> largest group for men. These results are unexpected; while we hypothesized that more men would be exposed to these substances, it is unlikely that they would account for >90% of exposed individuals. Further work is needed to ascertain whether this disparity is real, or if by using traditional methods of exposure assessment focusing on heavy industry, we have missed situations where women are exposed to carcinogens.

**Conclusion:** CAREX did not originally discriminate between the sexes in terms of proportions of workers exposed. Our results suggest that industrial and/or occupational groups where women typically work may have been missed in initial estimates.

#### ISEE-0813

##### Groundwater Uranium and Chronic Health Outcomes in South Carolina

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**Background and Objective:** Uranium is a naturally occurring alpha-emitting radionuclide with carcinogenic and nephrotoxic properties. South Carolina (SC) is a rural state with significant racial health disparities, extensive groundwater use, and elevated groundwater uranium in some regions.

**Methods:** Counts of incident cancer (total, leukemia, prostate, breast, colorectal, kidney, bladder, 1996–2005), and hospital discharges for hypertension, kidney, and bladder disease (1996–2007) were aggregated among census tracts with >25% groundwater use (N = 300 of 854 tracts). Aggregate demographic data were obtained from the 1990 census. Groundwater uranium concentrations (N = 4,600) were obtained from existing federal and state databases. A geographic information system and SaTScan cluster analyses were used to test the hypothesis that census tracts with elevated groundwater uranium have elevated disease rates.

**Results:** A total of 134,685 total cancer, 155,906 kidney disease, 243,857 bladder disease, and 84,040 hypertension cases were identified. Forty-seven census tracts had predicted uranium concentrations above the maximum contaminant level (30 mg/L); five were at least 17 times higher. Several census tract clusters were identified in northeast and northcentral SC regions with both elevated groundwater uranium concentrations

( $P < 0.05$ ) and elevated prostate, bladder, or kidney/renal pelvic cancer rates (all  $P < 0.05$ ). When tracts with predominantly African Americans were evaluated, clusters with both elevated uranium and increased incidence of several additional cancers emerged (colorectal, breast, both  $P < 0.05$ ; leukemia  $P < 0.1$ ). In the northeast, clusters were detected that had both elevated uranium concentrations ( $P < 0.05$ ) and elevated bladder or kidney disease, or kidney stone hospitalization rates, ( $P < 0.05$ ).

**Conclusion:** Clusters of elevated cancer incidence, bladder, or kidney disease were detected in some SC regions with elevated groundwater uranium concentrations. Spatial cluster analyses provide an efficient method to explore hypotheses relating contaminated groundwater with chronic health outcomes. More rigorous spatial or individual level analyses are required to validate these observations.

#### ISEE-0818

##### Cluster Analysis of Mortality in an Area of Campania Region (Italy), with Intense Environmental Pressure due to Waste

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**Background and Objective:** Different health effects have been repeatedly associated with residence close to waste landfill sites. The Campania region experienced a long period waste crisis including widespread illegal practice of dumping toxic and urban waste.

In that area, statistically significant clusters of mortality by lung, liver, gastric, kidney and bladder cancers and of selected congenital malformations have been reported (Fazzo et al. 2008); many of these outcomes resulted spatially correlated with an intensity index of waste-related exposure (Martuzzi et al. 2009).

The objective is to investigate whether non-cancer mortality causes show a tendency for clustering in the waste dumping areas.

**Methods:** Cluster analyses of causes of death (ICD-9) were performed for diabetes (250), circulatory (390–459), myocardial infarction (410–414), cerebrovascular (430–438), respiratory (460–519), digestive (520–579), cirrhosis (571), urogenital (580–629). The unit of the study consists of the 196 municipalities of the Provinces of Naples and Caserta. Mortality data were retrieved from the Italian National Institute of Statistics for 1994–2001. Cluster analysis by Spatial Scan Statistics using 5 km maximum radius of circular cluster was performed. The population resident in the provinces of Naples and Caserta, excluding Naples, was used as standard. For each gender SMR was standardized for age and deprivation index.

**Results:** Among 15 statistically significant most likely clusters emerged, 11 included sub-areas at higher waste risk: mortality due to diabetes, circulatory, myocardial infarction, cerebrovascular diseases for men and women, respiratory for women, digestive and cirrhosis for men. The observed/expected ratio ranged from 1.2 for myocardial infarction in men and women to 2.9 for cerebrovascular causes in women.

**Conclusion:** The clustering results indicate associations between some non-cancer mortality causes and residence in waste disposal areas similar to those described for cancer mortality. Many other risk factors can play a role and ad-hoc analytical studies need to be carried out.

#### ISEE-0819

##### Estimation for Reduced Trihalomethane Exposure Through Ingestion from Heated Tea and Drinking Water

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**Background & Objectives:** Trihalomethane (THM) exposure has been linked to cancer, miscarriages, and birth defects. Volatilization of THMs from beverages and foods can reduce the ingestion exposure. This study investigated reduction of THM exposure through volatilization from teas and other hot beverages, compared THM exposure from tea and water in four populations, and aimed at improving exposure assessment for epidemiological studies.

**Methods:** Typical methods of preparing tea were simulated. Tea and water samples were analyzed by headspace GC-ECD. THM losses in heated tea and water due to volatilization were used to adjust THM intake in general populations, pregnant women, and lactating women in the UK and the USA.

**Results:** THM concentrations decreased rapidly after heating and serving steps. Losses in water and tea after heating were  $35 \pm 7\%$  and  $30 \pm 7\%$ , respectively, and after standing in a cup for 10 min,  $70 \pm 6\%$  and  $52 \pm 6\%$ . The intake of  $\text{CHCl}_3$  in tea relative to that in water ranged from 0.70 in the US to 2.67 in the UK, reflecting the higher consumption in the general population in the UK.

**Conclusion:** Volatilization significantly reduces concentrations and ingestion exposures of THMs in tea and water. Most epidemiological studies have used THM levels in tap water and beverages made with tap water, without correction, as an exposure measure. This study suggests that such correction should be considered.

#### ISEE-0822

##### Association Between Short Term Variations in Atmospheric Pollutants' Levels and the Couples' Fecundability

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**Background and Objectives:** Associations between air pollution levels and semen characteristics have been reported. However, very few studies directly documented the possible effects of atmospheric pollutants on the couples' fecundity. Our aim was to characterize the short term effects of atmospheric pollutants on fecundability, the month-specific probability of pregnancy among non-contracepting couples.

**Methods:** Within a cohort of births that occurred between 01/1994 and 03/1999 in the Teplice area (Czech Republic), we focused on couples who had planned their pregnancy. We restricted the study period to pregnancy attempts started from August 1993 to August 1996 to limit bias due to truncation effects.  $\text{PM}_{2.5}$  levels were estimated from a central measurement site and averaged over 1-month and 3-month periods before the start of the pregnancy attempt. The occurrence of a pregnancy during the first month of the pregnancy attempt was analyzed by logistic regression, which allowed estimating fecundability odds-ratio (FOR).

**Results:** Among the 2267 recruited couples, 567 (25%) conceived during the first month of the pregnancy attempt. Compared to pregnancy attempts started after a month with a  $\text{PM}_{2.5}$  level below  $25 \mu\text{g}/\text{m}^3$ , a  $\text{PM}_{2.5}$  level above  $45 \mu\text{g}/\text{m}^3$  during the month before the start of the pregnancy attempt was associated with an adjusted FOR of 0.69 (95% confidence interval, 0.51–0.94). When  $\text{PM}_{2.5}$  levels were averaged over a 3-month period, levels above  $45 \mu\text{g}/\text{m}^3$  were associated with an FOR of 0.74 (95% confidence interval, 0.53–1.04). Point estimates changed little after further adjustment for season and year of the pregnancy attempt, although confidence intervals widened.

**Conclusion:** In this polluted area, short term temporal variations in  $\text{PM}_{2.5}$  levels tended to be associated with a decreased fecundability. Since important economic and social changes occurred in the area during the study period, simulations are necessary to determine if these changes could explain the observed associations.

#### ISEE-0826

##### The Association Between Fatal Coronary Heart Disease and Ambient Fine Particulate Air Pollution. Preliminary Findings from the Ahsmog-2 Study

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**Background and Objective:** Both cohort and case-control studies have reported that fine particulate matter is associated with coronary heart disease. However, most of these studies were based on large-area exposure assessment, included current smokers and were not able to control for lifestyle factors like diet. We evaluated the relationship between long-term ambient particulate matter and fatal coronary heart disease (CHD) in a largely non-smoking population.

**Methods:** A total of 97,000 subjects were enrolled from 2002–2006 into the Adventist Health Study-2, a multi-racial cohort from the entire US and Canada. Of these, 57,756 reported the same address since enrollment and are thus included in this study, the AHSMOG-2 study. Monthly concentrations of ambient air pollutants were obtained from the U.S. Environmental Protection Agency database and accumulated from 12 months prior to enrollment to one month prior to censoring. Ordinary kriging estimations were performed on individual-level geocoded addresses. All participants completed a baseline demographic and lifestyle questionnaire. Prevalent CHD cases were excluded and analyses controlled for a number of potential confounders including gender, education, body mass index, smoking status, race, prevalent diabetes and hypertension, use of statins and aspirin, alcohol intake, and a beef + pork index.

**Results:** A total of 159 fatal deaths occurred among the population during an average of 3 yrs of follow-up. An increase of  $10 \mu\text{g}/\text{m}^3$  in  $\text{PM}_{2.5}$  was associated with a 92% increased risk of fatal CHD (Hazard Ratio (HR)=1.92, 95% confidence interval (CI): 1.26, 2.92). Using standard errors from kriging to weight the model, slightly widened the CI (HR=1.89, 95% CI: 1.041, 3.439). Excluding individuals living beyond 50 km strengthened the association (HR=2.01, 95% CI: 1.25, 3.25). Adding  $\text{O}_3$  in a two-pollutant model did not change the results.

**Conclusions:** Long-term exposure to ambient fine particulate matter is positively associated with CHD mortality among non-smokers.

#### ISEE-0829

##### Toward a More Informative Approach for the Analysis of Environmental and Occupational Variables Based on Cumulative Exposure and Exposure Rate

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**Background:** Exposure information in epidemiologic studies is often characterized by exposure rate, duration and total exposure. Examples include smoking (duration, cigarettes per day [CPD] and pack-years), alcohol consumption (duration, drinks per day [DPD] and drink-years), and inhalation of airborne inorganic arsenic (As) (duration, mean As concentration and cumulative As exposure). In analyzing two factors jointly, investigators usually assess exposure duration and exposure rate. However, interpretations of these ORs are problematic, since ORs with increasing exposure rate for duration held constant inherently include the effects of increasing cumulative exposure.

**Methods and Results:** We demonstrate through a series of examples involving environmental (smoking and drinking) and occupational (inhaled As in smelter workers) exposures that ORs by cumulative exposure and exposure rate (pack-years and CPD, drink-years and DPD, or cumulative As exposure and As concentration) are fundamentally more informative. This approach disassembles risk into cumulative exposure and the modifying effects of "delivery rate", i.e., comparing risk for total exposure delivered at higher exposure rates for shorter durations with risk for equal

total exposure delivered at lower exposure rates for longer durations. Under this paradigm, we develop simple 2 and 3-parameter models that fully characterize risk for a range of environmental and occupational exposures.

**Conclusion:** We demonstrate: (i) an inverse exposure-rate effect for a broad range of smoking-related cancers, i.e., above 10–15 CPD and for equal pack-years, smoking at greater intensity for shorter duration is less deleterious than smoking at lower intensity for a longer duration; (ii) a direct exposure-rate effect for drinking, i.e., for fixed drink-years, increasing DPD and decreasing duration increases the strength of the association of drink-year and several alcohol-related cancers; and (iii) a direct exposure-rate effect for inhaled As, i.e., increasing As concentration increases the strength of the association between lung cancer and cumulative As.

#### ISEE-0841

##### Missing Data Imputation in Time Series of Air Pollution

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**Background and Objective:** Missing data is a frequent problem in epidemiological studies on the effects of air pollution on health. Air quality monitoring stations can present failures and stay off-line for several days. These gaps can distort the exposure assessment since the missing data mechanism is often ignored in the analysis. Analyses based only on the available observations can yield biased estimates of the association as well as overestimate the precision. We propose an imputation procedure for multivariate time series data, e.g. daily concentrations of atmospheric contaminants, based on the EM algorithm. The time component of the series can be modelled by using splines, regression models, or ARIMA models with multiple covariance regime.

**Methods:** A simulation study was carried out in order to evaluate the validity of the proposed method and compare it with those available as default in most software packages for statistical analysis. The accuracy and agreement of the methods were also evaluated and a penalty criterion due to the lost information was proposed in order to account for the imputation uncertainty in the analysis.

**Results:** (i) data analysis using only the complete units tended to underestimate the association between the air contaminants and the health events even when only a small amount of data is missing; (ii) mean and median imputation overestimated the association and estimates show high dispersion and low agreement between when compared to the original values; (iii) multivariate procedures presented better performance and accuracy than the univariate ones; (iv) multivariate methods with temporal adjustment presented higher accuracy and precision. This last approach also presented smaller prediction error and higher agreement between the imputed and the original values.

**Conclusion:** The methods proposed in this work are implemented as an open source library called mtsdi for the statistical software R.

#### ISEE-0844

##### Serum Biomarkers of Potential Hormonally Active Chemicals and Age at Pubertal Transition in Girls

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**Background:** The Breast Cancer and the Environment Research Centers (BCERCs) are investigating whether exposures to hormonally active chemicals may affect the onset of puberty, which influences later reproductive function, breast cancer, and other chronic diseases. The chemicals we measured in serum are environmentally persistent and routinely encountered in the diet and dust.

**Methods:** Ethnically diverse cohorts of 6–8 year old girls are being followed for several years. Serum samples from over 600 girls at two sites were analyzed for three biomarker panels (36 PCB congeners, 11 polybrominated diphenyl ether (PBDE) congeners and 9 organo-chlorine pesticides). Tanner stages (breast (B) and pubic hair (PH)), body mass index (BMI), and demographic variables were available from physical exams and questionnaires. Focusing on chemicals detected in >60% of the girls, we calculated geometric means by various factors, and adjusted odds ratios (AOR) for biomarker quartiles and tanner stage (2+ vs. 1).

**Results:** The mean levels of several pesticides and the PCBs were significantly lower among pubertal girls (B2+ or PH2+) at both exams, and among girls of higher BMI. The PBDE levels were also lower among girls of higher BMI or in B2+ at baseline, but not at the follow-up. Adjusting for age, race, site, and caregiver education, the AORs were still significantly inversely associated with B2+, but adding BMI to models attenuated most AORs to non-significant levels. The highest quartile of the PCB sum had an AOR for B2+ at baseline of 0.29 (95% CI = 0.10–0.86), but little association at follow-up (AOR 0.81, 95% CI 0.38–1.73).

**Conclusion:** After adjustment, the observed associations of delayed puberty with higher serum levels of several organo-halogenated compounds were greatly attenuated. However, there is a complex relationship of BMI, breast-feeding, and other factors with pubertal onset that we will continue to examine.

#### ISEE-0845

##### Health Impact Assessment of Arsenic in the Environment and the Food Chain in Europe

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**Background and Objective:** This study covers the full chain of health impact assessment of arsenic in the environment and the food chain from policy drivers to population health effect quantification across the EU. Three distinct policy scenarios are explored, namely the emission situation based on 2000 data, a business-as-usual scenario up to 2010 and 2020, and a scenario incorporating the most likely technological change expected.

**Methods:** Within the integrated modelling framework, the Stuttgart Emission Tool (SET) was used to estimate the distribution of country-specific emissions split by sectors of activity. The European-scale atmospheric transport model MSC-E-HM was used for operational calculations of transboundary pollution within Europe. The WATSON model was used to estimate concentrations in terrestrial and aquatic environmental media as well as human exposure through ingestion of food and drinking water. The XtraFood model was used to estimate specific food contamination from plant uptake processes. Biology-based dose-response models were used to estimate potential population health risk from the exposure levels reckoned.

**Results:** Results show that Greece, Italy, the Netherlands and Belgium have the highest arsenic-related risk of fatal cancer. The estimated values of fatal cancer incidence for all the cancer types considered, show that Germany, Italy, France and United Kingdom have the highest number of

deaths for each type of cancer due to their larger total exposed population. Lung cancer has the highest incidence followed by liver cancer; both types have an incidence rate of 10–7. Kidney and skin fatal cancer show incidence values of one order of magnitude lower with values ca. 10–8.

**Conclusion:** Fatal cancer risk from arsenic exposure is reduced over time as we move from 2000, to 2010 and finally 2020. Overall risk in Europe is not very high and is much lower than the risk of other environmental health stressors.

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#### ISEE-0846

##### Effects of the Climate Change on Hospital Admissions by Respiratory Diseases in the Subequatorial Amazon

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**Background:** The models of climate change proposed by the IPCC present optimistic and pessimistic scenarios regarding temperature increases in the Amazon region, ranging from 3 to 6°C in the period 2020 to 2099.

**Objective:** To estimate the effect of temperature changes on human health regarding hospital admissions by respiratory diseases in children and elderly in the municipality of Alta Floresta, located at the subequatorial Brazilian Amazon.

**Method:** Ecological study using time series of daily temperature as exposure, controlling for humidity and air pollution, the latter represented by the daily levels of PM<sub>2.5</sub> in µg/m<sup>3</sup>. The outcome was the number of daily hospital admissions by respiratory diseases in children and elderly (< 5, and ≥65 years of age). The effects were estimated using single lags and the polynomial distributed lag approach.

**Results:** For an increase of 1°C in the minimum temperature the estimated relative risk percentage increase (RR%) of hospital admissions in children were 7.5 to 10.1 (lags 6–7); 24.3 to 33.6 for the optimistic scenario; and 54.4 to 77.8 for the pessimistic one. For elderly the RR% corresponding to an increase of 1°C in the medium temperature ranged from a reduction of –4.0 (lag 1) to an increase of 6.6 (lag 7). For the optimistic and pessimistic scenarios the RR% ranged from 21.2 to 47.1 for lag 7.

**Conclusion:** The increase in temperature in the Amazon region should increase the hospital admissions by respiratory diseases in children and elderly groups, adjusting by humidity and air pollution.

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#### ISEE-0848

##### Mechanistic Full Chain Approach for ETS Carcinogenicity Impact Assessment in the EU

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**Background and Objective:** An alternative mechanistic full chain approach for accessing ETS (Environmental Tobacco Smoke) impact in EU-scale due to its main carcinogenic effects (lung cancer, leukemia and nasopharyngeal cancer).

**Methods:** A full chain approach for assessing ETS carcinogenicity due to the presence of three contaminants namely 4-(N-nitrosomethylamino)-1-(3-pyridyl)-1-butanone (NNK), benzene and formaldehyde, responsible for lung cancer, leukemia and nasopharyngeal cancer respectively was developed in an integrated modeling platform including emissions-indoor air concentrations-exposure-internal dose to target tissue-health outcomes. A key element is the development of physiology-based pharmacokinetic/dynamic (PBPK/D) models for each contaminant. Thus, uncertainty to each step of

the full chain approach was implemented through Monte-Carlo technique and the obtained results had the form of a probability density distribution.

**Results:** The results indicated that the estimated cancer risk among the individual EU citizens was of the order of 10–4 for lung cancer, 10–6 for leukemia and 10–8 for nasopharyngeal cancer. Policies related to smoking banning in public places significantly affected exposure to ETS and the related risk, followed by interventions regarding air exchange rate and residence volumes.

**Conclusions:** In contrast to simple exposure-response relationships, which are unable to take into account parameters such as the contaminant concentration per cigarette or the metabolic profile of each individual, the proposed mechanistic approach can exploit the presence of detailed environmental and physiological information. Thus, it results in more biologically-informed health risk estimates and is, therefore, a valuable tool for evaluating policies related to ETS exposure in any stage of the full impact pathway.

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#### ISEE-0849

##### Assessing Children's Dietary Pesticide Exposures—Pesticide Residues Measured in 24-Hour Duplicate Food Samples

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**Background and Objective:** Characterizing dietary pesticide exposure among young children has become an essential component of cumulative risk assessment since the passage of the Food Quality Protection Act in the US, in part due to a recent reporting identifying dietary intake as a predominant source of pesticide exposure among children, particularly for organophosphorus (OP) pesticides. The objective of this study is to quantify OP and pyrethroid insecticide residues in the 24-hour duplicate food samples collected from the Children Pesticide Exposure Study (CPES).

**Method:** We have established two CPES study groups with children ages 3–11 years, 19 and 20 children residing in Seattle, Washington (CPES-WA), and in Atlanta, Georgia (CPES-GA), respectively. The 24-hour duplicate food samples, mainly fresh vegetables, fruits, and juices, were collected from these study participants three times over a 6-month period and analyzed by US Food and Drug Administration labs in Atlanta GA and College Park MD for OP and pyrethroid insecticides.

**Results:** The frequencies of detection for at least one pesticide in the food samples are 14.7% for CPES-WA and 22.7% for CPES-GA. For food samples that contained detectable pesticide residues, we found 42% and 24% of those contain multiple residues in CPES-WA and CPES-GA, respectively. We found most of the OP residues in the fruit category, whereas pyrethroids were commonly detected in vegetables. The highest residues that we found in all the food samples were 350 ppb of Acephate (OP) in celery and 921 ppb of Permethrin (pyrethroids) in a composite food sample of strawberries and spinach.

**Conclusion:** We found 19 out of 100 food samples that children commonly consumed that contained at least one insecticide that is known as neurotoxin. These data will be valuable for validating urinary exposure biomarkers for the respective insecticides, as well as dietary risk assessment.

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#### ISEE-0851

##### Pleural Abnormalities and Community Exposure to Asbestos Contaminated Vermiculite

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**Background and Objective:** Asbestos contaminated vermiculite ore from Libby Montana was processed at the Western Mineral Products/W.R Grace processing plant in a densely populated urban residential neighborhood of Minneapolis, Minnesota, from 1936 to 1989. Waste rock from piles at the plant was made available to the community for use in yards, gardens and driveways.

**Methods:** To evaluate potential effects of community exposure to asbestos from contaminated vermiculite we recruited current and former community residents who never worked at the plant or lived with a plant worker, and were first exposed before 1980. Subsequent to an informed consent process, participants completed a self-administered questionnaire to supplement previously collected information, and were evaluated at regional clinics with occupational health expertise. Each participant completed a pulmonary function test and one PA chest x-ray to be evaluated using the NIOSH B-reading protocol. X-rays were read by two radiologists certified as NIOSH B-readers. Of particular interest in this analysis was intense, intermittent exposures experienced by community members, usually children, from playing on piles of vermiculite waste. We evaluated the prevalence of pleural abnormalities with respect to exposure to the waste. Prevalence odds ratios, adjusted for age, sex and history of jobs with potential asbestos exposure were estimated with multiple logistic regression.

**Results:** Clinic visits were completed by 461 individuals. Prevalence of any pleural abnormalities, as determined by at least one B-reader, was 15% overall. Those who ever reported playing in the piles of waste rock had a prevalence of 19% compared to 12% for non-pile players. Adjusted prevalence odds ratios for pleural abnormalities and reporting ever playing in a waste rock pile was 2.0 (95% CI = 1.1–3.6).

**Conclusion:** These analyses support the hypothesis that community exposure to asbestos contaminated vermiculite is associated with measurable changes on x-rays.

#### ISEE-0852

##### Ambient Air Pollutant Exposures, Gene-Interactions and Fluctuations in Pulmonary Function Among South African Schoolchildren

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**Objective:** To investigate associations between exposures to common ambient air pollutants and fluctuations in pulmonary function in children living in industrialized and non-industrialized areas of eThekweni municipality, adjusting for genetic modification of pollutant-outcome relationships.

**Methods:** Grade 4 pupils (n = 423) from seven schools were selected to perform peak expiratory flow manoeuvres (PEF) four times during the school day over four three week periods over 12 months. Ambient pollutants were continuously measured over 24 hours for the 12 months at each school. Generalized estimating equations were used to examine associations between daily mean levels of ambient air pollutants and measures of pulmonary function across 4 seasons in models adjusted for genetic polymorphisms and other covariates.

**Results:** Mean daily NO<sub>2</sub> concentrations varied from 11 ppb in non-industrial areas to 19–24 ppb in the city and industrial areas. Average SO<sub>2</sub> concentrations varied from 1–3 ppb in non-industrial to 12–20 ppb in industrial areas. Mean daily PM<sub>10</sub> concentrations ranged from 41–57 µg/m<sup>3</sup>. The GSTP1 minor allele was significantly associated with known or probable persistent asthma (OR = 2.74, CI: 1.29–5.84, P = 0.00), but not with atopy or BHR (OR = 0.93, CI: 0.29–1.99, P = 0.59; and

OR = 0.94, CI: 0.43–2.04, P = 0.88 respectively). GSTM1null was not associated with any outcomes, however statistically significant associations of NO<sub>2</sub>, NO, and SO<sub>2</sub> with FEV<sub>1</sub> and PEF outcomes in the expected direction were more frequent for individuals carrying the GSTM1null genotype. Significant decrements in pulmonary function associated with higher ambient concentrations were present for a substantial proportion of the regression models, with associations stronger and more frequent among those children with persistent asthma, compared to those without.

**Conclusion:** Industrial and vehicular exposures to moderate levels of air pollutants were associated with short-term decrements in pulmonary function among schoolchildren in Durban, especially among those with persistent asthma and those with the GSTM1null genotype.

#### ISEE-0856

##### A Dynamic Relationship Between Methyl Mercury, Inorganic Mercury, and Total Mercury in Umbilical Cord Blood

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**Background and Objectives:** Total mercury (THg) is a sum of all mercury compounds, mostly methyl mercury (MeHg) and inorganic mercury (IHg). THg values are used as a proxy for MeHg; many assume that 80–90% of THg is MeHg. Our objective was to test this assumption umbilical cord whole blood.

**Methods:** Umbilical cord mercury speciation was conducted in 78 samples with THg levels ≥2 µg/L selected from a cross-sectional study of 300 births in Baltimore, Maryland. Mercury was quantified using ICP-MS (THg) and HPLC-ICP-MS (MeHg, IHg) at the Centers for Disease Control and Prevention. Limits of detection (LOD) were 0.33 µg/L for THg, 0.45 µg/L for MeHg and 0.75 µg/L for IHg. Thirty-three IHg values were < LOD and replaced with LOD/√2.

**Results:** THg, MeHg and IHg levels ranged from 2–16.5, 1.1–15.4 and < LOD–1.9 µg/L, respectively. MeHg and THg were strongly correlated (Spearman's  $\rho$  = 0.91, P-value < 0.01); neither correlated with IHg. Geometric means were 3.03 µg/L for THg; 2.68 µg/L for MeHg and 0.76 µg/L for IHg. Average MeHg/THg was 0.88 (95% CI: 0.86, 0.91) and IHg/THg was 0.25 (0.22, 0.28). In a model with both MeHg and IHg, a 1 µg/L increase in MeHg or IHg was accompanied with a +0.98 µg/L (0.95, 1.01) and +0.47 µg/L (0.24, 0.71) change in THg, respectively. As THg increases, the MeHg/THg ratio increases, and the IHg/THg ratio decreases (P-trend for both is < 0.01).

**Conclusion:** In this population both MeHg and IHg contribute to THg levels, but the MeHg/THg ratio is higher at higher THg levels. These data suggest MeHg/THg ratios are not uniform across all values of THg, at least not in cord blood. Higher THg levels are strongly associated with MeHg exposure, likely reflecting differences in seafood consumption.

#### ISEE-0860

##### Determinants Characterizing Adaptive Capability for Island-Wide Cardiovascular Mortality at Extreme Temperatures in Taiwan

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**Abstract:** To identify the vulnerable regions in response to extreme cold and heat exposure in Taiwan, and further to characterize the determinants associated with such an increasing risk for better design of adaptive strategy in view of predicted weather change in the future. The mortalities of cardiovascular diseases for 358 townships were estimated with the number of deaths in the 2-week period after the extreme temperature event as the nominator, and the number of deaths before as the denominator. Metropolitan regions were found to have substantially lower mortality than those in rural areas after cold and heat events. Events of extreme cold, compared to heat, had greater impacts in mortality ratio in most townships. Negative association was identified, by spatial lag model, between the mortality after the extreme temperature events and urbanization and availability of medical resources. Higher percentage of the elders, the vulnerable, and the aborigines might have contributed to increasing vulnerability of the townships during cold and heat events. Our data, using an island wide spatial analysis, suggest urban areas are with greater adaptive capability than rural areas, plausibly due to higher socioeconomic status and more medical resource available. Social inequality across urban and rural townships is apparent, and developing customized adaptation program in vulnerable regions at the events of extreme heat and cold should be prioritized.

#### ISEE-0861

##### **Socioeconomic Status Modifies the Association Between Hospitalizations and Air Pollution (PM<sub>10</sub>, PM<sub>2.5</sub> and O<sub>3</sub>) in Santiago, Chile**

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**Objective:** To assess whether socioeconomic status modifies the associations between hospitalizations for respiratory and cardiovascular causes and exposure to air pollution (PM<sub>10</sub>, PM<sub>2.5</sub> and O<sub>3</sub>).

**Methods:** Daily figures of respiratory (RSP, ICD10:J000–J953, J980–J998, R065), cardiovascular (CVD, ICD10: G450–G452, G454, G458–G468, G936, G938, G951, I000–I879, I890–I891, I898–I978, I980–I990, R001, R008, R012), and cardiopulmonary (CP: RSP+CVD) hospitalizations in Santiago, between 2002 and 2006 was obtained from DEIS. The data were stratified according to the following age groups: all ages, less than 18 years old, 18–44, 45–64 and older than 65 years. The meteorological and air pollution data were provided from MACAM monitoring network. The association between socioeconomic status, hospitalizations and air pollution was studied separately in two annual income groups, according to the individual social security: public (**low** < 3100 US\$) and private (**high** >4000 US\$), by time series analysis in R software, controlling for seasonality, apparent temperature, day of the week and influenza for respiratory causes. Lags and moving average from 0 to 10 days were considered.

**Results:** Significant associations ( $P < 0.05$ ) were observed in **low-income people**: less than 18 years old for RSP (admissions increased by 0.8% (95%CI: 0.4–1.3), PM<sub>10</sub>, lag 0 and 1.7% (95%CI: 0.3–3.1), O<sub>3</sub>, lag 1); for those aged 18–44 we observed admissions increased by 1.5% ((95%CI: 0.5–2.4), PM<sub>10</sub>, lag 4); for people 45–65 years old we observed for CVD admissions increased by 1.8% (95%CI: 0.6–3.0), PM<sub>2.5</sub>, lag 0); for those over 65 years we observed for RSP admissions increased by 1.3% ((95%CI: 0.3–2.3), PM<sub>2.5</sub>, lag 0) and CVD admissions increased by 1.1% ((0.2–2.0), PM<sub>2.5</sub>, lag 0). In a group of **high-income people** the association was observed for adults older than 65 years for RSP only (admissions increased by 6.0% ((95%CI: 2.0–10.3), O<sub>3</sub>, lag 3).

**Conclusions:** These results suggest that the socioeconomic status modifies the association between air pollution and hospitalizations. The **low-income people** are at greater risk, but with higher risk in older age groups for both groups of admissions.

#### ISEE-0862

##### **Effects of Air Pollution from Biomass Burning in Amazon: A Panel Study of Schoolchildren**

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**Background:** Exposure to current levels of PM<sub>2.5</sub> resulting from biomass burning is a risk factor to human health in the Amazon region.

**Objective:** To investigate the association between PM<sub>2.5</sub> and lung function in schoolchildren in the Brazilian Amazon stratified by morning and afternoon shifts.

**Methods:** A panel study with a sample of 309 schoolchildren from 6 to 15 years old. Repeated measures of peak expiratory flow (PEF) were collected during 112 days. Daily measurements of PM<sub>2.5</sub>, temperature, humidity as well as respiratory symptoms were recorded. For the statistical analysis, the exposure measure was the average of PM<sub>2.5</sub> in the morning or afternoon. The analysis was based on random effects models. The effects were evaluated considering the air pollution levels on the current day, 1 to 3 days lag and cumulative effects of 2 and 3-days.

**Results:** Averages of PM<sub>2.5</sub> ranged from 3,3 to 120,8 µg/m<sup>3</sup>. The working model consisted of temporal trends, temperature and humidity lagged by 2-days, fitted via quadratic parametric splines with random coefficients. Further, the occurrence of respiratory symptoms such as cough, running nose, headache, tearing and visit to the hospital were regarded using random effects. Moreover the results were adjusted for age and asthma diagnosis (asthmatic and non-asthmatic). The effects of air pollution on lung function were significant only for the afternoon shift. For an increase of 10 µg/m<sup>3</sup> of PM<sub>2.5</sub> on the same day, the PEF average decreased 0,45 l/min. The cumulative effects of 2-days and 3-days decreased 0,44 l/min and 0,40 l/min, respectively.

**Conclusion:** Exposure to current levels of fine particulate matter in the Amazon region, caused by biomass burning, is associated with reductions in lung function of schoolchildren, especially those studying in the afternoon.

#### ISEE-0865

##### **Maternal PBDE Exposure and Time to Pregnancy**

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**Objective:** To examine the association of maternal exposure to polybrominated diphenyl ethers (PBDEs) with time to pregnancy (TTP).

**Methods:** The study population comprised 225 pregnant women participating in the Center for the Health Assessment of Mothers and Children of Salinas (CHAMACOS) study, a cohort study of low-income, predominantly Mexican women living in an agricultural region of California. Concentrations of 10 PBDE congeners were measured in serum collected from the women near the end of the second trimester of pregnancy using gas chromatography and isotope dilution high resolution mass spectrometry. Analyses were limited to four PBDE congeners (BDE-47, -99, -100 and -153) that were detected in more than 75% of women. TTP was defined as the number of months it took to become pregnant, censored at 13 months. Women who were using contraceptives at the time of conception (i.e. contraceptive failures) were excluded. We analyzed the association of TTP with lipid-adjusted PBDEs as continuous variables using discrete-time Cox proportional hazards models, to obtain fecundability odds ratios (FOR). PBDE levels were log transformed and levels below the limit of detection (LOD) were given the values of the LOD/2. All analyzes were adjusted for covariates.

**Results:** Median TTP was 3 months (range: 0–180 months). All four PBDE congeners were associated with longer time to pregnancy (i.e.  $\text{fOR} < 1$ ). Each 10-fold increase in BDE-153 was associated with a 50% decreased odds of conceiving each month (adjusted  $\text{fOR} = 0.5$ ,  $P = 0.001$ ). Similar results were seen for BDE-47 (adjusted  $\text{fOR} = 0.7$ ,  $P = 0.05$ ), -99 (adjusted  $\text{fOR} = 0.7$ ,  $P = 0.08$ ), and -100 (adjusted  $\text{fOR} = 0.6$ ,  $P = 0.006$ ).

**Conclusions:** Higher maternal PBDE levels during pregnancy were associated with longer time to pregnancy in this population.

#### ISEE-0866

##### Health Impact Assessment for Particulate Matter ( $\text{PM}_{10}$ ) in Mexico City

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**Background:** There is robust scientific evidence indicating that exposure to ambient particulate air pollution with aerodynamic diameter less than 10 micrometers ( $\text{PM}_{10}$ ), is associated with increased risk of death from broadly defined cardiovascular or respiratory causes.

**Objective:** This study conducted a health impact assessment (HIA) of  $\text{PM}_{10}$  exposure in Mexico City and the main objective was to provide an estimate of the potential health benefit that would result from a stepwise improvement of the air quality.

**Methods:** HIA is based on standard approaches to derive the number of adverse effects that are attributable to some established risk factor. The calculation requires three basic pieces of information: 1) Frequency or occurrence of a health problem in the population, 2)  $\text{PM}_{10}$  levels and 3) The quantitative information about the association between exposure to  $\text{PM}_{10}$  and the occurrence of health outcomes (concentration response function-CFR). The quantification of benefits was done by comparing the current burden with the one expected if air quality was at some lower levels. A geographical model using a Geographic Information System was built to estimate the population exposure to  $\text{PM}_{10}$ . To compare different estimates we selected three different sources of CFRs: international meta-analysis, Mexico City studies and ESCALA data (ESCALA is a recent multicenter project that examines the association between health effects and air pollution in several cities in Latin America.).

**Results:** The reduction of current levels of  $\text{PM}_{10}$  to the WHO standards would result in about 1191 (882–1499) fewer annual deaths using ESCALA CFRs. This reduction is more important in people older than 65 years with 805 (605–1285) avoided deaths and 102 (21–180) for  $>1$  year. The evaluation also included death due to respiratory, cardiovascular and brain's vascular causes.

**Conclusions:** The results of the study will provide useful information to policy makers for implementing air quality management policies in the next 10 years.

#### ISEE-0871

##### U.S. Environmental Protection Agency's (EPA) 2008 Report on the Environment (ROE): Identified Gaps and Future Challenges for Human Exposure and Health Indicators

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**Background/Objective:** With five main chapters encompassing air, water, land, human exposure and health, and ecological condition, U.S. EPA's 2008 ROE compiles in one place the most reliable national-level indicators currently available to help answer 23 questions EPA believes are critically important to its mission. ROE discusses critical gaps, limitations, and challenges that prevent the questions from being fully answered, providing valuable input to EPA in developing its strategic

outlook and priorities, and allowing the public to assess whether the Agency is succeeding in its overall mission.

**Methods:** The Human Exposure and Health Chapter addresses three questions using indicators reflecting exposure biomonitoring, general health status, acute, chronic, and infectious diseases, and birth outcomes. Questions include “What are the trends in human exposure to environmental contaminants?”, “What are the trends in health status in the United States?”, and “What are the trends in human disease and conditions for which environmental contaminants may be a risk factor?” The underlying indicator data come from the Centers for Disease Control and Prevention, and are presented by population subgroups and geographic regions wherever possible.

**Results:** Nineteen national-level indicators contributed to answering these questions. Identified gaps and challenges included lack of quality surveillance systems for many outcomes of interest, e.g., neurological conditions; difficulties with attributing changes in common health conditions to changes in exposures using national level indicators; lack of long term trend data for tracking exposures; inability to attribute body burdens of contaminants to specific exposure sources; and a need to develop health reference values to interpret biomonitoring results in a public health context.

**Conclusion:** Narrowing identified critical gaps will facilitate more informed application and interpretation of environmental exposure and health indicators for multiple audiences and users. Specific approaches for addressing identified gaps and challenges in future editions of the EPA's ROE will be presented.

#### ISEE-0873

##### Associations Between Maternal PBDE Serum Concentrations and Birth Weight and Duration of Gestation

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**Background and Objective:** Polybrominated diphenylethers (PBDEs) are synthetic chemicals used as fire retardants in a number of consumer products. These chemicals are persistent and lipophilic, accumulate in biological organisms and have been measured in multiple human populations. Though some studies have found prenatal exposure to other persistent organic pollutants to be associated with shortened gestation duration and lower birth weight, little human data is available on the subject regarding exposure to PBDEs. Our aims were thus to determine whether maternal PBDE serum concentrations during pregnancy were associated with these outcomes in the Center for the Health Assessment of Mothers and Children of Salinas (CHAMACOS) study population.

**Methods:** Pregnant women who were  $\geq 18$  years of age,  $<20$  weeks gestation, English or Spanish speaking, Medi-Cal eligible and planning to deliver at Natividad Medical Center, the county hospital, were eligible for participation in the study. Women who delivered a live birth and had enough stored serum for PBDE analysis were included in this analysis ( $n = 413$ ). We measured the concentration of 10 PBDE congeners in serum samples collected at 26 weeks gestation ( $n = 316$ ) and shortly before delivery ( $n = 97$ ).

**Results:** Total PBDE serum concentration ( $\Sigma\text{PBDE}$ ) in the CHAMACOS population (median = 24.6 ng/g lipids) was similar to levels reported by previous U.S. studies but was substantially higher than levels observed in Europe and Japan. Preliminary analyses suggest that serum concentrations of BDE-28, 47, 99, 100 and 153 measured at 26 weeks gestation, but not before delivery, were inversely associated with birth weight ( $\beta = 93$ –145 grams for every 10-fold increase in exposure;  $P < 0.05$ ) after controlling for potential confounders including gestational duration. Every 10-fold increase in  $\Sigma\text{PBDE}$  was associated with a 148 grams (95%CI = -260, -36) reduction in birth weight. Gestational duration was not associated with PBDE exposure.



**Conclusion:** Results suggest that maternal PBDE serum concentration at the beginning of the third trimester of pregnancy is inversely associated with birth weight.

#### ISEE-0876

##### Extent of Biomass Exposures and Health Effects Among Rural Women in Bangladesh

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**Background:** Use of biomass fuel (wood, agricultural residues and dung, etc.) has been linked to about 1.6 millions deaths annually from chronic obstructive pulmonary disease (COPD) and acute respiratory infection (ARI) among women and children worldwide. However, little is known about pollutant contents in particles released from biomass smoke and their effects on the risk of respiratory illnesses.

**Method:** We assessed the relationship between biomass exposure and respiratory illnesses in a group of non-smoking women (N = 121) in Araihaazar, Bangladesh by collecting personal fine particulate matter (i.e., PM<sub>2.5</sub>) samples for 8–12 hours. We also analyzed PM<sub>2.5</sub> samples (N = 40) for trace metals using X-ray fluorescence (XRF) technique. In addition, we measured total urinary Polycyclic Aromatic Hydrocarbons (PAHs) as an exposure biomarker and urinary 8-oxo-de-guanosine (8-OHdG), a biomarker of oxidative stress.

**Results:** We observe that on average these women were exposed to 804 µg/m<sup>3</sup> of PM<sub>2.5</sub>. The study participants who experienced respiratory illnesses within the past year had significantly higher levels of PM<sub>2.5</sub> than who had not (1,665 µg/m<sup>3</sup> vs. 671 µg/m<sup>3</sup>,  $P < 0.01$ ). A high level of metals including Fe (49%), Al (36%), Ni (9%), Mn (2%) and Sb (2%) and trace amounts of Cd (1%), Pb (1%), As, Cr, Co, Se, and V were found in PM<sub>2.5</sub> samples. Our data show a strong association between PM<sub>2.5</sub> and PAHs ( $r=0.40$ ,  $P < 0.05$ ) and between PAHs and 8-OHdG ( $r = 0.63$ ,  $P < 0.001$ ). We observed that trace metals alone explains 85% variation of PAH ( $R^2 = 0.85$ ,  $P < 0.001$ ); similarly, PAHs and metals together explain 72% of the variation in 8-OHdG ( $R^2 = 0.72$ ,  $P < 0.02$ ). Additional adjustment for age, body mass index and cooking time increased the model fit only slightly.

**Conclusion:** This is the first study that demonstrates metal contents in biomass smoke from rural Bangladesh. Our analysis suggests that PAH and the metals from biomass smoke may induce oxidative stress.

#### ISEE-0882

##### Fish Consumption in Vieques, Puerto Rico: A Possible Source of Inorganic Arsenic Exposure

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**Background and Objective:** The presence of arsenic (As) in Vieques-Puerto Rico is a major health concern due to past US military practices. A previous health risk assessment predicted that As levels in edible fish muscle from Vieques may be detrimental to fish consumers health. The objective of this study was to determine if fish consumption is a significant source of exposure to inorganic As in Vieques.

**Methods:** A questionnaire was administered to 52 participants to evaluate fish consumption patterns and other characteristics. Inorganic As

concentrations were determined in urine, nails, and hair samples of high fish consumers (ate fish at least 1 day/week,  $n = 30$ ), and low fish consumers (ate fish once a month or less,  $n = 22$ ). Urine and nail samples were sent to a private laboratory for analysis, whereas hair samples were acid-digested and analyzed at our laboratory by atomic absorption spectrometry.

**Results:** The sum of inorganic As species (As III and V) and their metabolites (monomethylarsonic acid-MMA and dimethylarsinic acid-DMA) in urine, known as TUAs, was less than 50 µg/g creatinine (used as a reference value). The highest concentration of TUAs in urine was 42.7 µg/g. DMA, an indicator of metabolism efficiency of inorganic As, varied from 62% to 95% of the TUAs. In nail and hair samples, the highest concentrations of As were 0.817 µg/g and 0.95 µg/g, respectively, both  $< 1$  µg/g (reference value).

**Conclusion:** Concentrations of As in biological samples were below reference values. Only As average concentrations (µg/g) in nails were statistically higher in the high fish consumers ( $0.22 \pm 0.03$ ) than in the low fish consumer group ( $0.15 \pm 0.03$ ). These results suggest that fish consumption is a source of chronic exposure to inorganic As, and that some people may be susceptible to inorganic As exposure, based on low %DMA.

#### ISEE-0883

##### Pre- and Postnatal PCB Concentrations and Child Behavior at Age 45 Months

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**Background and Objective:** While data have been published concerning children's cognitive development in relation to developmental polychlorinated biphenyl (PCB) exposure, less is known about the impact of PCBs on infant and child behavioral development. The current study assesses child behavior through maternal report using the Child Behavior Checklist (CBCL) in a cohort of families living in eastern Slovakia environmentally-exposed to PCBs.

**Methods:** Pregnant women were enrolled into the study at the time they came to the local hospital to deliver. Maternal and cord blood samples were collected for PCB determination, as well as 6-, 16-, and 45-month samples from the infant/child. A "total" PCB measure was calculated as the sum of six congeners (118, 138, 153, 156<sup>+171</sup>, 170, 180) for maternal concentrations, and as the sum of four congeners (138, 153, 170, 180) for cord and infant/child concentrations. After delivery, women completed questionnaires concerning lifestyle and sociodemographic characteristics, and were administered the Raven's Progressive Matrices. In addition, the Home Observation for Measurement of Environment Inventory (HOME) was completed at the 16-month follow-up. At the child's 45-month follow-up visit, mothers completed the Child Behavior Checklist 1.5-5. Subscale scores were calculated for the seven syndromes (emotionally reactive, anxious/depressed, etc.) as well as for internalizing and externalizing behaviors. The association between (natural log) total PCB concentrations and the various CBCL scores was estimated and tested using linear regression.

**Results:** Complete data were available for 398 children. After adjustment for HOME Scores, maternal Raven score, and Romani ethnicity, neither maternal nor postnatal (natural log) total PCB concentrations were associated with any of the seven syndrome scores, or internalizing or externalizing behavior scores.

**Conclusion:** Data from this cohort do not provide support for the hypothesis that developmental PCB exposure plays a role in early childhood behavioral development.

## ISEE-0886

**A Comparison of the Effects of Ambient Air Pollution on Outpatient Visits for Acute Respiratory Illnesses Over Two Time Periods**

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**Background and Objective:** Although the concentrations of some ambient air pollutants have declined in recent years in the United States, it is unclear how these declines impact health outcomes. The purpose of this analysis was to compare the levels of and relationships between air pollutants and acute respiratory outpatient visits over two consecutive time periods.

**Methods:** Air pollution data were collected at a centrally-located monitor in Atlanta, Georgia and included 24-hour averages of PM<sub>2.5</sub> and components, coarse PM, PM<sub>10</sub>, oxygenated VOC, 8-hour maximum ozone, 1-hour maximum NO<sub>2</sub>, CO and SO<sub>2</sub>, and several metals. Daily outpatient visit data were obtained from the electronic data warehouse of a managed care organization. Poisson general linear modeling was used to examine associations between daily levels of acute visits for four diagnosis groups (adult and child asthma, upper and lower respiratory infection) and each of the air pollutants.

**Results:** We observed overall declining trends in air pollutants and acute visits over the study period. The greatest number of significant associations occurred for childhood asthma visits, and particularly for zinc and EC. We observed a change from a 3 to 5 day lag between pollutant measurement and visit occurrence in the first time period to a 6 to 8 day lag in the later period, but significant associations for childhood asthma were generally consistent for the two periods. The strongest indication that a reduction in air pollution is associated with an improvement in health response was for lower respiratory disease visits.

**Conclusion:** Pollutants and visit rates generally declined, while associations between childhood asthma and zinc and EC were observed for both time periods. This consistency indicates potentially important PM components in the role of air pollution in childhood asthma. However, limitations of the analysis illustrate the difficulty in evaluating health consequences of trends in air pollution.

## ISEE-0888

**Fine Particulate Air Pollution (PM<sub>2.5</sub>) Increases Emergency Hospital Admissions due to Decompensate Heart Failure**

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**Background:** Recent studies have reported an association between ambient particulate matter and risk of hospitalization for heart failure. However, few of these studies have been carried out outside of North America or Western Europe. Moreover, whether these associations are modified by comorb conditions including diabetes mellitus (DM) and hypertension (HTN) is unknown.

**Objective:** To evaluate the association of particulate air pollution (PM<sub>10</sub> and PM<sub>2.5</sub>) on emergency hospitalizations due to decompensated heart failure, and whether patients with comorbid DM or HTN are more susceptible to particulate matter.

**Methods:** Patients admitted due to decompensated heart failure in 8 clinical centers in Santiago, Chile, from May 2003 to December 2007 were included. Clinical and laboratory characteristics were obtained from clinical records. Daily data for PM<sub>10</sub>, PM<sub>2.5</sub>, and meteorological variables were obtained from the MACAM monitoring network. We used the time-

stratified case-crossover design to estimate the effect of PM<sub>10</sub> and PM<sub>2.5</sub> on each of 0–6 days prior to admission. Each lag was considered in a separate model. We controlled for temperature and dew point using natural splines (3 d.o.f. each). We also estimated the effect separately among patients with DM or HTN. The statistical analyses were done using R software.

**Results:** 375 patients were included in the study. A significant association was observed between admissions due to decompensated heart failure and particulate air pollution (admissions increase 1.6% (95% CI: 0.9–3.0) per 10 ug/m<sup>3</sup> of PM<sub>2.5</sub>, lag1). Patients with DM were more susceptible (admissions increase 4.4% (95% CI: 1.2–7.7) per 10 ug/m<sup>3</sup> of PM<sub>2.5</sub>, lag1). No significant association was observed in HTN patients.

**Conclusions:** These results suggest that exposure of heart failure patients to fine particulate air pollution (PM<sub>2.5</sub>) is associated with an increase in emergency hospital admissions due to decompensated heart failure. Patients with diabetes mellitus constitute an especially susceptible group in Santiago, Chile.

## ISEE-0889

**Prenatal Exposure to Polycyclic Aromatic Hydrocarbons and CPG Methylation**

Julie Herbstman, Deliang Tang, Deguang Zhu, and Frederica Perera, *Columbia Mailman School of Public Health, New York, NY, United States.*

**Background and Objective:** Polycyclic aromatic hydrocarbons (PAHs) are carcinogenic environmental pollutants resulting from combustion. Prenatal PAH exposure is known to be associated with increased PAH-DNA adducts and may also lead to epigenetic alterations, including genomic cytosine methylation. We sought to explore whether prenatal airborne PAH exposure is associated with genomic DNA methylation in cord blood.

**Methods:** In a longitudinal cohort study of 730 non-smoking African American and Dominican women in New York City, we measured PAH exposure during pregnancy using personal air monitors. On a subset of 164 women, we quantified global DNA methylation in genomic DNA isolated from umbilical cord blood leukocytes using the Methylamp™ Global DNA Methylation Quantification Kit (Epigentek Group Inc, NY). We also measured gene-specific methylation in a smaller subset of 24 Dominican participants, 12 with prenatal PAH exposure in the highest and lowest tertiles of exposure, respectively, in 27,578 CpG dinucleotides across 14,495 genes, using the Illumina Infinium® Human Methylation27 assay (Illumina Inc, CA).

**Results:** We found that prenatal exposure to PAH was significantly associated with genomic hypomethylation ( $\beta = -0.24$ , 95%CI:  $-0.40$ ,  $-0.08$ ). In preliminary analyses of the Infinium data, we found differential CpG methylation in a small proportion of genes identified a priori to be associated with PAH metabolism and detoxification. In cases where a gene was represented by more than one CpG loci on the Infinium BeadChip, differences between PAH exposure groups was not consistently observed across loci.

**Conclusion:** Our findings indicate that prenatal PAH exposure is associated with global DNA hypomethylation in cord blood. We also show that it is possible to detect prenatal PAH exposure-related gene-specific methylation differences at ambient exposure levels using high-throughput genome-wide methylation technology. Further analyses will explore patterns and pathways of exposure-related methylation differences.

## ISEE-0900

**Application of Two Probabilistic Models, Using Either Environmental Monitoring or Human Biomonitoring Data, to Estimate Human Health Risk due to Mercury Exposure in a Small Scale Gold Mining Region in Central Nicaragua**

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**Objective:** To compare predicted mercury concentrations in cord blood (Hg-PC<sub>cb</sub>) of women of childbearing age living in a small-scale gold mining town and the probability by which Hg-PC<sub>cb</sub> would exceed international proposed benchmark dose levels (BMDLs), from two difference models, which use either environmental monitoring or human biomonitoring data.

**Method:** We built two models: 1) In the first model, we used available field measurements of mercury from the local river water and sediments, as point of origin to estimate Hg-PC<sub>cb</sub> by applying proposed toxicokinetic models for stream organisms (fish and macroinvertebrates) and humans. Then, we predicted Hg concentration in whole and cord blood, assuming humans were solely exposed to Hg through fish consumption. We obtained data on fish consumption rates in the general population from reports published by US EPA; 2. In the second model Hg-PC<sub>cb</sub> was estimated based on available measurements of mercury concentration in whole blood from general population. Probability density functions (PDF) were calculated and fitted to the data from the two models, by Monte Carlo simulations.

**Results:** The Hg-PC<sub>cb</sub> in women of childbearing age estimated by the model #1 is one order of magnitude lower than the estimated Hg-PC<sub>cb</sub> resulting from model #2 (t-test,  $P = 0.0001$ ). Consequently, the probability that a predicted Hg concentration in cord blood exceeds the benchmark values was also higher in model #1 than in model #2 (10%). A sensitivity analysis shown that fish consumption data is a major contributor to the observed variation in both models.

**Conclusion:** Results from an environmental monitoring based model and a human biomonitoring based model are comparable. The observed differences in model results might suggest that humans are exposed to Hg sources other than local fish or that the fish consumption rate of the population from the study area is higher compared to the literature.

## ISEE-0901

**Causal Models for Addressing the Healthy Worker Effect in an Occupational Cohort Study**

Jonathan Chevrier,\* and Ellen Eisen,\*† \*University of California, Berkeley, Berkeley, CA, United States; and †Harvard University, Cambridge, MA, United States.

**Background and Objective:** Individuals who are hired and remain at work are generally healthier than those who are unemployed or leave work. Due to this healthy worker effect, potential health consequences of occupational exposures may be underestimated.

**Methods:** We present results obtained using three different methods to control for the healthy worker effect in a longitudinal mortality study which includes over 40,000 workers with potential exposure to metalworking fluids (MWF). Individuals who were hired between 1938 and 1981 in one of three Michigan automobile manufacturing plants were enrolled in the study. Their vital status and cause of death was ascertained using the National Death Index and state health records from 1941 to 1994. Date of birth, race and work history, including time off work, were obtained from company records. Annual exposure to mineral oil-based

MWF was estimated based on work history and health status was approximated using the amount of time off work for every year of follow up. To adjust for time off work as a time-varying confounder, we applied standard Cox models and compared results with those obtained using two causal modeling approaches: Marginal Structural Models with Inverse Probability of Treatment Weights (IPTW) and Structural Nested Models using G-estimation. We considered exposure to straight MWF in relation to three outcomes: all-causes of death combined, all cancer mortality, and heart disease mortality.

**Results:** We will demonstrate that despite the lack of direct comparability between methods, since they estimate different parameters, standard methods based on cumulative exposure are biased. The bias arises because leaving work is associated with mortality, determines future exposure and is predicted by past exposure and employment history.

**Conclusion:** The g-estimation method is unique in that it takes into account the fact that health status is both a confounder and an intermediate variable between exposure and disease.

## ISEE-0903

**Developing an Environmental Health Tracking Web Portal to Meet the Information and Communication Needs of Diverse Users**

Michelle Wong, Galatea King, Craig Wolff, Eric Roberts, and Paul English, California Department of Public Health, Richmond, CA, United States.

**Background and Objective:** Public health is promoted by individuals from government, community and non-governmental organizations, academia, and the private sector. A major challenge in environmental health surveillance is communicating information in a way that is useful, understandable, and accessible to this range of users. We sought to develop a public web portal that makes environmental health data available and informative to a diverse audience.

**Methods:** First, we conducted needs assessments via surveys and focus groups to learn about environmental health information needs of our stakeholders, including local governments, community and non-governmental organizations, and academia. Based on results, we developed portal components, including data query and web tools; data displays; text-based content; and page design and navigation. Finally, we conducted evaluations to obtain feedback on the utility of the portal, including functionality and usability surveys.

**Results:** We found that the portal had broad utility, but applicability of its components differed depending on user need. Maps, tables, and charts produced by data queries were most useful for routine activities of local government agencies. Web tools, such as the traffic volume calculator, were useful for city planning decisions and epidemiological research. Interactive, neighborhood-level maps were of particular interest to community groups. While most information on the portal was not novel, users reported the integration of various data and tools to be valuable. For technical users, the portal freed time or resources for other activities. Others benefited because they lacked capacity to generate data themselves.

**Conclusion:** The iterative approach of needs assessments, development, and evaluation allowed us to prioritize the most common requests and the interests of users with least access to data resources. Communicating and disseminating information in a manner useful to a range of users enables environmental health surveillance data to be actionable for policy and public health.

## ISEE-0905

**Associations Between Maternal PBDE Serum Concentrations and Child Neurodevelopment in the Chamacos Cohort**

Brenda Eskenazi,\* Amy Marks,\* Jonathan Chevrier,\* Kim Harley,\* Asa Bradman,\* and Andreas Sjödin,† \*University of California, Berkeley, Berkeley, CA, United States; and †Centers for Disease Control and Prevention, Atlanta, GA, United States.



**Background and Objective:** Polybrominated diphenylethers (PBDEs) are fire retardants commonly used in furniture, textiles and electronics. Californians may be the most highly exposed population in the world due to strict flammability standards. We aimed to determine whether pre- and postnatal exposure to PBDEs was associated with child neurodevelopment.

**Methods:** We used data collected as part of the Center for the Health Assessment of Mothers and Children of Salinas (CHAMACOS) which comprises women living in California but primarily born in Mexico. We measured the concentration of 10 PBDE congeners in serum samples collected from 422 mothers (26 weeks gestation) and in a subset of 100 of their 7 year-old children. We assessed neurodevelopment at 6 months and 1 and 2 years using the Bayley Scales of Infant Development and at 5 and 7 years using several tests of intelligence, behavior, motor performance, memory, and language development.

**Results:** Mothers' PBDE serum levels were similar to those in NHANES; however, women who lived in the U.S. longer had higher levels, which were similar to the levels reported for other Californians. Initial results show no significant associations between prenatal exposure to PBDEs and child neurodevelopment at 6 months and 1, 2 and 5 years of age. However, preliminary analyses of child PBDE serum concentrations suggest very high postnatal exposure. Median total PBDE levels were more than 3 times higher in children (79.9ng/g lipids) than in their mothers (24.6ng/g lipids) and almost twice as high as reported by NHANES in 12–19 year olds (~45ng/g lipids).

**Conclusion:** Though we found no significant association between prenatal exposure to PBDEs and child neurodevelopment, we will determine whether there are adverse associations between the very high PBDE concentrations at age 7 years and concurrent performance neurodevelopmental tests. These data will be presented.

#### ISEE-0906

##### Exposure to Heavy Metals in Children Working at a Waste Disposal Site, and in Reference Children from Managua, Nicaragua

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**Objective:** The study aimed at assessing the exposure to heavy metals of children working at a waste disposal site in Nicaragua, and of referent children.

**Method:** Concentrations of lead, mercury, cadmium and selenium were determined in blood samples obtained from 103 children aged 6–15 working at the Managua waste disposal site, 102 referent children from a nearby neighborhood (Acahualinca), and 34 children from a remote city area, being the socioeconomic conditions similar in all three cases. Exploratory soil sampling was also performed to investigate diffuse and point sources of lead contamination at the waste disposal area and in the neighborhood nearby.

**Results:** The children working at the waste disposal site showed higher blood levels of lead, mercury and cadmium than the other children, 28% having lead levels higher than 100 µg/L, the level the Center for Disease Control (CDC) considers as action level; 36% of the referent having levels above 50 µg/L, a level suggested to induce subtle developmental and cognitive effects. In all the groups, the levels of mercury and cadmium observed were generally lower than those for which adverse health effects have been reported. The selenium status appeared adequate. The lead content in soil around homes located at the waste disposal site was higher than for homes in Acahualinca.

**Conclusions:** Occupational and environmental exposure to heavy metals at the waste disposal site was observed. Lead is of major concern, both for the children themselves and the next generation. Many of the examined girls can be expected to soon be mothers since 21% of

adolescent females in Managua have children or are pregnant. Urgent action is needed in order to reduce the impact on children's health of the condition noted.

#### ISEE-0915

##### Blood Lead Levels of Children and Its Trend in China

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**Objective:** To evaluate Chinese children's blood lead levels (BLLs) and identify its distribution features together with its trend with times and to provide data for policy development to the prevention on environmental lead pollution.

**Methods:** Articles on children BLLs published from 2004 to Aug, 2007, with sampling time since 2001, using Chinese Biomedical Disk (CBMDisk), Chinese Journal Full-test Database (CJFD) and other ways were collected. Finally 35 articles eligible for the following criteria were reviewed: (1) BLLs measured by Atomic Absorption Spectroscopy (graphite or others) or Inductively Coupled Plasma-mass Spectrometry; (2) strict quality control; (3) no local lead pollution sources in the areas where the screened subjects live; (4) sample size bigger than 100. The data also was compared with the former study carried out in 2004 with articles studying time between 1995 and 2003.

**Results:** The mean BLLs of Chinese children between 2001 and 2007 was 80.7ug/L (45.5~165.3ug/L) and 23.9% (3.2%~80.7%) of the subjects have BLLs higher than 100ug/L, both of which are lower than the levels of 1995 to 2003. Four of 24 provinces or cities reported had average BLLs ≥ 100ug/L. Of the 24 provinces or cities, only four have higher BLLs and prevalence rates of elevated BLLs than that of 1995 to 2003. The mean BLLs of children living in industrial areas were higher than children in urban and suburbs areas, suburbs higher than urban areas, and showed a statistically significant difference. The BLL of boys was 79.3ug/L, significantly higher than girls 76.9ug/L ( $P < 0.001$ ), while both of which are getting lower than the former study. BLLs of children ≤ 6 years increased with ages and decreased compared with the former study.

**Conclusion:** The BLLs of children in China were getting lower with times but still higher than some developed countries, suggesting that prevention and control of lead poisoning for children would be a long-term mission for the whole nation.

#### ISEE-0917

##### The Study on the Effects of Traffic Exhausts on Children's Behavioral Problems

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**Objective:** To explore the health effect of traffic exhausts on children's behavioral problems by using the Achenbach's Child Behavior Checklist.

**Methods:** Three primary schools were chosen based on the counts of automobiles that passed by and the monitoring data of ambient air pollutants. All students from Grade 2 to Grade 5 were chosen as the target population and were investigated with a self-completion questionnaire as well as the Achenbach's Child List. Finally, 1363 cases were analyzed, of whom have been local resident for more than 2 years and were in condition during investigation.

**Results:** A total of 141 children, with the rate of 10.34%, were reported to have behavioral problems. The reported rates of behavioral problems are 9.04% in School A1, 9.77% in School A2, and 11.99% in School A3, respectively. However, there was no significant difference  $\chi^2 = 2.556$ ,  $P = 0.279$ . The reported rate of behavioral problems in boys' is higher than that of girls' in all schools. Analysis of 11 behavioral problem factors showed that, the highest rates of Depression, Social withdrawal, Hyperactivity, Sexual problem, Cruelty, and Forcing were found in School A3. Single-factor analysis showed that fever experience, eye sight condition, drinking experience of children, experience of being beaten and scolded, second hand smoke exposure, drinking habit of father, occupation of parents, education level of parents, born at full-term, medical history in neonatal period, history of unhealthy pregnancy of mother, history of touching adverse factors and drinking experience of mother during pregnancy had a significant influence on the reported rate of behavioral problems.

**Conclusion:** Traditional factors are still the main influencing factors of children's behavioral problems. Moreover, long term-low level exposure to traffic exhausts may be related to the increase in reported behavioral problems.

## POSTER PRESENTATIONS

### ISEE-0006

#### Hemochromatosis Gene Variants Modify Effect of Arsenic on Impaired Glucose Tolerance During Pregnancy

Adrienne Ettinger,\* Angeliki Lambrou,\* Marianne Hopkins,\* Chitra Amarasiriwardena,\* Joel Schwartz,\* Howard Hu,† David Bellinger,\*‡ and Robert Wright,\*‡ \*Harvard School of Public Health, Boston, MA, United States; †University of Michigan School of Public Health, Ann Arbor, MI, United States; and ‡Children's Hospital, Harvard Medical School, Boston, MA, United States.

**Introduction:** Hemochromatosis (*HFE*) is an autosomal recessive disorder of iron metabolism characterized by excess iron accumulation often leading to glucose intolerance. Prevalence of *HFE* gene variants has been found to be higher among pregnant women with gestational diabetes (GD) suggesting a genetic susceptibility to development of GD. We have recently shown that arsenic exposure is associated with increased risk of impaired glucose tolerance during pregnancy and, therefore, may also be associated with increased risk of GD.

**Methods:** We studied 280 women living near the Tar Creek Superfund Site (Oklahoma USA) to determine if *HFE* gene variants modify the effect of arsenic exposure on impaired glucose tolerance during pregnancy. Blood arsenic was measured at delivery and plasma glucose was measured at 24–28 weeks gestation after a 1-hour 50-g oral glucose tolerance test (GTT). High-molecular-weight DNA was extracted from white blood cells and genotyped for: *H63D* (rs1799945) and *C282Y* (rs1800562).

**Results:** Arsenic concentrations ranged from 0.3 to 8.2  $\mu\text{g/L}$  (ppb). Impaired glucose tolerance ( $>140$  mg/dL) was observed in 10% of women. 30% and 13% of women carried the *HFE H63D* and *HFE C282Y* variants, respectively, while 4% carried both variants. Presence of either or both *HFE* variant was not an independent predictor of arsenic or glucose concentrations. However, among carriers of any *HFE* variant ( $N = 111$ ), blood arsenic was a stronger predictor of higher plasma glucose ( $\beta = 5.47$ ,  $P = 0.03$ ) compared to wildtype ( $N = 169$ ) subjects ( $\beta = 0.32$ ,  $P = 0.88$ ).

**Conclusion:** Among this population of pregnant women, *HFE* variants modified the effect of arsenic on impaired glucose tolerance during pregnancy and, therefore, may be associated with increased susceptibility to the effects of arsenic on development of GD. Since gestational diabetes is a major potential complication of pregnancy worldwide, with detrimental effects for both mother and child, identification of individual susceptibility factors should be a global health priority.

### ISEE-0007

#### Skin Cancer (Squamous Cell Carcinoma of the Skin) and UV Exposure: More Cancer on the Coast Than in the Inland

Eva Andersson, and Gunilla Wastensson, *Occupational and Environmental Medicine, Sahlgrenska University Hospital and Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden.*

**Background and Objective:** Squamous cell carcinoma of the skin is the second most common form of skin cancer. The incidence increases with closeness to the equator, and the association with sun exposure is considered proved. In Sweden we have seen that regions with low available UV radiation have a low skin cancer incidence. However, here we are concentrating on the differences between coast and inland at the same latitude.

**Methods:** Data on age adjusted incidence for the period 1970–2005 were analyzed. The investigated area was the southwest part of Sweden. Each municipality was classified as “1701–1900 sun hours per year” or “up to 1700 sun hours per year”, based on the average sun hours during 1961–1990. Almost all municipalities on the west coast were classified as having high exposure, and the rest as having low exposure. Furthermore, the investigated area was split into northern and southern parts. Regression analysis was used to estimate the trend of the incidence.

**Results:** For the northern part, we saw a significantly higher increase of the incidence on the coast compared to the inland, for both men and women. Likewise, we saw a significantly higher increase on the coast compared to the inland in the southern part, but only for women. We could not, however, find a significant difference between northern and southern coast, nor between the northern and southern inland.

**Conclusion:** We show that even though the distance to the equator might be the same, there is still a difference in incidence, depending on how close you are to the coast. Less clouds and free horizon may be part of the explanation for the higher incidence on the coast; these factors influence the intensity of the UV radiation. Differences in sun exposure due to behaviour may also be important.

### ISEE-0009

#### The Association of Body Fatness and Sedentary Time with Respiratory Symptoms and Asthma in 5<sup>th</sup> Grade Schoolchildren in Kaohsiung, Taiwan

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**Background and Objectives:** Increasing prevalence of asthma and obesity in schoolchildren is an important public health concern. The aim of this study is to evaluate the association of body fatness and sedentary status with asthma and respiratory symptoms in schoolchildren in Kaohsiung, Taiwan.

**Method:** A questionnaire study elicited episodes of respiratory symptoms and data on lifestyle and anthropometric parameters in 1329 5<sup>th</sup> grade schoolchildren.

**Results:** Results showed that 12.4% of boys and 9.5% of girls had physician-diagnosed asthma, whereas 15.1% of boys and 12.4% of girls had suspected asthma. Significantly greater proportions of boys had non-exercise-induced respiratory symptoms than girls ( $P < 0.05$ ). The number of respiratory symptoms was positively correlated with TV-watching time per day and self-reported sedentary time per weekend-day in girls ( $P < 0.05$ ). Being underweight was positively associated with one of the seven respiratory symptoms in girls ( $P < 0.05$ ). At risk of being overweight was positively associated with two of the seven respiratory symptoms in boys and one of the seven respiratory symptoms in girls (all  $P < 0.05$ ). The risk of having physician-diagnosed asthma and suspected asthma increased 93% and 72%, respectively, in schoolchildren

at risk of being overweight ( $P < 0.05$ ). Being overweight was associated with a 78% increase in physician-diagnosed asthma (adjusted odds ratio (aOR) = 1.78, 95% CI = 1.08–2.91,  $P < 0.05$ ). Higher sedentary time was significantly associated with more occurrences of one of the seven respiratory symptoms in girls (aOR = 1.05, 95% CI = 1.00–1.11,  $P < 0.05$ ). Higher body mass index (BMI) was significantly correlated with longer TV-watching time per day in girls and longer self-reported sedentary time per weekday in boys ( $P < 0.05$ ).

**Conclusion:** In summary, schoolchildren who are at risk of being overweight or overweight and/or have more sedentary time have an increased risk of respiratory symptoms and asthma. Weight and sedentary statuses of schoolchildren can impact on their respiratory health.

#### ISEE-0010

##### An Integrated Assessment of Heavy Metals at the European Level

Peter Fantke, Alexandra Kuhn, and Rainer Friedrich, *IER, Universität Stuttgart, Stuttgart, Germany*.

**Background and Objective:** Public concern exists around impacts of heavy metals (HMs) which tend to accumulate in the environment. Human activities, e.g. combustion processes, contribute to releases into environmental media and have drastically altered some HMs' biogeochemical cycles. Humans are exposed to HMs particularly through inhalation and ingestion.

**Methods:** An integrated assessment has been performed at the European scale by means of a multimedia modelling framework in order to estimate damage costs of selected HMs by applying a full chain approach. Aiming to demonstrate that oral intake plays a major role, the framework facilitates the coverage of exposure through ingestion in a spatially-explicit pan-European setting. Health effects, calculated by means of exposure-response functions, usually occur during long time spans. Hence, discounting future damages is important to be comparable with present damages.

**Results:** In this paper we show that for arsenic and lead the overall ingestion dose is much larger than the inhalation dose, ranging from 5.34 inhaled  $\mu\text{g}/\text{capita}$  and 51.03 ingested  $\mu\text{g}/\text{capita}$  arsenic to 52.40 inhaled  $\mu\text{g}/\text{capita}$  and 223.48 ingested  $\text{mg}/\text{capita}$  lead. Significant health damages via ingestion could, thus, be identified. However, they occur further in the future which is why it is an issue of sustainability versus current welfare. The average marginal damage costs for some health effects range from 13.02 Euro/kg (bladder cancer, arsenic) to 71.54 Euro/kg (IQ points loss, lead) with zero percent discounting.

**Conclusion:** With respect to the complete assessment, the most limiting and uncertain part has been identified that related to existing epidemiologically derived effect information. Hence, more investigation is required covering the improvement of existing effects and effect assessment for further substances.

#### ISEE-0011

##### Assessment of Air Pollution with Air Quality Indices in Szeged, Southern Hungary

László Makra, and Tekla Eötvös, *University of Szeged, Szeged, Hungary*.

**Background and Objective:** The air quality index is a standardized indicator of the air quality in a given location. The aim of air quality indices is to express the concentration of individual pollutants on a common scale. The database for this research comes from the Szeged monitoring station and represents the 30-minute mass concentrations of  $\text{NO}_2$ ,  $\text{SO}_2$  and  $\text{PM}_{10}$  over the ten year period 1997–2006. The study aims to analyse air quality indices for Szeged using annual and diurnal air pollution and their characteristics.

**Methods:** Average air pollution stress ( $\text{ASI}_1$ ) and the planning-related air stress index ( $\text{ASI}_2$ ) for short-term air pollution stress were applied. Modified categories for  $\text{ASI}_2$  were used for the calculations.

**Results:** The mean annual air quality index ( $\text{ASI}_1$ ) did not indicate a significant trend. According to this metric, the best air quality occurred in 1999 and 2004, whereas the most polluted air was observed in 1997 and 1998. The short term (diurnal) air quality index ( $\text{ASI}_2$ ) was observed to be higher on weekdays and lower at weekends. At weekends the improvement of air quality reached 13%. The maximum of mean diurnal concentrations did not exceed the threshold value in the case of any of the three air pollutants. The mean values of the diurnal concentration of  $\text{NO}_2$  and  $\text{SO}_2$  were far below their health limit.

**Conclusions:** The short term (diurnal) air quality index ( $\text{ASI}_2$ ) showed high frequency in the air pollution categories III and IV due to the high frequency of the  $\text{PM}_{10}$  exceedance days. Levels of  $\text{NO}_2$  and  $\text{SO}_2$  were medium and low respectively; however, high diurnal concentrations of  $\text{PM}_{10}$  are responsible for air quality degradation in Szeged.

#### ISEE-0012

##### Effect of Long-Range Transport on Urban $\text{PM}_{10}$ Levels

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**Background and Objective:** Particulates can cause respiratory problems or can trigger cardio-vascular diseases. Some European cities, besides local PM, may also suffer from additional impact of remote sources of particles, which is independent from the local emissions. For these settlements, it is important to identify source regions of the transported particulates and to quantify their contribution to the local urban  $\text{PM}_{10}$  levels. The aim of the study is to identify long-range transport patterns that may have an important influence on  $\text{PM}_{10}$  levels in four European cities of different latitude, namely Thessaloniki, Szeged, Helsinki and Oulu.

**Methods:** Trajectory positions are computed using the HYSPLIT model. 4-day, 6-hourly 3D backward trajectory positions at the above locations at 1200 GMT are produced on each day during the 5-year period 2001–2005. Non-hierarchical cluster analysis with k-means method is applied using a Mahalanobis distance.

**Results:** 2D clustering procedure proved to be more efficient for each city than 3D cluster analysis. The analysis of variance, performed on the basis of the mean  $\text{PM}_{10}$  values, detected significant difference in the mean  $\text{PM}_{10}$  levels among clusters retained for each of the cities. Results of the cluster analysis assume that for Thessaloniki, Szeged and Helsinki, clusters of the trajectory positions originating from North Africa and/or Sahara are strongly associated with the highest  $\text{PM}_{10}$  episodes, though with different frequency; while for Oulu, the farthestmost source regions are the Mediterranean, the Near East and Kazakhstan.

**Conclusions:** The study represented that the application of the HYSPLIT model together with different statistical techniques on pollutant data might be a useful tool to detect long-range transport patterns influencing air quality in given European cities. In order to clarify a more detailed relationship of the clusters to local  $\text{PM}_{10}$  exceedances, meteorological variables at the trajectory positions should also be taken into account.

#### ISEE-0013

##### Weather and Pollutants Related Incidence of Asthma and Rhinitis

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**Background and Objective:** Over the recent decades, a worldwide increase of respiratory diseases has been experienced. The aim of this



study is to identify those weather types that are either influential in increasing patient numbers of respiratory diseases or are negligible in triggering asthma and rhinitis. The database comprises daily values of 13 meteorological parameters, 8 chemical and 8 biological pollutants, and the number of patients for the period 1999–2003 in Szeged, Hungary. In the summer to early autumn period a total of 26,703 patients, while in the winter months a total of 14,507 patients, registered with respiratory diseases were considered.

**Methods:** An objective definition of the characteristic weather types was carried out by using factor and cluster analysis. ECMWF ERA 40 database was used to determine the average sea level pressure field of the weather types retained. Significance analysis of the differences in the calculated means of the air pollutants and the disease data between the resultant weather types was performed by one-way analysis of variance (ANOVA) and Tukey test.

**Results:** Characteristic relationships between the weather types and patient numbers were detected in the summer to early autumn period. Weather type 7, with a weak anticyclonic ridge character and the highest patient numbers, was linked to high temperature parameters, low relative humidity, as well as high chemical and biological pollutant levels. At the same time, type 2 (anticyclonic ridge character) was associated with the lowest patient numbers and was characterized by high temperature and medium relative humidity parameters, as well as high levels of chemical and low levels of biological air pollutants.

**Conclusions:** Results of the relationships of the meteorological parameters and chemical air pollutants, as well as weather types, can be built into a model to predict, and in this way to prepare for, days of severe risk of respiratory illness.

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#### ISEE-0020

##### An Approach to Assessment of Long-Term Toxic Exposures Through Food

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**Background and Objective:** In big countries nutrition profiles differ significantly between different regions and even areas within a region. On the other hand, although modern-day trade has virtually erased geographic differences in the composition of foodstuffs, still in many areas locally produced foodstuffs constitute a major part of nutrition, while their chemical contamination depends on contamination of soils. Thus one needs an approach to assessing toxic exposures through food not only on national but also on local level.

**Methods:** We have developed a personal questionnaire (Q) for estimating (a) average daily consumption of 44 types of foodstuffs, and (b) for 12 of them – the percentage contribution of the main sources of supply. We distribute this Q among households to be filled in. Depending on results of data analysis, we choose foodstuffs (usually about 30 names) for determining their contamination with chemicals. Based on the obtained data it is decided whether for some foodstuffs samples from different sources are necessary. Where family kitchen gardens are located in areas with significantly unequal levels of chemical contamination, samples of vegetables grown in each of them are analyzed separately.

**Results:** We have tested this approach in 7 townships and found differences among them as well as among children and adults in respect to toxic exposures through food. People with a relatively high income consume more milk, cheese, meat, fish, poultry and fruit but less bread and potatoes than those with medium or low income, whereas ca. 80% of consumed potatoes are grown locally and thus depend on each area's contamination with lead and other pollutants. Although daily intakes of

toxicants do not exceed WHO tolerable levels, their contribution to the total environmentally dependent dose is very important.

**Conclusion:** The methodology described above can be recommended for use in epidemiological and risk assessment studies.

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#### ISEE-0021

##### Climate Variability and Salmonella Infection in an Australian Temperate Climate City

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**Background and Objectives:** Food-borne diseases are public health concerns in both developed and developing countries. This paper examines the impact of weather on the transmission of Salmonella, one of the most common food-borne pathogens detected in the Australian population.

**Methods:** A retrospective analysis was conducted on data for the period 1990–2004 for Adelaide, Australia. Seasonal Autoregressive Integrated Moving Average analysis was used for the time-series data, using weekly notifications. A Hockey Stick model was used to detect potential threshold temperatures.

**Results:** The SARIMA model indicated that only maximum temperature ( $r = 0.08$ ) and minimum temperature ( $\beta = 0.15$ ), were significantly associated with incidence of salmonellosis, with a time lag from zero to two weeks. Other weather variables did not show any significant effect. A potential 1°C increase in weekly mean maximum temperatures may bring about 7% more Salmonella infections in Adelaide. Thresholds for the effect of both maximum and minimum temperatures (19.5°C and 12.1°C, respectively) were detected.

**Conclusions:** Global warming could increase the likelihood of food-borne infections in Australia. Closer monitoring of temperature variables can prompt relevant infectious disease prevention mechanism, public health interventions can then be empowered to deal with the challenge of future climate change.

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#### ISEE-0024

##### Sanitarian and Epidemiological Surveillance in Clenbuterol Outbreaks in Polluted Food Consumption by People in Michoacan State, Mexico During 2004 to 2008

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**Background:** A main route of animal and human exposure to chemical pollutants is via food ingestion. There are some drugs used like food additives in animal farming, cow and pig cattle, to gain weight (mass muscle) like clenbuterol and, finally, increases costs in commercialization process. Clenbuterol is a known drug in human medicine to treat respiratory symptoms. But, in veterinary use, it is an animal growth promoter, and is metabolized by liver and its residues are found in carcasses. As a result, people are exposed in higher doses than is permitted. Also, clenbuterol is an illegal drug introduced into Mexico for veterinary use. This report shows recent human outbreaks, epidemiological and monitoring laboratory surveillance by local sanitarian human regulations in Michoacan, Mexico in the last five years.

**Methods:** Retrospective outbreaks reports were obtained from the state epidemiological surveillance system since 2004 to 2008 in Michoacan, Mexico, and from the clenbuterol monitoring lab in samples of the involved food. Besides, we reviewed the sanitarian surveillance system and follow up. This system included searching and testing of clenbuterol from liver, kidney and eye samples of cow and pig species for human consumption in the same years. The determination of clenbuterol was

done with Ridascreen clenbuterol fast enzyme immunoassay, r-biopharm lab, Germany. The sensitivity was 90% and its specificity, 85% with this technique.

**Results:** There were 42 outbreaks of human poisoning during 2004 to 2008, with 188 cases and 108 food samples obtained. 45, 41.6% were positive for clenbuterol. To control this public health problem, we developed a sanitarian surveillance system in food, so, there were analysed 861 samples and 199, 23.1% were positive and 662, 76.9% negative.

**Conclusions:** The risk of epidemics with clenbuterol exposure in food will continue if we do not adopt and enforce strong regulations to avoid and stop the international illegal traffic in clenbuterol.

#### ISEE-0025

##### OGG1 Genetic Polymorphism Is Associated with Mitochondrial DNA Damage in Pesticide-Exposed Fruit Growers

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**Abstract:** Pesticide exposure has been observed to be associated with various neoplastic diseases in previous epidemiological studies. Oxidative damage to mitochondrial DNA (mtDNA) has also been proposed to be an important mediator in cell death and carcinogenesis. In mitochondria, the manganese superoxide dismutase (MnSOD) is the first line of defense against superoxide radicals. The 8-oxoguanine DNA glycosylase (OGG1) is also the major DNA glycosylase for the repair of 8-oxoG lesions in the mitochondrial DNA. However, the mitochondrial genotoxicity of pesticides in people with various genetic variation of human MnSOD and OGG1 has not been investigated. In this study, the mtDNA (ND1 gene) and nuclear DNA ( $\beta$ -actin gene) in the peripheral blood of 120 fruit growers who experienced pesticide exposure and 106 unexposed controls was quantified by real-time quantitative polymerase chain reaction (real time qPCR). To evaluate mitochondrial DNA damage, mitochondrial to nuclear DNA ratio was calculated by dividing the mtDNA quantity for ND1 gene by the corresponding  $\beta$ -actin quantity. Questionnaires were administered to obtain demographic data, and histories of cigarette-smoking habits, and occupation. The genotypes of MnSOD and OGG1 were identified by the PCR based restriction fragment length polymorphism (RFLP). The results showed that subjects experiencing high or low pesticide exposure had a greater mtDNA content (mtDNA damage) than did controls. Interestingly, after adjusting the effect of possible cofounders, the multiple regression model revealed that OGG1 Ser-Ser genotype ( $P = 0.03$ ) was significantly associated with an increased relative content of mtDNA. However, no significant association between MnSOD genotype and mtDNA damage was revealed. Thus, results suggest that individuals with susceptible OGG1 genotype may experience an increased risk of mitochondrial DNA damage by pesticide exposure.

#### ISEE-0026

##### Air Pollution due to Wood Burning for Heating: A Health Impact Assessment

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**Abstract:** The health impact of air pollution is well established. Dose-effect-estimates exist for several outcomes and pollutants. The impact of source specific air pollution is less well studied. However, since

abatement measures concern sources and not single pollutants a source specific impact assessment would be very relevant.

Burning of wood for heating purposes is deemed an environmental friendly technology because wood is a renewable source. This perception neglects the important contribution of wood burning to air pollution, especially regarding fine particles. In fact, chemical analyses indicate that wood smoke is among the top contributors of particle pollution, particularly in rural regions.

Assuming a worst-case scenario in which all existing domestic heating systems based on oil were replaced by wood burning devices we estimated the increase in average particle pollution in Upper Austria. Based on established emission factors using a Lagrangian Particle Diffusion Model, an increase in the average annual  $PM_{10}$  concentration in Upper Austria by 3–5  $\mu g/m^3$  was calculated.

Current scientific literature indicates that aerosol from wood incineration is at least as dangerous on a “per  $\mu g$ ”-basis as the total ambient aerosol. Therefore, dose-effect estimates of ambient  $PM_{10}$  from epidemiological studies were used to estimate the health impact in the worst-case scenario.

For the federal country of Upper Austria an increase in the annual average of  $PM_{10}$  by 3–5  $\mu g/m^3$  translated into a relevant public health impact. For example, chronic exposure as reported in cohort studies would lead to up to approximately 170 additional deaths per year, mostly from cardiovascular causes.

Stricter emission rules are needed for domestic heating. Climate-change preventing policies targeted at domestic heating should improve the insulation of houses and support district heating and solar energy instead of biomass burning without proper emission control.

#### ISEE-0029

##### Respiratory Infections Associated with Average Daily Ozone Exposure Was Significant for Schoolchildren in the Taipei Metropolitan

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**Background:** Respiratory infections are common ailments with both the annual total hospital admission rate and the medical reimbursement highest in Taiwan. This study investigated whether the hospitalization for acute respiratory infection (ARI) and upper respiratory infection (URI) is associated with the ambient ozone concentration for schoolchildren less than 15 years of age in Taipei metropolitan from 2000 to 2006.

**Methods:** The Taiwan National Health Insurance program established a hospitalization specific cohort of 327,000 persons, which was used to measure the prevalence rates of ARI and URI (ICD9 CM 460–466 and 470–478, respectively). The relative risks (RR) of the ailments for schoolchildren were measured in association with 6 ozone metrics ( $O_{3,max}$ ,  $O_{3,8h}$ ,  $O_{3,24h}$ , Ox, AOT40 and AOT80) by the monthly exposure levels using Poisson regression. The regression model was conducted for each metric controlling for daily mean temperature,  $SO_2$ ,  $PM_{10}$ ,  $NO_2$  and CO, long term trend, season, day of week and daily hospitalization of pneumonia and influenza. Lag effects of single day and moving average were evaluated.

**Results:** The monthly analyses for average daily ozone concentration ( $O_{3,24h}$ ) and Ox revealed two peaks, one in March-May and the other in October-November, with lower concentration from June to September. The levels of  $O_{3,max}$  and  $O_{3,8h}$  peaked in April-September. We observed consistent positive associations between hospital admission rates of ARI and URI and  $O_{3,24h}$  for schoolchildren from September to January. The relative risks of 10 ppb increase of  $O_{3,24h}$  were 1.025 (95% CI: 1.022–1.028) for ARI and 1.035 (95% CI: 1.023–1.047) for URI.

**Conclusions:** Our findings show that hospital admission of ARI and URI for schoolchildren aged less than 15 years are significantly associated with the daily  $O_{3,24h}$  concentrations from September to January in Taipei.

#### ISEE-0030

##### Variability of Urinary Metabolite Levels of Pesticides in Turf Applicators; Implications for Exposure Measurement in Prospective Epidemiologic Studies

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**Background and Objectives:** Epidemiologic studies of pesticides have been subject to important biases arising from exposure misclassification. While turf applicators are exposed to a variety of herbicides and insecticides, these exposures have not been well characterized.

**Methods:** To examine variations in urinary markers of pesticides, repeated urine samples were obtained from 135 TruGreen turf applicators employed in six branches across the U.S. Urine samples ( $n = 1028$ ) were collected in the 3 spraying seasons: the spring (April and May) and fall (October and November) herbicide sprays, as well as the summertime (June and July) insecticide spray. Total urine was collected for two consecutive 24-hour periods during the herbicide sprays, and four consecutive 12-hour periods (insecticide) following a minimum of 3 consecutive workdays. Measured pesticides included: 2,4-D, MCPA, Mecoprop, dicamba, the bifenthrin metabolite (MPA) and imidacloprid, and its metabolite 6-CNA. High performance liquid chromatography tandem mass spectrometry was used to measure ppb levels of pesticides in the 12 and 24 hour samples and these were used to estimate total amount of pesticides in  $\mu g$  over a 24 hour period. The distributions of these exposures were characterized through the use of boxplots. Mixed model methodology was employed to between and within worker variability.

**Results:** The intraclass correlation coefficients (ICC) for all pesticides were less than 0.31, indicating considerable within subject variability over the three spraying seasons. However, considerably higher ICCs were observed when estimated separately within each season (ICC for MCPA overall was 0.31 but ranged from 0.63 to 0.89 when analysed by season).

**Conclusions:** Exposure measurement error could be reduced by performing sampling within individuals across seasons for the majority of herbicides tested. For some pesticides (i.e. MCPP and imidacloprid), repeated samples within seasons may be necessary to characterize exposures. The implications of these results within the context of a prospective cohort study are discussed.

#### ISEE-0032

##### Air Pollution Exposure – A Trigger for Myocardial Infarction?

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**Background and Objective:** Ambient air pollution has been associated with increased hospitalization for cardiovascular and respiratory events in

several studies. Only three studies, with conflicting results, have specifically studied the exact time of the onset of myocardial infarction in relation to short term fluctuations of air pollution levels. Using well-characterized data concerning risk factors and time of onset of myocardial infarction the objective was to study the effect of preceding 2-hour and 24-hour exposure periods on the risk of onset of first-time myocardial infarction.

**Methods:** A case-crossover design was used to investigate the effects of air pollution in 660 subjects who experienced their first myocardial infarction in Stockholm between 1993 and 1994 and who could be interviewed by trained health care professionals shortly after diagnosis, by use of a standard protocol. Air pollution data was collected from central monitors reflecting urban background levels.

**Results:** No associations were observed between the risk for onset of myocardial infarction and 2-hour air pollution exposure with estimated odds ratios for an increase of one interquartile range increase ranging from 0.93 (95% CI: 0.81, 1.08) for  $PM_{10}$  to 1.02 (95% CI: 0.85, 1.23) for  $O_3$ . Furthermore, no associations were seen for any of the pollutants using 24-hour averages and no evidence of susceptible subgroups was found.

**Conclusion:** This study does not provide support that moderately elevated air pollution levels trigger first-time myocardial infarction.

#### ISEE-0035

##### Genetic, Environmental and Clinical Factors Related to Treatment Failure of Cervical Precancerous Lesions among Brazilian Women

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**Objective:** To ascertain the risk of pre-cancerous treatment failure considering selected *TP53* polymorphism at codon 72 and environmental and clinical risk factors among Brazilian women.

**Methods:** A prospective study was carried out among 285 outpatients treated for cervical precancerous lesions at the Brazilian National Cancer Institute in Brazil between 2004 and 2008. All patients were interviewed to ascertain epidemiological and clinical characteristics, had blood samples collected, had a colposcopic examination, and signed the informed consent. *P53* polymorphism was ascertained using PCR-RFLP procedures. After treatment, the women were followed up with Pap test exams over 2 years. Treatment failure was evaluated using three different outcomes definitions: any altered Pap test during follow up (failure 1); a first HSIL or two subsequent LSIL cytological results (failure 2); and histological confirmation of any altered tissue (failure 3). Statistical analysis to evaluate failure univariate risks was performed using the Kaplan Meier method, and the Proportional Cox Regression to ascertain hazard ratios and their 95% Confidential Interval.

**Results:** *P53* polymorphisms frequencies in the studied sample were 177 (62.1%) of Arg72Pro allele (Arg/Pro), 55 (19.3%) of Arg72 allele (Arg/Arg), and 53 (18.6%) of Pro allele (Pro/Pro). The risks for SIL treatment failure related to the involvement of endocervix margins were:  $adjHR_{failure1}$ : 1.88 (95%CI: 1.19–2.99);  $adjHR_{failure2}$ : 2.00 (1.02–3.91);  $adjHR_{failure3}$ : 7.01 (1.73–28.44). Current smoking was also statistically related to an increased risk for SIL treatment failure ( $adjHR_{failure2}$ : 1.78 (95%CI: 1.03–3.08);  $adjHR_{failure3}$ : 3.90 (95%CI: 1.28–11.91)). Compared to Arg/Arg form, the risks for treatment failure were: Arg/Pro:  $adjHR_{failure1}$ : 1.22 (95%CI: 0.70–2.12),  $adjHR_{failure2}$ : 1.28 (95%CI: 0.55–2.98),  $adjHR_{failure3}$ : 1.51 (95%CI: 0.23–9.80); Pro/Pro:  $adjHR_{failure1}$ : 1.43 (0.91–2.22),  $adjHR_{failure2}$ : 1.28 (95%CI: 0.64–2.35),  $adjHR_{failure3}$ : 1.41 (95%CI: 0.31–6.52).

**Conclusion:** Our results suggest that *P53*/Pro72 allele seems to be associated with an increased risk of SIL treatment failure, despite not being statistically significant. Margins involvement and current tobacco



smoking presented independent risks for SIL treatment failure among the studied Brazilian women.

#### ISEE-0036

##### The Effects of Blood Lead and HFE Polymorphism on Serum Iron and RBC Mean Corpuscular Volume among Lead Workers in Taiwan

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**Background and Objective:** It is known that long-term exposure to lead harms the hematopoietic system. HFE mutation is associated with hereditary hemochromatosis, which affects iron absorption in the intestine. The objective of this study is to investigate whether the HFE genotype modifies the blood lead levels, affecting distributions of serum iron and the other red blood cell indices.

**Methods:** 121 lead workers and 117 non-exposure age-matched subjects enrolled in the study. We collected the following data from physical examination: blood lead levels (BLL), haemoglobin, hematocrit, serum iron, total iron binding capacity and ferritin. All subjects filled out questionnaires regarding their demographic information, medical history, alcohol consumption and smoking history. HFE genotyping for C282Y and H63D was using PCR/RFLP.

**Results:** The mean BLL in lead workers was 19.75 ug/dL (SD = 14.70) and 2.86 ug/dL (SD = 1.85) for non-exposure subjects. The mean of serum iron in lead workers was 95.65 ug/dL (SD = 41.13), and 94.18 ug/dL (SD = 40.86) for non-exposure subjects, which was not significant. Of 238 subjects, 221 (92.9%) subjects were wild-type (CCHH) for HFE C282Y and H63D, and 17 (7.1%) subjects were heterozygous for H63D mutation (CCHD). All subjects in this study were free from C282Y mutation. In multiple regression analyses that adjusted for BLL, HFE genotype (C282Y/H63D), age, gender, smoking and alcohol consumption, serum ferritin of H63D heterozygous mutation was 121.4 ng/ml higher than H63D wild-type ( $P < 0.05$ ). Using multiple regression to analyze the interaction between BLL and HFE genotype, the HFE genotype would be a modifier for the effect of lead to mean corpuscular volume (MCV) with adjustment of age, gender, smoking, and alcohol consumption. The effects of lead on MCV in the CCHH genotype was  $-0.116$  (SE = 0.045), while the CCHD genotype was 0.138 (SE = 0.124).

**Conclusion:** Our research found a significant modifying effect of HFE genotype on the effect of lead on MCV. The HFE H63D heterozygous (CCHD) may be a protective factor.

#### ISEE-0037

##### Comparison of Two Cross-Sectional Studies on Health Status with Different Response-Rate

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**Background and Objective:** Decreasing response-rate in questionnaire studies in the last decade poses the question of representativeness of their results. Our objective was to compare results of two questionnaire surveys on health status, life style and SES using the same questionnaire in two different samples of the same population and to evaluate impact of a low response-rate on validity of study results.

**Methods:** A questionnaire was distributed to a random sample of population in Ostrava using a postal delivery in a first survey in 2001, while personal delivery and collection of questionnaires was used in the second study in 2003. The statistical analysis was identical in both surveys. Logistic regression models with random effects were employed to test heterogeneity between both study results on 5% significance level.

**Results:** In the first study 634 questionnaires were collected out of 3,000 (response-rate 21.1%), in the other study 575 questionnaires out of 1,000 were analysed (response-rate 57.5%). Results of models with random

effects confirmed homogeneity of study findings of both studies for most of the relationships investigated. The only statistically significant between study difference was found in the model for psychical well-being, which was associated only with economic situation. Improvement of population economic situation caused by the time-gap between both studies was probably the source of the difference identified.

**Conclusion:** The overall study results confirmed that in spite of differences in methods used for data collection and also in response rates the results did not vary significantly. This study results suggest that also cross-sectional studies with lower response-rate but with quite large study sample might provide valid information. A future studies should be carried out to confirm these findings.

**Acknowledgement:** This study was supported by the Czech MoH NJ/6139-3 and Moravian-Silesian Region MSK/0687/2003/SZ.

#### ISEE-0040

##### Dietary Patterns in Adolescence and Brain Tumors in Adults: A Case-Control Study in Rio de Janeiro, Brazil

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**Background and Objectives:** Brain tumour incidence and mortality have increased, especially in women and the elderly. From 1980 to 1998 was observed a 50% increase in mortality rate of these tumours in Brazil. The relationship between diet and the occurrence of brain tumours in adults is still poorly understood. Studies on the role of diet have evaluated nutrient and food consumption during relatively recent periods and show conflicting results. This study aimed to describe dietary patterns during adolescence and investigate their association with the occurrence of brain tumours in adulthood.

**Methods:** A hospital based case-control study of primary intracranial neoplasm took place during 1999 to 2002. This analysis was of 202 cases of both sexes, aging from 30 to 65 years, living in the metropolitan area of Rio de Janeiro and 254 controls hospitalised in the same institutions and resident in the same area. Information on consumption during adolescence was collected with a food frequency questionnaire, adapted from an instrument previously validated for the population of Rio de Janeiro. Patterns of food consumption were defined from factor analysis using principal components as method of extraction.

**Results:** Four dietary patterns were identified. The findings indicate that the patterns associated with the lowest odds of developing brain tumours were rich in sugar and fats (the snacks pattern, OR = 0.61; CI = 0.37–1.00;  $P$  trend = 0.007 and the animal fat pattern OR = 0.55; CI = 0.32–0.94). Higher consumption of the mixed pattern showed a slight inverse association among women (OR = 0.67; CI = 0.35–1.28) and cases of meningioma (OR = 0.91; CI = 0.47–1.77), while the traditional pattern was only protective against cases of glioma (OR = 0.78; CI = 0.30–2.00).

**Conclusion:** The continuity of the research allows a better understanding of the etiologically relevant moment for evaluating environmental exposures, the role of lifetime eating behaviour and their relationship to the development of brain tumours.

#### ISEE-0042

##### Bayesian Spatial Analysis of Lung Cancer Incidence in Relationship with Socio-Economic Deprivation

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**Background and Objective:** Lung cancer (ICD-C34) mortality risk was confirmed to be correlated with area socioeconomic deprivation in a previous study. Standardized mortality index (SMR) in geographical areas with a small numbers of inhabitants is not stable therefore Bayesian models were used for detailed exploration of spatial clustering and variation allowing also evaluation of socioeconomic deprivation effect on SMR.

**Methods:** Lung cancer mortality risk (SMR) in men in 22 smaller geographical units (ORP) of the North-Moravian Region (total population 1.2 mil.) and census based socioeconomic deprivation index (SESDI) on ORP level entered into the analysis. Bayesian models for relative risk of lung cancer smoothed according average risk in the Czech Republic, in the North-Moravian Region and average risk in the neighbour ORPs were applied using software WinBugs v. 4. Convolution regression model was used for analysis of SESDI effect on SMR. ArcView v. 3 was used for visualisation of results.

**Results:** SMR in specific ORPs varied in range from 0.40 to 2.25. Using Bayesian methods the relative risk varied in range from 0.82 to 1.25 for all models. ORPs were divided into 3 categories according the relative risk (<0.97; 0.97–1.03; >1.03) and also into 3 categories of deprivation according SESDI. The results of regression model confirmed effect of deprivation on lung cancer mortality risk in 20 ORPs; at least 9 % of SMR variability was explained by the level of area deprivation.

**Conclusion:** Estimates of mortality or morbidity risk in areas with a small number of population are more precise using Bayesian methods than those without smoothing.

**Acknowledgement:** This study was realized within the program EUREKA (E!3751 ISTAHIS).

“New information tools for analysis of health data in managerial information systems (2007–2009)”.

#### ISEE-0044

##### Exposure to Magnetic Fields Generated by Transmission Lines in the Metropolitan Area of São Paulo, Brazil

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**Background and Objective:** Consistent epidemiologic evidence relates the exposure to magnetic fields (MF) to the occurrence of several outcomes. The population is exposed to varying degrees of MF worldwide, including the exposure generated by power lines and use of electricity. Therefore our goal was to estimate the prevalence of exposure to MF generated by transmission lines (TL) in the metropolitan area of São Paulo, Brazil, and to characterize this population demographically and socioeconomically.

**Methods:** Information about TL was provided by the utilities and mapped using Mapinfo® GIS software. Demographic and socioeconomic data was obtained from the Census and added to the GIS. We defined as exposed all households and their residents located within a distance close enough to a TL sufficient to generate a MF  $\geq 0.3 \mu\text{T}$  (microteslas), and the prevalence was obtained using corridors of exposure bordering the TL. The socioeconomic information among the exposed and non-exposed populations was compared by a test of Two-proportions ( $\alpha = 5\%$ ).

**Results:** The prevalence of exposure to MF  $\geq 0.3 \mu\text{T}$  was 1.4%, which corresponds to 267,924 inhabitants of the metropolitan area of São Paulo. The results indicated higher prevalence of exposure to MF in the younger population, those with lower levels of education and income ( $P < 0.001$ ).

**Conclusion:** The prevalence of exposure to MF generated by TL in the metropolitan area of São Paulo was lower than results found in other studies, although comparisons are difficult due to the different methodologies applied. These results also suggest the presence of inequalities in the exposure to MF in the metropolitan area with greater

risks among the most vulnerable populations such as children and less socioeconomically favoured.

#### ISEE-0046

##### An Update on the Research Activities of the Environmental and Occupational Working Group for the Ontario Health Study (OHS)

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**Background and Objectives:** An Environmental and Occupational (E-O) Working Group has been created to advise on research priorities and develop the E-O component of the Ontario Health Study (OHS). In the next five years, 150,000 participants will be recruited into the OHS. Information from questionnaires, physical measures, biospecimens and individual and community level environmental data will be collected to identify and characterize occupational and environmental causes of cancer.

**Methods:** The E-O Working Group met in January 2009 to discuss prioritization and selection of exposures and/or contaminants for measurement, to develop a proposal for an “Envirobank,” and to develop the E-O questionnaires that will be sent to participants 3 months after baseline data collection. Members were asked to recommend key contaminants or exposures that should be given immediate consideration for measurement in the OHS.

**Results:** Priority exposures include: aflatoxins, brominated flame retardants, EMF, metals, PAHs, perchlorate, perfluorochemicals, pharmaceutical estrogens, NOx, phenols (nonylphenol, bisphenol-A), particulates, select pesticides, phthalates, radon, shift work, solvents, water chlorination byproducts, and WiFi exposures.

House dust and drinking water were recommended as the most useful samples to collect for the Envirobank to provide information on priority contaminants. Also recommended was the storage of residual urine (not sent to the Biorepository) from spot urine samples collected at the OHS assessment centers. A proposal to include indoor radon monitoring in a pilot study of 1500 individuals from 3 communities is being developed with the Radiation Protection Bureau of Health Canada.

The Environmental Exposures and Residential History questionnaire is under development using the priorities outlined above. The E-O group is also working with the newly established Occupational Cancer Research Center in Ontario in developing the Occupational History and Exposures Questionnaire.

**Conclusions:** The OHS presents a unique opportunity to collect environmental and occupational exposure data and provide more detailed information on absorbed dose for a population-based prospective cohort.

## ISEE-0047

**Indium Lung: Specificity of Association Between Exposure to Indium and Lung Interstitial Damage**

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**Background and Object:** Except for specificity of association, authors have demonstrated a causal relationship between indium dust exposure and lung interstitial damage. The aim of this study was to assess the specificity of the damage by contrasting the differences in lung interstitial damage between indium-exposed workers who started working before (Group B) and after (Group A) improvements (reduction of indium concentration) in the working environment.

**Methods:** Baseline health checkups were performed on 500 indium-exposed workers in 13 factories. Detailed job history was obtained from 379 workers in Group B and 109 in Group A. Average exposure duration, mean age, and smoking rate in Groups B and A were 67.1 and 17.3 months, 37.6 and 33.0 years, and 71.2 and 66.1%. Indium in serum (In-S) was measured as an exposure index. KL-6, SP-D and SP-A were assessed as early effect markers of lung interstitial damage.

**Results:** Geometric means of In-S in Groups B and A were 3.24 and 0.15 ng/ml. Age- and smoking-adjusted odds ratios of Group A vs. Group B exceeding reference values of KL-6, SP-D and SP-A were 0.09 (95%CI 0.03–0.26), 0.22 (0.09–0.54) and 0.48 (0.26–0.91). Geometric means of KL-6, SP-D and SP-A were 380 U/ml, 61.7 ng/ml and 37.7 ng/ml in Group B, and 216, 41.7 and 28.6 in Group A; all Group A values were significantly lower.

**Conclusion:** Reduction of indium exposure seemed to reduce the early effects of indium on the lung interstitium. This suggests the specificity of the association between indium exposure and lung interstitial damage.

## ISEE-0049

**Hearing Loss in Occupationally Exposed to Radio Frequencies (RF) and Microwave (MW) Non-Ionising Radiation**

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**Background and Objective:** This study proposes a comparison between auditory system of subjects exposed to RF and MW electro magnetical radiation and a control group non-exposed to such radiation or other physical or chemical toxins with influence on the ears.

**Methods:** The exposed group, irradiated concomitant or alternative with RF (160–180 MHz) and MW (2.6–3.1 GHz) was constitute from 73 radar operators (men). The subjects from the control group was selected from those who have never been exposed to occupational toxins. The traditional audiometric measurement (250, 500, 1000, 2000, 3000, 4000, 6000 and 8000 Hz) of hearing threshold level (HTL) were performed in both exposed and control group. The radiation level assessment of non-ionising radiation (NIR) was prepared with an EMR-200 instrument, after current used method in developed country.

**Results:** These measurements results for work places of radar operators show high levels that exceed by many times the value of flux density of electric and magnetic field reference value used in European countries. So, the mean value of flux density measurements has varied between 3.8 and 25.4 mW/cm<sup>2</sup> for exposed group to NIR. The mean value of exposure time for radar operators was  $9.7 \pm 6.2$  years, and they have a mean age of  $33.7 \pm 8.7$  years. The same calculations for control group indicates  $9.1 \pm 5.8$  years and  $34.2 \pm 8.2$  years. The mean magnitude of hearing threshold level showed a statistically significant decrease of the hearing threshold in exposed, as compared to the non-exposed, with the value of 7.1; 8.9; and 9.1 dB for 4, 6 and 8 kHz frequencies.

**Conclusion:** These results indicate that the occupational exposure to NIR of radar systems can produce a significant hearing loss, with the damage to cochlea related to the high frequency region (4, 6 and 8 kHz).

## ISEE-0053

**Food Contamination and Human Exposure to Endocrine Disrupting Compounds from Food Packaging**

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**Background and Objective:** Endocrine disrupting compounds (EDCs) received increased awareness since publication of “Our Stolen Future” by Colborn, Dumanovski and Myers in 1996. While there is a growing body of toxicity information for some EDCs, human and environmental exposure routes are not well characterized. EDCs are being widely used in food packaging materials, and migrate to food during normal storage and use. The aim of this paper is to investigate food packaging as relevant source of food contamination and thus route of human exposure to EDCs.

**Methods:** I reviewed EU and US food contact materials regulation, reports and peer-reviewed studies.

**Results:** More than 50 different confirmed or suspected endocrine disrupters are authorized for food contact purposes. For selected compounds migration studies are available. Whole migrates from polymer-based food packaging are highly complex mixtures including compounds from adhesives, inks, and non-intentionally added substances (NIAS). Overall migrate toxicity of the finished packaging is usually not assessed, as for regulatory purposes biological tests with single substances are required, if at all. Human biomonitoring studies show exposure of the general public to mixtures of many different chemicals, including those substances presumably originating from food containers. Long-term effects of exposure to such mixtures are unknown and especially sensitive stages of development are of concern.

**Conclusions:** Regulatory tolerance for human exposure to EDCs needs rethinking in the light of recent toxicological developments, i.e. low-dose effects, mixture toxicity, developmental origins of adult disease, and epigenetics. There is a need for epidemiological studies to determine the relevance of food packaging for development of chronic diseases.

## ISEE-0054

**Cohort Study of Petrochemical Workers in Gela Polluted Site**

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**Background and Objective:** Gela area is an Italian site qualifying for remediation because of documented soil contamination by petrochemical industry. In 1960, the largest petrochemical plant in Europe started its operations in Gela. Ecological investigations suggested occupational exposures as a possible cause of increased mortality from lung cancer among male residents in Gela.

Environmental monitoring showed that the Gela area is heavily affected by industrial and urban emissions of heavy metals.

Epidemiological studies in polluted sites contribute to define priorities for remediation activities: the case of Gela occupational cohort illustrates such an application.

**Methods:** A cohort of petrochemical workers was studied in terms of mortality and morbidity. Mortality was evaluated for the cohort of 5,621 petrochemical workers, hired from 01.01.1960 to 31.12.1993 and followed-up for mortality in the period 1960–2002. The morbidity study was restricted to 5,219 workers, employed from 01.01.1960 to 31.12.2000, not deceased or lost to follow-up. Analysis of morbidity was based on Hospital Discharge Records (2001–2006).



Workers were classified in terms of job qualification and “likelihood” of residence in Gela.

For mortality, Standardized Mortality Ratios (SMR) and Rate Ratios (RR) were computed. Morbidity was analyzed in terms of Prevalence Ratios (PR).

**Results:** SMR for lung cancer was 0.71 (obs. 54; 90% Confidence Interval 0.55–0.88). RRs for lung cancer were 1.69 (0.93–3.13) and 1.99 (1.26–3.16) in two categories of workers more “likely” to have been residents in Gela. For the same categories PRs for COPD (obs. 69) were respectively 1.46 (0.8–2.66) and 1.53 (1.0–2.37).

**Conclusion:** The results suggest a possible excess of residential/environmental risk of mortality from lung cancer and morbidity from COPD for those petrochemical plant workers more “likely” to have been residents in Gela. Ongoing soil remediation activities should be integrated with a better characterization of emission sources contributing to air pollution.

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#### ISEE-0057

##### Low-Level Nitrogen Dioxide Exposure and Low Birth Weight Risk in Kaunas City

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**Background and Objective:** Recent epidemiological studies, conducted in various countries, have reported different level relationships between elevate levels of traffic-related air pollutants and birth outcomes. We studied long-term maternal exposure to NO<sub>2</sub> effect on low birth weight (<2500 g, LBW) risk in a Kaunas pregnant women cohort.

**Methods:** This epidemiological study comprised all singleton newborns (2744) born in 2008. We used Kaunas HiWATE cohort data base to obtain information on maternal characteristics and birth outcomes. The following information was available: residential history, socioeconomic characteristics, maternal smoking, family status, education and other. To estimate residential exposure levels to NO<sub>2</sub> a database on Kaunas vehicle stock and streets network was developed and measurements of cumulative traffic density were linked to the individual address of the mother. We used an air quality modelling system AIRVIRO and verified exposure modelling results by NO<sub>2</sub> level measurements from three air monitoring stations.

**Results:** Basing on modelling results, three NO<sub>2</sub> exposure zones were estimated: 1<sup>st</sup>-referent, mean NO<sub>2</sub> level was  $\leq 10 \mu\text{g}/\text{m}^3$ , 2<sup>nd</sup>-moderate-NO<sub>2</sub> level was 10–20  $\mu\text{g}/\text{m}^3$  and 3<sup>rd</sup>-high-NO<sub>2</sub> >21  $\mu\text{g}/\text{m}^3$ . The relationship between NO<sub>2</sub> levels and LBW risk was estimated by multivariate logistic regression. After adjustment for gestational age, smoking, family status and education, in moderate exposure zone adjusted odds ratio for LBW was 1.28; 95% CI 0.35–4.64 and in high exposure zone it was 2.48; 95% CI 0.68–9.11.

**Conclusion:** The present study suggests that there might be a relationship between prenatal exposure to relatively low-levels of NO<sub>2</sub> and the risk of LBW.

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#### ISEE-0058

##### Association of Bladder Cancer with Residential Exposure to Petrochemical Air Pollutant Emissions in Taiwan

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**Background and Objective:** The objective of this study is to investigate the relationship between petrochemical air pollution and risk of death due to bladder cancer.

**Methods:** This study was conducted using a matched cancer case-control design based upon deaths that occurred in Taiwan from 1995 through to

2005. Data on all eligible bladder cancer deaths were obtained from the Bureau of Vital Statistics of the Taiwan Provincial Department of Health. The control group consisted of individuals who died from causes other than neoplasms or diseases associated with genitourinary problems. The controls were pair matched to the cases by gender, year of birth and year of death. Each matched control was selected randomly from the set of possible controls for each case. The proportion of a municipality's total population employed in the petrochemical industry in a municipality was used as an indicator of a resident's exposure to air emissions from the petrochemical industry.

**Results:** The subjects were divided into three levels (< or = 25th percentile; 25th–50th percentile; >50th percentile). Subjects who lived in the group of municipalities characterized by the high levels of petrochemical air pollution had a significantly higher risk of death attributed to bladder cancer (OR = 1.68, 95%CI = 1.22–2.31) than subjects in the group that lived in municipalities with the lowest petrochemical air pollution levels, after controlling for possible confounders.

**Conclusion:** This study shows that under the conditions found in Taiwan, petrochemical air pollution may increase the risk of death from bladder cancer. The findings of this study warrant further investigation of the role of petrochemical air pollution in the etiology of bladder cancer.

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#### ISEE-0059

##### Association Between Trihalomethane Concentrations in Drinking Water and Adverse Pregnancy Outcome in Taiwan

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**Background and Objective:** Chlorination has been the major strategy for disinfection of drinking water in Taiwan. Recently there has been interest in the relationship between by-products of disinfection of drinking water and pregnancy outcomes including low birth weight and preterm delivery.

**Methods:** We performed a study to examine the effects of exposure to total trihalomethanes (TTHMs) on the risk of term low birth weight (TLBW), small for gestational age (SGA), and preterm delivery in Taiwan. TTHMs data was available for 65 municipalities in Taiwan.

**Results:** The study population comprised 90,848 women residing in the 65 municipalities who had a first parity singleton birth between January 1, 2000 and December 31, 2002, and for which complete information on maternal age, education, gestational age, birth weight, and sex of the baby were available. Maternal TTHMs exposure was estimated from the TTHMs concentration for the municipality of residence at birth.

**Conclusion:** The study results provide no evidence of an increased risk of TLBW, SGA, and preterm delivery at the relatively low concentrations of TTHMs in Taiwan's drinking water.

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#### ISEE-0061

##### The Environment: A Common Source of Exposure for Human Beings and Dogs: First French Case-Control Study for Testing the Use of Dogs as Sentinels for Cancers from Environmental Origins

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**Background and Objective:** Dogs have, in a few studies, been used as early biomarkers of risk for some human cancers. Indeed, they have a shorter lifespan and they demonstrate no addictive behaviour. In addition, as they are exposed through different routes to pollutants present in air, dust and soil, these pets can be proposed as sentinels for cancers of environmental origins and valuable alarm bells for human risk managers.

France, with a population of 8 million dogs, seems adequate for epidemiological studies testing such a hypothesis.

**Methods:** We organised a case-control study to check a potential link between canine cancers and environmental factors. We included 206 dogs from Alfort veterinary school campus: 103 (cases) in the Alfort Centre of Veterinary Cancerology, 103 (controls) in the vaccination clinics. Their owners answered an environmental questionnaire (way of living, uses of biocides or pesticides). The exposures have been quantified by an index taking into account the frequency of contact and the proximity to the dog.

**Results:** We can propose suggestive findings as the number of animals is not sufficient to reach statistical significance. For example, dogs having access to their owner's garden show more cutaneous tumours in comparison to those having no such access ( $P = 0.05$ ; OR = 6.3 [1.0–50]). Dogs exposed to home perfumes show more nasal tumours than others not exposed ( $P = 0.06$ ; OR = 13.5 [0.92–423]). The exposure to Wi-fi signals needs to be documented to allow assessment.

**Conclusion/Discussion:** Our results deal principally with cutaneous tumours. A second case-control study will be initiated on a larger scale. We plan to add to the descriptive data, blood samples allowing biological measures to know the nature and the level of environmental dangers. Finally, discussion with dermatologists could result in a fruitful collaboration.

#### ISEE-0070

##### Prevalence and Risk Factors of Noise-Induced Hearing Loss among Liquefied Petroleum Gas (LPG) Cylinder Infusion Workers in Taiwan

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**Background and Objective:** Noise-induced hearing loss (NIHL) has been gradually recognized as an occupational hazard. It is important to characterize NIHL in various job environments to help in prevention of premature hearing loss among workers. Thus, we conducted a project to determine the prevalence and risk factors of NIHL among workers by assessing occupational hazards with respect to standardized hearing and environment noise measurements in a liquefied petroleum gas (LPG–propane, butane, or their mixture) cylinder infusion factory in Taipei City, Taiwan.

**Methods:** We assessed the exposure levels of noise and estimated prevalence of NIHL, and identified risk factors for NIHL among male workers in a cross-sectional study. Workers exposed to noise and administrative controls were enrolled in 2006 and 2007. Face-to-face interviews were conducted to assess demographics, employment history, and drinking/smoking habits. We then performed measurements of noise levels in factory and administration areas, and hearing thresholds of study subjects using standard apparatus and protocols. Existence of hearing loss >25 dBHL for averages of 500Hz, 1k Hz, and 2k Hz was determined. Associations between NIHL and noise exposure, predisposing characteristics, employment-related factors, and personal habits were estimated by univariate and multivariate logistic regressions.

**Results:** A total of 75 subjects were recruited and 56.8% of factory workers had NIHL. Between the factory and administration groups, hearing thresholds on the worse ear showed significant differences at frequencies of 4k, 6k, and 8k Hz after adjusting for aging. Adjusted odds ratio for factory noise exposure (OR = 99.57, 95% CI: 3.53, 2,808.74) and frequent tea or coffee consumption (OR = 0.03, 95% CI: 0.01, 0.51) were statistically significant.

**Conclusion:** This study addressed NIHL in a specific industry in Taiwan. Further efforts in minimizing its impact are still needed.

#### ISEE-0071

##### Trihalomethanes Exposure Through Drinking Water and Low Birth Weight Risk in Kaunas Cohort

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**Background and Objective:** Recent epidemiological studies of the relationship between disinfection by-products, as measured by trihalomethanes (THM) in drinking water, and adverse birth outcomes have reported inconsistent and inconclusive findings. In the current study, we examined whether chronic maternal exposures to THM through drinking water have an effect on low birth weight (LBW) risk.

**Methods:** We conducted a prospective cohort study (N = 2744) and analyzed LBW incidence in 2008 Kaunas offspring. Residential tap water samples were collected as part of a cohort study being conducted in Kaunas city, Lithuania. All water samples were collected using identical procedures and tested at a single laboratory. We computed an average THM level from multiple tap water samples taken in the areas covered by four water companies, and these levels linked to female residential district and water usage questionnaire data. We classified THM exposure into three categories based on THM concentration and individual drinking water consumption. We used multivariate logistic regression to estimate adjusted odds ratios (OR) and their 95% confidence intervals (CI) for LBW while controlling for selected covariates.

**Results:** Adjusting for gestational age, maternal smoking, family status and education, we found a dose-related trend towards increasing LBW risk with increasing THM exposure. Adjusted OR was 1.32; 95% CI 0.76–2.29 for moderate, and OR 1.61; 95% CI 1.00–2.72 for high THM exposure.

**Conclusion:** This study provides some evidence for an association between exposures to THM through drinking water and LBW risk.

#### ISEE-0078

##### Daily Mean Temperature Effects on the Old People-Meta-Analysis of the Effects of Temperature Variation on Mortality among the Elderly with Different Latitudes and Lags

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**Background:** The concern of temperature-related mortality across different geographic regions has been arisen. The elderly are one of the most vulnerable groups on the impact of temperature. Little study has focused on the mean temperature effects on the old people in a macro level.

**Objectives:** To quantify the mean level of percent changes in mortality associated with one degree change in daily average temperature among the elderly.

**Methods:** In this study, the literature on studies of the effects of temperature on all-cause mortality for the elderly between January 1996 and November 2008. A two-stage Bayesian hierarchical model was performed to summarise the percent increase in mortality with a 1°C temperature increase on hot days or 1°C decrease on cold days with different lag days and latitudes.

**Results:** 10 studies that met the eligibility criteria were identified. For hot days, a temperature increase of 1°C was associated with an increase of 2.14% (95% PI: 0.47, 3.69) in all cause mortality among the elderly. For cold days, a 1°C drop in temperature was associated with an increase of 2.06% (95% PI: 0.55, 3.54) in mortality. Exposure lag [−0.06 (95%PI: −0.10, −0.02)] and latitude [0.06 (95%PI: 0.03, 0.09)] were significantly

associated with the effects of the cold temperatures but not with hot temperatures.

**Conclusion:** Both cold and hot temperatures were significantly associated mortality from all causes in the elderly and the magnitude of the effects was similar. The cold effects were also associated with where older people lived and the length (lag) of exposure.

**Keywords:** Elderly; meta-analysis; mortality; temperature.

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#### ISEE-0079

##### **Prevalence of Blood Lead Level in Children Living in a Community Exposed by Lead Glazed Ceramics in Michoacan, Mexico**

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**Objective:** There are many references worldwide on the sources, pathways, risks and health effects of lead exposure in people, and in particular, people who work with lead glazed ceramics. Exposure to several sources of lead is a widespread and serious threat to the health of the children of Michoacan. Our aim is to assess the blood lead levels in children from a community that has produced lead glazed ceramics for four centuries.

**Material and Methods:** 92 children from Santa Fe de la Laguna were tested in October, 2003. The children ranged between the ages of one to 11, and all of them were from families that regularly worked with lead glazed pottery. With the parents' written permission letter, we obtained capillary blood samples. The blood was then analyzed in the field with portable equipment, provided by the National Institute of Perinatology, from Mexico City.

**Results:** All 92 children had measurable blood lead levels with a range of 6.40 to 65 micrograms per deciliter. The mean was 31.94 with standard deviation of 15.18 and a standard error of 1.59. 95% confidence interval for the mean was 28.78 to of 35.11.

**Conclusions:** Mexican regulations allow levels of up to 10 micrograms per deciliter in children. Above this, there is an increased risk to health. Thus, the future of these children is uncertain. We hope to study more about susceptibility in ethnic groups with genetic polymorphisms to lead and treat with calcium, folic acid and others. We suggest to National Health authorities a strong policy and public health programme to reduce this problem.

**Disclaimer:** These findings and conclusions do not necessarily represent the views of the official institution report.

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#### ISEE-0081

##### **The Effects of Lead Exposure on the Activities of $\delta$ -Aminolevulinic Acid Dehydratase (ALAD) with the Modification of the Relative Genotypes**

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**Background and Objective:** To investigate the effects of blood lead and other related factors on  $\delta$ -aminolevulinic acid dehydratase (ALAD) activity in lead workers.

**Methods:** In 121 lead workers and 117 reference subjects, the following data were collected from health examination: blood lead, BMI, glucose AC, and Hct. A questionnaire including demographic data, medical history, smoking and alcohol consumption was completed by each of subjects. ALAD activity was determined by the standardized method of the European Community. ALAD polymorphism genotyping was using a method of PCR-RFLP.

**Results:** In this study, 229 ALAD1-1 homozygotes (96.2%), 8 ALAD1-2 heterozygotes (3.8%) were identified, and none of ALAD2-2 homozygote was observed. Blood lead levels in lead workers and reference subjects

were 19.5  $\mu\text{g/dL}$  (SD = 14.7) and 2.9  $\mu\text{g/dL}$  (SD = 1.9), respectively. Lead workers had significantly lower ALAD activity than reference subjects ( $42.6 \pm 22.4$  U/L vs.  $64.3 \pm 13.8$  U/L,  $P < 0.001$ ). According to the multiple regression results, the following independent variables were significant related to ALAD activity: ALAD activity in females was much lower (8.15 U/L) than males ( $P < 0.001$ ); blood lead and glucose AC were inversely associated with ALAD activity ( $P < 0.001$ ), but the effect of blood lead was profound. The regression coefficients of blood lead and glucose AC were 1.04 and 0.11, respectively. Individuals with alcohol consumption showed lower ALAD activity ( $P = 0.049$ ). The possible threshold value of blood lead for ALAD activity was determined at around 10  $\mu\text{g/dL}$ .

**Conclusions:** ALAD activity was inhibited by lead sensitively and stoichiometrically, thus ALAD activity may be adopted as a reliable biomarker of lead toxicity in humans.

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#### ISEE-0082

##### **Noise Exposure on Welding Workers**

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**Background and Objective:** Noise emitted by welding equipment is occasionally discussed in research concerning welding workers' health. However, investigations into noise exposure and its effects among welding workers are scarce. This research sought to study welding workers at several construction factories, using a cross-sectional study design to assess the noise levels when welding operators were at work, which were compared with survey information and hearing tests.

**Methods:** This research studied an exposure group of 86 on-site workers involved in welding and a control group of 63 administration personnel. Noise levels in the welding sites and office were measured by a sound level meter. Hearing thresholds of 500, 1000, 2000, 3000, 4000 and 6000 Hz were evaluated with pure tone audiometric tests.

**Results:** The equivalent sound levels at welding sites in the construction industry were generally high ( $\text{Leq} = 82.2 \pm 2.0$  dB(A)) with peak levels exceeding 100 dB(A), which were significantly higher than that in the office ( $\text{Leq} = 59.5 \pm 1.6$  dB(A)) ( $P < 0.001$ ). The average value of the hearing indicator calculated by the three-division method was  $35.5 \pm 10.5$  dB(A) for the worst ear in the exposure group and  $24.9 \pm 6.4$  dB(A) in the control group. From the surveys, smoking, drinking and blood pressure were all found to have a relationship with hearing loss ( $P < 0.05$ ). The exposure group was at a 5-times greater hearing loss risk than the administration group (95% CI: 2.1–12.2).

**Conclusion:** Although the average noise level at workplace was kept within the standards stipulated in the country's regulations, 93% of workplaces were found to be without means of protection. This did not conform to the Labor Safety and Health Equipment and Facility Law in Taiwan. Workplaces that were potentially damaging to the hearing of welding workers should take steps to enhance workers' health.

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#### ISEE-0084

##### **Reduced Atmospheric Manganese in Montreal Following Removal of Methylcyclopentadienyl Manganese Tricarbonyl (MMT)**

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**Background and Objectives:** Methylcyclopentadienyl Manganese Tricarbonyl (MMT) was used as an antiknock agent and as an octane booster in Canadian unleaded gasoline. Its combustion leads to Mn emissions. Considering that MMT is no longer used in the Canadian gasoline since 2003, the objective of this research was to examine the variations in atmospheric Mn in Montreal (Canada) from 2001 to 2007, covering the period prior (2001–2003) to and following (2005–2007) MMT use.

**Methods:** Three sampling stations were selected because their proximity to roads with widely differing and well-known traffic. Filters from 2001 to 2007 were obtained. The first sample of each month was selected and Mn analysis was performed by neutron activation analysis. TSP (total suspended particulates) was calculated by weighing the filters before and after dust collection.

**Results:** Results show a significant decrease of Mn over time at each station while TSP decreased significantly in two stations. Comparing atmospheric Mn during and after the period of use of MMT 2001–2003 vs 2005–2007 showed a significant decrease at all stations. For TSP, only one station showed borderline significant difference between these two periods. The difference between the two periods shows 41% and 17% of decrease for Mn and TSP, respectively.

**Conclusion:** These data suggest that the combustion of MMT led to an increase of airborne Mn of approximately 24%. These results should help in decision-making processes leading to the acceptance or rejection of the use of MMT in gasoline in other countries.

#### ISEE-0085

##### The Association Between the Particulate Matter and the Hospital Emergency Room Visits for Circulatory Diseases: A Case-Crossover Study

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**Background and Objective:** Some studies have found that ambient particles are associated with the population mortality, however, little work has been done to explore the effects of the air particles on the hospital emergency room visits for cardiovascular diseases in China. Our study seeks to explore the association between the levels of particulate matter with an aerodynamic diameter of  $<10 \mu\text{m}$  ( $\text{PM}_{10}$ ) and the hospital emergency room visits for circulatory diseases (International Classification of Diseases, tenth revision ICD-10: I00–I99) in Beijing, China.

**Method:** We collected data on daily hospital emergency room visits for circulatory diseases (ICD-10: I00–I99) from Peking University Third Hospital and the data of relevant ambient air  $\text{PM}_{10}$  from the Beijing Municipal Environmental Monitoring Center. The time-stratified case-crossover design was used to do data analysis.

**Results:** The no-lagged unidirectional case-crossover design with 1:4 matched pairs had the best effect for the odds ratios (ORs) between the  $\text{PM}_{10}$  and the hospital emergency room visits for circulatory diseases. After adjusting the temperature and the relative humidity, a  $10 \mu\text{g}/\text{m}^3$  increased in the  $\text{PM}_{10}$  was associated with the emergency room visits on value of Odds ratios 1.006 (95%CI: 1.003–1.008) for the total circulatory diseases (ICD-10: I00–I99), 1.003 (95%CI: 0.996–1.010) for the coronary heart disease (ICD-10: I20–I25), 1.005 (95%CI: 0.997–1.013) for the cardiac arrhythmia (ICD-10: I47–I49), 1.019 (95%CI: 1.005–1.033) for the heart failure disease (ICD-10: I50), and 1.003 (95%CI: 0.998–1.007) for the cerebrovascular diseases (ICD-10: I60–I69), respectively.

**Conclusion:** Elevated levels of the  $\text{PM}_{10}$  are positively associated with the hospital emergency room visits for the total circulatory diseases and the heart failure disease in Beijing ( $P < 0.05$ ).

#### ISEE-0086

##### Prenatal Phenol Exposure and Expression of Imprinted Genes in Human Placenta

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**Background and Objective:** Many phenols are hormonally active and are thought to impact human development. Alteration of imprinted gene expression in placenta may be one underlying mechanism.

**Methods:** We measured 8 phenol metabolites in urine and amniotic fluid from 11 women enrolled in a prospective pregnancy cohort for assessing toxicant exposures in women undergoing amniocentesis. We examined the relation between analyte concentrations in urine adjusted for specific gravity and expression of imprinted genes in placentas.

**Results:** 2,5-Dichlorophenol (25-DCP), methyl paraben (MPB), and ethyl paraben (EPB) were detected in all urine samples while triclosan was detected in 10 of 11 samples. Neither 25-DCP nor EPB were detected in amniotic fluid. Phenol metabolites most frequently detected in amniotic fluid were MPB and benzophenone-3 (BP-3). We observed no correlation between amniotic fluid and urinary concentrations of MPB; however, amniotic fluid and urine concentrations of BP-3 were highly correlated ( $R\text{-square} > 0.7$ ). Bisphenol-A (BPA) was detected in 3 of 3 urine samples from women who delivered large for gestational age babies as compared to 1 of 8 samples for average sized babies.

The most biologically active analytes appear to be BP-3, BPA, and 25-DCP; associations between biomarker level and gene expression levels were observed for 20, 17, and 14 imprinted genes, respectively. The gene most sensitive to phenol exposure appears to be HYMA1, with higher levels of 5 biomarkers. BMPR2, WT1, MKRN3, and CTNNA3 were each associated with higher levels of 4 biomarkers.

**Conclusion:** Biomarkers of phenol exposure were detectable in prenatal urine and amniotic fluid. Continued exploration of the effect of phenols on human development is warranted given the high rate of detection in this vulnerable population combined with the observed potential for dysregulating placental gene expression.

#### ISEE-0087

##### Socioeconomic Status May Slightly Modify Climate Effect on Mortality from Chronic Obstructive Pulmonary Disease in Taiwan

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**Background:** Mortality from cardiovascular and respiratory diseases have been associated with ambient temperature and other climate conditions, but less is known about the effect socioeconomic status (SES) has on this climate mortality relationship. This study measures whether the area gross domestic product (GDP) and education level, in interaction with weather status are associated with mortality from chronic obstructive pulmonary disease (COPD) for the period 1980–2006 in Taiwan.

**Methods:** Computerized data of vital statistics, weather, air pollution, and SES were obtained from the offices of Executive Yuan. Data analyses first

measured the monthly average mortality to observe the seasonality of the deaths, followed by the correlation coefficients between air pollution factors and SES potentially associated with mortality from COPD. Significant factors were included in the step down Poisson regression model with significant weather variables.

**Results:** During the study period, the mortality from COPD was approximately 2 times greater in males than females (73.0 vs. 35.4 per 1000). The mortality was higher in cold months than the warm months. There was a V-shape association between mortality rates and temperatures, with the lowest rate of 56.1 per 1000 at the daily mean of 25–29 degrees C and the highest rate of 71.8 per 1000 at <15 degrees C. The relative risk (RR) of deaths was 1.4 (95% confidence interval (CI) 1.3–1.5) greater in the lower temperature days. No other weather variable was significant in the Poisson analysis. However, people in the low GDP areas were at higher risk than people in the high GDP area (RR = 1.10, 95% CI 1.02–1.14).

**Conclusions:** Our findings suggest that COPD patients in Taiwan are sensitive to climate change with greater risk of death in cold days. And the risk may also increase in areas with lower SES status.

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#### ISEE-0088

##### Maternal Smoking, GSTT1 and GSTM1 Polymorphisms and Infant Birth-Weight Reduction in a Kaunas Cohort Study

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**Background and Objective:** A number of environmental factors, including smoking and xenobiotic-metabolising genes, have been associated with birth outcomes. However, only limited data are available on the molecular mechanisms underlying foetal growth. We examined the association between tobacco-smoke exposure during pregnancy and birth weight of the infant among genetically susceptible women in Kaunas, Lithuania.

**Methods:** We carried out an epidemiological study including 527 women. The gene GSTM1- and GSTT1- null genotypes were identified by the multiplex polymerase chain reaction in peripheral blood DNA samples. We evaluated associations with a multiple linear-regression model, adjusting for gestational age, maternal education, family status, body mass index, blood pressure, and parity.

**Results:** We found that among Lithuanian women, the prevalence of the GSTT1-null genotype is 16.8%, GSTM1-null–46.1% and the carriers of the double-null genotypes comprised 8.7% of the total population studied. The findings suggested a non-significant birth-weight reduction among light-smoking mothers (mean: 6 cigarettes/day) with the GSTT1-null genotype (–149.4 g,  $P = 0.129$ ) and those with the GSTM1-null genotype (–117.5 g,  $P = 0.145$ ). Double-null genotype for both GSTT1 and GSTM1 among the smokers showed a synergistic effect and the interaction between these genes was associated with a 309.3-g reduction in birth weight ( $P = 0.029$ ).

**Conclusion:** The study shows the synergistic effect of the GSTT1 and GSTM1 double-null genotypes on reduction in birth weight among smoking women and presents evidence that carriers of the double-null genotypes should be treated as an increased susceptibility group for adverse pregnancy outcomes. Our data also indicate that identification of the group of susceptible subjects should be based on both environmental exposure and gene polymorphism.

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#### ISEE-0089

##### The Relationship Between Dental Caries and Unleaded Gasoline Usage Among Children

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*Occupational Medicine, National Health Research Institutes, Miaoli, Taiwan.*

**Background and Objective:** The use of leaded gasoline can cause combustion particulates and lead emissions in air. Empirical studies found that higher lead level in air is associated with higher blood lead levels (BLLs) in human beings. In Taiwan, the use of unleaded gasoline has been completely adopted since 2000. The use of unleaded gasoline probably reduces lead emissions in air. Past literature indicates that lead emissions may increase the prevalence of dental caries. Therefore, this study investigates the relationship between dental caries and unleaded gasoline usage.

**Methods:** Our data were collected from three official databases between 1998 and 2007: 1) lead level in air was from Taiwan's Environmental Protection database; 2) the diagnoses of the dental disorders were from Taiwan's National Health Insurance database; 3) the Income Per Capita was from Taiwan's Ministry of Economic Affairs.

Using the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM), we identified the diagnoses code with dental disorders from 520 to 529. Multiple linear regression was used to estimate the impact of dental caries on age, gender, income, lead levels in air and the number of dentists.

**Results:** The levels of lead in air reduced steadily from 0.09 to 0.06  $\mu\text{g}/\text{m}^3$ . In all beneficiaries, the average frequency of caries (ICD-9 code 521.0) also declined gradually from 2.38 to 2.1. However, the average frequency of dental disorders (ICD-9 code from 520 to 529) was not decreased (3.44 vs. 3.46 times). In addition, the frequency of decay was notably reduced in 5–14 years old and their caries model of linear regression revealed that caries were highly associated with the lead levels in air ( $\beta = 1.06$ ;  $P = 0.01$ ).

**Conclusion:** The average frequency of caries was significantly related to the use of unleaded gasoline, especially in the 5–14 age-groups.

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#### ISEE-0091

##### Fish Consumption in Relation to Different Dietary Characteristics

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**Background and Objective:** It has been suggested that at least a part of the health benefits of fish consumption could be explained by a generally healthy dietary pattern. Our aim was to study fish consumption in relation to food consumption and nutrient intake, i.e., diet as a whole.

**Methods:** The study population consisted of 114 professional fishermen and 115 fishermen's wives (the Fishermen study), and 580 males and 715 females of the nationally representative Health 2000 Health Examination Survey (the Health 2000 sub-study). Dietary data were collected using a validated food-frequency questionnaire on whole diet. Spearman correlation coefficients and means by fish consumption tertiles with  $P$ -values for linear trend were calculated. Age and energy intake were adjusted for in the analyses.

**Results:** Fish consumption was 85% higher among the fishermen than among the Health 2000 sub-study men, and 45% higher among the fishermen's wives than among the Health 2000 sub-study women. Fish consumption associated positively with vegetable consumption, and negatively with milk, red meat (except for the Health 2000 sub-study men), and sugar, confectionary, and chocolate consumption. Among the men, fish consumption associated positively with alcohol consumption. Further, fish consumption associated positively with oil and poultry consumption among the Health 2000 sub-study participants.

With regard to nutrients, fish consumption associated positively with omega-3 polyunsaturated fatty acid, vitamin D, vitamin B12, sodium, and selenium intake, and negatively associated with sugar intake. In all the other groups except for the fishermen, fish consumption associated positively also with vitamin A, E, and K, niacin, pyridoxine, folate, phosphorus, and iodine intake.

**Conclusion:** High fish consumption seemed to be associated with a generally healthy diet. Dietary pattern among fish consumers should be taken into account in the future studies on the health effects of fish and fish-derived environmental contaminants.

#### ISEE-0092

##### **Lack of Association Between GSTM1, GSTT1, GSTP1 and GSTA1 Polymorphisms and Occurrence and Severity of Coronary Artery Disease in Taiwan**

Chih-Ching Yeh,\* Fung-Chang Sung,\* and Li-Tang Kuo,† \*China Medical University, Taichung, Taiwan; and †Chang Gung Memorial Hospital, Keelung, Taiwan.

**Background and Objective:** The genetic polymorphisms of xenobiotic-metabolizing enzymes, such as those encoded by glutathione-S-transferase (GST) systems, have been associated with the risk of coronary artery disease (CAD). In order to investigate the interaction of environmental factors with genetic factors predisposing to CAD, we examined GSTM1, GSTT1, GSTP1, and GSTA1 genotypes in a Chinese population in Taiwan.

**Methods:** Participants who consented to this study were 459 CAD cases and 210 normal subjects receiving coronary angiography check-up at a medical center. Information on soci-demographic and lifestyle was obtained using a self-administered questionnaire. The severity of CAD was evaluated by the number of coronary vessels with >50% stenosis. Polymorphisms of GSTM1, GSTT1, GSTP1 (Ile105Val), and GSTA1 (C-69T) genes were determined by polymerase chain reaction or in combination with restriction fragment length polymorphism methods. Logistic regression was used to calculate the odds ratios (ORs) and 95% confidence intervals (CIs).

**Results:** Among all examined polymorphisms, GSTT1 null genotype was more prevalent in patients with three narrowed vessels than in normal subjects (OR = 1.64,  $P = 0.02$ ). This association was reduced to an OR of 1.28 ( $P = 0.40$ ) after adjustment for age, sex, smoking, drinking, cholesterol, diabetes mellitus, and high density lipoprotein cholesterol. Both univariate and multivariate logistic regression analyses found no significant association between CAD and other studied polymorphisms measured either separately or in combination. Also, there was no significant interactive effect between genotypes and environmental factors, such as cigarette smoking, for the CAD risk.

**Conclusion:** Our results suggest that GST polymorphisms are not associated with the susceptibility to CAD in the Chinese population.

#### ISEE-0094

##### **The ERA-ENVHEALTH Project: Coordination of National Environment and Health Research Programmes—Environment and Health ERA-NET**

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**Background and Objectives:** Reducing uncertainties about the links between environment and health (E&H) and taking action through protection and prevention measures is necessary. For these to be effective, cooperation must be improved and research driven by a common set of priorities. ERA-ENVHEALTH, co-funded by the European Commission

under FP7 "Coordination Actions", enhances European coordination of environment and health research programming.

**Methods:** The project started in September 2008 with 16 E&H research programmers from 10 countries. To establish sustainable collaboration, an integrated step-by-step approach is implemented to evaluate methods, define priority themes and respond to these through joint activities and transnational calls.

The originality of ERA-ENVHEALTH is that a first call for proposals was launched simultaneously to experiment joint funding and fully assess its implementation.

**Results:** Better collaboration means avoiding duplication of financial and scientific effort, shared understanding of priority issues, greater access to information and experts, better use of resources to provide answers to common problems and developing common approaches.

After a year, ERA-ENVHEALTH has developed a shared vision and improved exchange of knowledge and expertise between countries through access to data at European level (website, expert and research programme databases). The consortium is analysing the collected data and identifying common research priorities.

Also, a transnational joint call, funded by three partners, was successfully launched on: "Health vulnerability resulting from future climate change impacts on soil-water ecosystems, land use and water resources at regional scale" and two projects selected for funding.

**Conclusion:** ERA-ENVHEALTH will bring dynamism to E&H research in Europe by promoting collaboration and fostering innovative ideas and increase its visibility as a key area. With the development of new programmes and changes to existing ones, the consortium expects an increase in the diversity of disciplines involved in research and in multinational projects.

#### ISEE-0096

##### **Strengthening the Role of Street Food Vendors to Reduce the Burden of Foodborne Diseases in Developing Countries**

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**Background and Objective:** Street food vending continues to expand as a source of affordable food and beneficial economic activity in developing countries. At the same time street foods have been the cause of outbreaks of foodborne diseases worldwide. The objective of this study is to examine the health risks of street food vending and recommend actions to strengthen the role of street food vendors to provide wholesome and safe food.

**Methods:** Literature review; observation of street food vendors' hygiene practices in major cities of developing countries (Addis Ababa, Johannesburg, Bangkok, New Delhi, Mexico City, etc.); review of a survey of 200 food vendors and interview of health officers in charge of food safety in South Africa.

**Results:** Very few street vendors apply some hygiene principles of food protection during preparation, storage and sale. The common hygiene fault practices observed were related to washing hands, utensils and pots in the same water container; drying hands and utensils with the same towel; sneezing, coughing, smoking and spitting near food; not wearing rubber gloves, hair cover and apron; and not removing jewellery while preparing food. Where food stalls are not provided, food was exposed to the sun, dust, wind, smoke, flies and dirty surfaces with a risk of cross contamination. Facilities such as running water, toilets, drainage and garbage disposal were non-existent at most of the sites for use by the vendors. There was evidence of bacterial contamination after cooking where few samples examined.

**Conclusion:** In order to reduce the burden of foodborne diseases, developing countries should strengthen the role of street food vendors by providing training, guidelines, legislation and infrastructure. There is a need for collaboration among health authorities, municipalities, local



government, the community and the associations of street food vendors to achieve this objective.

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**ISEE-0101****Exposure to Volatile Organic Compounds and Kidney Dysfunction in One Thin-Film Transistor-Liquid Crystal Display (TFT-LCD) Company**

Ta-Yuan Chang, and Guei-Hong Huang, *China Medical University, Taichung, Taiwan.*

**Background and Objective:** The thin-film transistor-liquid crystal display (TFT-LCD) is a new emerging industry worldwide but the health status among workers is unclear. The aims of this study were to investigate the exposure to volatile organic compounds (VOCs) and to determine the prevalence rate of kidney dysfunctions among workers in a TFT-LCD company.

**Methods:** We selected a TFT-LCD manufacturing company with 2162 employees as the subject population. The hazardous zones were identified by a walk-through survey. Canisters and the gas chromatography/mass spectrometry were used to determine VOCs concentrations in workplaces of array, cell and module processes. We collected self-administered questionnaires and health-checkup data from a panel of 155 volunteers to perform the health assessment. Logistic regression models were conducted to associate VOCs exposure with workers' kidney dysfunctions.

**Results:** We found that ethanol ( $1302.2 \pm 1493.8$  ppb), acetone ( $709.8 \pm 586.5$  ppb) and isopropyl alcohol ( $297.3 \pm 395.3$  ppb) were three dominant solvents used in this company. The average concentration of total VOCs in module processes ( $4651.4 \pm 1855.4$  ppb) was significantly higher than those in array processes ( $1867.2 \pm 1161.9$  ppb) and cell processes ( $2775.2 \pm 1878.3$  ppb). Sixty-three array workers were at higher risk of kidney dysfunction than eighteen in module processes (odds ratio = 3.84, 95% confidence interval = 1.02–14.40). Workers with cumulative exposure to VOCs  $\leq 327$  ppb-years had significantly higher risk of kidney dysfunctions (OR = 2.71, 95% CI = 1.07–6.83) after adjusting potential confounders.

**Conclusions:** Our findings revealed that array workers are at higher risk of kidney dysfunction compared to workers in module processes. Cumulative exposure to VOCs is associated with kidney dysfunction. Further studies with detail measurements of personal exposure and a longer follow-up are suggested to investigate adverse effects related to occupational exposure among TFT-LCD workers.

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**ISEE-0105****Spatiotemporal Trends of Incidence Rates of Ulcerative Colitis and Crohn's Disease**

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**Background and Objective:** Ulcerative colitis and Crohn's disease are assumed to be caused by a dysregulation in the immune system due to the commensal bacteria flora in genetically susceptible individuals. Incidence rates of the diseases, however, show large geographic and temporal variability. The temporal increase is often explained by the "hygiene hypothesis", stating that reduced number of infections in early life will increase the likelihood for developing autoimmune diseases in adulthood, but this hypothesis is less likely to explain differences between countries. We will therefore decompose worldwide incidence rates of ulcerative colitis and Crohn's disease and correlate the incidence values to latitude, temperature, time, and economic conditions.

**Methods:** We used published incidence studies of both Crohn's disease and ulcerative colitis from 1966 to 2007. The incidence rates were modelled as functions of latitude, mean annual temperature for the study areas, year of the study, and gross national product per capita.

**Results:** Incidence rates of both diseases increase with increased gross national product per capita ( $P < 0.001$  and  $P = 0.046$  for UC and CD). Incidence rates of ulcerative colitis were significantly related to latitude ( $P = 0.028$ ). For Crohn's disease incidence rates were associated to both latitude and mean annual temperature ( $P = 0.016$ ,  $P < 0.001$ ).

**Conclusions:** Incidence rates for both diseases are related to economic changes and either latitude and/or mean annual temperature. Mean annual temperature is also assumed to reflect latitudinal change. We postulate that both economic and latitudinal variability are aspects of the same phenomena: microbial diversity. Improved economic conditions are related to a reduced microbial load. Species diversity is also known to be larger closer to equator than far from equator—the latitudinal diversity gradient. Reduced contact with commensal flora or "old friends", due to reduced microbial load or ecological conditions could therefore explain the worldwide trends in incidence rates.

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**ISEE-0106****Soluble Adhesion Molecules in Serum of Healthy Adults—Effects of Wood Smoke Exposure As Well As Variability Within and Between Individuals**

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**Background and Objective:** Wood smoke is an important source of particular air pollution (PM) in Sweden and globally. PM increases mortality and morbidity in cardiovascular and respiratory diseases, possibly through local airway and systemic inflammation, increasing atherosclerosis and coagulation. Cellular adhesion molecules (CAMs) are expressed in endothelium during inflammation, facilitating diapedesis of leukocytes. Soluble CAMs (sCAMs) in serum increase with increased endothelial expression, making them possible markers of inflammation. They are also affected by oestrogen, diet, circadian rhythm etc.

**Methods:** 13 healthy adults were exposed to filtered air and one week later to wood smoke for four hours. The mass concentration of PM<sub>2.5</sub> and PM<sub>1</sub> in wood-smoke was 240–280  $\mu\text{g}/\text{m}^3$  and the number concentration 95–180000  $\text{cm}^{-3}$ , half of which were  $< 100\text{nm}$ . Blood was collected before and at three times after exposure. sCAMs were measured in serum and analyzed with ELISA.

**Results:** Soluble P-selectin was higher after exposure, but in part because of a decrease after exposure to clean air. There was no significant effect of wood smoke on sICAM-1 or sVCAM-1 on the whole group, but sVCAM-1 increased in women 3 hours after exposure. sVCAM-1 showed a circadian variation, with lower levels late afternoon than morning and midday. Men had higher levels of sICAM-1, but not sVCAM-1, than women. For sICAM-1 the variation between individuals was larger than the variation within individuals, but for sVCAM-1 it was about the same.

**Conclusion:** Possible effects of wood smoke exposure on sCAMs are neither confirmed nor rejected by these results. The limited effects on sP-selectin, and sVCAM-1 in women, suggests inflammation but chance is an alternative explanation. We are continuing with analysis of biomarkers after wood smoke exposure to strengthen or disprove this effect. Normal variation, timing and functions of soluble adhesion molecules and influencing factors must be considered when studying adhesion molecules.

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**ISEE-0110****Correlations of Urinary and Amniotic Fluid Phthalate Metabolite Concentrations and Expression of Imprinted Genes in Human Placenta**

Stephanie Engel,\* Mary Wolff,\* Antonia Calafat,† Andreas Diplas,\* Manori Silva,† Luca Lambertini,\* Rebecca Bausell,\* Molly Meadows,\*

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**Background and Objective:** Prenatal exposure to phthalates has been associated with reproductive toxicity and neurodevelopmental consequences in offspring. Fetal exposure is typically estimated by prenatal maternal urinary biomarker levels; however, the extent to which fetuses are directly exposed to metabolites in amniotic fluid has not been established.

**Methods:** A pilot study to estimate the correlation between urine and amniotic fluid concentrations of phthalate metabolites, and their relations with placental expression of imprinted genes was performed (n = 11). This study was nested within the Study of Advanced Reproductive Age and Environmental Health (SARAEH), which enrolled 97 women who were undergoing amniocentesis at the Mount Sinai Medical Center as a part of their routine prenatal care. Women were enrolled on the day of their procedure, and a sample of their urine was obtained immediately following the amniocentesis. At delivery, placental biopsies were obtained for RNA collection. Phthalate concentrations were normalized by specific gravity.

**Results:** Women were predominantly white (n = 10), with a mean age of 36 years. Eleven phthalate metabolites were detected in most prenatal urines. Few amniotic fluid samples had measureable phthalate metabolites, with the exception of mono(2-ethyl-5-carboxypentyl) phthalate (MECPP), an oxidative metabolite of di(2-ethylhexyl) phthalate, which was detectable in all samples. Amniotic fluid concentration of MECPP ranged from 0.7–2.1 ug/L (med 1.1, sd = 0.23). Urine concentration of MECPP ranged from 4.2–359 ug/L (med 81.6, sd = 105.8). There was no correlation between amniotic fluid and urinary concentrations of MECPP. Among other associations, placental expression of IGF2 was increased with increasing urinary concentration of high molecular weight metabolites.

**Conclusion:** Direct fetal exposure to phthalate metabolites in amniotic fluid appears to be minimal, and limited to MECPP. Disruption of placentally imprinted genes may be an alternative mechanism linking phthalate exposure to effects in offspring.

#### ISEE-0114

##### Contributions by the University of Guadalajara's Masters' Program on Environmental Health with Respect to Research on Corn Farming and Processing Technologies

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**Background and Objective:** This paper presents the contributions to food research by the Masters' program on environmental health established in 1995. Its objective is to present the contributions of the program with respect to the assessment of risk in farming activities relating to corn and to the production of tortillas.

**Methods:** The work includes lab studies: complete blood count, chemical pathology, lipid profiling, kidney function tests, erythrocyte cholinesterase count, lipid peroxidation profile, adjacent DNA count in exposed and "non-exposed" farm workers. At the qualitative level, labor history questionnaires were used, as well as surveys to analyze vulnerability factors among the farm workers. To assess the presence of fumonisin counts were conducted at several stages of the tortilla manufacturing process.

**Results:** The farm workers studied in the farming valley of Zapopan were subject to high levels of risk due to the risks associated to the use of pesticides (organophosphates, carbamates and bipyridyls, 2, 4-D, glyphosate

and paraquat) and the conditions of vulnerability of the workers related to management, training, awareness and response capacity practices and habits. 61% reported having suffered and intoxication at least once, 40% have been exposed to pesticides for over a third of their life. The lab tests report blood disorders, kidney damage and damage at cell levels with different results among the exposed group and the "non-exposed" group. An important finding concluded that, 34% of the couples composed by farm workers had suffered from spontaneous abortions.

The tortilla manufacturing process reported high levels of fumonisins, with average levels of 5.79 ppm in corn and 2.95 ppm in the corn dough, such levels being considered a cancer risk.

**Conclusions:** Farm workers suffer from high risk levels due to the dangerous pesticides used and the levels of exposure. The group that was studied also reported fertility and cancer problems.

#### ISEE-0116

##### Risk Communication/Issuance of Risk Warnings with Respect to Air Pollution: Assessment of Actions Undertaken by the Government Authorities in Guadalajara, Mexico

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**Background and Objective:** Society today faces an increase in high levels of exposure and risk to causes associated to air pollution. The local government's ability to respond to environmental threats is often surpassed, as is their ability to prevent, reduce and eliminate such risks.

The aim of this research is to assess governmental action in communicating and issuing risk warnings in an area with high levels of exposure to air pollution.

**Methods:** We followed a methodology based on ideal models, which has no point of reference in reality. Such ideal models are defined by the characteristics and values of the elements which determine an appropriate communication of the presence of risks. The elements of analysis are: citizen involvement; planning of the communication process and the message; the means of communication and the information.

**Results:** Current practices related to risk communication reveal several important weaknesses with respect to governmental agencies: citizens are viewed simply as the recipients of the information; the strategy does not define target groups; citizen involvement is not incorporated into the planning process; there is no clear definition of the problem to be addressed nor of the periods for execution of the strategy; the messages do not take into consideration the specific population they are addressing nor their information needs; there is no action regarding assessment of the risk communication's effectiveness and its impact on the population.

Governmental practices center on undertaking actions that are not linked to the causes of the air pollution problem and protection measures necessary to reduce the community's exposure and vulnerability.

**Conclusion:** The situation found in risk communication processes is the result of a lack in human, organizational and institutional skills and abilities. It is necessary to work at three basic levels: human resources; organizational change and institutional reform.

#### ISEE-0119

##### Effects of the Mixology Course on Dental Caries and Blood Lead Level for Culinary Students

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**Background and Objective:** Mixology course is either an elective or a mandatory course for culinary students. It is necessary for food and wine tasting in the mixology course, thus sweet and alcohol would impact the dental health for these students. Alcohol and blood lead can affect the dental caries. This study investigated the effect of taking a mixology course on the risk of dental caries in voluntary freshman participants.

**Methods:** Participants included 133 students who had ever selected the mixology course during high school (study group) and 160 who did not select the mixology course (control group).

**Results:** Comparing with the control group, students took mixology courses had a higher prevalence of caries (92.5% vs. 81.2%) and blood lead levels ( $3.12 \pm 1.02$  vs.  $2.67 \pm 0.83$   $\mu\text{g/dL}$ ). After adjustment for potential confounders, dental caries was significantly associated with participation in the mixology course.

**Conclusion:** In conclusion, the exposures from the mixology course may increase caries prevalence in students. These findings suggest the need to promote occupational safety education for the mixology course of students.

#### ISEE-0121

##### Air Pollution and Hospital Admissions for Congestive Heart Failure in a Subtropical City: Taipei, Taiwan

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**Background and Objective:** This study was undertaken to determine whether there was an association between air pollutant levels and hospital admissions for congestive heart failure (CHF) in Taipei, Taiwan.

**Methods:** Hospital admissions for CHF and ambient air pollution data for Taipei were obtained for the period from 1996 to 2004. The relative risk of hospital admission was estimated using a case-crossover approach, controlling for weather variables, day of the week, seasonality, and long-term time trends.

**Results:** In the single-pollutant model, the number of CHF admissions was significantly associated with the environmental presence of the contaminants particulate matter ( $\text{PM}_{10}$ ), nitrogen dioxide ( $\text{NO}_2$ ), carbon monoxide (CO), and ozone ( $\text{O}_3$ ) on warm days ( $>20$  degrees C). However, statistically significant positive effects on increased CHF admissions on cool days ( $<20$  degrees C) was observed only for CO levels. For the two-pollutant model,  $\text{NO}_2$  and  $\text{O}_3$  were significant in combination with each of the other four pollutants on warm days for enhanced CHF admissions.

**Conclusion:** This study provides evidence that higher levels of ambient air pollutants increase the risk of hospital admissions for CHF.

#### ISEE-0125

##### Temperature and Mortality in Taiwan, a Subtropical Country

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**Background and Objective:** Ambient temperature, especially extreme weather, has been found to influence mortality in human beings. Taiwan is a subtropical country where heat waves and cold storms rarely occur. This study aims to assess whether there is still a significant association of mortality with temperature in Taiwan, where extreme weather is generally lacking.

**Methods:** Daily mortality data during the period from 2001 to 2003 were obtained from the Taiwan Death Registry. Daily temperature ( $3.3^\circ\text{C}$ – $31.0^\circ\text{C}$ ) for the study period was averaged from 33 monitoring stations nationwide. Daily mortality rates of all-causes (excluding accidents, suicide, and homicide), respiratory and circulatory diseases were investigated for the associations with temperature. Generalized least square model was constructed to assess the relation between two time-series trends (i.e., temperature and mortality). Additionally, the cross-correlation function was used to determine the possible time lag for the influence of temperature on mortality.

**Results:** As the temperature increased, the daily mortality rates of all-causes ( $b = -0.006$ ) and respiratory disease ( $b = -0.012$ ) decreased. On the other hand, the apparently inverse relationship ( $b = -0.028$ ) between daily temperature and circulatory disease mortality rate was observed only for days with temperature of  $26.36^\circ\text{C}$  or lower. The circulatory disease mortality rate increased ( $b = 0.011$ ) with rising temperature in warm and hot days ( $>26.36^\circ\text{C}$ ). The study also demonstrated a lag effect between two time trends. The time lag for all-causes and circulatory disease mortality was similar at 4–6 days, while the lag for respiratory disease was longer at 13–16 days.

**Conclusion:** Data from the subtropic area still showed an apparent inverse relationship between temperature and all-causes mortality, and the increased temperature posed a greater beneficial effect on mortality of circulatory disease than on that of respiratory disease. Additionally, lower temperature in sub-tropic area didn't increase the risk of mortality.

#### ISEE-0129

##### Effects of $\text{SO}_2$ on the Respiratory Systems of Child Miyakejima Residents Nearly 2 Years after Returning to the Island

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**Background:** Mt. Oyama on Miyakejima Island erupted in June 2000. All Miyake village citizens were forced to evacuate the island in September 2000, due to continuous eruptions and emissions of unsafe amounts of volcanic gas, mainly sulfur dioxide ( $\text{SO}_2$ ). Beginning in February 2005, residents returned to live in the island despite the fact that volcanic gas was still being emitted.

**Objective:** To examine the changes in child citizens' respiratory systems from February 2006 to November 2007.

**Methods:** The study population was 142 child citizens who participated in health checkups in November 2007, including 27  $\text{SO}_2$  hypersusceptible children who had a current or past history of asthma, obstructive lung function, current symptoms of whistling and wheezing, and/or deterioration of respiratory symptoms [KN11].



Respiratory effects were evaluated by a questionnaire for respiratory symptoms and spirometry. SO<sub>2</sub> was monitored at 7 sampling points within inhabited areas, and the mean SO<sub>2</sub> concentration from February 2006 to November 2007 was 0.027 ppm. The area was categorized into four areas by average SO<sub>2</sub> concentration, namely, areas L, H-1, H-2, and H-3, where the SO<sub>2</sub> level was 0.010, 0.025, 0.030, and 0.040 ppm, respectively.

**Results:** Compared to children in area L, the frequency of "irritation of the nose" was significantly increased in the children in areas H-2 and H-3. Average %FVC(%) and %FEV1(%) in hypersusceptible children reduced -4.85 and -8.57 in November 2007 compared to February 2006, though no reduction observed in normosusceptible children.

**Conclusion:** SO<sub>2</sub> exposure-related respiratory systems were observed in child Miyakejima citizens nearly 2 years after they returned to the island where volcanic gas containing SO<sub>2</sub> continued to be emitted.

#### ISEE-0132

##### Does the Presence of Desert Dust Modify the Effect of PM<sub>10</sub> on Mortality in Athens, Greece?

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**Background and Objective:** Recent reports indicate that windblown desert dust may exacerbate the short-term health effects associated with particulate pollution in urban centers. We have tested this hypothesis by using daily air pollution and mortality data for Athens, Greece during the period 2001–2004.

**Methods:** We investigated the effects of exposure to PM<sub>10</sub> on total and cause-specific mortality, for all ages and stratified by age groups and gender. We tested the corresponding associations for PM<sub>2.5</sub> and coarse particles for a shorter period of about one year when we had available measurements. We identified 110 dust days between 2001–2004, by using back-trajectory analysis in combination with a data driven criterion based on high particle concentrations. We used Poisson regression models with penalized splines allowing for overdispersion to control for possible confounding by season, meteorology and day of the week effect.

**Results:** A 10 µg/m<sup>3</sup> increase in previous day exposure to PM<sub>10</sub> was associated with an increase 0.57% (95% confidence interval (CI): 0.17%, 0.96%) increase in all deaths in the greater Athens. In accordance with previous findings the effects of particles were greater in females and for those above 65 years of age. When a variable indicating days with desert dust was introduced, the main effect and the interaction effect of desert dust days with air pollution were not significant. The negative sign of the interaction effect indicated that particles originating from other sources (e.g. urban) were more toxic.

**Conclusions:** The adverse effects of particulate pollution in Athens, Greece on mortality are more likely to be attributed to traffic-related particles than to windblown desert dust.

#### ISEE-0134

##### Fish Consumption and Omega-3 Polyunsaturated Fatty Acid Intake in Relation to Self-Reported Physical and Mental Health Status

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**Background and Objective:** High fish consumption and omega-3 PUFA intake have various health benefits. Our aim was to study whether fish consumption and omega-3 PUFA intake are associated with self-reported health status.

**Methods:** The Health 2000 Survey (n = 5977) represented the general population and the Fishermen Study (n = 309) a population with high fish consumption. Fish consumption and eicosapentaenoic (EPA) and docosahexaenoic (DHA) acid intakes were collected using a validated food-frequency questionnaire. Self-reported health status was measured with the EuroQol-5D descriptive system comprising five dimensions of health (mobility, self-care, usual activities, pain/discomfort, anxiety/depression). Age- and energy-adjusted prevalences and odd ratios (OR) were calculated.

**Results:** The prevalence of current anxiety/depression was 12% in the Health 2000 Survey, and 7.3% in the Fishermen Study. Fish consumption and the omega-3 PUFA intake were approximately 1.5-fold in the Fishermen Study subjects compared with the general population.

In the Health 2000 Survey men, the prevalence of anxiety/depression decreased from 14% to 9% across the quartiles of fish consumption (ptrend = 0.02). Similar negative trend from 13% to 10% was seen across the quartiles of EPA (ptrend = 0.06) and DHA intakes (ptrend = 0.03). In the Health 2000 Survey men, the ORs (the highest quartile to the lowest one) for current anxiety/depression were 0.6-fold (95% CI 0.4–0.9) for fish consumption, 0.7-fold (95% CI 0.7–1.0) for EPA and 0.7-fold (95% CI 0.5–1.1) for DHA intakes.

For the remaining dimensions of health, no significant trends across the quartiles of fish consumption or omega-3 PUFA intake were detected. In Health 2000 Survey women or in the Fishermen Study participants, there were no clear associations.

**Conclusion:** Higher fish consumption was associated with lower prevalence of current self-reported anxiety/depression in the general population men. The role of fish consumption as part of lifestyle should be taken into account in future studies.

#### ISEE-0135

##### Epidemiological Survey of Food-Borne Botulism in Iran During 2004–2008

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**Background and Objective:** Foodborne botulism poisoning is one of the most hazardous food intoxication due to consumption of contaminated food such as meat, canned vegetables, traditional sea foods and, in rare cases, dairy products. In Iran, for instance, it is considered a health problem with variable prevalence rate.

**Methods:** The goal of this survey was to study epidemiological aspect of foodborne botulism in Iran during a five year period. In this cross-sectional study, data of the botulism cases in Iran from 2004–2008 have been collected and analyzed epidemiologically in relation to food origin, type of processing, distribution in rural and/or urban vicinities and widespread types.

**Results:** Overall, 341 suspected cases of botulism have been recorded in Iran during this five year period. The highest number of cases were reported in 2008 (28.28%) and the lowest number of cases were reported in 2004 (12.6%). Among the provinces, most of cases were reported from Gilan (90 reports) and West Azerbaijan reported the lowest number of cases (4 reports 1.17%). According to the survey, spawn and saline fish are the most frequent foods involved in botulism outbreaks (31.08 %). The prevalence rate was higher in rural areas (56.59%) than in cities (39.29%).

**Conclusion:** This survey shows an increase of botulism cases from 2004 until 2008 probably due to improved reporting systems. Some preventive measures such as health education, good sanitation practices, avoiding traditional food processing, and consumption of non-pasteurized dairy products and food inspection can prevent botulism cases.

## ISEE-0136

**The H63D Mutation in the Hemochromatosis (HFE) Gene Modifies the Impact of Bone Lead (Pb) Burden on Pulse Pressure (PP): The VA Normative Aging Study (NAS)**

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**Background and Objective:** Increased PP is a strong predictor of cardiovascular disease. We have previously shown that cumulative low-level Pb exposure is associated with an elevation of PP and, separately, that lead impacts on cognition are modified by the HFE mutations (C282Y and H63D). This study assessed whether the HFE mutations modify the Pb-PP relationship in community-dwelling older men.

**Methods:** We examined 695 participants with a total of 1585 observations of PP (median 53 mmHg) in NAS between 1991–2002. We used K-x-ray fluorescence and atomic absorption spectrometry for bone and blood Pb measurements. We used the mean of the right and left arm BP to calculate PP, multiplex PCR for HFE genotyping, and linear mixed effects regression models with a random intercept adjusted for covariates of interest.

**Results:** Of 695 subjects, 93 (13.4%) and 169 (24.3%) carried the HFE C282Y and H63D variants, respectively. After adjusting for age, race, diabetes, family history of hypertension, education, waist circumference, alcohol, smoking, height, heart rate, fasting glucose, and total cholesterol-to-HDL ratio, baseline bone Pb levels were associated with steeper increases in PP in men with at least one H63D allele ( $P$  for interaction = 0.02 for tibia and <0.01 for patella), compared with men with only the wild-type allele or C282Y allele. Among H63D variants, an interquartile range increases of the Pb levels in tibia (13 mg/g) and patella (19 mg/g) was associated with 2.89 mmHg (95% CI 5.49–0.29 mmHg) and 3.07 mmHg (95% CI 5.60–0.40 mmHg) increases in pulse PP, respectively. No effect of blood Pb levels on PP was found.

**Conclusion:** The HFE H63D polymorphism, but not the C282Y mutation, enhances susceptibility to the deleterious impact of cumulative Pb on PP.

## ISEE-0137

**Short-Term Associations Between Coarse PM Levels and Emergency Department Visits for Asthma in Stockholm**

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**Background and Objective:** Many epidemiological studies have shown short-term associations between air pollutants and respiratory illnesses by considering the daily hospital admissions. However, for respiratory diagnoses hospital admissions are decreasing and emergency department visits are more frequent even if the cost per case is lower. The objective was to study the relation between air pollution levels, especially for traffic related pollutants, and respiratory emergency department visits in Greater Stockholm over a 5 year period, 2001–2005. In particular we were interested in the association for the daily number of visits for asthma (mv = 22.17, min = 0, max = 71) and asthma not specified as allergic (ICD10: J45.1 and J45.9, mv = 12.8, min = 0, max = 41).

**Methods:** The effect of short-term changes in air pollutants on emergency department visits were studied by using additive Poisson regression models. Models included air pollutants (lag01), terms to describe the seasonal patterns in the emergency department visits, their dependence on weather conditions, and their associations with holiday periods and influenza and pollen episodes. Pollutants included were urban background 24h mean ( $\mu\text{g}/\text{m}^3$ ) of  $\text{PM}_{10}$  (mv = 18, min = 4, max = 90),  $\text{PM}_{2.5}$  (mv = 11, min = 3, max = 47), coarse PM ( $\text{PM}_{10}-\text{PM}_{2.5}$ ) (mv = 7,

min = 0, max = 57), NOx (mv = 22, min = 4, max = 175), and 8h maximum ozone (mv = 61, min = 5, max = 127). Both single and several pollutant models (two-pollutant models with PM variables or NOx + ozone and three-pollutant models with coarse PM and  $\text{PM}_{2.5}$  or NOx + ozone simultaneously in the model) were considered.

**Results:** For asthma and its subgroups we generally found significant associations for coarse PM and  $\text{PM}_{10}$ , while other variables show less of an association with emergency visits for asthma. Several pollutant models showed robust effects for coarse PM.

**Conclusion:** We conclude that coarse particles, in Stockholm originating mainly from road dust, seem to worsen asthma and increase respiratory emergency department visits. There is also support for an effect of vehicle exhaust indicated by NOx.

## ISEE-0139

**Impacts of Exposure to Highway Traffic Exhaust on Childhood Respiratory Health in Trans-Alpine Highway Valleys**

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**Background and Objective:** Although trans-alpine highway traffic exhaust is the major source of air pollution along the highway valleys of the Alpine regions, little is known about its impacts on respiratory health. Our previous study showed significant associations between respiratory symptoms and highway exposure in adults. This study focuses on children's respiratory health.

**Methods:** Between 2007 and 2008, 2,305 schoolchildren (ages 7–14) were recruited from the Alpine communities. Respiratory symptoms and information on potential confounders were collected by questionnaires. Highway exposure was represented by either residential distance to the highway as a Gaussian function or dispersion model estimates of annual mean outdoor  $\text{PM}_{10}$ ,  $\text{PM}_{2.5}$  and NOx concentrations from trucks and cars at home and school locations. Logistic regression models were used to assess respiratory health impacts. A subset of 13 children with asthma also undergo comprehensive respiratory and exposure assessment including measurements of inflammation and oxidative stress makers via exhaled NO and exhaled breath condensate, monthly outdoor and indoor measurements of  $\text{NO}_2$  and  $\text{PM}_{2.5}$  between November 2007 and June 2009.

**Results:** When exposure was modeled as a Gaussian function of distance, a positive trend between exposure and wheezing, hay fever, several reported asthma attacks, as well as nose and eye problems were observed. Using the dispersion estimates, home outdoor  $\text{PM}_{10}$  from trucks was significantly associated with wheezing in the chest (OR = 1.24, 95% CI: 1.01–1.52) and hay fever (OR = 1.26, 95% CI: 1.05–1.52). Significant associations were also found between  $\text{PM}_{10}$  from cars and wheezing (OR = 1.30, 95% CI: 1.02–1.67). Similar results were observed for  $\text{PM}_{2.5}$ . NOx concentrations showed no associations with respiratory outcomes. Analysis of the asthma panel study is currently underway.

**Conclusion:** Our results so far demonstrate that PM emitted from the trans-Alpine highway traffic, especially from trucks, is a significant risk factor for adverse respiratory effects in school children.

## ISEE-0140

**Effect Modification of Asthma by SES and Pest Exposure in US and Foreign-Born Children**

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**Background and Objective:** Study of differences in asthma prevalence between native and foreign-born children might help elucidate this problem of why some children develop asthma.

**Methods:** We pooled data from 5 surveys in Boston that asked about asthma diagnosis and place of birth. We used tabular analysis and logistic regression to assess associations with asthma and interaction for exposure variables.

**Results:** Consistent with our smaller individual studies, place of birth was significantly associated with asthma (OR = 3.31,  $P < 0.001$ ; N = 961). We found evidence of interaction for both SES and exposure to pests. In children not born in the US, SES level had no significant effect on asthma (OR = 1.43,  $P = 0.53$  comparing high low SES; N = 623), while for children born in the US, those from higher SES families were less likely to have asthma and the effect was significant (OR = 0.48,  $P = 0.001$  for higher versus lower SES). The odds ratio for exposure to household pests was significant (OR = 1.6,  $P = 0.017$ ; N = 685) for children born in the US but was non-significant and in a different direction for children born outside the US (OR = 0.47,  $P = 0.28$ ). Constructing a logistic model for all subjects was difficult because of the heterogeneity of effects, especially for SES. Building two models resulted in the variables SES, family history of asthma, and wheeze being included for children born in the US. For foreign-born children, the best model included only wheeze.

**Conclusion:** Foreign-born children appear to have resistance to developing asthma when exposed to the factors that are associated with asthma in US-born children. This may reflect either the effect of other exposures providing protection (hygiene hypothesis) to the foreign-born, or conversely, US-born children have early detrimental environmental exposures, which predispose them to asthma.

#### ISEE-0142

##### An Assessment of the Effect of Highway Proximity to Homes and Schools on Pediatric Asthma and Lung Function

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**Background and Objective:** Numerous studies have found that living or attending school near highways, or exposure to pollutants associated with heavy motor vehicle traffic are associated with higher prevalence of asthma and reduced lung function. Few studies have assessed school and home exposure in the same study.

**Methods:** We recruited children ages 5–19 from a pediatric clinic in an urban center (Boston Chinatown) for many of whom housing and the local school are located immediately adjacent to two major highways. A questionnaire was used to assess self report of diagnosis of asthma and proximity of schools and homes to highways as well as basic demographic information. Pulmonary function was assessed and resulting data were reviewed by a pediatric pulmonologist blinded to survey responses and, based on this review, we excluded lung function tests of low quality.

**Results:** Analysis did not demonstrate any associations or mean differences between near-highway exposure at school, at home, or at both with diagnosed asthma ( $P > 0.10$  in all analyses; N = 124). For the lung function data analysis (N = 87), neither direct measures (FEV<sub>1</sub>, FVC, and FEF<sub>25–75</sub>) nor ratio measures (FEV<sub>1</sub>/FVC and FEF<sub>25–75</sub>/FVC) had significant association with near-highway exposure ( $P > 0.10$  in all analyses). Certain predisposing factors, such as diagnosed allergies and family history of asthma, were strongly associated with diagnosed asthma ( $P < 0.05$  and  $P = 0.001$ , respectively), findings we have seen consistently in other work with children recruited from the same clinic.

**Conclusion:** Our findings suggest that either limitations in our study design restricted our ability to see the associations reported by others, or that these associations do not exist in this.

#### ISEE-0143

##### Community Assessment of Freeway Exposure and Health: Approach and Methods

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**Background and Objective:** There is evidence that exposure to airborne ultrafine particles that are elevated near highways increase risk of cardiovascular morbidity and mortality. We hypothesize that measured UFP will be associated with cardiovascular disease and markers in older adults.

**Methods:** Community Assessment of Freeway Exposure and Health is a 5-year, observational, cross sectional community-based participatory research study of exposure and health outcomes in neighborhoods immediately adjacent to major highways in the Boston, Massachusetts area. We will deploy a mobile platform capable of real-time measurement of size-segregated ultrafine particles, PM<sub>2.5</sub>, NO, NO<sub>2</sub>, CO, BC, PAH, and meteorology. In each of the three geographic areas close to highways in which we will work, we will conduct extensive exposure assessment measurements at different times of the day, days of the week and seasons. We expect our final exposure model to allow for differences in exposure with time. Random samples of residents living <100 m, 100–400 m and at distant background urban sites will be selected for participation. A survey will assess demographics, time-activity patterns, cardiovascular diagnoses and numerous confounders, including diet, exercise, smoking, and other exposure to combustion sources. A module of questions will also ask about perceptions of risk from air pollution. A subset of survey respondents will be recruited to have blood pressure and ankle brachial artery measurements done and to donate blood samples that will be assayed for C-reactive protein, fibrinogen and lipids.

**Results:** We are in the start-up phase of this study and seek here to present the methods and approach for this study.

**Conclusion:** There is a need for studies, like this one, that measure and model near highway ultrafine gradients and assess their association with cardiovascular outcomes with consideration of time activity patterns of residents.

#### ISEE-0145

##### A Feasibility Study on Assessing Public Health Impacts of Cumulative Air Pollution Reduction Activities in a Small Geographic Area

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**Background and Objective:** The main objective of this study was to examine the feasibility of conducting a local (e.g., city level) assessment of the public health impacts of cumulative air pollution reduction activities (a.k.a. accountability) from the federal, state, local and voluntary



actions in the city of New Haven, CT (population ~127,288) for a variety of health outcomes.

**Methods:** First we examined the availability of existing health (e.g., hospital discharge, mortality, vital records, school absenteeism), ambient air quality, and exposure related data (e.g., emissions related to pollution control actions, ambient concentrations, transportation data) for the city of New Haven, CT. Next, a hybrid modeling approach that combines regional and local-scale air quality models was used as inputs into human air exposure models (SHEDS and HAPEM). Ambient and exposure concentrations for multiple air pollutants (e.g., PM<sub>2.5</sub>, NO<sub>x</sub>, benzene, and formaldehyde) were then estimated for base year 2001 emissions as well as projected emissions for years 2010, 2020, and 2030. Finally, a feasibility assessment for conducting an accountability study was performed for 34 different pollutant/health outcome linkages.

**Results:** Model simulations indicated a modest overall decrease (~10%-30%) in median pollutant concentrations mainly from local sources and mostly between 2001 and 2010 but greater than 60% decreases were projected for NO<sub>x</sub>. Considerable spatial variability in concentrations was found within the city for most pollutants. The only feasible pollutant/health outcome linkages were found for NO<sub>x</sub> related improvements with all-cause mortality, asthma diagnosis for children, and respiratory hospitalizations.

**Conclusion:** With traditional epidemiologic study designs significant reductions in air pollution are often needed in small communities, such as New Haven, to assess the health impacts of environmental actions. Alternative study designs incorporating the air quality and exposure models that can provide intra urban gradients may be a more powerful alternative that warrants further exploration.

#### ISEE-0146

##### The Effect of Ambient Air Pollution on Sperm Quality

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**Background:** We assessed exposure to ozone (O<sub>3</sub>) and particulate matter less than 2.5 microns in aerodynamic diameter (PM<sub>2.5</sub>) and altered sperm quality.

**Methods:** We conducted a re-examination of a previous cohort study of water disinfection by-products to evaluate sperm quality in 228 presumed fertile men with different air pollution profiles in Raleigh, NC, Memphis, TN and Galveston, TX. They completed a telephone interview about demographics, health history, occupational and other exposures and provided a semen sample. Outcomes included sperm concentration and morphology, as well as DNA integrity and chromatin maturity. Exposures to O<sub>3</sub> and PM<sub>2.5</sub> were evaluated using monitoring data obtained from the U.S. EPA. We used multivariable linear regression to assess the relationship between exposure to air pollutants during key periods of sperm development and adverse sperm outcomes.

**Results:** The mean concentration of O<sub>3</sub> ranged from 30.5 to 32.2 ppm and the mean concentration of PM<sub>2.5</sub> ranged from 10.8 to 14.0 µg/m<sup>3</sup> across the three sites. Sperm concentration and count were not associated with exposure to PM<sub>2.5</sub>, though there was a suggestive (but not statistically significant) association with O<sub>3</sub> concentration and decreased sperm concentration and count, which is consistent with the results of a previous study. Also, there was an indication of an increase in the percent of sperm cells with cytoplasmic droplet associated with PM<sub>2.5</sub> concentration. For other outcomes, we found no consistent pattern of increased abnormal

sperm quality with elevated exposure to O<sub>3</sub> or PM<sub>2.5</sub>. Neither site-specific analyses nor different exposure windows changed these results.

**Conclusions:** The results of this study provide suggestive evidence for an association between concentrations of O<sub>3</sub> or PM<sub>2.5</sub> below regulatory limits and adverse sperm outcomes in humans. (This work does not necessarily reflect EPA policy.).

#### ISEE-0149

##### Assesment of Effects of Formaldehyde Exposure on Respiratory Health: An Innovative *in vitro* Model

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**Background and Objective:** Many epidemiological studies have shown the existence of an association between air pollution and certain respiratory diseases. To study such a relationship, it is necessary to have toxicologic elements to describe the impact of these pollutants on biological models targets. The currently available toxicology models are often too remote from human exposure. The objective of this project is to develop a toxicological tool suited to studying the cellular impact of air pollutants emitted at low doses. To implement this approach, we focused a major pollutant of indoor air: formaldehyde (CHOH).

**Methods:** In an *in vitro* exposure system (Vitrocell®), allowing direct contact between the atmosphere and to study the target cells, human alveolar epithelial cells (A549), grown at confluence were exposed for 30 min and 60 at different levels of CHOH (123 to 984 µg/m<sup>3</sup>). After 24 hours of post-incubation, the mitochondrial activity (XTT) cells were evaluated and the chemoattractant cytokine IL-8 was assayed by ELISA.

**Results:** No toxicity was measured for 123 µg/m<sup>3</sup> of CHOH, whatever the exposure time, while for 30 min of exposure to 246 µg/m<sup>3</sup>, a 30% reduction in measured activity is observed. For acute exposure and for all tested concentrations, there wasn't significant increase of IL-8 release compared to the control.

**Conclusion:** These results concern an exposure range close to areas of discomfort described by some guidelines (<100 µg/m<sup>3</sup>) and do not demonstrate clear toxicity at these levels. Next, we can turn to the study of the inflammatory response related to CHOH with repeated exposures.

#### ISEE-0150

##### Characterizing Quantities and Nutritional Qualities of Household Foods Supplies for Emergency Preparedness

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**Background and Objective:** Characterizing nutritional qualities of household food supplies (HFSs) is important to emergency planning and relief efforts. This study's objective was to describe the calorie and nutrient content of HFSs.

**Methods:** HFS inventories were conducted in 160 households using barcode scanning technology linked with a database containing nutrient content data. Demographic data were collected via survey.

**Results:** HFS calories were comprised of ~14, 57, and 31% protein, carbohydrate, and fat, respectively; low income households (LIHs, n = 60) had significantly ( $P < 0.02$ ) more fat calories and fewer protein calories on hand than both middle income households (MIHs, n = 46) and upper income households (UIHs, n = 54). To permit comparisons across nutrients, expression of nutrients were standardized to days available at 100% Daily Value (DV), and nutrient adequacy ratios (NAR) were computed. Overall, NARs for fiber, iron, fat, and carbohydrate were ~1 indicating availability per 2000 calories approximated DVs. Calcium, cholesterol, and saturated fat NARs were <1, indicating availability was

below DV recommendations. NARs for vitamin C, vitamin A, protein, sugar, and sodium were  $>1$ , indicating availability exceeded DV recommendations. ANOVA and follow-up procedures revealed that per 2000 calories, NARs for iron, calcium, vitamin C, sugar, sodium, and fat were significantly lower in LIHs than both MIHs and UIHs. Compared to UIHs, LIHs had significantly lower vitamin A and fiber NARs. Nutrient density of HFSs did not differ with income group. LIHs contained  $50+28\text{SD}$  days of calories at 100% DV (i.e., 2000 calories), which is significantly lower than MIHs ( $115+66\text{SD}$  days) and UIHs ( $122+78\text{SD}$  days). Thus, for a family of 5, LIHs, MIHs, and UIHs have  $\sim 10$ , 23, and 24 days, respectively, of calories on hand.

**Conclusion:** Findings have implications for interventions aimed at improving HFSs as well as projecting time households could be sustained during emergencies (e.g., quarantine) that preclude HFS augmentation.

#### ISEE-0151

##### The Evaluation for Dust Exposure on Dental College Students

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**Background and Objective:** Dental laboratory technicians may be exposed to metal alloys that are used in the production of crowns, bridges and removable partial dentures. The aim of this study was to assess whether dental college students are investigated the particulate exposure actual condition accompanying cutting and grinding, polishing work under student training of a dental technician college, and considered concentration evaluation.

**Methods:** The T-R personal sampler (T-R: Total and Respirable Dust) was used for individual exposure concentration for 20 persons, it equipped each student's collar in the breathing zone with the filter holder, and sampled it by 2.5 L/min. for about 3 hours.

The personal dust sensor (PDS-2 type) is designed to clip on to three student's collar in the breathing zone, monitored a time concentration change of the particulates under training, and observed work record.

The Sioutas Personal Cascade Impactor Sampler (PCIP) operates at a flow rate of 9.0 L/min. for about 3 hours.

**Results:** Change of the temporal particulate exposure concentration under typical gypsum polish and crown polish, and crown steamer work is shown in Fig. 1.

The particulate exposure concentration ranged from  $0.02 \text{ mg/m}^3$  to  $0.30 \text{ mg/m}^3$  for respiratory dust, and total dust with  $0.55 \sim 3.96 \text{ mg/m}^3$  respectively. The aerodynamic size was  $0.32 \mu\text{m}$  (50% cumulative size,  $\sigma = 5.0$ ) as a result of PCIP measurement (Log-probability graph).

**Conclusion:** Since this investigation was the pilot field evaluation for the particulate exposure actual condition accompanying cutting and grinding polishing work of the student of a dental technical college, the necessity of analysis metal concentration, such as palladium in particulates and a nickel alloy, from now on was suggested.

Further research on the health information of the respiratory symptom and somatic symptoms using standard questionnaire method was done the subject.

#### ISEE-0155

##### Cold Counts, but How Cold May Not

Yasushi Honda,\* Victoria Likhvar,\* Kazutoshi Sugimoto,\* and Masaji Ono,† \**University of Tsukuba, Tsukuba, Ibaraki, Japan*; and †*National Institute for Environmental Studies, Tsukuba, Ibaraki, Japan*.

**Background and Objective:** In evaluating temperature-mortality relation among populations, controlling for chronological year only and controlling

both for chronological year and season yielded different results; the relation of the former was V-shaped with the x-axis as temperature and the y-axis as mortality, whereas for the latter this was hockey-stick shaped, i.e., no cold effect on mortality. The objective of this study is to obtain some clue for this discrepancy by month-specific analysis of temperature-mortality relationship.

**Methods:** We obtained data on mortality and meteorology from the governmental agencies for 47 Japanese prefectures for the period 1972–1995. For each prefecture, we plotted the relation between daily maximum temperature and year-adjusted mortality rate; here the season was not controlled for. Then, using smoothing splines, we obtained regression lines for each month, as well as those for entire year.

**Results:** All the prefectures showed a V-shaped relationship when the whole year data were used. In the month-specific analysis, hot months showed mostly monotonous relationships; the higher the temperature, the higher the mortality rate. On the other hand, for cold months, i.e., from December to February, each month mostly showed that temperature did not affect the mortality within the month. Also, the mortality level in December was lower than that in January or February. This suggests that influenza or other respiratory diseases may have contributed to the higher mortality rate in January and February; in Japan, influenza epidemics occurred more frequently in January and February than in December.

**Conclusion:** There was a seasonal effect in that the mortality was higher in winter, but how cold it was did not appear to affect the mortality rate. We need further investigations on this mechanism, because global warming may not attenuate the mortality due to cold as expected from the V-shaped relation.

#### ISEE-0156

##### Maternal Care-Giving and Hygiene Behavioral Determinants of Diarrhea among Under-Five Children in Nekemte Town, Western Ethiopia

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**Background and Objective:** Various studies have addressed the relationship between maternal care giving and hygiene behaviors for diarrhea occurrence in children. However, very few studies have been conducted in Ethiopia. The present study assessed the prevalence of under-five diarrhea morbidity due to mothers/care takers behavior related determinants.

**Methods:** A community-based cross-sectional study was conducted in Nekemte town, western Ethiopia from 15 October – 26 November, 2007. 477 mothers of index under-five children living in the households selected randomly from Kebeles in the town constituted the study population. Data were collected using structured and pre-tested questionnaire, entered into a computer database, edited and analyzed using SPSS for windows version 12.0.1. A stepwise logistic regression model was used to calculate odds ratios and 95% confidence intervals for the different risk factors.

**Results:** Of 477 sampled mother/care takers-child pairs, 461 (response rate of 96.6%) participated in the study. The mean ages of the respondents and the index children were 32.4 ( $+8.8 \text{ SD}$ ) years and 25.27 ( $+15.16 \text{ SD}$ ) months, respectively. Diarrheal morbidity prevalence over two week's period preceding the study was about 28.9%. In the bivariate analysis, a number of risk factors including presence or absence of drinking water container cover during transportation to house, home drinking water treatment, storage container cover in the house, hand wash practice after cleansing child's feces ( $P < 0.05$ ), child breast feeding status ( $P < 0.05$ ) and the use of bottle to feed the child ( $P < 0.001$ ) appeared to be significantly associated with under-five childhood diarrheal morbidity. However, the use of cover material during drinking water transportation and bottle feeding were the only significant variables on multivariate analysis ( $P < 0.05$ ).

**Conclusion:** As diarrhea morbidity is a major problem among under-five children in this region, appropriate intervention programmes targeting the

use of cover material during drinking water transportation and bottle feeding should be designed.

#### ISEE-0158

##### German Residents Exposed to PFOA-Contaminated Drinking Water: One Year Follow Up

Michael Wilhelm,<sup>\*</sup> Thomas Göen,<sup>†</sup> Jürgen Angerer,<sup>‡</sup> Knut Rauchfuss,<sup>‡</sup> Martin Kraft,<sup>§</sup> Peter Kleeschulte,<sup>¶</sup> and Jürgen Hölzer,<sup>\*</sup> *\*Department of Hygiene, Social and Environmental Medicine, Ruhr-University Bochum, Bochum, Germany; †Institute and Outpatient Clinic of Occupational, Social and Environmental Medicine, University Erlangen-Nuremberg, Erlangen, Germany; ‡North Rhine-Westphalia State Agency for Nature, Environment and Consumer Protection, Recklinghausen, Germany; §Ministry of Environment and Conservation, Agriculture and Consumer Protection, North Rhine-Westphalia, Düsseldorf, Germany; and ¶Public Health Department of the Hochsauerlandkreis, Meschede, Germany.*

**Background and Objective:** 40 000 residents had been exposed to PFOA-contaminated drinking water (500–640 ng PFOA/l; May 2006) in Arnsberg, Germany. After installation of activated charcoal filtering by the waterworks in July 2006, the PFOA-concentrations in drinking water were lowered significantly, mostly below the limit of detection (10 ng/l). The results of the first human biomonitoring study have recently been published (Hölzer et al. 2008): PFOA-concentrations in blood plasma of residents living in Arnsberg were 4.5–8.3 times higher than in the reference groups. All participants of the first study 2006 were invited to take part in a follow-up study. It was the aim of the study to determine the decline of the PFOA-concentrations in blood plasma.

**Methods:** Lifestyle factors and drinking water consumption habits were assessed by questionnaire and interview. Perfluorooctanoate (PFOA), perfluorooctanesulfonate (PFOS), perfluorohexanoate (PFHxA), perfluorohexane-sulfonate (PFHxS), perfluoropentanoate (PFPA) and perfluorobutanesulfonate (PFBS) in blood plasma and PFOA/PFOS were measured by solid phase extraction, HPLC and MS/MS detection.

**Results:** 291 persons (82%) took part. The (median) PFOA-concentrations in blood plasma of Arnsberg's residents decreased from 22.1 to 17.6  $\mu\text{g/l}$  in children, from 24.9 to 20.0  $\mu\text{g/l}$  in mothers and from 27.4 to 25.7  $\mu\text{g/l}$  in men, respectively, within one year. The average (median) changes in each individual's PFOA-concentrations were approx. 8 (men), 19 (mothers) and 20 (children) percent/year.

**Conclusion:** The reported decline in PFOA-concentrations indicates a slow elimination in humans. This finding is in line with data on long elimination half-lives observed in occupationally exposed workers.

Reference: Hölzer, J., Midasch, O., Rauchfuss, K., Kraft, M., Reupert, R., Angerer, J., Kleeschulte, P., Marschall, N., Wilhelm, M., 2008. Biomonitoring of perfluorinated compounds in children and adults exposed to perfluorooctanoate-contaminated drinking water. *Environ. Health Perspect.* 116, 651–657.

#### ISEE-0159

##### Long-Term Exposure to Ambient Air Pollution and Mortality: Design Features of a New Cohort Study of Ontario Adults

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**Background and Methods:** This presentation outlines the design features of a new population-based retrospective cohort that we have assembled to investigate the relationship between long-term exposures to ambient air pollution and mortality and cancer outcomes.

**Methods:** Individuals were randomly selected from the T1FF database which contains records of all income tax returns filed by Canadians. Eligible cohort members were resident in one of 10 urban areas in the province of Ontario between 1982 and 1986. Vital status was ascertained by record linkage to the Canadian Mortality Data Base. Internal linkage within the income tax database allowed for the determination of place of residence on a year-by-year basis up to December 31, 2004. Air pollution data are being assigned to place of residence data using a variety of methods that include: fixed-site monitoring, satellite imaging, roadway and traffic densities, and land use regression estimates.

**Results:** The cohort is comprised of 646,005 individuals (325,636 men and 320,369 women). The mean age of participants at baseline was 51.6 years (range 35–84). In total, 195,014 deaths were observed among cohort members. Non-malignant respiratory disease, ischemic heart disease and lung cancer accounted for 15,526, 41,791 and 16,688 of the total deaths, respectively.

**Conclusion:** The population-based nature of this study, the ability to track air pollution exposures over a lengthy interval, and the availability of socio-demographic data at an individual and ecological level will be used to characterize health risks of ambient air pollution. To date, there has been no large scale longitudinal investigation of ambient air pollution in Canada.

#### ISEE-0161

##### Immune and Oxidative Response in the Simultaneous Exposure to Formaldehyde and Wooden Dust. Experimental Studies

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**Abstract:** Prolonged inhalation of wood dust is associated with alteration of the cellular immune functions and oxidative response, leading to an excess in risk of cancer in the respiratory tract. Wood products using adhesives that contain urea-formaldehyde (UF) resins are recognized as producing high exposure to formaldehyde. Several studies have shown an excess of respiratory tract cancer in individuals occupationally exposed to formaldehyde. The objective of our study was to identify the cellular processes induced by wood dust and formaldehyde, administered alone and together.

An in vivo experiment was carried out on Wistar rats, divided into 5 groups as follows: 1. Control group, 2. Formaldehyde (F) group, 3. Wooden dust (WD) group, 4. F+WD group, 5. Industrial dust containing pressed wood including particleboard +F (PWF) group. Animals belonging to groups 3 and 4 were instilled intratracheally with 0.8 mg WD; animals belonging to group 5 were instilled with 20 ppm PWF and animals belonging to groups 2 and 4 inhaled 20ppm F, 5 hours/day, 5 days/week, for 6 months. The animals were sacrificed at 6 months. The following parameters were assessed: 1. 3HTdR incorporation test; 2. IL-1- assay; 3. TNF- assay; 4. Chemiluminescence's assay; Lipid Peroxides; 5. Histopathological exam. Our results point to the following findings: 3HTdR incorporation was decreased in the all the groups exposed to respiratory risk factors, but the most important reduction in immune response was found in groups 4 and 5. In comparison with the control group, the values of the IL-1, TNF, ROS and LP were increased in all the exposed groups, and for TNF and ROS such differences were statistically significant.

Wood dust and formaldehyde, administered separately, interfered with immune and oxidative reactions. Their joint administration deeply altered cellular reactions known to be associated with an increased risk of developing cancers in the respiratory tract.

#### ISEE-0162

##### Free Radicals, Lipid Peroxidation and Immune Response in Experimental Exposure to Electromagnetic Fields

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Regional Public Health Center, Cluj-Napoca, Romania; and ‡Land Forces Academy, Sibiu, Romania.

**Abstract:** Although the physical techniques for measuring electromagnetic fields (EMF) are well developed, adequate characterization of the biological effects induced by EMF is still subject to discussion. Data from recent experiments suggests that EMF is associated with the iron-mediated free radical generation, that can cause damage in biologic molecules. The aim of this study was to show the effects of chronic exposure to EMF on the oxidative and immune response.

In vivo experiment was carried out on Wistar rats, divided in to 4 groups as follows: 1. Control-group, without exposure, sacrificed at 1 month; 2. Control-group, without exposure sacrificed at 6 months; 3. EMF-exposed group, sacrificed at 1 month; 4. EMF – exposed group, sacrificed at 6 months. The rats were exposed to EMF that covered a range of frequencies between 160–170 MHz, with  $S = 8 \text{ W/m}^2$ , for 2 hours/ day, 1 month and 6 months.

The following parameters were assessed: a) 3HTdR incorporation test, b) IL-1 assay, c) TNF-assay, d) Chemiluminescence assay, and e) Lipid peroxides.

The 3HTdR incorporation was decreased in the EMF- exposed groups, as compared with control groups, but with statistically significant difference (ssd) only in the third group. Increased values of the cytokines (IL-1 and TNF) were found in the groups 3 and 4, but with ssd only in group 4. Chemiluminescence assay and lipid peroxides were increased in groups 3 and 4, but ssd were found only in the fourth group. In the fourth group, an important suppression of the immune response and increased activity of the cytokines was demonstrated.

Our results indicate an association between EMF and immune and oxidative response and suggest these reactions could have a key role as a mechanism leading to irreversible injury in EMF prolonged exposure.

#### ISEE-0168

##### In-Utero p,p'-DDE Exposure and Child Neurodevelopment at 48 Months of Age: A Mexican Cohort

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**Background and Objectives:** Prenatal p,p'-DDE (DDE) exposure during the first trimester of pregnancy is associated with a significant reduction in child motor neurodevelopment during the first year of life. The persistence of this effect beyond twelve months of age is not sufficiently documented. In this report, we assessed prenatal DDE levels and infant neurodevelopment (IND) at 48 months, in relation to previous tests performed in this child cohort.

**Methods:** The cohort was assembled in January 2001, in an endemic malaria zone in Morelos, Mexico, where DDT was used until 1998. Women of reproductive age were interviewed before, during, and after pregnancy. IND was evaluated through the first 30 months of age using the Bayley Assessment Scale. At 48 months of age, the McCarthy Scale of Children's Abilities (MSCA), including six subscales (general cognitive, verbal, perceptual-performance, quantitative, memory, and motor) was applied (119 children). Home stimulation was determined using the HOME Scale. DDE maternal levels during pregnancy were also available for this report.

**Results:** No significant associations between prenatal DDE exposure and the MSCA were detected. Breastfeeding ( $\geq 12$  weeks) had no significant positive effect on any subscale of the MSCA, except for motor. Children

who received more home stimulation showed a significant performance in perceptual and motor subscale scores.

**Conclusions:** Our results suggest that prenatal DDE exposure, primarily during the first trimester of pregnancy, is not permanently associated to IND impairment. Breastfeeding and home stimulation may be key factors in preventing IND deficiencies.

#### ISEE-0169

##### Current Traffic Noise Exposure Assessment and Noise Effect of Distraction in Class Among Children in Xi'an City

Junhan Liu, and Xiaochuan Pan, Peking University, Beijing, China.

**Background and Objective:** The purpose of this study was to investigate the current traffic noise level in Xi'an city and to examine exposure-effect relationships between traffic noise exposure and children's distraction in class.

**Methods:** The overall current noise levels were monitored, especially noise from traffic. We set up 126 monitoring sites in the whole city, and collected data for three months. We compared the noise level in different life zones to try to find out which was the highest. We also conducted a study assessing 1890 pupils, aged 8–10, from 42 schools near major traffic roads and not, from all eight urban areas in Xi'an. Children were selected on the basis of exposure to external road traffic noise exposure. A well-administered questionnaire concerning distraction in class and demographic information was distributed to these pupils and their teachers.

**Results:** The noise from major roads was above 20% of the overall noise in Xi'an city, and reached an average level of 62 dB, exceeding the concern level for causing public health problems. Among all the life zones, the ones near the major traffic roads had the highest noise levels. Traffic noise exposure was significantly associated with an increased score on distracted behavior among children after full adjustment.

**Conclusion:** The assessment of noise level in Xi'an city suggested that noise level in urban areas of Xi'an has reached an alarming level. Meanwhile, a population survey in children revealed that living near a road with heavy traffic volume is one of the risk factors for distraction in class among pupils—this is an important problem impacting on behaviour at school and effective learning among children.

#### ISEE-0174

##### Placenta as Biomarker of Environmental Pollution

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**Background:** Detecting areas polluted with different xenobiotics is of great importance. Direct investigation of the soil, air and water is time-consuming and requires a large number of samples. The placenta is a unique organ which protects the fetus from noxious agents and accumulates xenobiotics, so is considered to be a reliable biomarker of environmental pollution.

**Materials and Methods:** Placenta content of pesticides and concentration of uranium, thorium, and salts of heavy metals were measured by gas-liquid chromatograph, X-ray spectrum analyses and sorptographic analysis.

**Results:** Thirty-seven placentae taken from the town of Mailuusuu (26 tailing pits, 13 waste dumps with total amount of 2 mln.m<sup>3</sup>, radiation level ranges up to 30000  $\mu\text{r/h}$ ) were analysed. Out of these, 14 placentae were taken from women living 7 km above the tailing pits (Group I) and 23 from women residing at a distance of 23 km below the tailing pits (Group II). Uranium and thorium levels were  $0.045 \pm 0.01 \text{ mg/kg}$  and  $0.026 \pm 0.01 \text{ mg/kg}$  ( $P < 0.01$ ) in Group I,  $0.90 \pm 0.5 \text{ mg/kg}$  and  $0.24 \pm 0.1 \text{ mg/kg}$  ( $P < 0.01$ ). Uranium concentration in water was  $0.31 \times 10^{-6}$ , thorium  $-0.1 \times 10^{-6} \text{ mg/kg}$ .

Forty-six placentae were examined in the antimonial biogeochemical zone of the town of Kadamjay. Antimony concentration ranged from  $0.012 \pm 0.0057$  mg/kg ( $P < 0.05$ ) up to  $0.331 \pm 0.1$  mg/kg ( $P < 0.01$ ). At a distance of 3–4 km from tailing pits its concentration decreased  $-0.003 \pm 0.001$  mg/kg ( $P < 0.05$ ).

The results of analyses of 246 placentae showed the highest OCP levels in samples taken from cotton-growing area (42.2%) and tobacco-growing area (24.6%). The lowest concentration of OCPs was found in samples from the territories where the local population were engaged in cattle-breeding and pulse plant cultivation.

**Conclusion:** The concentration of xenobiotics in the placenta were directly associated with environmental xenobiotic pollution levels.

#### ISEE-0178

##### Short Term Associations Between Daily Cardiovascular and Respiratory Emergency Admissions and PM<sub>10</sub>-Levels in Switzerland

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**Background and Objective:** Comprehensive data on daily hospital admissions and PM<sub>10</sub>-levels have become available in Switzerland only in the last 10 years. The purpose of the present study was to assess short term associations between daily cardiovascular and respiratory emergency admissions and PM<sub>10</sub>-levels in Switzerland.

**Methods:** Twelve environmentally homogeneous regions within 16 cantons of Switzerland were defined, each represented by one fixed monitoring station (choice based on measurement method, correlation with nearby stations, percentage of inhabitants within 5 km and other conditions). Daily data of hospital admission counts, PM<sub>10</sub> and covariates were collected for the period 2001–2005. The total underlying population included 5 million inhabitants.

Associations were estimated using Poisson regression (PR) and time-stratified case-crossover models, which included functions of calendar time (PR), meteorological variables and influenza frequency, indicator variables for different week days and holidays, in addition to PM<sub>10</sub> exposure. Summary risk estimates were obtained using meta-analytic methods.

**Results:** Cardiovascular admissions in subjects aged 65 years or more were most strongly associated with the 2-day mean of PM<sub>10</sub> (0.6% (95%-CI: 0.07–1.15) increase for a 10 µg/m<sup>3</sup> increment in PM<sub>10</sub>), whereas respiratory admissions were more strongly associated with levels of PM<sub>10</sub> at lags 2 to 6 (e.g., 1.6% (95%-CI: -0.1 to 3.3) increase for a 10 µg/m<sup>3</sup> increment in the 4-day mean of PM<sub>10</sub>). In two-pollutant (PM<sub>10</sub> and NO<sub>2</sub>) models, respiratory admissions were positively associated with PM<sub>10</sub>-levels at lags 2 to 6 and with NO<sub>2</sub>-levels at lags 0 and 1.

**Conclusion:** PM<sub>10</sub>-effects on cardiovascular emergency admissions appeared to be very short term whereas effects on respiratory admissions tended to occur with a delay of more than 1 day. Moreover, our two-pollutant models results suggest that pollutants deriving from local traffic also had more immediate effects on respiratory admissions while the delayed effects were mostly associated with pollutants from other sources.

#### ISEE-0179

##### Allergic Rhinitis, Allergic Sensitization, and Exposure to Traffic-Related Air Pollution in School Children

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*Chungnam, Korea, Republic of; and ‡Ulsan Univ. College of Medicine, Seoul, Korea, Republic of.*

**Objective:** To assess the relationship between individual-based exposure to traffic-related air pollutants and onset of allergic rhinitis in a prospective cohort study.

**Methods:** We studied 1451 children of age 8 years and 10 years from 10 schools to investigate allergic rhinitis and allergic sensitization. Allergic sensitization was measured by skin prick tests. Two indicators of traffic-related air pollution exposure were assessed, i.e. averaged concentrations of air pollutants (SO<sub>2</sub>, NO<sub>2</sub>, O<sub>3</sub>, CO and PM<sub>10</sub>) using measurements of near monitoring stations, and the residential NO<sub>2</sub> levels estimated by a land-use regression model.

**Results:** Positive association was found between long-term exposure to NO<sub>2</sub> and allergic rhinitis. Onset of allergic rhinitis was higher (RR, 1.87; 95% CI, 1.17–2.99) in the highest NO<sub>2</sub> tertile categories.

**Conclusion:** The results of this study suggest that residential traffic-related air pollution exposure is associated with onset of allergic rhinitis in school children.

#### ISEE-0180

##### Exposure to Volatile Organic Compounds and Loss of Pulmonary Function in the Elderly

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**Background:** Volatile organic compounds (VOC) are reported to cause adverse effects on pulmonary function in occupationally exposed workers. However, evidence is lacking on the effect of exposure to ambient VOC on pulmonary function in the general population. We hypothesized that exposure to VOC results in oxidative stress and changes in pulmonary function, especially in the elderly population.

**Methods:** A longitudinal panel study of 154 elderly people was performed at three different regions in South Korea. Repeated spirometric tests were performed on 8 different days. We measured the concentration of metabolites of VOC (Muconic acid, Mandelic acid, Hippuric acid, and Methylhippuric acid) and markers of oxidative stress (Malondialdehyde[MDA] and 8-hydroxydeoxyguanosin[8-OHdG]) from urine samples. A mixed linear regression model was used to evaluate the association between the environmental exposure and the outcome variables.

**Results:** The mean age of the participants was 73.5 years old. We found significant association between the metabolites of VOC and at least one of the two markers of oxidative stress ( $P < 0.05$ ). There were also significant associations between the markers of oxidative stress and pulmonary function tests such as forced expiratory volume in 1 second (FEV<sub>1</sub>), FEV<sub>1</sub> as a percentage of FVC (FEV<sub>1</sub>/FVC), and forced expiratory flow between 25 and 75% of the FVC (FEF<sub>25–75</sub>) ( $P < 0.05$ ). We found that the urinary levels of hippuric acid and methylhippuric acid were significantly associated with reduction of these pulmonary function parameters ( $P < 0.05$ ).

**Conclusion:** Exposure to ambient VOC in elderly people exacerbates systemic oxidative stress and thus exerts a harmful effect on pulmonary function.

## ISEE-0181

## Asian Dust Storms and Pulmonary Function of School Children

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**Background:** Health effects of Asian Dust Storm (ADS) have not been evaluated adequately, even though it may affect health of people in East Asia. This study was conducted to evaluate whether the ADS affects the particulate air pollution and the pulmonary function of children.

**Methods:** We studied 335 school children in three cities (Ala Shan and Beijing in China and Seoul in Korea), with daily measurement of PEF from May 13 to June 15, 2007. PM<sub>2.5</sub> (particulate with aerodynamic diameter < 2.5  $\mu\text{m}$ ), PM<sub>10</sub> (< 10  $\mu\text{m}$ ) and their metal components were also determined daily.

**Results:** ADS arrived at Seoul mostly from the desert areas through eastern China. We found that ambient concentrations of PM<sub>2.5</sub> and PM<sub>10</sub> for each city were not significantly associated with PEF in school children during the study period ( $P > 0.05$ ). However, most of the metal concentrations bound to the particulates were significantly associated with increase of the children's PEF in Beijing ( $P < 0.05$ ), whereas they were significantly associated with decrease of the PEF in Seoul ( $P < 0.05$ ). The lag distribution of the PEF change by metal concentrations showed almost symmetrically opposite patterns of the effect between Beijing and Seoul.

**Conclusion:** This result indicates that ADS affects the concentrations of particulate air pollutants, and the effect on pulmonary function of school children varies depending on the locations of cities along the paths of the ADS. This study suggests that the ADS contribute to displacement of urban air pollution and the health effect from eastern China to Korea.

## ISEE-0182

## Phthalates Exposure and Attention Deficit Hyperactivity Disorder in School-Aged Children

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**Background:** Very few studies have examined the association between attention deficit hyperactivity disorder (ADHD) and phthalate exposure in humans. The aim of this study was to investigate the impact of phthalates on symptoms of ADHD in school-aged children.

**Methods:** A cross-sectional examination of urine phthalate concentrations was performed, and scores on measures of ADHD symptoms and neuropsychological dysfunction with regard to attention and impulsivity were obtained from 261 Korean children, aged 8–11 years.

**Results:** Mono-2-ethylhexyl phthalate (MEHP) and mono-2-ethyl-5-oxohexylphthalate (MEOP) for metabolites of di-2-ethylhexylphthalate (DEHP), and mono-n-butyl phthalate (MNB) for metabolites of dibutyl phthalate (DBP) were measured in urine samples. The mean concentrations of MEHP, MEOP, and MNB were 34.0  $\mu\text{g/dL}$  (SD = 36.3; range: 2.1–386.7), 23.4  $\mu\text{g/dL}$  (SD = 23.0; range: 0.75–244.8), and 46.7  $\mu\text{g/L}$  (SD = 21.4; range: 13.2–159.3), respectively.

After adjustment for covariates, teacher-rated ADHD scores were significantly associated with DEHP metabolites but not with DBP metabolites. We also found significant relationships between the urine concentrations of metabolites for DEHP and DBP and the number of omission errors in continuous performance tests. The commission errors were significantly associated with DBP metabolites but not with DEHP metabolites.

**Conclusion:** The present study showed a strong positive association between phthalate metabolites in urine and symptoms of ADHD among school-aged children.

## ISEE-0184

## Nitrogen Dioxide Spatial Variability in Rome (Italy): An Application of the LUR Model Over a Decade

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**Background and Objective:** Land Use Regression (LUR) models have been increasingly used to assess exposure to air pollution within urban areas. There are no available studies comparing the performance of two or more LUR models over long time periods. To estimate exposure to air pollution among subjects enrolled in a large cohort study in Rome, we compared two LUR models from NO<sub>2</sub> measurements collected in two periods.

**Methods:** We measured NO<sub>2</sub> at 67 and 78 locations in 1995/96 and in 2007, respectively, over three three-weeklong periods (winter, spring and fall). The sites stayed the same, but 11 were added in 2007. Several land-use and traffic variables were available. The association between each land-use variable and NO<sub>2</sub> concentrations was assessed by univariate and multiple linear regressions. The final model was constructed through a backward elimination procedure ( $P > 0.20$ ).

**Results:** Mean NO<sub>2</sub> concentration was 45.4  $\mu\text{g/m}^3$  (SD = 6.9) in 1995/96 and 44.6  $\mu\text{g/m}^3$  (SD = 11.0) in 2007. There was a high correlation between the surveys ( $r = 0.79$ ). The most important predicting variables in 1995/96 were circular traffic zones, altitude, geographic coordinates, inverse population density, distance from the nearest high traffic roads and traffic density in a 150 meter buffer zone. A multiple regression model including these variables resulted in an adjusted R<sup>2</sup> of 0.724. The model for 2007 included circular traffic zones, altitude, geographic coordinates, size of census block, and meters of high traffic road in a 150 meter buffer zone (R<sup>2</sup> = 0.659).

**Conclusion:** The models developed for the two periods were sufficiently comparable, although some of the variable performed differently. The approach is useful for studying a large cohort over a long period of time.

## ISEE-0188

## Body Burdens of Mercury (Hg), Cadmium (Cd), and Lead (Pb) and Oocyte Fertilization among Women Undergoing a First Cycle of In Vitro Fertilization

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at Buffalo, SUNY, Buffalo, NY, United States; and \*\*Department of Obstetrics, Gynecology, and Reproductive Sciences, University of California at San Francisco, San Francisco, CA, United States.

**Background and Objective:** Exposures to non-essential trace metals, including Hg, Cd, and Pb, are ubiquitous and threaten reproductive health. This study aims to investigate associations between body burdens of these metals and in vitro oocyte fertilization among a cohort of women undergoing a first IVF treatment cycle.

**Methods:** Between 2006 and 2008, 55 women between 28–44 years of age initiating their first IVF treatment cycle were recruited to and finished the study. Urine specimens were analyzed for Cd using inductively-coupled plasma mass spectrometry (ICP-MS) and corrected for creatinine concentrations. Whole blood specimens from 50 participants were analyzed for total Hg, Cd, and Pb using ICP-MS. The successful fertilization of a mature oocyte (MII) was defined as the presence of two pronuclei 16–18 hours following insemination. Participants contributed a median of 8 oocytes (range 2–39). Multiple logistic regression models were used to evaluate associations between successful fertilization and metals, while adjusting for potential confounders selected using directed acyclic graphs. Generalized estimating equations were used to adjust standard errors for clustering of outcomes by subject.

**Results:** Median blood concentrations for total Hg (4.15  $\mu\text{g/L}$ ) exceeded that reported by NHANES for the 2001–2002 female U.S. population (0.70  $\mu\text{g/L}$ ); however concentrations for the other metals were comparable. Adjusting for age, cigarette smoking, and ethnicity, there were no statistically significant associations between successful fertilization and blood total Hg ( $\beta = 0.05$   $P = 0.557$ ), Cd ( $\beta = 0.82$   $P = 0.134$ ), or Pb ( $\beta = -0.31$ ,  $P = 0.587$ ), or urine Cd ( $\beta = 0.52$   $P = 0.503$ ). A comprehensive model simultaneously including blood Hg, Cd and Pb, as well as potential confounders produced similar results, as did a model considering only urine Cd and potential confounding variables.

**Conclusion:** These results are not supportive of a deleterious effect for body burdens of Hg, Cd, or Pb received from background sources on oocyte fertilization during first IVF cycles.

#### ISEE-0190

##### Remediation of Arsenic-Contaminated Sites in Sweden—Few Avoided Cancer Cases

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**Background and Objective:** Sweden has only begun remediation of its many contaminated sites. A risk assessment carried out by the Swedish EPA (SEPA) is mainly driven by health effects, and based on divergence from guideline values. It does not consider actual exposure. Arsenic (As) is the single most common primary contaminant, mainly from impregnation of wood. At low-level exposure, cancer risk is the relevant health outcome. Our aim was to estimate cancer risk at As-contaminated sites and compare it with the cost of remediation.

**Methods:** Arsenic concentrations in soil were scrutinized at 23 As-contaminated remediation sites. A rough classification of numbers of exposed people (residential areas, work-places or recreational areas) was performed. Exposure and dose from inhalation, oral intake and dermal uptake was estimated using appropriate (although “conservative”) exposure factors, mainly based on the US EPA Exposure handbook. Drinking water was not relevant. Estimated numbers of extra cases of cancer (lung, bladder, and skin) was estimated using WHO (skin) and NAS (lung and bladder) exposure-response relationships, adapted to Swedish background rates.

**Results:** Mean pre-remediation As concentrations at the 23 sites ranged 23–1128 (median 119)  $\mu\text{g/g}$ . The number of extra cases of cancer was only 0.24, summed up over a 30 year period at all sites. Using an average mortality of 50% (lung, bladder and skin), 0.12 lives were saved at a remediation cost of SEK 881 million (about 100 million USD), about 900 million USD per life saved.

**Conclusion:** The cancer risk from As exposure at contaminated sites was low, and the cost to save a statistical life was high. The SEPA risk assessment does not permit socioeconomic calculations since it stops at comparisons with guideline values without assessing the number of exposed subjects or extent of exposure. Socioeconomic analyses may be appropriate when considering costly environmental policy measures.

#### ISEE-0193

##### Environmental Lead Exposure and Mortality in Taiwan: Implementation of Petrol-Lead Phase-Out Program from 1981 to 2006

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**Background and Objective:** Environmental lead exposure has long been recognized as resulting in significant health impacts, and has also been reported to be associated with cardiovascular disease and all-cause mortality. More recently, the lead content of various environmental components has decreased in response to replacement of leaded petrol. The purpose of this study is to examine whether disease mortality has reduced following petrol lead emission, and meanwhile consider tobacco consumption, economic and medical resources.

**Method:** The national death record was obtained from the Taiwan Department of Health. Based on the 2000 W.H.O. world standard population, standardized mortality ratios (SMRs) for disease were calculated. The economic index, per capita income, consumption of tobacco and medical resources were acquired from the Taiwan Directorate General of Budget, and motor gasoline consumption was obtained from the Bureau of Energy. Blood lead levels were compiled from 12 international/national studies for inclusion in the data assessment.

**Results:** In Taiwan, the petrol-lead phase-out program was mainly divided into three phases—(1) leaded petrol phase (0.72–0.12 g/l) (1981–1992); (2) transitional phase (0.08 and 0.026 g/l) (1993–1999); and (3) the ban of leaded petrol phase (after 2000). Mean blood lead levels have fallen from 20.14  $\mu\text{g/dl}$  in the leaded petrol phase to 3.00  $\mu\text{g/dl}$  in the unleaded petrol phase. Adjusted for economic growth rate, per capita income, consumption of tobacco and medical resources, we found that the trend of SMRs for all causes of death, cerebrovascular disease, nephrosis, and congenital anomalies declined gradually by annual petrol lead emission.

**Conclusion:** The data analysis provides a benchmark of Taiwan experience in common with the global effort in the petrol-lead phase-out program that has been a key contributor to the dramatic decrease of blood lead along with mortality from all causes of death, cerebrovascular disease, nephrosis, and congenital anomalies.

#### ISEE-0195

##### Air Temperature and Inflammatory and Coagulation Responses in Patients with Coronary or Pulmonary Diseases

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**Background and Objective:** Air temperature changes have been associated with increased cardiovascular and respiratory risk, but the role of inflammation and coagulation markers in these relationships is not well

understood. We investigated the associations between temperature and several blood markers in individuals with coronary heart disease (CHD) and pulmonary disease (PD).

**Methods:** Two panel studies were conducted in Erfurt, Germany, in two subsequent winters. In total, 578 and 381 repeated blood measurements from 57 CHD and 38 PD patients were collected, respectively. Data on patient characteristics and disease history were gathered at the baseline visit. Meteorological data were collected from existing networks. Associations were analyzed using additive mixed models with random patient effects. Effect modification by diabetes status was investigated only in CHD patients, as only two diabetic individuals were part of the PD panel.

**Results:** Mean daily air temperature varied between  $-13^{\circ}\text{C}$  and  $16^{\circ}\text{C}$  in both study periods. A  $10^{\circ}$  decrease in the 5-day-average of temperature before the blood withdrawal led to an increase in fibrinogen (%-change from the mean: 5.5%; 95%-confidence interval (CI): [1.3%; 9.7%]) and platelet counts (3.0%; 95%-CI: [0.6%; 5.5%]), and to no change in C-reactive protein in PD patients, whereas for CHD patients a decrease was observed. A two day delayed increase in factor VII in association with a temperature decrease was seen in CHD patients (4.9%; 95%-CI: [0.7%; 9.2%]), while PD patients showed no effect. The effects in CHD patients without diabetes were similar to those of the PD patients, whereas diabetic CHD patients showed a strong effect (12.1%; 95%-CI: [5.8%; 18.9%]).

**Conclusions:** The present study suggests that a temperature decrease is associated with a change in several blood parameters. It can only be speculated that the partly opposite findings in CHD and PD patients might be influenced by their differing diabetic status.

#### ISEE-0196

##### Non-specific Physical Symptoms in Relation to the Actual and Perceived Exposure to EMF (Electromagnetic Fields) and the Underlying Mechanisms\*

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**Background and Objective:** The major goal of the current multidisciplinary project is to examine the relationship between non-specific symptoms (MUPS) and actual exposure to EMF and to identify the role of psychological factors that might influence this relationship. The project "EMPHASIS" consists of four multi component stages, preceded by a literature review. The poster presentation will briefly introduce the aim and design of the project and will reveal the results of the review.

##### Methods:

- I. Literature review regarding the relationship between EMF and MUPS.
- II. A pilot study using an existing data-set (N = 3600) in 22 residential areas.
- III. A questionnaire survey (N = 7000) exploring the relationship between exposure to EMF, psychological factors and non-specific health symptoms. Study areas with varying distances to a base-station will be matched with registry data from general practitioners.
- IV. Analysis of routinely collected health data on MUPS in relation to EMF exposure.
- V. Routinely collected data at different scale levels will be combined with individual data from the questionnaire study to minimize bias, and thus taking advantage of both study designs.

Statistical approaches including multilevel analysis, before-after analysis and small area statistics will be applied.

**Results:** Results of the literature review indicate that many reported studies have serious methodological shortcomings: description and correction for selective non-response, small sample sizes, weak exposure

characterization and lack of data on psychological mechanisms come forward as the major research gaps.

**Conclusion:** This study is an effort to fill the gaps of the previous research by combining a cross-sectional and longitudinal design, using a questionnaire that includes perceived exposure and other psychological factors with registry data to determine the health outcomes.

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#### ISEE-0201

##### Occupation Solvents Exposure and Cognitive Decline in Older Adults

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**Background and Objective:** Evidence for an association between occupational solvent exposure and dementia is sparse. This study of a cohort from 3 Chicago neighborhoods uses exploratory analysis to describe correlates of occupational solvent exposures and examines associations between these exposures and cognitive decline.

**Methods:** In a biracial population of 4391 adults aged 65–102 years, cognitive performance was measured at 3-year intervals. Global cognition scores were computed by averaging the z-transformed scores of 4 cognitive tests (the East Boston tests of immediate and delayed recall, the Mini-Mental Status Exam, and the Symbol Digit Modalities Test). We assessed solvent exposure, including "likelihood of exposure," by linking the National Occupational Exposure Survey solvent data to each participant's 'most of life' job and industry. We used mixed linear models to compare differences in global score change across level of occupational exposure to solvents, as a class and individually.

**Results:** Compared with whites, blacks were more likely to have been exposed for the entire workday to formaldehyde, ethylene glycol, toluene, methanol, xylene, acetone, or hexane (Age-adjusted RR range = 1.5 (95% CI: 1.1–2.2) to 4.9 (95% CI: 3.3–7.4). Adjusting for age, sex, race, education, and cognitive activities, we found very small ( $-0.0003$  to  $0.007$  standard deviation units [SDU]/year), statistically non-significant ( $P = 0.12$  to  $0.7$ ) differences in change in cognitive scores between exposed and unexposed persons when we examined: exposure to any solvent; ever/never exposure to each of the specific solvents above; or solvent exposure for the entire workday.

**Discussion:** The disparate exposure for blacks is large, consistent with other findings of race-based exposure disparities. The apparent lack of association between our exposure measures and cognitive decline may be due to misclassification since the estimate of exposure likelihood is based on the proportion of workers in jobs and industries nationwide rather than participants' individual workplaces.

#### ISEE-0202

##### A Spatial Case-Control Study of Birth Defects and Exposure to Spraying *Bacillus Thuringiensis* Var. *Kurstaki* (Btk) for Painted Apple Moth *Teia Anartoides*, Walker in New Zealand

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**Background and Objective:** During 29 October 2001–18 February 2005, Foray 48B (active ingredient *Bacillus thuringiensis* var. *kurstaki* (Btk)) was applied aerially in western Auckland, New Zealand to eradicate the exotic painted apple moth *Teia anartoides*. Public concern was generated about possible health effects, including birth defects. A spatial case-control study (two control areas) was 'carried' out to determine any change in the prevalence of birth defects in the exposed area.

**Methods:** Exposed and unexposed (before and after spraying) time periods, and minimal and maximum likely exposure areas were designated. East Auckland and Christchurch were selected as 'control' areas, because they were metropolitan areas of similar socio-economic status as the exposed area. Data on birth defects were extracted from the NZ Birth Defects Monitoring Programme (NZBDMP). Odds Ratios (OR) and 95 confidence intervals (CI) were calculated for the prevalence of birth defects occurring in the case areas compared to the control areas.

**Results:** The overall risk of a live birth having a birth defect in the exposed areas was similar to that in both the East Auckland (OR = 0.99, 0.91–1.08) and Christchurch (OR = 0.94, 0.86–1.03) control areas. The exposed areas did have a higher risk for 'other congenital musculoskeletal anomalies' (OR = 1.74, 1.12–2.71) and 'congenital anomalies of ear, face, and neck' (OR = 1.40, 1.00–1.96). The risk of 'all chromosomal anomalies' was lower in the exposed than the control areas.

**Conclusions:** These data provide little consistent evidence that the spraying of Foray 48B resulted in an increased prevalence of livebirths with birth defects. Where there was a suggestion of increased risk in the spray areas, this was not internally consistent between the two exposure areas, or externally consistent with the two control areas. The results are consistent with the international literature reporting no plausible mechanism of Foray 48B causing harm in utero.

#### ISEE-0203

##### Healthy Food Sesame Oil Protects Against a Synthetic Chelating Agent Ferric-Nitritoltriacetate Induced Renal Failure

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**Background and Objective:** Environmental pollutant ferric nitritoltriacetate (Fe-NTA) complex causes acute nephrotoxicity in animals and humans. Sesame oil, a healthy food, increases resistance to lipid peroxidation and to protect against multiple organ injury in various animal models. We examined the prophylactic protective effects of sesame oil against Fe-NTA-induced acute renal injury in mice.

**Methods:** Hepatic injury was induced by intraperitoneal injection of Fe-NTA (0, 1, 2, and 4 mg/kg) for 3 hrs in SPF BALB/c mice. Various doses of sesame oil (from 0 to 4 ml/kg) were given to Fe-NTA-treated mice. Renal injury was assessed by the raise of serum blood urea nitrogen (BUN) and creatinine levels, as well as the histological examination. Further, serum ferrous levels are also determined 3 hrs after Fe-NTA administration.

**Results:** In dose response study, Fe-NTA, at the doses of 2 and 4 mg/kg, significantly increased serum BUN and creatinine levels compared with control group at 3 hrs after Fe-NTA administration. In time course study, sesame oil (4 ml/kg) decreased serum BUN and creatinine levels compared with Fe-NTA alone group 3 and 6 hrs after Fe-NTA (4 mg/kg) administration. In addition, sesame oil dose-dependently decreased serum BUN and creatinine levels compared with Fe-NTA (4 mg/kg) alone group. Furthermore, sesame oil (4 ml/kg) significantly decreased serum ferrous levels compared with Fe-NTA (4 mg/kg) alone group.

**Conclusion:** Sesame oil may attenuate Fe-NTA-induced renal injury by diminishing serum ferrous levels in mice.

**Keywords:** nitritoltriacetate (Fe-NTA), sesame oil, renal injury, ferrous, mice.

#### ISEE-0204

##### $\alpha$ -Synuclein Repeat Polymorphisms and Pesticide Exposure in Parkinson's Disease

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**Background:** Variability in lengths of a dinucleotide repeat sequence (Rep1) within the  $\alpha$ -synuclein gene (SNCA) promoter has been shown to be related to Parkinson's disease (PD) risk. Several lines of evidence link pesticides as possible contributors to PD pathogenesis. While multiple insults may together contribute to loss of homeostatic self-regulation of the dopaminergic system, possible SNCA-pesticide interactions have not been well-investigated, and previous analyses have relied on self-reported pesticide exposure.

**Methods:** We developed a GIS-based exposure assessment tool to estimate pesticide exposures from agricultural applications using data from the California Pesticide Use Reports, land-use maps, and geocoded historical residential addresses. We assessed interactions between Rep1 SNCA promoter polymorphisms and pesticide exposure among Caucasian participants in a population-based study (290 incident PD cases, 293 controls) in rural Central California. Rep1 allele lengths were measured using genotyping methods, assigned scores (0–8), summed across genotype, and then categorized as short ( $\leq 6$ ), regular (8) or long ( $\geq 10$ ).

**Results:** In logistic regression models adjusted for age, sex, education, smoking and family history of PD, consistent with previous reports, longer repeat lengths tended to be associated with increased PD risk and shorter repeat lengths with decreased PD risk. Stratified models suggested that the SNCA effect possibly varies by level of pesticide exposure. Compared to the regular Rep1 length, at high paraquat exposure, the long length (OR 1.71, 95% CI 0.45, 6.51) but not the short length (OR 1.12, 95% CI 0.58, 2.18) tended to be associated with increased PD, while at low paraquat exposure, the long length (OR 0.95, 95% CI 0.45, 2.01) was not associated with PD, and the short length (OR 0.72, 95% CI 0.46, 1.12) tended to be protective.

**Conclusion:** Results somewhat suggest a SNCA-pesticide interaction yet are limited by the number of subjects; additional genotyping is planned to increase sample size.

#### ISEE-0205

##### Speciation Analysis of Arsenics in Commercial Edible Brown Alga (Hijiki: *Hijikia fusiforme*) by an HPLC- MS/MS and an HPLC-ICP-MS

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**Background and Objective:** Consumption of seaweed has recently increased as a diet food in Western countries. Edible brown alga (hijiki; *hijikia fusiforme*) contains not only a high content of inorganic arsenic (iAs) but also various kinds of arsenosugars (AsSug) which are metabolized to dimethylarsinic acid (DMA) in mammals. Since DMA is considered to be tumorigenic in rodents, it is necessary to accurately measure the contents of AsSugs as well as iAs for the risk assessment of seaweed consumption.

**Methods:** Nine kinds of dried hijiki products were provided for analysis. Total arsenic (T-As) was measured by DRC-ICP/MS after wet-digestion. After water-extraction, speciation analysis of arsenics was performed by HPLC-ICP/MS using PRP-X100 anion exchange column with mobile phase of 20 mM  $\text{NH}_4\text{HCO}_3$  and detection mass of  $m/z$  75 ( $^{75}\text{As}^+$ ), 72



( $^{72}\text{Ge}^+$ ), and  $^{35} (^{35}\text{Cl}^+)$ . AsSugs were detected by HPLC-MS/MS with multiple-reaction monitoring in the positive ion mode.

**Results:** The ranges of T-As, water soluble total As and water soluble iAs concentrations in nine hijiki samples were 37.1–118.6, 20.0–81.6, 9.2–55.8  $\mu\text{gAs/g}$  dry weight, respectively. The ratio of iAs to T-As ranged from 24.5 to 60.1%. The major compound detected was arsenate in all samples and the concentrations ranged 8.9–70.5  $\mu\text{gAs/g}$  dw. Five kinds of oxo-AsSug were detected in eight of nine samples. The peak of dimethylarsenosugarsulfate (MW = 408) was higher than any other oxo-AsSugs. The content ratio of AsSugs to T-As ranged from 6.8–52.5%.

**Conclusion:** The contents of T-As, iAs and AsSug varied with hijiki products. Five kinds of oxo-AsSug were detected by HPLC-MS/MS, which was much more highly sensitive than HPLC-ICP/MS. Since iAs could not be detected by HPLC-MS/MS, combination analysis of HPLC-MS/MS and HPLC-ICP/MS would be necessary for determination of arsenic speciation in seafood.

#### ISEE-0207

##### Impacts of Weather Events on Gastrointestinal Medical Visits in Taiwan

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**Background:** Studies have shown that infectious disease outbreaks are often associated with natural disasters, such as floods and excessive precipitation. However, exploring the impact of drought on human health is scarce. This study explored impacts on gastrointestinal medical visits in connection with typhoons, floods and water outage in Taiwan.

**Methods:** Health care data, weather events data (including typhoon, flood and water outage), and meteorological data were obtained from the National Health Insurance Bureau and the Central Weather Bureau, respectively. We measured the monthly average morbidity of medical visits for gastroenteritis, and the associated relative risks (RR) by demographic factors, ambient temperature and climatic events.

**Results:** Monthly medical visits for gastroenteritis were higher during January-March and July-September. Comparing to normal periods, the relative risk (RR) (1.31, 95% confidence interval (CI) 1.27–1.33) for a gastrointestinal medical visit was higher during the water outage period, and lower in typhoons and floods (RR = 0.944 and 0.934, respectively, both  $P > 0.05$ ). After adjusting for weather events, demographic factors and daily maximum temperature, the relative risk for gastrointestinal medical services increased at higher ambient temperatures. The probability to have medical visits for gastroenteritis was lower in males than in females (RR = 0.69,  $P < 0.05$ ). The elderly were more likely to have medical visits for gastroenteritis.

**Conclusions:** Our findings suggest that people are more likely to have medical visits for gastroenteritis in water outage period than in typhoon and flood periods. Higher temperature may increase the probability of gastrointestinal diseases.

#### ISEE-0208

##### Co-exposure of Arsenic and Iron Causes Hepatic Injury: A Tale of Two Hits

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**Background and Objective:** Inorganic arsenic is a ubiquitous element and a natural drinking water contaminant. Chronic exposure to arsenic has

been linked with a myriad of possible health effects, including liver abnormalities. Iron is an essential trace element for the growth development and long-term survival of most organisms. However, the effect of iron on arsenic associated toxicity has not been studied. Therefore, we studied the effect of coexposure of arsenic and iron on rats.

**Methods:** Wistar rats were exposed to arsenic, iron and arsenic plus iron. We assessed the effect of arsenic and iron on rat liver at different dose for different time-intervals.

**Results:** We found that a low dose of arsenic and iron acted synergistically to initiate rat liver injury. This was confirmed by the increase of serum aspartate and alanine transaminase levels. In addition, we found the levels of lipid peroxidation were also increased in rat liver tissue.

**Conclusion:** We conclude that even a low dose of arsenic can interact with a low dose of iron and acts synergistically to induce acute hepatic damage in rat liver tissue.

#### ISEE-0210

##### The Relationship Between Air Pollution Reduction and Heart Rate Variability in Aged Susceptible People During Beijing Olympic Games in 2008

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**Background and Objective:** Epidemiological studies have demonstrated a consistent increased risk for cardiovascular events in relation to concentrations of ambient pollution. This study is to explore the associations between the heart rate variability (HRV) of the aged people and the air pollution reduction during Beijing Olympic Games in 2008.

**Methods:** Panel study design. Twenty-six persons over 55 years of age with a history of coronary heart disease or myocardial ischemia were recruited as a panel and followed up five times by HRV measure and other related examinations from June to September, 2008. Data on air pollutants and meteorological conditions were collected from local municipal environmental protection bureaux and the meteorological bureau in Beijing. The data were analyzed using linear mixed-effects models.

**Results:** The ambient concentrations of sulfur dioxide ( $\text{SO}_2$ ), nitrogen dioxide ( $\text{NO}_2$ ) and particulate matter less than  $10 \mu\text{m}$  in aerodynamic diameter ( $\text{PM}_{10}$ ) decreased by 37.93%, 33.33% and 40.08%, respectively ( $P < 0.05$ ) during the Olympic Games compared to the average concentrations of last two months. There was a significant improvement in subject's HRV during the Olympic Games compared to control periods ( $P < 0.05$ ). In single-pollutant mixed-effects models, we found that the reduction in ambient  $\text{SO}_2$  concentration was significantly associated with improvement of the total power and high-frequency power (HF) of HRV in the panel subjects ( $P < 0.05$ ). A  $10 \mu\text{m}^3$  decrease in  $\text{SO}_2$  level was associated with 526.74 (95%CI: 298.23, 755.25) ms rises in total power and 198.55 (95%CI: 109.84, 287.26) ms rises in high-frequency power (HF) of HRV, respectively.

**Conclusions:** The traffic-control measures during the Olympics improved the air quality in Beijing effectively and also improved the HRV level of exposed aged people. It suggests that air pollution reduction could improve the cardiovascular function of susceptible populations.

#### ISEE-0213

##### Aircraft Noise and Blood Pressure in the Populations Living Near the Ciampino Airport in Rome

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**Background and Objective:** Evidence from HYENA study suggests that aircraft noise exposure increases the risk of hypertension and that night-time aircraft noise is associated with raised blood pressure (BP). Airport traffic noise has been increasing in recent years in Ciampino (Rome) because of the large rise in low cost flights. We aimed at evaluating these associations in local residents.

**Methods:** We studied a randomly selected sample of subjects aged 45–70 years who had lived in the study area for at least 5 years. Data collected via interview included personal characteristics and pharmaceutical use. BP was measured five times for each participant (three times during the interview, once before sleeping and once in the morning before getting up). We defined three aircraft noise levels ( $L_{aeq,24h} < 65$ , 65–74, and 75+ dB) using the Integrated Noise Model linked to each participant's address using a GIS. As a proxy for road traffic noise, we calculated morning rush-hour traffic volume. The effects of airport noise on hypertension (WHO 2003 definition), nocturnal and early morning BP were analysed through adjusted regression models.

**Results:** The response rate was 50%, resulting in a study population of 578 subjects. We did not find a statistically significant association between aircraft noise levels and hypertension (RR 0.72, 95%CI 0.36–1.45 for level 75+ dB vs <65 dB). However, there was an increase in nocturnal systolic pressure (5.4 mmHg, 95%CI 0.45–10.4) for subjects in the highest exposure category (75+ dB). There was no effect on nocturnal diastolic pressure or on early morning measurements.

**Conclusions:** Our results confirm the impact of aircraft noise exposure on nocturnal systolic pressure. This effect may be related to a sympathetic nervous system response to stress and may be transient in nature.

#### ISEE-0214

##### Fine Particulate Matter Measurements in Swiss Hospitality Venues: What Is the Effect of Spatial Separation Between Smoking and Non-smoking Areas?

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**Background and Objective:** Worldwide, a variety of non-smoking policies have been implemented for public places. In Switzerland, four different smoking regulations can be encountered in hospitality venues within a relatively small geographic area: i) complete smoking bans, ii) designating of smoking and non-smoking areas in the same room, iii) separating smoking and non-smoking rooms, and iv) no restrictions. The impact of such regulations on ETS exposure levels is still unclear.

**Methods:** We performed 124 measurements of particulate matter ( $PM_{2.5}$ ) in 95 hospitality venues. We compared  $PM_{2.5}$  concentrations between venues with different smoking regulations, taking relevant characteristics of the venue into account, such as the type of ventilation, the presence of additional  $PM_{2.5}$  sources and outdoor fine particle concentration. In particular, we evaluated the effect of different types of spatial separation between smoking and non-smoking areas within the same venue on  $PM_{2.5}$  levels.

**Results:** In non-smoking venues with a complete smoking ban, the geometric mean  $PM_{2.5}$  level was 20.4  $\mu g/m^3$ . In venues with smoking restrictions, geometric mean  $PM_{2.5}$  levels were 56.5  $\mu g/m^3$  in non-smoking areas and 119.0  $\mu g/m^3$  in smoking areas. In venues without smoking restrictions mean  $PM_{2.5}$  concentration was 98.5  $\mu g/m^3$ .  $PM_{2.5}$  levels in non-smoking areas that were located in the same room as smoking-areas were 75.6  $\mu g/m^3$ . Even if the non-smoking areas were spatially separated into two rooms in the same venue, geometric mean

$PM_{2.5}$  levels were still considerably increased compared to entirely smoke-free venues (52.2  $\mu g/m^3$  vs. 20.4  $\mu g/m^3$ ).

**Conclusions:** Significantly increased  $PM_{2.5}$  levels were found in non-smoking areas if smoking was allowed anywhere in the venue. This study shows that spatial separation of smoking room does not effectively protect non-smoking areas from ETS.

#### ISEE-0217

##### Study of Cancer Incidence in Areas Characterized by Dumping Waste Sites in Campania (Italy)

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**Background and Objective:** In a previous study, we investigated cancer mortality in Naples and Caserta Provinces of Campania Region, characterized by legal and illegal dumping waste sites. Total and cancer mortality showed significant trends with an indicator of waste exposure at municipality level (Martuzzi et al, OEM in press).

The present study investigates spatial distribution of cancer in a subarea of Naples Province served by a Cancer Registry.

**Methods:** The study includes 17000 cases diagnosed in 35 municipalities (years 1997–2005). Standardized Incidence Ratios (SIR) and hierarchical Bayesian estimators (BIR) for each municipality were computed for 24 cancer sites, using the whole population of the area as reference. Cluster analysis, allowing for socioeconomic deprivation, was computed ( $\alpha = 0.10$ ). Poisson regression method was then used to assess the specific correlation between some cancer sites incidence and an index of waste exposure at municipality level, “IR”.

**Results:** Significantly increased SIRs were found for lung, leukaemia, NHL, STM (topographic) and liver in some municipalities; the latter confirmed in two municipalities by BIRs (BIR = 1.41; 95%CrI = 1.17–1.68; BIR = 1.57; 95%CrI = 1.28–1.89). Significant clusters were detected for liver (RR = 1.64,  $P$ -value = 0.0003), lung (RR = 1.15,  $P$ -value = 0.08), leukaemia (RR = 1.33,  $P$ -value = 0.05) and STM (RR = 2.02,  $P$ -value = 0.08). Some trend coefficients were comparable to those of the mortality study; only the trend for testicular cancer was statistically significant (RR = 1.18; 95%CI: 1.03–1.35). Significantly increased relative risks occurred in specific “IR” categories for lung (RR = 1.44; 1.01–2.05) and bladder (RR = 1.85; 1.13–3.03) cancer in men; biliary ducts (RR = 1.63; 1.00–2.63) and leukaemia (RR = 1.82; 1.08–3.07) in women.

**Conclusions:** The present study was based on a high quality of caseness assessment but included a low number of municipalities in order to test the hypothesis of correlation with the waste exposure index. Notwithstanding these limitations, the study detected a number of associations of potential etiological interest that warrant ad hoc analytical investigation.

#### ISEE-0218

##### Impact of the Unusual Heatwave of 2007 on Mortality in Hungary

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**Background and Objective:** The impact of heatwaves is well known in big cities. Less information is available on its effects on rural population. Between 16–25<sup>th</sup> July 2007 an unusual heatwave hit Hungary. The authors aimed to study its impact in Budapest, on regional levels and in the bigger cities.

**Methods:** Daily total and cardiovascular mortality data by age groups and by sex were provided by the Central Statistical Office. Daily maximum

and minimum temperature data of 70 stations were gained from the National Meteorological Service to calculate the daily mean values for seven regions between 01.06–31.08. Excess mortality was calculated by extracting the daily mean value on days with mean temperature less than the threshold of 25°C defined earlier, from the mean daily mortality of the heatwave period.

**Results:** The highest mean of daily mean temperature was recorded in the Central and Southern Regions (30.1–30.5°C), the lowest was 26.2°C in the Northern Region during the heatwave, 1170 excess deaths occurred on national level. Great spatial differences were observed with the highest excess in the Southern Region (396 cases, 44.5%) and the lowest one in the Northern Region (66 cases, 20.3%). On city level the greatest excess was found in a city in the Northern Region (59.0%), in Budapest it was 48.5%. Women were slightly more affected than men (34.3% vs 32.2%), however men had higher excess cardiovascular mortality (45.0% vs 36.9%).

**Conclusion:** The impact of the heatwave could be detected even in counties where the mean of daily mean temperature was less than 25°C. The effect depended not only on temperature but on the rate of vulnerable elderly population of the given area. The study was funded by the Research group “Preparation for climate change” of the Hungarian Academy of Science (2006TKI246).

#### ISEE-0219

##### Impact of Heat on the Urban and Rural Population in Hungary

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**Background and Objective:** The impact of temperature on urban population is well known. Few data are, however, published in the case of smaller settlements. The authors aimed to compare the impact of temperature on daily mortality in the capital and the neighbouring county, respectively, and in another city in the South and in the corresponding county.

**Methods:** All cause mortality data in different age groups and by sex for the period of 1996–2004 were provided by the Central Statistical Office. Daily maximum and minimum temperature data of two stations were gained from the National Meteorological Service to calculate the daily mean values. Time series analysis was carried out by applying generalized additive models (GAM) for the summer periods (01.04–30.09). Models were adjusted for long time trends, seasonality, for the days of week. Mortality data were normalized to the mean mortality of the studied period to correct for the population change.

**Results:** The pattern of association of daily mean temperature and daily all cause mortality did not differ significantly, although a small difference was detected between the capital and Pest County. The impact of temperature above 20°C daily mean on mortality is between 2.1% (95% CI 1.7–2.5%) and 2.8% (95% CI 2.4–3.2%) per 1°C increase. The highest impact was observed on the elderly group especially in the capital. Regarding the younger groups the impact was more pronounced for the 0–64-year old population in cities. No significant difference was seen by sex.

**Conclusion:** The impact of temperature on mortality in the cities and in surrounding settlements is similar. The results help assess the impact of heat on national level with higher certainty. The study was funded by the Research group “Preparation for climate change” of the Hungarian Academy of Science (2006TKI246).

#### ISEE-0224

##### Acute Effects of PM<sub>2.5</sub> on Cardiac Autonomic Modulation

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**Background and Objective:** Studies have implicated an effect of PM on cardiac autonomic modulation (CAM) as a potential mechanism for the PM-cardiac disease relationship. However, the time course of PM effects has not been well established. Thus, we carried out a population-based Air Pollution and Cardiac Risk study to investigate the time-course of PM effects.

**Methods:** We recruited 79 community-dwelling individuals  $\geq 45$  years. We obtained 24-hour beat-to-beat RR data using a high resolution 12-lead Holter (1000 Hz). We visually identified and removed all artifacts and ectopy and performed heart rate variability (HRV) analysis on each 30-minute segment to obtain time-specific measures of CAM. We used a personal PM<sub>2.5</sub> monitor to measure 24-hour individual-level real-time PM<sub>2.5</sub> exposures and calculated 30-minute time-specific average PM<sub>2.5</sub> exposure. We used linear mixed-effects models to calculate autocorrelation corrected regression coefficients between 30-minute PM<sub>2.5</sub> and HRV. We sequentially put lagged-terms into a single model until the last entered term was no longer significant ( $P > 0.05$ , type I sums of squares).

**Results:** Mean age was 56 (SD = 7.8), with 53% female and 68% white. The regression coefficients (SE,  $P$ -value) of HRV variables in relationship to a 10  $\mu\text{g}/\text{m}^3$  increase in PM<sub>2.5</sub> on log-HF (log ms<sup>2</sup>) were 0.004 (0.006,  $P = 0.47$ ) and  $-0.016$  (0.006,  $P = 0.005$ ) for lag0 and lag1 respectively, for log-LF (log ms<sup>2</sup>) were 0.005 (0.005,  $P = 0.33$ ) and  $-0.014$  (0.005,  $P = 0.006$ ) for lag0 and lag1 respectively, and for SDNN (ms) were 0.16 (0.19,  $P = 0.40$ ) and  $-0.48$  (0.20,  $P = 0.02$ ) for lag0 and lag2 respectively. Longest PM<sub>2.5</sub> effect was on RMSSD (ms) at lag7 ( $\beta = -0.47$  (0.16,  $P = 0.004$ )).

**Conclusion:** Most of the adverse CAM effects from PM<sub>2.5</sub> occurred within 1–3 hours, towards a reduced parasympathetic and an increased sympathetic outflow. Such acute effect may contribute to triggering acute cardiac events, such as sudden cardiac death.

#### ISEE-0225

##### Effects of Exposure to Metal-Rich Air Particles on DNA Methylation

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**Background and Objective:** Air particles and their metal components induce aberrant gene expression related to their systemic effects, including cardiorespiratory disease and lung cancer. The mechanisms determining particle-related gene deregulation are largely undetermined. In foundry workers with well-characterized exposure to airborne metal-rich particles, we evaluated promoter DNA methylation, a major epigenetic mechanism for expression inhibition, in ten cardiorespiratory and cancer genes.

**Methods:** We measured DNA methylation (expressed as %5-methylcytosine) by PCR-Pyrosequencing on blood DNA from 63 foundry workers on the first day of a workweek (following two days off) and after three days of work (post-exposure). Personal exposures to particulate matter with diameter  $<10 \mu\text{m}$  (PM<sub>10</sub>) or  $<1 \mu\text{m}$  (PM<sub>1</sub>), and their metal components (Cr, Cd, As, Pb, Mn, Ni) were estimated using area-specific measurements.

**Results:** Post-exposure samples exhibited a significant increase in methylation of APC (difference = 0.24,  $P = 0.005$ ) and p16 (difference = 0.14,  $P = 0.006$ ), and a decrease in Rassf1A (difference =  $-1.09$ ;  $P < 0.001$ ), CDH13 (difference =  $-0.61$ ;



$P = 0.001$ ), TNF $\alpha$  (difference =  $-0.35$ ;  $P = 0.005$ ), and IFN $\gamma$  (difference =  $-0.86$ ;  $P < 0.001$ ). No differences were found in p53, IL-6, eNOS, and Et1.

In post-exposure samples, APC methylation was associated with PM<sub>10</sub> ( $\beta = 0.65$ ;  $P < 0.001$ ) and PM<sub>1</sub> ( $\beta = 0.75$ ;  $P = 0.002$ ) exposure; RASS1A methylation with Cr ( $\beta = -2.59$ ;  $P = 0.03$ ), Pb ( $\beta = -3.44$ ;  $P = 0.005$ ), and Cd ( $\beta = -2.68$ ;  $P = 0.01$ ); CDH13 methylation with Cd ( $\beta = -2.90$ ;  $P = 0.02$ ). TNF $\alpha$  methylation was borderline associated with Ni ( $\beta = -1.65$ ;  $P = 0.07$ ) and Mn ( $\beta = -0.65$ ;  $P = 0.06$ ). IFN $\gamma$  methylation did not show any consistent association with exposure levels.

Some of the exposures were associated with methylation in both pre- and post-exposure samples, possibly reflecting effects operating over an extended timeframe. Et1 methylation was associated with Pb ( $\beta = -3.03$ ;  $P = 0.005$ ) and Cd ( $\beta = -2.46$ ;  $P = 0.01$ ), eNOS with PM<sub>10</sub> ( $\beta = 0.71$ ;  $P = 0.03$ ), Cr ( $\beta = -1.37$ ;  $P = 0.01$ ), Pb ( $\beta = -1.20$ ;  $P = 0.04$ ) and Cd ( $\beta = -1.41$ ;  $P = 0.004$ ).

**Conclusions:** Metal-rich air particles modify the DNA methylation of genes related to cardiorespiratory and cancer outcomes.

#### ISEE-0227

##### The Role of Socioeconomic Status in Lung Cancer Incidence Around a Dutch Steel Plant: A Spatial Epidemiology Study

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**Background and Objective:** Residents around a large steel plant in The Netherlands, have been concerned about their health for some considerable time. In 2007, the Regional Public Health Service published a report indicating higher incidence rates of lung cancer in one municipality near the steel plant. Air pollution emissions from the steel plant were mentioned as one of the possible explanations. The incidence rates were not adjusted for life-style variables like smoking. We re-analysed the lung cancer data with more advanced methods at a lower aggregation level and in a larger study area.

**Methods:** Small area health statistics with time-space smoothing methods were used to analyse the data. The study area covered 106 postcode areas, each having around 6,000 inhabitants on average (total population almost 600,000). Twelve years of data were analysed (1995–2006). Standardisation was performed using population data stratified by age and sex for each postcode area. We adjusted for socioeconomic status as a proxy for smoking. Standardized Incidence Ratios (SIRs) for lung cancer were estimated per postcode area, and maps were produced to assess the spatial pattern in SIRs in the study area.

**Results:** Before adjusting for socioeconomic status, SIRs for lung cancer were higher than the overall average in postcode areas close to the steel plant: up to 33% in men, up to 44% in women, both statistically significant. After adjusting for socioeconomic status, the SIRs reduced to up to 13% higher in men and up to 17% higher in women, and were no longer statistically significant.

**Conclusions:** Socioeconomic status, as proxy for smoking, partly explained the increased incidence rates for lung cancer in postcode areas close to the steel plant. This result does not exclude the influence of other factors on lung cancer incidence, such as housing conditions, occupational exposure, and local air pollution.

#### ISEE-0232

##### Occupation and Bladder Cancer in a Population-Based Case-Control Study in Northern New England

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**Background and Objectives:** Bladder cancer mortality rates have been elevated for decades in northern New England. We used data from a population-based case-control study to examine the relationship between occupation and bladder cancer risk and to examine whether occupational exposures play a role in the New England excess.

**Methods:** We obtained lifetime occupational histories from 1,158 patients newly diagnosed with bladder cancer from 2001–2004 in Maine, New Hampshire, and Vermont, and with 1,402 population controls. Odds ratios (ORs) and 95% confidence intervals (CIs) were computed for each job using unconditional logistic regression models.

**Results:** In men, we observed significant positive trends in risk with increasing duration of employment among precision metalworkers (OR = 2.2, CI = 1.1–4.6 for 10+ years of employment,  $P_{\text{trend}} = 0.012$ ), metalworking/plasticworking machine operators (OR = 2.4, CI = 0.9–6.3,  $P_{\text{trend}} = 0.045$ ), textile machine operators (OR = 10.4, CI = 2.2–48,  $P_{\text{trend}} = 0.0013$ ), and automobile mechanics (OR = 2.1, CI = 1.1–4.2,  $P_{\text{trend}} = 0.019$ ) – occupations with strong a priori evidence of a bladder cancer association. Men reporting ever being exposed to metalworking fluids (MWF) had a 60% increase in risk (CI = 1.2–2.2) compared to men with no MWF exposure. Other occupations with significant duration effects for men included computer systems analysts (OR = 6.3, CI = 1.2–33,  $P_{\text{trend}} = 0.021$ ), brickmasons (OR = 10.7, CI = 1.2–92,  $P_{\text{trend}} = 0.028$ ), and plumbers (OR = 3.3, CI = 1.1–9.6,  $P_{\text{trend}} = 0.030$ ); and for women, cleaning service occupations (OR = 4.0, CI = 1.3–13,  $P_{\text{trend}} = 0.0068$ ) and nurses' aides (OR = 4.4, CI = 1.6–12,  $P_{\text{trend}} = 0.0039$ ). These findings are generally consistent with previous studies. Calculations of attributable risk indicate that occupational exposures do not appear to explain the excess risk of bladder cancer in this region.

**Conclusions:** This study adds to the growing body of evidence that some components of MWF are probable bladder carcinogens. Detailed analyses of jobs using information collected using job-specific questionnaires administered in this study should help to elucidate specific bladder carcinogens.

#### ISEE-0233

##### Serum Levels of p,p'-DDE and Reproductive Hormone Profile in Male Greenhouse Workers of Morelos, Mexico

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**Background:** Some evidence suggests that organochlorine pesticides (OC) have estrogenic, antiestrogenic and androgen-interfering properties, however the data regarding association between these compounds and hypothalamo-pituitary-gonadal axis function are limited.

The objective of this study was to evaluate the association between OC exposure, as assessed by serum levels of p,p'-dichlorodiphenyldichloroethene

(p,p'-DDE), and reproductive hormone profile in male greenhouse workers of Morelos, Mexico.

**Methods:** During the period July–September 2004, we interviewed and collected blood and urine samples from 104 male greenhouse workers. The questionnaire included information on their socioeconomic characteristics, tobacco and alcohol use, presence of chronic and acute diseases, occupational history and anthropometry.

Serum levels of p,p'-DDE were analyzed by gas chromatography. Serum samples were analyzed for FSH, LH, Testosterone, Estradiol, Inhibin B and Prolactin by enzymatic immunoassay.

We also analyze urinary levels of dialkylphosphates (DAPs: dmp, dmt, dmdtp dep, detp, dedtp) by gas chromatography.

Associations between serum levels of p,p'-DDE and male reproductive hormones (transformed to their natural logarithm) were evaluated using multiple linear regression models.

**Results:** After adjusting for potential confounders (age, body mass index and DAPs urinary levels), we found that p,p'-DDE levels were negatively associated with testosterone serum levels ( $\beta = -.000042$ ,  $P = 0.000$ ) and positively with inhibin B ( $\beta = .000120$ ,  $P = 0.002$ ). No association was observed between serum levels of p,p'-DDE and the other hormones.

**Conclusion:** The results of this study show that there are significant differences in the male hormonal profile according to serum p,p'-DDE levels, and provides additional support for that OC exposure can affect hypothalamo-pituitary-gonadal axis function in humans.

#### ISEE-0236

##### Concentrations of Urinary Phthalate Metabolites in Mexican Women with and without Diabetes

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**Background and Objective:** Positive associations between phthalate metabolites and abdominal obesity as well as insulin resistance in adult US males are documented. Phthalates are ubiquitous chemicals in the environment and are associated with endocrine disorders. We explored the associations between urine concentrations of phthalate metabolites in Mexican women with and without self-reported diabetes mellitus (DM) history.

**Methods:** Subjects were 221 women that participated as controls in an ongoing population-base case-control study in northern Mexico. All women were directly interviewed about their reproductive, dietary and clinical history. Anthropometric measures (waist and hip circumference, weight and height) were performed by standardized personnel. The following phthalate metabolites were determined by HPLC-MS/MS at the CDC: monoethyl phthalate (MEP), monobenzyl phthalate (MBzP), mono-n-butyl phthalate (MBP), mono-isobutyl phthalate (MiBP), mono-2-ethylhexyl phthalate (MEHP), mono-2-ethyl-5-oxohexyl phthalate (MEOHP), mono-2-ethyl-5-hydroxyhexyl phthalate (MEHHP), mono-2-ethyl-5-carboxypentyl phthalate (MECCP) and, mono-3-carboxypropyl phthalate (MCPP).

**Results:** Higher mean concentrations of MEHHP (62.25 vs. 42.22 mcg/g creatinine) and MEOHP (41.40 vs. 31.86 mcg/g creatinine) were detected in women with DM history ( $n = 39$ ) compared to women without DM history ( $n = 182$ ).

**Discussion:** MEHHP and MEOHP are metabolites of di-2-ethylhexyl phthalate, a major PVC plasticizer. Our results are in agreement with a recent report suggesting a metabolic impairment associated with exposure

to some phthalates. “The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention.”

#### ISEE-0237

##### Chlorination Disinfection By-Products and Risk of Stillbirths in England and Wales

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**Background and Objective:** We investigated the association between still births and Trihalomethanes (THM) concentrations in tap water across a large population residing in 12 regions of England and Wales.

The study data cover the period 1993–2001 and include 2.79 million births with 14,265 stillbirths.

Two cause-specific subgroups of stillbirths, as defined by Wigglesworth codes, were also investigated.

Trihalomethanes are one of the main groups of disinfection byproducts and are widely used in epidemiological studies as a marker for DBPs as they are routinely collected by the water companies.

**Methods:** Routinely collected THM data from each water company were modelled using a hierarchical mixture model.

The modelled individual and total THM concentrations for the final trimester of the pregnancy were categorized into one of three predefined exposure categories and linked to the outcome data via the postcode of the maternal birth address.

Logistic regression was carried out with maternal age, split into 5 categories, and deprivation, as measured by quintiles of the Carstairs Index, included in the model as confounders.

**Results:** Analyses were conducted to investigate the relationship between total THMs and risk of stillbirths. Further analyses using individual THMs and also the cause specific subgroups of stillbirths were also undertaken. Full results will be presented.

**Conclusions:** Previous studies have shown inconsistent evidence for the association between stillbirths and trihalomethanes.

Concern remains of the possible adverse impact of disinfection by products on births outcomes due to the large population at risk.

It is probable that any adverse effects will only be definitively established by using more detailed exposure data such as water consumption, showering and swimming diaries.

#### ISEE-0240

##### Use of Nontraditional Epidemiologic Methods to Link Environmental Exposure and Disease: An Example

Dina Schreinemachers, *U.S. Environmental Protection Agency, Research Triangle park, NC, United States.*

**Background and Objectives:** Chlorophenoxy herbicides, applied since World War II, are present in our environment. They are used in grain agriculture and for maintenance of parks and home lawns. Spring wheat, grown in Minnesota, Montana, North Dakota, and South Dakota, is treated for  $\geq 85\%$  of its acreage with these herbicides. Population studies were used to compare disease mortality in counties at different levels of wheat farming. Significantly increased rates of birth defects and mortality from cancer, acute myocardial infarction, and type-2 diabetes were observed in the comparison of high to low wheat counties. These initial studies provided hypotheses for a more targeted study with the objective to explore exposure to 2,4-D in association with risk factors for myocardial infarction and type-2 diabetes in NHANES III data.

**Methods:** Presence of urinary 2,4-D was examined in relation to biomarkers of lipid and glucose metabolism. The effect of 2,4-D on triglycerides, insulin, and C-peptide was estimated by linear regression

with adjustment for HDL and additional covariates based on their use in other studies.

**Results:** Initial analyses indicated that 2,4-D was associated with an 8% decrease in HDL level. In addition, presence of 2,4-D changed the relation between HDL and the dependent variables. Taking the effect of HDL on triglycerides (both log transformed) as an example, the parameter estimates (95% confidence interval) are  $-1.52 [-1.89, -1.15]$  and  $-0.94 [-1.08, -0.80]$  for subjects with 2,4-D above and below the level of detection, respectively. The *P*-value for this effect modification is 0.004.

**Conclusion:** Among susceptible, low-HDL subjects, exposure to 2,4-D may increase risk factors for acute myocardial infarction and type-2 diabetes. Potential mechanisms include PPAR $\alpha$  activation and thyroid hormone disruption. 2,4-D may be a prototype for other chemicals with similar characteristics.

**Disclaimer:** This is an abstract of a proposed presentation and does not reflect EPA policy.

#### ISEE-0241

##### PCB Exposure In Vitro (PBM): Differential Gene Expression, Pathway Analysis for Possible Mode(s) of Actions, and Disease Development in Comparison with PCB-Exposed Slovak Population

Somiranj Ghosh,\* Sisir Dutta,\* Shizhu Zang,\* Tomas Trnovec,† Lubica Palkovicova,† Eva Sovcikova,† Svetlana Ghimbovski,‡ and Eric Hoffman,‡ \*Molecular genetics Laboratory, Howard University, Washington DC, United States; †Slovak Medical University, Bratislava, Slovakia; and ‡Center for Genetic Medicine, Children's National Medical Center, Washington DC, United States.

**Background and Objective:** PCBs are associated with adverse effects leading to human diseases e.g., development, growth, neurobehavioral, immunologic functions, and cancers. The present work is to identify the human genome-wide gene expression pattern upon exposure of congener specific PCBs in Human Peripheral Blood Mononuclear Cells (PBM) *in vitro* to correlate risk in epidemiological situation.

**Methods:** The PBM cells were exposed with the Slovak median human equivalence level of PCB 138 (0.877ng/ml of blood) and PCB 153 (1.381 ng/ml of blood). Microarray experiments were done for global gene expressions and data were analyzed with Gene Spring GX 10. The Ingenuity Pathway Analysis software was used to see top bio-functions, networks, and major molecules activated towards the disease and developmental processes during the exposure of these chemicals *in vitro*, and were compared with the Slovak epidemiological data.

**Results:** We found 396 genes induced by PCB 153 and 298 by PCB 138 which were differentially expressed, with only one (PRIM2, 215709\_at; *P* value <0.0001) being common, and are congener specific. There are differences in gene expression between *in vitro* and epidemiological studies, but the Pathways Analysis studies showed that there are significant similarities in functionality, pathway, and disease & disorder development with some exceptional differences in p53 signaling, Glycosphingolipid Biosynthesis (in Pathway); DNA Replication, Endocrine System Disorder, Dermatologic (in Functions); and Immunological Disease, Endocrine System Disorder (in Disease and Disorders).

**Conclusion:** The present work established that *in vitro* and epidemiological studies will improve our ability and empower us to study the process of development of diseases and is important for understanding the potential health risk from these compounds in general. A strong correlation between the disease and significant gene expression both at *in vitro* and epidemiological studies will help us to identify robust biomarkers for environmental toxic exposures.

#### ISEE-0242

##### Overview of USEPA/NERL Cooperative Agreement Research Program on Air Pollution Exposure and Health

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**Background and Objective:** USEPA's National Exposure Research Laboratory recently initiated a two-year Cooperative Agreement Research Program between EPA and three academic institutions: Emory University, Rutgers University and University of Washington. The overall goal of this "Air Pollution Exposure and Health Program" is to enhance the results from epidemiologic studies of ambient PM and gaseous pollution by using refined approaches for characterizing personal and population exposures.

**Methods:** The methodologies for each of the three groups are complimentary. The Emory-Georgia Tech group is developing and evaluating five exposure metrics for examining acute morbidity effects of ambient traffic-related (CO, NO<sub>x</sub>, PM<sub>2.5</sub> and PM<sub>2.5</sub> EC) and regional (O<sub>3</sub> and SO<sub>4</sub><sup>2-</sup>) pollutants in Atlanta. These will be applied during time series analysis of ED visits and case-crossover analysis of ICD cohort data bases from Atlanta, GA. The Rutgers/EOHSI-LBL group is examining associations between PM<sub>2.5</sub> mass and species and adverse health outcomes using logistic regression analysis with birth outcomes and case-crossover analysis with myocardial infarctions data in New Jersey using four different exposure tiers. The University of Washington team is conducting research to improve epidemiology study health effect estimates under the MESA Air and other air pollution cohort studies by fine-scale spatio-temporal modeling of ambient PM<sub>2.5</sub> and NO<sub>x</sub>.

**Results:** Comparison and evaluation of results derived from application of alternative air quality and exposure predictors using monitoring or modeling (CMAQ, AERMOD, SHEDS) information will be presented. Application of selected exposure metrics in the upcoming health effects analyses will be described.

**Conclusion:** Depending on the study design, uncertainties in estimating exposures to air pollution can influence the results derived from epidemiologic studies that rely upon available ambient monitoring data. These may be especially important for individual level studies examining health effects due to PM<sub>2.5</sub> species and co-pollutants.

#### ISEE-0246

##### Absence of Effect-Measure Modification Between Polychlorinated Biphenyls and Methylmercury on ADHD-Like Behaviors in the New Bedford Cohort

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**Background and Objective:** Two prior studies report effect modification between polychlorinated biphenyls (PCBs) and methylmercury (MeHg) on neurodevelopmental outcomes in children, including behavior and cognition. We previously reported minor to moderate main effect associations of low-level prenatal PCBs and MeHg with ADHD-like behaviors, such as inattention and impulsivity in the New Bedford cohort. We investigated a synergistic relationship between PCBs and MeHg on ADHD-like behaviors at 8 years of age using the NES2 Continuous Performance Test (CPT) and the Conners' Rating Scale for Teachers (CRS-T).

**Methods:** Participants came from a prospectively followed cohort of children born between 1993 and 1998 to mothers residing near a PCB-



contaminated harbor and Superfund site in New Bedford, Massachusetts. Prenatal PCB exposure was measured in cord serum and maternal hair was collected 10 days postpartum and measured for total mercury (Hg), as a proxy for MeHg. We assessed additive effect modification between PCBs and Hg on: 1) sustained attention (errors of omission) and impulse control (errors of commission) measured with the CPT, and 2) Conners' ADHD Index, DSM-IV Inattention, DSM-IV Impulsivity-Hyperactive and DSM-IV Total (combined subtypes) measured with the CRS-T, with multivariable regression models using the likelihood ratio test.

**Results:** Median (and range) cord serum levels for the sum of four prevalent PCB congeners (118, 138, 153, 180) and hair Hg levels for the 485 subjects with data on both toxicants was 0.18 (0.01–4.41) ng/g serum and 0.4 (0.03–0.5) ppm, respectively. The Spearman correlation coefficient between PCBs and Hg was 0.4. No statistically significant or consistent additive effect modification between PCBs and Hg was observed for any of the CPT and CRS-T outcomes.

**Conclusion:** We did not observe additive effect modification between PCBs and Hg on ADHD-like behaviors. Our findings do not support synergism between these toxicants at these low exposure levels.

#### ISEE-0247

##### Identification of Early Disease Biomarkers in 45 Months PCB-Exposed Slovak Population

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**Background and Objective:** Improper disposal of PCBs in eastern Slovakia during 1959–1985 resulted in several health and developmental problems in children e.g., thyroid pathology, glucose homeostasis, hearing impairment, neurobehavioral disorders, dental enamel defects, and low birth weight. The present work is to identify signature disease biomarkers for PCB exposure at an early stage before clinical symptoms arise.

**Methods:** We selected 21 children, aged 45 months, from a birth cohort of 500 enrolled 2002–2004, and grouped them into High (H) (>14 ng/ml), Low PCB but high others (O) (from 4 to 6 ng/ml), and Control (L, background Exposure, i.e., < 0.54 ng/ml), in serum PCB concentrations. Blood RNAs were isolated by PAXgene kit and microarray experiments were done on Affymetrix platform. Differential gene expression was done using GeneSpring GX 10. Ingenuity Pathway Analysis was used towards understanding disease mechanism of action and toxicity.

**Results:** We identified 80 and 22 genes associated with Group H and Group O respectively, and 1552 genes were common. Based on the differential gene expression between H and L groups ( $P < 0.001$ , Fold change <1.5), signature biomarkers included: CCK, MYC, CDK2, CAP2, PON1, CYP2D6, BAX, ARNT, BCL2, APC. The canonical pathways showed that, specific genes associated with PCBs have effects on Aryl Hydrocarbon Receptor Signaling, while genes (SGK1, SGK3, GLCCI1, GRLF1) associated with other chemical agents (e.g., HCH, HCB, pp-DDE, and pp-DDT) involved on Glucocorticoid Receptor Signaling. Both PCBs and other chemical agents were found to have toxic effects on P53 Signaling, Positive Acute Phase Response Proteins, TR/RXR Activation and FXR/RXR Activation.

**Conclusion:** The present work combined with personalized measures of PCB exposures and genomic information has identified potential pathways by which environmental insult may influence expression of genetic risk factors which are being further validated.

#### ISEE-0248

##### Serum Zinc and Prostate Cancer Risk in the Multiethnic Cohort study

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**Background and Objective:** Because zinc is highly concentrated in prostatic tissue and is essential to DNA synthesis, immune function, and antioxidant activity, it may be protective against the development and progression of prostate cancer. On the other hand, because it is essential for androgen production, it may increase prostate cancer risk. In this study, we evaluated the association between prediagnostic serum zinc and subsequent prostate cancer risk in a multiethnic population.

**Methods:** This case-control study was nested within the Multiethnic Cohort of African Americans, Native Hawaiians, Japanese Americans, Latinos, and whites in Hawaii and California. The analysis included 392 incident prostate cancer cases and 783 matched controls over a 1.9-year follow-up period. Multivariate conditional logistic regression was used to estimate odds ratios (OR) and 95% confidence intervals (CI).

**Results:** The mean serum zinc concentration did not significantly differ between cases (94.9  $\mu\text{g/dl}$ ) and controls (93.9  $\mu\text{g/dl}$ ). No association was found between serum zinc level and prostate cancer either overall or by tumor stage/grade. In ethnic-specific analyses, positive associations were found in Japanese Americans (OR for the highest vs. the lowest tertile = 2.54, 95% CI = 1.08–6.00,  $P$  for trend = 0.03) and Latinos (OR = 2.72, 95% CI = 1.04–7.08,  $P$  for trend = 0.09), whereas no association was observed in African Americans and whites; however, there was no heterogeneity across ethnic groups ( $P = 0.11$ ). Additional adjustment for soy intake, the only dietary factor associated with risk in this cohort, did not alter the findings.

**Conclusion:** We found no evidence to support a protective effect of zinc against prostate cancer, and a suggestion in the ethnic-specific results of a possible increase in risk. This offers some support to the hypothesis that higher zinc exposure may increase prostate cancer risk by raising testosterone levels.

#### ISEE-0250

##### Biomarkers of Inflammation and Short-Term Fine Particulate Exposures

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**Background and Objective:** Biomarkers of systemic inflammation have been shown to be associated with adverse cardiovascular outcomes, and in some studies, with increases in ambient air pollution. Our objective was to assess the association of a selection of inflammatory markers with fine particulate matter ( $\text{PM}_{2.5}$ ) in a group of healthy working volunteers.

**Methods:** We collected blood samples from 353 employees at two separate trucking industry work locations (Chicago, IL and Carlisle, PA, USA). Plasma C-reactive protein (CRP), soluble intercellular adhesion molecule-1 (sICAM1), and interleukin-6 (IL6) levels were assessed in each sample. Volunteers completed a questionnaire on demographics, work history, medication use, comorbidities, recent illnesses, and lifestyle factors. Daily  $\text{PM}_{2.5}$  levels were obtained from the closest same-city US EPA monitoring locations, and ambient pollution on the day of blood draw and the previous two days were extracted for each participant. Spearman correlations were used to identify the strongest pollution metric for each marker. We used linear regression models to determine the association of  $\text{PM}_{2.5}$  with each

inflammatory marker, controlling for age, race, gender, BMI, smoking, physical activity, medications, job title and hours worked in the last week, recent illnesses, and sleeping habits.

**Results:** 337 participants had complete information. The median (IQR) CRP was 1.02 (0.45–2.09) mg/L, sICAM1 was 246.66 (203.40–294.37) ng/mL, and IL6 was 1.61 (1.03–2.71) pg/mL. None of the inflammatory markers were correlated with same-day pollution. In the adjusted regression models, CRP was not associated with PM<sub>2.5</sub>. PM<sub>2.5</sub> (in units of  $\mu\text{g}/\text{m}^3$ ) measured the previous day was statistically significantly positively associated with sICAM1 ( $\beta = 1.94$  ng/mL) and IL6 ( $\beta = 0.12$  pm/mL). PM<sub>2.5</sub> two days before blood draw was associated with elevations in both sICAM1 and IL6, though neither was significant.

**Conclusions:** There are indications of an association between ambient PM<sub>2.5</sub> and sICAM1 and IL6, but not CRP, in this health working population.

#### ISEE-0251

##### Exposure to Thimerosal in Tetanus-Diphtheria Vaccine During Pregnancy and Neurodevelopment at Six Months of Breastfed Babies

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**Background and Objective:** Depending on the stage of central nervous system development, fetus and infants are vulnerable to the effects of Hg exposure. Outside industrialized countries, infants may be exposed to ethylmercury degraded from thimerosal in vaccines. Therefore, in these countries, the burden of low-dose ethylmercury toxicity taken during pregnancy and additional loads of thimerosal-containing vaccines during infancy coincides with critical periods of neurodevelopment.

**Methods:** We measured Gesell Developmental Schedules (GDS) to assess motor and social skills, language development, and comprehension capacity in 82 healthy exclusively breastfed Brazilian infants at six months, as a function of maternal exposure to thimerosal in tetanus-diphtheria vaccines (Td).

**Results:** Compared to the group of infants not exposed to thimerosal in utero the infants whose mothers were immunized with Td showed no significant difference in neurodevelopment delays. However, regression analysis showed that number of vaccines was marginally ( $P = 0.056$ ) associated with general development delay without any given domain being specifically affected. Although there was a significant correlation between hair-Hg of mothers and hair-Hg of neonates ( $r = 0.2928$ ;  $P = 0.0076$ ) there was no significant correlation between level of in utero exposure to thimerosal-Hg and neonate's hair-Hg concentrations (Spearman  $r = 0.060$ ;  $P = 0.5922$ ).

**Conclusion:** In exclusive breastfed infants of a healthy cohort born at term with weight adequate-for-gestational age, doses of ethylmercury in Td vaccines during pregnancy and puerperium cannot portend clinical neurodevelopment delays in exclusive breast-fed infants at six months, but depending on the vaccination schedule it can be marginally associated with overall delay in GDS. We speculate that breastfeeding remains a significant strategy to improve CNS protection of infants facing prenatal and early exposure challenges of thimerosal in vaccines.

#### ISEE-0252

##### Prolonged Exposure to Occupational Noise and Hypertension among Workers in the Aviation Industry

Jen-Yin Chen, and Ta-Yuan Chang, China Medical University, Taichung, North District, Taiwan.

**Background and Objective:** Several epidemiologic studies have reported that people living near airports with long-term exposure to aircraft noise had increased risk of hypertension, but such a relationship among aviation industry workers is uncertain. This cross-sectional study aimed to investigate the effects of chronic noise exposure on prevalence of hypertension among workers in the aviation industry.

**Methods:** We recruited an aircraft manufacturing company with 2524 employees in 2008. There were 1412 volunteers who provided personal information on health checkups and potential confounders using a standardized questionnaire. We measured noise exposure and calculated the cumulative exposure index (CEI, dBA-year) for each subject. We divided workers into high-exposure, low-exposure, and control groups according to the quartile distribution of CEIs. Logistic regression models were used to associate occupational exposure to noise with hypertension between different groups.

**Results:** High-exposure workers ( $\geq 1220$  dBA-year) had the significantly highest proportion of using earplugs/earmuffs at work (46%), as opposed to 17% in the low-exposure workers (1220–870 dBA-year), compared with 12.9% in the control group ( $< 870$  dBA-year). Only high-exposure workers had significantly lower prevalence of hypertension (21.6%) than the control group (28.5%). We also found a significant inverse association between hypertension and noise exposure with adjusted odds ratios ranging from 0.15 (95% CI = 0.09–0.25) in high-exposure workers to 0.29 (95% CI = 0.19–0.45) in low-exposure workers compared to the control group.

**Conclusion:** Our findings suggest that the implementation of guidelines for occupational noise management might have contributed to the prevention of hypertension caused by noise exposure at work.

#### ISEE-0253

##### Acute Effects of Environmental Noise Exposure on the Control of Cardiac Output in Healthy Adults

Hsiu-Hui Hsieh, Yu-An Lai, and Ta-Yuan Chang, China Medical University, Taichung, North District, Taiwan.

**Background and Objective:** Epidemiologic studies have demonstrated that environmental noise exposure is associated with hypertension at night, but the related mechanism is unclear. This study aimed to investigate acute effects of environmental noise exposure on the control of cardiac output.

**Method:** We recruited 60 volunteers and divided them into a high-noise-exposure group of 23 and a low-noise-exposure group of 37 based on 24-hour personal noise measurement from a university. We determined individual noise exposure and measured personal cardiac parameters simultaneously at night. Linear mixed-effects regression models were used to estimate transient effects of noise exposure on cardiac parameters by adjusting some confounders.

**Results:** We found that high-noise-exposed subjects ( $70.6 \pm 7.9$  dBA) had significantly higher mean values of heart rate (HR;  $65.59 \pm 10.45$  bpm), stroke volume (SV;  $69.10 \pm 11.24$  ml) and cardiac output (CO;  $4.46 \pm 0.80$  L/min) than the low-noise-exposed ones ( $42.3 \pm 10.7$  dBA). An increase of one dBA increase in noise exposure at night was significantly associated with an increment of 0.03 L/min CO in the high-noise-exposed group, as well as 0.007 L/min CO in the low-noise-exposed group, after 60-minute time lag noise exposure. Additionally, the high-noise-exposure group had the significantly higher CO ( $0.19 \pm 0.07$  L/min) and HR ( $4.96 \pm 1.14$  bpm) compared with low-noise-exposed group over a night-time period.

**Conclusions:** Our findings suggest that exposure to environmental noise may be associated with a transient elevation of cardiac output at night by stimulating sympathetic nerves. One possible mechanism of hypertension caused by environment noise exposure may be through sympathetic stimulation to increase HR and CO. Future studies are encouraged to

investigate the association between cardiac output and vascular changes for the development of hypertension.

#### ISEE-0255

##### Does One Size Fit All? The Suitability of Standard Ozone Exposure Metric Conversion Ratios and Implications for Epidemiology

Brooke Anderson, and Michelle Bell, *Yale University, New Haven, CT, United States.*

**Background and Objective:** Several exposure metrics have been applied in health research and policy settings to represent ozone exposure, such as the 24-h average and daily 8-h maximum. Frequently in scientific and policy settings, results calculated using one exposure metric are converted using a simple ratio to compare or combine findings with results using a different metric. This conversion, however, assumes that such a ratio is constant across locations and time periods. We investigated the appropriateness of this common practice.

**Methods:** We examined the relationships among various forms of ozone concentrations (24-h average, daily 1-h maximum, and daily 8-h maximum) between communities and within single communities across time for 78 U.S. communities from 2000–2004 and compared results to commonly used conversion ratios. Regression analysis and stratification methods were applied to explore how relationships between ozone exposure metrics differ by region, weather, season, and city-specific characteristics.

**Results:** Analysis revealed variation in the relationship among ozone metrics, both across communities and across time within individual communities, indicating that conversion of ozone exposure metrics with a standard ratio introduces uncertainty. For example, the average ratio of the daily 8-h maximum to the daily concentration ranged from 1.23 to 1.83. Within a community, days with higher ozone levels had lower ratios. The community-average exposure metric ratios were lower for communities with higher long-term ozone levels.

**Conclusions:** We recommend that health effects studies present results from multiple ozone exposure metrics, if possible. When conversions are necessary, more accurate estimates can be obtained using summaries of data for a given location and time period if available, or by basing conversion ratios on data from a similar city and season, such as the results provided in this study.

#### ISEE-0256

##### Angiotensinogen Gene, Noise and Their Interaction in the Development of Hypertension among Aerospace Workers in Taiwan

Kang-Yin Cheng, Bing-Fang Hwang, and Hsin-Hua Chan, *Department and Graduate Institute of Occupational Safety and Health, Taichung, Taiwan.*

**Background and Objective:** Hypertension is a complex multifactorial disease caused by genetic and environmental exposure. The interaction between genetic and environmental determinants has not been investigated. We conducted an industry-based cohort study to evaluate the independent and joint effects of chronic noise exposure and angiotensinogen (AGT) gene on the development of hypertension.

**Method:** We recruited 929 subjects aged 18 to 60 among aerospace workers in Taiwan since entered factory until 2008. The risk of hypertension was estimated according to four exposure categories assigned on the basis of noise intensity, low (50–70 dBA), medium (70–80 dBA), high (>80 dBA) and noise (<50 dBA) as reference category. The angiotensinogen M235T gene polymorphism variants were investigated using allele specific polymerase chain reaction, and the PCR product was subjected to PstI digestion to define genotypes (TT, TM and MM).

**Results:** In a Poisson regression adjusting for confounding, the risks of hypertension (adjusted rate ratio (RR)) for low noise intensity were

RR = 1.18 (95% confidence interval (CI): 0.84–1.65), medium noise intensity RR = 1.94 (95% CI: 1.26–2.98), and high noise intensity RR = 1.18 (95% CI: 0.65–2.16) i.e. risks were significantly higher in medium but not high exposure categories. Compared with the AGT M235T genotype, the genotype of TT had a significantly increased risk of hypertension (RR = 1.71, 95%CI: 1.23–2.38) compared with the genotype of CC.

**Conclusion:** The M235T variant of the AGT is significantly associated with hypertension whereas the genotype TT is a possible genetic marker for hypertension among aerospace workers. There was no apparent effect of chronic high noise exposure, which is possibly explained by high compliance rates with use of personal protective equipment.

#### ISEE-0257

##### The Relation Between Home Dampness and Molds, Interleukin-4 Promoter, and Atopic Asthma among Taiwanese School Children

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**Background and Objective:** The weather is warm and wet in Taiwan. Children exposure to mold or mold odor in dwellings are quite common. The objective of study was to assess whether or not exposure to mold or mold odor in dwellings and IL-4 promoter were related to atopic asthma.

**Method:** We conducted a population-based case-control study among Taiwanese school children in northern Taiwan. The study population consisted of 113 atopic asthma children and 376 controls. The PCR amplification followed by Bsm FI restriction digestion were used to determine genotype at the IL-4 promoter C-589T locus.

**Results:** In the logistic regression adjusting for confounding, the risk of childhood atopic asthma was positively associated with visible mold (adjusted odds ratio (aOR) = 2.45, 95% confidence interval (CI) = 1.43–4.19) and mold odor (aOR = 2.30, 95%CI = 1.40–3.80). The adjusted odds ratio for atopic asthma was slightly more elevated in CT genotype (aOR = 1.17, 95%CI = 0.72–1.91) than reference (TT genotype). The joint effect of CT genotype and exposure to visible mold (aOR = 3.32, 95%CI = 1.52–7.25) or mold odor (aOR = 3.86, 95%CI = 1.65–9.06) was a significantly increased risk of atopic asthma than the TT genotype without any dampness and mold problem.

**Conclusion:** The presence of visible mold and mold odor in the home may be an important environmental factor of atopic asthma and its effect may also be modified by IL-4 promoter.

#### ISEE-0258

##### Ambient Temperature and Mortality: An International Study in Four Capital Cities of East Asia

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**Background and Objective:** Extreme ambient temperature has been associated with increased daily mortality across the world. We describe the ambient temperature-mortality association for four capital cities in East Asia, Seoul, Beijing, Tokyo, and Taipei, and identify a threshold temperature for each city and the percent increase in mortality.

**Methods:** We observed that threshold temperatures vary by latitude. We adapted generalized linear modeling with natural cubic splines (GLM+NS) to examine the association between daily mean apparent temperature and total mortality, as well as mortality due to respiratory and cardiovascular causes in a threshold model. We conducted a time-series analysis adjusting for day of the week and long-term time trend. The study period differed by city.

**Results:** The threshold temperature for all seasons was estimated to be 30.1–33.5°C, 31.3–32.3°C, 29.4–30.8°C, and 25.2–31.5°C for Seoul, Beijing, Tokyo, and Taipei, respectively, on the same day. For the



summer season, the threshold temperature was 33.2–34.2°C, 30.8–29.7°C, 31.5°C, and 30.7–31.5°C for Seoul, Beijing, Tokyo, and Taipei, respectively. For the mean daily apparent temperature increase of 1°C above the thresholds in Seoul, Tokyo, and Taipei, estimated percentage increases in daily total mortality were 2.7 (95% confidence interval (CI) = 2.2–3.1), 1.7 (95% CI = 1.5–2.0), and 4.3 (95% CI = 2.9–5.7), respectively. Beijing provided no total mortality counts.

Estimated percentage increases were 2.7–10.5 for respiratory mortality, 1.1–9.3 for cardiovascular mortality in 4 cities.

**Conclusions:** This study identified increased mortality due to exposure to elevated apparent temperature. The importance of effects of apparent temperature and city-specific threshold temperatures suggests that analyses of the impact of climate change should take regional differences into consideration.

#### ISEE-0259

##### German Environmental Survey for Children (GerES IV): Fungi in Homes and Sensitisation of Children in Germany

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**Background and Objective:** GerES IV was a module of the Health Survey for Children and Adolescents (KiGGS). In GerES exposures to chemical, physical and also biological agents were determined on a representative basis. Sensitisation of children aged 3 to 14 years against specific indoor fungi (*Walemia sebi*, *Eurotium spec.*, *Cladosporium herbarum*, *Aspergillus versicolor*, *Aspergillus fumigatus*, *Penicillium chrysogenum*) was measured in 1538 serum samples.

**Methods:** A positive result (IgE  $\geq$  0.35 IU/ml) for one of the fungi was the criteria to define a case for an embedded case-control study. Controls were matched according to age, gender and region in a proportion of 1:3. Thus the case control study consisted of 66 cases and 198 controls. The homes of these 264 children were visited and indoor air and household dust was analysed for mould spores.

**Results:** 8.3% of the 1538 children were tested positive for a sensitisation against at least one of the fungi. Four of these fungi are not part of commercial test kits. 40% of these children did not show a sensitisation against other allergens that are part of commercial allergen test kits.

There was a significant correlation between visible mould in the living/children rooms as well as between a basic reconstruction of the home and sensitisation. Spore counts and extent of visible mould were significantly correlated.

**Conclusions:** The analysis of sensitisation against indoor fungi should be part of commercial allergy tests. The results show that long term exposure against fungi is a risk factor for a sensitisation and that exposure to substances used for reconstruction might promote the development of sensitisations.

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#### ISEE-0260

##### Hair Mercury Levels, Fish Consumption and Cognitive Development in Preschool Children from Southern Spain

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**Background and Objective:** The main source of human exposure to mercury is the consumption of fish contaminated with methylmercury, which may adversely affect early neurodevelopment. This study assessed mercury levels in hair of preschoolers in Spain, where fish consumption is elevated, with the aim of investigating the influence of their fish intake and other factors on mercury exposure and evaluating their association with cognitive development.

**Methods:** A population-based birth cohort from Southern Spain was studied at the age of 4 yrs. Total mercury (T-Hg) levels were determined in children's hair, and daily fish intake was assessed by a food frequency questionnaire. The McCarthy Scales of Children's Abilities (MSCA) were used to assess children's motor and cognitive abilities. Complete data were gathered on 72 children, and multivariate analyses were performed to evaluate the influence of mercury exposure and fish intake on MSCA outcomes.

**Results:** Mean concentration of T-Hg in hair was 0.96  $\mu\text{g/g}$  (95% confidence interval = 0.76; 1.20  $\mu\text{g/g}$ ). T-Hg levels were associated with higher frequency of oily fish consumption, place of residence, maternal age and passive smoking. After adjustment for fish intake, T-Hg levels  $>1 \mu\text{g/g}$  were associated with decrements in the general cognitive (−6.6 points), memory (−8.4 points) and verbal (−7.5 points) MSCA scores.

**Conclusion:** Higher mercury exposure in children from this Mediterranean area was associated with cognitive development delay. Studies on the putative benefits of fish intake during early development should consider mercury exposure from different fish species.

#### ISEE-0263

##### International Cooperation in Environmental Epidemiology: The Case-Study of ISS (Italy)—IFA (Ecuador) Cooperation

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**Background and Objective:** The interactions between hazardous environmental and occupational exposures and poverty represent a framework for international cooperation on environment and health. This work aims to present an experience of technical and scientific cooperation on these themes between a developed and a developing country, through a case-study involving the Italian National Health Institute (ISS, Istituto Superiore di Sanità) and an Ecuadorian NGO (IFA, Corporación para el Desarrollo de la Producción y el Medio Ambiente Laboral).

**Methods:** This cooperation benefits of the ISS multidisciplinary expertise on public health issues concerning environment and health and the corroborated IFA expertise on occupational and environmental field studies. IFA, a NGO particularly keen on Ecuadorian community needs and problems, ensures the adoption of a participative methodology and the transfer of knowledge toward social groups, communities and decision-makers.

High scientific standards for environmental epidemiological investigations and robust scientific methodologies are adopted to strengthen the capacity building process for guaranteeing the long-term sustainability of scientific cooperation outcomes.

**Results:** In this framework studies have been focused on known risks affecting particular population groups, concerning namely the effects of pesticides exposures for children in a school near a flower plantation and the synergy of social and environmental factors as determinants of silicotuberculosis affecting a community living close to a mining industry.

Also the possible impact on health of non-ionizing radiation exposures due to different sources existing in the neighbourhoods of Quito has been investigated.

**Conclusions:** These studies demonstrate the interconnection between environmental and socio-economic factors in a low-income country and corroborate the need to investigate in-situ well-known questions to get solutions appropriate to the local context. Further studies focused on unknown non-voluntary exposures of large sectors of the population contribute to better estimate the distribution of environmental exposures, whose adverse effects are still debated in the literature.

#### ISEE-0265

##### Residence Near Power Lines and Risk of Childhood Leukemia in Two Northern Italy Municipalities

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**Background and Objective:** Some epidemiological studies suggest an association between electromagnetic fields exposure, such as that induced by residence near high-voltage power lines, and childhood leukemia, but null results have also been yielded and the possibility of bias induced by unmeasured confounders has been suggested.

**Methods:** We identified the corridors along the high-voltage power lines in the municipalities of Modena and Reggio Emilia, northern Italy, with estimated magnetic fields exposure cutoffs of 0.1, 0.2 and 0.4  $\mu$ T. We identified all cases of leukemia diagnosed in children (age 0–13) residing in these two municipalities during the 1986–2006 period through a nationwide hospital-based registry. As a control group we randomly selected four residents for each case, matched for year of birth, sex and municipality of residence. We collected information about historical residence and parental education for all study subjects. We included this information in a GIS database and calculated the risk of childhood leukemia associated with residence for at least 6 months in the exposed area.

**Results:** Among the 47 cases and 188 controls included in the study, only 1 case and 2 controls had a historical residence in the exposed areas. The risk of leukemia associated with antecedent residence in the area with exposure exceeding 0.1  $\mu$ T was 2.0 (4.16 in the analysis adjusted for parental education), but this estimate was statistically unstable; its 95% confidence interval being 0.2–22.1.

**Conclusion:** The number of exposed children in this study was too low to allow firm conclusions, suggesting the need to substantially increase the study population. Though on the basis of these results an excess risk of leukemia among children exposed to electromagnetic fields from high-voltage power lines cannot be ruled out, the possibility of no association must also be considered.

#### ISEE-0266

##### Dynamic Change of Night Shift Loading and Sleep Quality

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*Taiwan;* and ¶*Department of Family Medicine, Kaohsiung Medical University Hospital, Kaohsiung, Taiwan.*

**Abstract:** Shift work is related to many health problems and sleep disturbance is one of them, especially for those working night shifts. Hence, we evaluated the association between night shift and sleep quality among registered nurses, whose work usually includes night shift rotation schedule.

This study recruited 458 nurses with night shift working schedule registered in Kaohsiung area, Taiwan. They completed two similar structured questionnaires in 2005 and 2006. The data included demographic characteristics, status of work schedule in the previous two months, and sleep conditions evaluated by the Pittsburgh Sleep Quality Index (PSQI).

In 2005 and 2006, averaged scores were 8.79 and 8.76. Among the 458 nurses, 79.3% and 77.9% had a bad sleep quality, defined as PSQI above 5. We found that having done less than 7 night shifts in the previous two months resulted in better sleep quality in 2005 and 2006 compared to rotas with more night shifts, with the PSQI score 8.33 and 8.24; whereas the PSQI scores were 9.02 and 8.94 for 7–14 night-shift, and PSQI scores were 9.26 and 9.54 for those with over 14 night-shift (*P* for trend: 0.027 for 2005 and 0.002 for 2006). Between these two surveys, increasing number of days of night shift during the follow-up period was significantly associated with detrimental change in sleep quality. For those with increased number of night shift days, the PSQI score increased from 8.81 to 9.56 (*P* = 0.0131). However, for those with decreased number of night shift days in between the two surveys, sleep quality did not improve significantly (PSQI score 8.87 in 2005 and 8.79 in 2006, *P* = 0.7818).

Although the night shift arrangement is unavoidable, the number of night shift days has a negative effect on sleep quality and this does not improve easily after a decrease in night-shift days. At one year follow up, the effect of increasing number of night shift days may be to aggravate sleep quality, but there is no improvement following a decrease in number of night shift days.

#### ISEE-0267

##### The Use of Personal Monitoring of Environmental Toxic Exposures of Children for Health Risk Assessment

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**Background and Objective:** Assessment of the environmental risks for children's health based on multimedia personal toxic exposures.

**Methods:** Our studies were carried out in 2003–2008 in kindergartens of 7 industrially polluted towns of the Sverdlovsk Region, Russian Federation, covering 287 children aged 3 to 7. The following personal samplers were used for measuring concentrations of chemicals in ambient and indoor air and in the breathing area of children: CHEMEXPRESS™ (USA) – for formaldehyde; OGAWA Co. (Japan) – for nitrogen dioxide and sulfur dioxide; 3M ORGANIC VAPOR MONITOR 3500 – for volatile organic compounds (VOC); “Breeze-1” (Russia) for heavy metals. Concentrations of lead, copper, zinc, cadmium, arsenic, nickel, and chromium were measured also in vegetables, drinking water, dust, and soil by mass spectrometry with inductively coupled plasma. We conducted timekeeping and used a special questionnaire to detect individual risk factors.

**Results:** The timekeeping showed that almost 80% of time children spent indoors. Personal factors of environmental risk included dwelling in the vicinity of industrial enterprises, predominance of synthetic decoration

materials at home, gas stove in the kitchen, smoking of parents, etc. The exposure to VOC, formaldehyde, and nitrogen dioxide was due mostly to the indoor air. We found that oral (through food and drinking water) exposure to toxicants was the most dangerous for children's health. Carcinogenic risk is predominantly related to arsenic exposure.

**Conclusions:** We believe that measuring personal exposures is most important for the assessment of integrated environmental exposure to toxicants, enabling one to develop an effective strategy of health risk management in an exposed population. On the individual level, such personal monitoring, along with detecting prevalence of other potential health risk factors helps to establish an association between different health conditions in a child and environment.

#### ISEE-0268

##### Organochlorine Compounds in the Serum of Two Cohorts of Pregnant Spanish Women (INMA-Gipuzkoa and INMA-Sabadell)

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**Background and Objective:** The INMA (Infancy and the Environment) project was set up to study the effects of environmental pollutants on infant growth and development. This study aimed to analyse the exposure of two cohorts of Spanish women (Sabadell (Catalonia) and Gipuzkoa (Basque Country)) in their first trimester of pregnancy to organochlorine (OC) compounds.

**Methods:** Blood samples were taken from 1269 women (630 in Gipuzkoa and 693 in Sabadell), between 2004–2008 who attended for their first ultrasound scan and the following compounds quantified: DDT and DDE, hexachlorocyclohexane (lindane;  $\beta$  and  $\gamma$ ), hexachlorobenzene (HCB) and PCBs. Analyses were performed with a high resolution gas chromatograph fitted with an electron capture detector and a low resolution mass detector.

**Results:** DDE was detected in all samples, PCB-153, PCB-180, PCB-138 and HCB in more than 75%, and lindane in 89% of samples from Sabadell but only 46% of those from Gipuzkoa. The mean levels of PCB-153 (50.1 vs. 30.7), PCB-138 (29.3 vs. 16.5) and PCB-180 (36 vs. 20.3), in ng/g lipid, were significantly higher in samples from Gipuzkoa than in those from Sabadell, whereas the levels of HCB (32 vs. 35.1),  $\beta$ -HCH (12 vs. 30.3) and DDE (95.8 vs. 126.1) were significantly higher in the Sabadell samples. The levels of OCs in both cohorts increased by 1.07 ng/g lipid per year of age and decreased with breastfeeding, with a significant reduction of 0.60 ng/g lipid being observed for breastfeeding periods of more than one year. The consumption of fish, meat or dairy products did not increase the predicted levels of OCs significantly.

**Conclusion:** The DDE levels were lower, and the PCB levels higher, than those reported for the USA (National Health and Nutritional Examination Survey; 2005). The levels of OCs increased with age, and breastfeeding is an important detoxification pathway.

#### ISEE-0269

##### Independent Effects of Air Pollution and Temperature on Myocardial Infarction

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**Background and Objective:** Increments of temperature and air pollution have been suggested to have positive associations with cardiovascular mortality and morbidity. In this study, we estimated the effects of temperature and air pollution on admission for myocardial infarction.

**Methods:** Daily numbers of admissions for myocardial infarction (ICD-10: I21, I22) occurred in Seoul, Korea between January 1, 2001 and December 31, 2006 were extracted from the National Health Insurance Corporation database. Meteorological data of the same period were obtained from the Korea Meteorological Administration database. Daily levels of PM<sub>10</sub>, NO<sub>2</sub>, SO<sub>2</sub>, CO and O<sub>3</sub> were extracted from the Ministry of Environment's monitoring database. We used Poisson regression models to estimate the effects of temperature and air pollution separately and combined on daily admissions for myocardial infarction stratified by months. Interactions of temperature and air pollutants were included in the statistical model.

**Results:** For each 1°C increase of temperature, RR of admission for myocardial infarction was significantly increased in August (1.82%, 95%CI:3.32%~0.34%). After adjusting for PM<sub>10</sub>, NO<sub>2</sub>, SO<sub>2</sub>, CO and O<sub>3</sub>, the increase slightly reduced but still significant (1.57%, 1.76%, 1.61%, 1.74% and 2.15%, respectively). For increment of PM<sub>10</sub> (10  $\mu$ g/m<sup>3</sup>), SO<sub>2</sub> (0.5 ppb) and CO (0.5 ppm), RRs were significantly increased in July and August. However, after adjusting for temperature, increases of RRs were not significant except for PM<sub>10</sub> (1.96%, 95%CI:3.51%~0.42% in July, 2.05%, 95%CI:3.88%~0.24% in August). With increment of O<sub>3</sub> (5 ppb) in June, RR increased 1.00% (95%CI:1.93%~0.06%) without adjustment for temperature, but increased 2.17% (95%CI:3.61%~0.76%) after adjustment. Interactions of pollutants and temperature were not significant.

**Conclusion:** Our results suggest that temperature and air pollution increase the risk of admission for myocardial infarction independently, particularly in summer season.

#### ISEE-0270

##### Individual Determinants of Serum Levels of 1,1-dichloro-2,2-bis(p-chlorophenyl)ethylene (DDE) and Polychlorinated Biphenyls (PCBs) among French Women

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**Background:** DDT and its metabolite DDE or PCBs are persistent organochlorine compounds (OCs) with hormonal disrupting properties that are suspected to play a role in the etiology of breast cancers, but most epidemiological studies reported no link between OCs concentrations in biological tissues and breast cancer risk. In these studies, however, OCs were measured at only one point in time, generally close to the time of cancer diagnosis. The observed values may not be etiologically relevant exposure indicators, since they do not only reflect lifetime cumulative exposure, but also individual differences in metabolism and key events that affect OCs kinetics.

**Objective:** To identify the individual characteristics that influence DDE and PCBs concentrations among French women, using data collected for a large population-based case-control study on breast cancer.

**Methods:** The sample consisted of 2135 women who answered a detailed questionnaire on sociodemographic characteristics, reproductive history, height, weight history since puberty, diet, alcohol drinking and tobacco smoking. These women also gave a blood sample that was used to measure OCs concentrations. Statistical analyses were conducted using ordinal regression models.

**Results:** The median concentration was 0.55  $\mu$ g/l for DDE and 0.61  $\mu$ g/l for total PCBs. The concentrations increased with age. In multivariate



analyses, the factors that were independently associated with elevated DDE levels were high body mass index (BMI), low weight gain during the last 10 years, low parity among women younger than 50 years, and high consumption of freshwater fish among older women. The most important determinants of high PCB levels were low BMI, low weight gain during the last 10 years, high consumption of saltwater fish, and short duration of lactation among younger women.

**Conclusion:** These results are consistent with data derived from pharmacokinetic models. Several individual characteristics should be considered thoroughly when studying the role of OCs in breast cancer.

#### ISEE-0271

##### **Biokinetic Model for Evaluation of Effects of Breast Feeding and Consecutive Normal Food Intake on PCB Plasma Concentration-Time Profile in Infants Until 45 Months of Age**

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**Background and Objective:** Polychlorinated biphenyls (PCBs) are persistent pollutants identified worldwide as human blood and breast milk contaminants. Because they bioaccumulate, consumption of meat, fish, and dairy products predicts human blood concentrations. The aim is a quantification of the effect of breastfeeding and consecutive normal food intake in infants using single-compartmental mathematical model.

**Methods:** A subgroup of 58 infants from a cohort of 1030 was used in a toxicokinetic study with sampling time schedule: 0 (blood cord) and 6, 16 and 45 months after birth. PCB was examined in blood serum. Open one-compartmental model of PCB kinetics was used for quantification of the effect of breastfeeding and consecutive normal food intake on PCB concentrations over time. The following three model parameters were evaluated from measured concentration-time profiles of PCB and length of breastfeeding using Monte Carlo Method: MRT (Mean Residence Time, in months),  $I_{BF}$  and  $I_F$  (Intensity of breastfeeding and of normal food intake, in PCB concentration per unit of time).

**Results:** To date, we have processed 58 concentration-time profiles of serum PCB with various lengths of breastfeeding. Results show various types of model curves depending on the length of breastfeeding and food composition. Evaluated intensities of PCB exposure during breastfeeding ( $I_{BF}$ ) and consequent normal food intake ( $I_F$ ) and evaluated MRT enable prediction of the future time course of serum PCB and a check of the fit of the measured values.

**Conclusion:** The model was optimized for the sample on which it was developed. Length of breastfeeding predicts PCB concentration-time profile at given food schedule. The model takes into account a presently unknown PCB intensity ( $I_{NEXT}$ ) using measured data from the next time period after the end of this initial phase. It should be tested in a further sample to determine generalizability.

#### ISEE-0272

##### **Levels of Cord Blood Lead in Pregnant Women from the INMA-Gipuzkoa Cohort (Basque Country; Spain)**

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**Background and Objective:** The INMA project (Childhood and Environment) studies the possible effects of environmental contaminants on infant growth and development. Exposure to lead (Pb) during the prenatal period has been associated with adverse effects on fetal development. This study aims to investigate exposure to Pb in 524 children born in Zumarraga hospital (INMA-Gipuzkoa cohort), which serves 25 municipalities in Gipuzkoa (Basque country, Spain).

**Methods:** During 2003–2007, Pb and  $PM_{10}$  levels in the air were measured in urban centres with metallurgical activity and in one municipality without such activity. Cord blood Pb was analysed in 524 children, as an indicator of exposure. The level of Pb in drinking water was analyzed throughout all 25 municipalities. Pb,  $PM_{2.5}$  and  $PM_{10}$  levels were determined using gravimetric analysis and inductively coupled plasma atomic emission spectroscopy. Cord blood Pb was determined using electrothermal atomic absorption. Pb in drinking water was analysed quarterly using graphite furnace atomic absorption spectrophotometry.

**Results:** Only in Zumarraga were atmospheric Pb levels detected that were higher than the limit established by law ( $0.5 \mu\text{g}/\text{m}^3$ ) (Mean:  $0.5 \mu\text{g}/\text{m}^3$ ), exceeding the limit on 23.9% of days. Eighty-six percent of drinking water samples presented levels lower than the detection threshold ( $1 \mu\text{g}/\text{l}$ ), with the mean level for all samples at  $4.5 \mu\text{g}/\text{l}$ . Ninety-two percent of cord blood samples displayed values lower than the detection threshold ( $1 \mu\text{g}/\text{l}$ ), with a mean level for all samples of  $2.6 \mu\text{g}/\text{l}$ .

**Conclusions:** Exposure to lead via air and water, at levels that are below the values required by law, is reflected in low cord blood lead levels in the study area.

#### ISEE-0273

##### **Asthma Admission Associated with Meteorological Factors in Taiwan**

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**Background:** The seasonal variation of asthma deserves extensive studies for the association with weather conditions among areas. This study evaluated the risk of hospitalization incidence for asthma associated with weather from 1997 to 2006.

**Methods:** A cohort of 862,842 individuals insured with the National Health Insurance program in Taiwan was identified in 1997. The first hospitalization rates for asthma were measured by month. Relative risks for asthma admissions were estimated in association with information on temperature, barometric pressure, relative humidity, wind speed, accumulated rainfall, and dew point, provided by the Center of Weather Bureau.

**Results:** During the 10-year study period, all the newly admitted asthma cases ( $N = 12,536$ ) appeared a J-shape association with the diagnosed months. The highest average rate of 16.6 per 100,000 was in March and the lowest rate of 10.2 per 100,000 in August. The multivariate Poisson regression analysis estimated risk for daily asthma incidence revealed a significant inverse association with temperature after controlling for sex, age, year, and other weather variables. Compared with the daily mean temperature of  $25\text{--}29^\circ\text{C}$ , the relative risk (RR) of the disease increased to 1.23 (95% confidence interval (CI) = 1.04–1.45) when the mean temperature decreased to  $< 15^\circ\text{C}$ . The risk was also higher when the atmospheric pressure was  $< 985 \text{ hPa}$  (RR = 1.12, 95% CI 1.05–1.19). The risk was also associated with higher humidity.

**Conclusions:** This study demonstrates that the asthma attack risk in Taiwan is elevated when it is colder, with higher atmospheric pressure and higher relative humidity.

**Key words:** asthma, hospital visits, climate change, meteorology, Taiwan.

## ISEE-0274

**Ambient Particulate Matter (PM<sub>2.5</sub>, PM<sub>10</sub>) and Associated Metals in Industrialized Urban Areas of Gipuzkoa (Basque Country, Spain)**

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**Background and Objective:** This study analyses the air quality in an area (519 km<sup>2</sup>) which includes three valleys in Gipuzkoa (Basque Country, Spain) containing 25 municipalities (1000–14,000 inhabitants), total population of 90,000.

**Methods:** Levels of PM<sub>2.5</sub> and various metals (Cd, As, Mn, Cu, Cr, Ni, Fe, Pb and Hg) were determined in six municipalities with industrial activity and one without such activity in 2006 and 2007. Sampling was performed with three high volume DIGITEL samplers. The annual and seasonal variation of these pollutants was determined for each valley. The correlation between pollutants for municipalities situated in the same valley was also calculated, as was the percentage of metals associated with PM<sub>10</sub> and PM<sub>2.5</sub> in one municipality. All analyses were performed by gravimetry and inductively coupled plasma atomic emission spectroscopy.

**Results:** A decrease in PM<sub>2.5</sub> concentrations was observed for all municipalities between 2006–2007; this decrease was significant ( $P < 0.05$ ) for Azkoitia (28.9 vs. 12.2 µg/m<sup>3</sup>), Azpeitia (23.4 vs. 13.6 µg/m<sup>3</sup>) and Legazpi (17 vs. 12.5 µg/m<sup>3</sup>). Manganese exceeded the reference value (WHO; 10–70 µg/m<sup>3</sup>) in Azkoitia (124 ng/m<sup>3</sup>) and Olaberria (104.4 ng/m<sup>3</sup>). Seasonal averages were found to differ significantly ( $P < 0.001$ ) for all pollutants, with the highest values being found in autumn and winter. A strong correlation was found between the pollutant levels found in the same valley ( $0.7 < r < 0.9$ ). The percentages of Ni, Fe and Cr were higher in PM<sub>10</sub> than in PM<sub>2.5</sub> ( $P < 0.05$ ), whereas the percentage of lead was higher in PM<sub>2.5</sub>.

**Conclusion:** The levels of particles and metals in the study area are similar to, or higher than, those in metropolitan areas, which suggests that the health risk for small municipalities in periurban environments needs to be assessed.

## ISEE-0275

**Levels of Trihalomethanes and Haloacetic Acids in Drinking Water, Spatio-Temporal Variations and Exposure of the INMA-Gipuzkoa Cohort (Spain)**

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**Background and Objective:** The INMA project (Childhood and Environment) studies the effects of environmental contaminants on infant growth and development. Exposure to trihalomethanes (THM) and haloacetic acids (HAA) during the prenatal period has been associated with adverse effects on fetal development. The aims of this investigation are the following: to describe THM and HAA levels in drinking water in the 25 municipalities in the INMA-Gipuzkoa cohort (Basque Country, Spain), to analyse spatio-temporal variability and to calculate intake in 590 pregnant women.

**Methods:** During 2006–2008 THM and HAA levels were analysed bi-monthly using gas chromatography with electron capture detection

throughout the 25 municipalities. The characteristics of the distribution networks were obtained from the Health Monitoring Program for Water for Public Consumption. Water consumption habits were obtained via a survey. Intake (µg/day) was calculated by multiplying the mean THM and HAA values by water consumption (l/day).

**Results:** THM and HAA concentration is lower in spring water that has undergone chlorination only, than in reservoir water subjected to full drinking water treatment: (8.8 µg/l vs. 19.1 µg/l;  $P < 0.01$ ) and (8.2 µg/l vs. 11.7 µg/l;  $P < 0.01$ ) respectively. THM and HAA levels increase significantly as the number of tanks in the network increase and with later chlorination. THM levels are greater in summer and autumn. THM and HAA intake show asymmetric distributions for mean, median and standard deviation of 18.8, 19.0 and 7.5 µg/day for THM; and 12.3, 12.2 and 4.9 µg/day for HAA.

**Conclusion:** The main source of variability in THM and HAA levels is the origin of the water. The mean levels of THM and HAA in drinking water are 17% and 5.4% respectively, of the established guideline values (WHO 2006).

## ISEE-0277

**The Health of Children and Outdoor Air Pollution**

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**Objective:** The main aim of the study was to look for associations of ambient air pollution with morbidity of preschool children.

**Methods:** The birth cohort consists of children delivered (in 1994–1998) and living in two districts of the Czech Republic: the district of Teplice with, especially in the past, extremely high air pollution and the district of Prachatice, with lower levels of particulate air pollution. Lists of all illnesses of the children (N = 1007) from birth to the age of 6 years (in ICD-10 codes) were obtained from medical records. The multivariate negative binomial regression was used to compare morbidity of children in the city of Teplice, in the rest of the district, and in the district of Prachatice.

**Results:** The highest incidence of lower respiratory infections (LRI–pneumonia, acute bronchitis and laryngitis/tracheitis) in both the younger and older age was in the city of Teplice: 0–2 years–RR (rate ratio) 1.33, CI 95% 1.14–1.55 compared to Prachatice, and RR 1.39, CI 1.17–1.65 compared to the rest of the district Teplice. At the age 2–6 years: RR 1.28, CI 1.18–1.48 compared to the district of Prachatice and RR 1.68, CI 1.44–1.96, compared to the rest of the district. This difference was clearly due to a high incidence of laryngitis in the city of Teplice.

**Conclusion:** The highest incidence of LRI and otitis media and influenza was observed in children living in the city of Teplice. A higher population density and a higher concentration of NO<sub>2</sub> in the urban environment may be among factors underlying an increased morbidity of children.

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## ISEE-0279

**Cardiovascular Effects of the Outdoor Air Pollution in Tuscany: Preliminary Results of the Riscat Study**

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**Background and Objective:** Several studies have reported significant associations between outdoor air pollution and health outcome, such as

deaths and hospital admissions for respiratory and cardiovascular diseases. RisCAT study (Cardiovascular RISks and Air pollution in Tuscany) aimed to evaluate the relationship between the incidence of acute myocardial infarction (AMI) and air pollution levels in urban areas in Tuscany.

**Methods:** Data on AMI events, air pollution and meteorological variables were collected for the period 2002–2004. We included both hospitalised AMI events and coronary deaths without hospital admissions. We selected air quality monitoring stations classified as background urban sites and we calculated daily mean concentrations for main pollutants. We identified six homogeneous areas (covering 43% of the total population in Tuscany), according to the values recorded at the monitoring sites. A bi-directional case cross-over design was performed to evaluate the short term effects of air pollutants on AMI events at different time lags. A conditional logistic regression analysis was carried out in each area and the pooled association was estimated in a random-effect meta-analysis.

**Results:** We identified 14,000 AMI events in the 6 areas (73.1% in hospital and 26.9% coronary deaths without admission). 58% of events occurred in subjects over 74 years of age. We observed a general increase of health risk, especially for elder people. For subjects over 74 years for all events we observed an OR = 1.03 (lag 0–3 95% CI 1.003–1.067) for 10  $\mu\text{g}/\text{m}^3$  increase in ozone, in summer months; an OR = 1.02 (lag 0–1 95% CI 1.001–1.035) for 10  $\mu\text{g}/\text{m}^3$  increase in PM<sub>10</sub>. Significant associations were reported for coronary deaths without admission, but not for AMI events occurred in hospital.

**Conclusion:** Our study confirmed the negative effects of outdoor air pollution on cardiovascular health. Elder people have higher risks of disease, mainly during the hot season.

#### ISEE-0281

##### Detection of Antibodies to *Coxiella Burnetii* in Employees of Veterinary University

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**Background and Objective:** *Coxiella burnetii* is an obligate intracellular pathogen known to be the causative agent of Q fever, a zoonosis with a worldwide occurrence. The organism has been found in many wild and domestic animals. Infected animals shed highly stable bacteria in urine, faeces, milk and through placental and birth fluids. Humans acquire the infection mainly by inhaling infected aerosols, or by ingesting contaminated raw milk or fresh dairy products, tick transmission has been proven but is probably rare. The aim of the present study was to determine the titres of immunoglobulin IgG against phase I and II of *C. burnetii* and to evaluate the risk factors that might be associated with exposure to *C. burnetii* among employees of Veterinary University.

**Methods:** Venous blood was obtained from 92 employees. IgG antibodies were determined by ELISA method modified in our laboratory using whole cells of the Nine Mile *C. burnetii* strain. The questionnaire was filled out by every subject to obtain epidemiological and clinical data.

**Results:** Phase I antibodies were detected in 35 subjects, i.e. in 38%, and phase II antibodies in 58 subjects, i.e. in 63%. When using the titre  $\geq 1:800$  as a cut-off level, two samples were positive for phase I antibodies (2.1%) and 12 for phase II antibodies (13 %). Factors predisposing to infection or exposure to *C. burnetii* included professional orientation and regular contact with farm animals and pets. Clinical history of some seropositive subjects revealed substantial problems, such as fever of unknown origin, rheumatic disease, disease of heart, liver, respiratory tract (particularly atypical pneumonia), chronic fatigue syndrome and spontaneous abortion in females.

**Conclusion:** Q fever is a profession-related disease and prevention of its spreading within the risk population groups requires observation of basic safety rules.

#### ISEE-0282

##### Sero-Epidemiology of Measles among Adult Working Population in Southern Taiwan

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**Background and Objective:** According to previous epidemiologic studies, more than 90% of the people in Taiwan contracted measles and had immunity at the childhood age. However, several cases of endemic measles among the adult population have been reported in Japan in the last two years. We conducted this survey to understand the pattern of current immunity among adult working population in southern Taiwan.

**Methods:** We collected data on annual health examination from four companies in southern Taiwan in Sep. 2007, which included demographic data, measles IgG titer and blood biochemistry.

**Results:** In total, 970 participants were recruited, including 647 males (mean age 33.1 y/o) and 323 females (mean age 29.6 y/o). The overall seropositive rate of measles was 89.2% (90.9% for men, 85.8% for women). We found those of older age had higher seropositive rate ( $P < 0.05$ ). There was no difference in seropositive rate between the group born before September 1976 and that born afterwards. However the participants born before 1976 had higher measles IgG antibodies titer than that borne after 1976 (0.893 OD vs. 0.655 OD,  $P < 0.001$ ). Among those born before 1967, the measles seropositive rate was 100%.

**Conclusion:** We found most of the adult working population had measles immunity. However, there was still 10.8% of the population lacking immunity. Vaccination for adults without immunity should be encouraged to prevent the spreading of measles in the workplace.

#### ISEE-0283

##### Decrease in Seroprevalence of Hepatitis A after the Implementation of Nationwide Disposable Tableware Use in Taiwan

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**Background and Objective:** Taiwan is an endemic area of viral hepatitis, including hepatitis A, which is transmitted mainly from the fecal-oral route. In order to reduce the transmission through food intake, the government implemented a policy of nationwide disposal tableware use in public eating places in 1982. The objective of this study is to evaluate changes in the seroprevalence of hepatitis A after the implementation.

**Methods:** We recruited workers of an industrial park during their annual health examinations in 2005 and measured their anti-hepatitis A virus IgG titer using microparticle enzyme immunoassay. We compared the seroprevalence among different birth cohorts within the study population and also analyzed data from previous studies.

**Results:** The overall sero-positive rate was 22.0% in the 11,777 participants. The rate was much lower among those who were covered by the program since birth (born after 1982) in comparison with those who were not (2.7% vs. 25.3%,  $P < 0.001$ ). From the analyses of data from previous studies, we found the age-specific rates were similar in cohorts born in or after 1982 across studies conducted in different time periods but decreased with the calendar year in cohorts born before 1982. In particular, the age-specific seroprevalence dropped to less than one third in a three-year period among those who were born around 1982.

**Conclusions:** Data from both the current and previous studies in different time periods supported the effectiveness of disposal tableware in preventing the transmission of hepatitis A.



## ISEE-0286

**Comparison of Different Exposure Definition in a Case-Crossover Study on Air Pollution and Daily Mortality: Counterintuitive Results**

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**Background and Objective:** Due to practical and theoretical problems associated with an individual assessment of exposure to air pollutants, almost all epidemiologic studies assign exposure with data acquired by fixed site monitoring stations. We will show counterintuitive results we obtained about the impact of different exposure definition in an observational ecologic case-crossover study of air pollution and mortality.

**Methods:** The associations of daily concentrations of PM<sub>10</sub>, O<sub>3</sub> and NO<sub>2</sub> with daily mortality were investigated using a case crossover design. Conditional logistic regression was used to estimate percent increase in the risk of dying for an increase of 10 µg/m<sup>3</sup> in PM<sub>10</sub> (lag 1). The study area covers the main 6 cities in the central-western part of Emilia-Romagna region. We used four approaches to assign exposure to air pollutants for each individual considered in the study. The first one is to choose a background reference station in each city. The second approach was based on averaging daily data collected by stations within the same urban area. The third and the fourth methods consisted in defining average daily values on macro-areas and on the regional scale (100 × 150 km<sup>2</sup>).

**Results:** Odds ratios generally increased enlarging the spatial dimension of the exposure definition and were highest for regional exposure definition. The effect is especially evident for PM<sub>10</sub>. The impact of using different exposure assignments were similar for PM<sub>10</sub> and NO<sub>2</sub> while for ozone we did not find any change in risk estimates.

**Conclusion:** Spatial aggregation of monitoring station data lead to higher and most robust risk estimates for PM<sub>10</sub> and NO<sub>2</sub>, even if monitor-to-monitor correlations showed a light decrease with distance. We discuss this results in terms of sources of errors in assigning exposure by means of fixed site stations and present some practical implications of our findings.

## ISEE-0289

**Projected Changes in Reportable Enteric Disease Incidence in New Brunswick, Canada in Response to Changes in Temperature, Precipitation and Snow Depth**

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**Background and Objectives:** Annually, thousands of Canadians become ill due to infection with enteric pathogens. Among other causes, disease incidence has been linked to increased ambient temperature and to extreme weather events, conditions which are projected to worsen across Canada under global climate change. The objective of this study was to estimate the potential impacts of changes in temperature and precipitation consistent with global climate change projections on reportable enteric illness in New Brunswick, Canada.

**Methods:** Predictive models estimating the relationship between temperature, precipitation and changes in snow depth were evaluated using data from the New Brunswick Reportable Disease Surveillance System. Negative binomial regression was used to identify variables best suited at predictors of disease incidence. The potential impacts of changes in weather variables, significantly associated with disease incidence, on reportable enteric disease incidence were evaluated using incidence rate difference mapping.

**Results:** Incidence rate difference maps indicated that increases in temperature (at levels consistent with those projected under global climate change) have the potential to provoke relatively large increases in enteric disease incidence in some regions of New Brunswick.

**Conclusions:** This study employed a new method for assessing changes in an environmental factor related to enteric disease incidence. This method allowed for the identification of regions that may be adversely affected by increases in temperature and precipitation consistent with global climate change projections in New Brunswick.

## ISEE-0291

**Aircraft Noise and Incidence of Hypertension among Swedish Men and Women**

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**Background and Objective:** Recent studies show associations between aircraft noise and cardiovascular outcomes such as hypertension. However, the studies were mostly cross-sectional and there are uncertainties regarding sensitive subgroups as well as potential gender differences. We investigated the incidence of hypertension in relation to aircraft noise exposure among Swedish men and women living in Stockholm County.

**Methods:** A total of 4721 men and women, aged 35–56 at baseline, were followed for 8–10 years. The population was selected according to family history of diabetes, which was present for half of the subjects. The exposure assessment was performed using geographical information systems and based on residential history during the period of follow-up. Blood pressure was measured at baseline and at the end of follow-up. Additional information regarding diagnosis and treatment of hypertension was provided by questionnaires.

**Results:** A RR of 1.02 (95% CI 0.90–1.16) for hypertension was found among subjects exposed to ≥50 dB(A) L<sub>den</sub>. Stratifying for sex, the adjusted RR was 1.09 (0.92–1.29) for males and 0.92 (0.76–1.11) for females. When restricting the cohort to those not using tobacco at the blood pressure measurements, a significant risk increase per 5 dB(A) was found in males; RR 1.21 (1.05–1.39), but not in women; RR 0.97 (0.83–1.13). In both sexes combined, aircraft noise annoyance was suggested as an effect modifier.

**Conclusions:** The results suggest an increased risk of hypertension following long-term noise exposure in men but not in women. This gender difference was, however, not statistically significant.

## ISEE-0299

**The Effect of Air Filtration on Traffic Related Air Pollution Components in an Occupied Classroom along a Major Highway**

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**Background and Objective:** Traffic related air pollution (TRAP) poses a health threat to people living in the vicinity of major roads. Especially in densely populated areas space is tight. In Amsterdam homes and schools are therefore sometimes located adjacent to the major ring road (A10), which carries about 90,000 vehicles/day. Our aim was to study the effect of three different filtration systems on TRAP in an occupied classroom with 22 children aged 8–9 years, comparing indoor and outdoor air pollution components under real life circumstances.

**Methods:** A classroom in a school located 200 meters from the A10 was selected as the study location. Differences between outdoor and indoor

PM<sub>2.5</sub> (including absorption and EC/OC), ultrafine particles and NO<sub>x</sub> concentrations were studied. The effects of three filtration systems were tested consecutively for about four weeks each during the period Jan-April 2009, after baseline testing during four weeks. Preliminary results are only available for ultrafine particles and System1. Data on ultrafine particle concentrations were available for every minute of 4–6 daytime hours during five Baseline-days and eight System1- days.

**Results:** At baseline, average concentrations of ultrafine particles were 23209 particles/cm<sup>3</sup> indoors and 39656 particles/cm<sup>3</sup> outdoors. The average Indoor/Outdoor ratio was 0.57 (95% CI:0.51–0.63). With System1 (including F7 filter) installed in the classroom, infiltration of ultrafine particles decreased about twofold (Indoors: 6471 particles/cm<sup>3</sup> and outdoors 21145 particles/cm<sup>3</sup>, ratio 0.27, 95% CI:0.24–0.33).

**Conclusion:** In situations where demand for space is tight and schools are located close to major roads, exposure to ultrafine particles can be reduced by installing ventilation systems equipped with filtration techniques. Indoor ultrafine particle concentrations were about twofold lower using a F7 filter. Effects on other air pollution components and the other filtration systems techniques will also be studied and will be available soon.

### ISEE-0302

#### Mercury – An Important Contaminant and Its Existence in Milk and Blackcurrant in the Slovak Republic

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**Background and Objective:** The aim of our paper is to find out the amount of mercury in selected foodstuffs because the amount of mercury in soil of Slovakia in comparison with the world soil is higher. Heavy metal can be distributed into a human organism via the food chain.

**Methods:** We monitored the presence of mercury milk (n = 30), blackcurrant (n = 30) and the soil. To find the concentration of mercury in some commodities we used the analytic method for stating mercury by method of fireless atomic absorption spectrometry AMA 254.

**Results:** Milk: For the purpose of mercury content quantification, the analysed milk was separated into three categories, from the lowest level to allowable limit 0.010 mg.kg<sup>-1</sup>. The lowest concentration was in milk was 0.00073 mg.kg<sup>-1</sup>, the highest 0.01428 mg.kg<sup>-1</sup>. From the 30 analysed samples there was just one sample over the limit of 0.010 mg. kg<sup>-1</sup>.

Blackcurrant (*Ribes nigrum*): The lowest concentration of Hg was in wood (0.77231 mg.kg<sup>-1</sup>). Higher concentration of Hg was in the roots (1.12323 mg.kg<sup>-1</sup>). The highest concentration of mercury was measured in fruit (3.72111 mg.kg<sup>-1</sup>). In samples of soils there was from 170 mg.kg<sup>-1</sup> up to 450 mg.kg<sup>-1</sup> Hg.

**Conclusion:** In all plants where the soil had been contaminated by concentrations of Hg measured exceeded the limit.

We have to take into account that soil is important, and it is also important to measure the amount of mercury as well as the distribution of mercury into the body of a plant. That is the reason why it is important to continue monitoring the mercury concentration in fruit. Milk does not represent a real danger to the humans, as seen in our experiment.

### ISEE-0307

#### Completeness and Positional Accuracy of Two Food Outlet Databases in a Rural Environment

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**Background and Objective:** There is increasing interest in the impact of the built nutritional environment on health behaviors and outcomes. Little is known about the validity of readily available databases from public or commercial sources.

**Methods:** We conducted a comprehensive field census of the rural food environment in seven South Carolina counties identifying all food outlets (i.e. supermarkets, grocery stores, food wholesalers, discount stores, drug stores, restaurants, delis and specialty stores, convenience stores with or without gas stations). Locations were acquired using a handheld global positioning system unit (GPS, Trimble Juno ST). A data source from a state agency (DB-A) and a commercial business listing (DB-B) were compared to field census results. We computed concordance (number agree/total number identified in field census or database), sensitivity (number agree/number in field census), and positional accuracy (Euclidian distance between GPS and geocode among concordant outlets).

**Results:** The field census identified a total of 1,054 food outlets, DB-A listed 823 outlets and DB-B listed 767 outlets. DB-A and the field census showed good agreement (concordance = 0.63) on the presence of food outlets, while DB-B showed only moderate agreement (concordance = 0.47). The sensitivity was quite good for DB-A at 69% but poor for DB-B at 53%. The positional accuracy varied tremendously, with a median difference of 122 meters for DB-A and 104 meters for DB-B. Despite these spatial discrepancies, 77.3% of food outlets in DB-A and 79.8% of those in DB-B were allocated to the correct census tract.

**Conclusion:** Our study suggests that in rural areas the validity of readily available data sources used for the characterization of the nutritional environment differs markedly in terms of completeness and spatial accuracy. Both undercount of food outlets and positional inaccuracies can introduce bias into studies evaluating the impact of the built nutritional environment on health.

### ISEE-0311

#### Comparison of the Performances of Land Use Regression Modeling and Dispersion Modeling for Estimating Intra-Urban Air Pollution Concentrations

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**Background and Objective:** Exposure assessment of intra-urban air pollution concentrations for epidemiological studies remains difficult. Current approaches include dispersion modeling and land use regression (LUR) modeling. There is however not much known about the comparability of the performances of both methods. We compared the performances of a LUR model and a dispersion model in a Dutch study area.

**Methods:** For the Rijnmond area, i.e. Rotterdam and surroundings, NO<sub>2</sub> concentrations for 2001 were estimated for 231,191 grid cells. The LUR model was developed using monitoring data from the national monitoring network and potential Geographic Information System (GIS) predictor variables. First, concentrations measured at regional background sites were interpolated and residual concentrations at urban background and traffic sites were calculated. LUR models were then developed to explain these residual concentrations. The URBIS model was used to estimate NO<sub>2</sub> concentrations using dispersion modeling.

**Results:** The LUR model for the residual concentration at urban and traffic sites included as predictor variables the area of residential land in a 300 m buffer, the traffic intensity in a 200 m buffer, the area of industry in a 1,000 m buffer, and the population density in a 100 m buffer, with R<sup>2</sup> value of 88% and RMSE value of 3.7 µg/m<sup>3</sup>.

Because of the large number of grid cells, the data were sorted and averaged over groups of 1,000 records. The correlation between estimates of both methods was 0.98. The average predicted concentration was

however higher for the LUR estimates, especially for the lower concentrations. Differences in model assumptions and model development partly explained the differences in model predictions.

**Conclusion:** LUR and dispersion modeling have their own advantages and limitations, but both were able to estimate intra-urban NO<sub>2</sub> concentrations. Predictions were highly correlated, and could be used in epidemiological studies.

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#### ISEE-0313

##### Children's Cancer and Carcinogens in Alberta: A Mapping Pilot Study

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**Background and Objectives:** Early epidemiology used maps to link cholera cases to a contaminated water-pump, resulting in outbreak containment after closure of the pump. This exemplifies how mapping can help in understanding the environmental contribution to disease. Although mapping continues to be an effective way to deliver information on the spatial distribution of pollutants and disease in a particular region, little has been done to link, co-locate and map concurrent variables.

**Methods:** We mapped carcinogens (IARC group 1) released into the air, childhood cancers (all types) and childhood distribution (age 0 to 19) in Alberta, testing whether existing publicly funded databases could be used for GIS mapping research. Data (1994–2005) from the National Pollution Release Inventory, Alberta Cancer Board and Statistics Canada were obtained. Identification of a geographical unit that would serve to display information with enough resolution without giving away individuals privacy was a major challenge; we worked with Forward Sortation Areas (FSAs).

**Results:** We found heterogeneous distributions of children, carcinogenic emissions and cancers throughout Alberta. The overall release of selected carcinogens has been decreasing in general, with startling increases in the release of arsenic, cadmium and chromium from 2001 onwards. However, cancer occurrence has been stable after adjusting for child population growth. Ten out 150 FSAs co-located high releases; high cancer occurrence; high child population, and high observed/expected cancer occurrences. The distribution of those variables within the FSAs was heterogeneous, calling for higher resolution before conclusive evidence can be drawn.

**Conclusions:** Our data indicates that existing databases can be used to construct maps, overlaying information on environmental factors and disease. This mapping tool identifies potential areas of concern for further research and possibly surveillance. A major challenge in this research incorporates the ethics concerning individual privacy vs. a community right to know.

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#### ISEE-0316

##### Perceived Health Effects of Pesticides and Herbicides Used in Tobacco Cultivation in Nigeria

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**Background:** Tobacco production has increased in recent years in Nigeria because of the establishment of modern companies by the big multinational tobacco companies. There has been wide distribution of pesticides and herbicides to farmers and encouragement of more production. These products have been associated with ill-health effects in other parts of the world. This study was designed to elicit the perceptions of farmers about these products.

**Methods:** One hundred and forty three participants were recruited among farmers in Ibadan. All the participants were males. Four focus group discussion sessions were then conducted for 25 willing participants who

said they had used or knew someone who used these products in the past. The discussions were audio-taped, transcribed and coded using the NUDIST software. Inter-observer variability was 84%. We also had a component that explored feeling of wellness during the period of use of pesticides.

**Results:** Twenty-three (91%) reported health effects include nausea, vomiting and feeling of lassitude during the period of use or immediately after use in the past. No respondent was a consistent user of Personal Protective Equipments (PPE) during the use of these chemicals. None of the respondents thought consistent use of these products could jeopardize their health on the long term. The qualitative responses could be classified under four major themes were identified: (1) Herbicides and Pesticides used for tobacco cultivation can be used by all ages (2) Herbicides and pesticides are now safer than ever (3) Herbicides and Pesticides products can be used without PPE if used in minute quantities.

**Conclusion:** Perceptions about health effects of pesticides of these products is distorted. There is also a need to further explore the immediate and long-term health effects of these products in a larger population of farmers.

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#### ISEE-0318

##### Aphekom – The Science/Decision Interface in Air Quality Policy: Lessons from a Local Multi-Stakeholder Process in France

Yorghos Remvikos,\* Sylvia Medina,<sup>†</sup> and Jeroen Van der Sluijs,\* \*University of Versailles SQY, GUYANCOURT, France; and <sup>†</sup>InVS, PARIS, France.

**Background and Objective:** Public decisions regulating environmental issues such as air quality rely on the proper integration of complex scientific evidence. Aware that pressing gaps remain in stakeholders' understanding of the continuing threat to health represented by air pollution, the Aphekom project aims to develop and deliver reliable and actionable information and tools so that decision makers can set more effective local and European policies.

**Results:** Because the institutional process of decision-making also affects the quality of the science/decision interface, one of the Aphekom's work-packages focuses on sharing knowledge and uncertainties between scientists and stakeholders. In this framework we decided to analyse, as a local case study, the elaboration of the Regional Air Quality Plan (RAQP) of Ile-de-France (including Paris area).

This process presents advantages: it was conducted as a participatory process (more than 150 people participated in six working groups for almost two years) in a region where 19% (11 million) of the French population lives, and where 2–4 million are regularly exposed to inadequate air quality.

A document including 21 recommendations was drafted and opened to stakeholders' criticism in October 2008, over the Internet and during four thematic round tables. The issue of proximity to traffic dominated the debates with questions about specific health risks, but also about environmental equity, highlighting the necessity to bring together public health scientists, urban planners and local authorities.

**Conclusion:** In this work we have developed indicators about health, quality of life, urban planning, transportation and economic impacts that we will use in interviews with stakeholders in order to stimulate the dialogue among decision-makers, stakeholders and citizens about scientific evidence, its limits and its relevance to policy.

A questionnaire will be available at the ISEE meeting allowing participants to give their opinion and enrich the Aphekom data collection process.

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#### ISEE-0320

##### Estimating the Global Burden of Disease from Foodborne Chemicals

Herman Gibb, Tetra Tech Sciences, Arlington, VA, United States.

**Background and Objective:** In 2007, the World Health Organization launched an initiative to estimate the global burden of foodborne disease.



As part of this initiative, WHO established a technical advisory body known as the Foodborne Epidemiology Reference Group (FERG). The FERG consists of a Steering Group and four thematic Task Forces—Infectious Disease (includes enteric and parasitic), Chemical, Source Attribution, and Country Burden of Disease Studies. This presentation will describe the work of the Chemical Task Force. Final disease burden estimates from the FERG are expected to be available by 2012.

**Methods:** The Chemical Task Force has selected aflatoxin, cyanide (cassava), peanut allergens, dioxin, lead, methylmercury, and organophosphates as its highest priorities based on the severity of the diseases associated with these chemicals and the sizes of the populations likely to be affected. Manuscripts being prepared on priority chemicals are expected to provide for all relevant disease outcomes age-specific incidence rates, case-fatality rates and estimates of the duration of the disease associated with the chemical. Using this information, the burden of disease will be quantified by WHO using a summary health metric known as Disability Adjusted Life Years (DALYs) which combines morbidity (weighted for the level of disability) and mortality.

**Results:** Currently, manuscripts on aflatoxin, cyanide, dioxin, and peanut allergens are in various stages of preparation or peer review.

**Conclusion:** It is envisioned that this monumental effort will play an important role in assessing and managing the risks of foodborne chemicals. The results will provide useful input to the setting and evaluation of food safety standards. They will also produce an increased capacity at country level to conduct risk assessment, risk management and risk communication related to foodborne hazards.

#### ISEE-0322

##### Socio-Cultural Influences on Obesity and Inflammation among 2-Year Old Puerto-Rican Children at Risk for Asthma Development

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**Background and Objective:** Recent studies have shown obesity tends to pre-date childhood asthma. While the pathways are not understood, inflammatory biomarkers are thought to play a role. The objectives are to assess serum levels of leptin and high-sensitivity C-reactive protein (hs-CRP) in early childhood and investigate their associations with body mass index (BMI), respiratory symptoms, and allergy.

**Methods:** In a birth cohort of 181 Puerto-Rican babies born in New York City with a maternal history of inhalant allergy and/or allergic asthma, home/demographic characteristics and respiratory symptom questionnaires were administered every 6 months from birth through age 2 years. Children's weight and height were measured and blood was collected at age 2. Serum was analyzed for leptin, hs-CRP, and allergen-specific sensitization. Obesity was defined as >95th percentile of BMI.

**Results:** At age 2-years, median BMI percentile was 85%. Geometric mean leptin and hs-CRP concentrations were 2.66 (GSD = 1.7) and 0.30 (GSD = 7.5) ng/ml, respectively. Leptin was associated with obesity (OR = 2.4; 1.4–2.9). More girls had leptin levels above the median than did boys (60% vs 37%,  $P = 0.0061$ ). At age 2 years, children in daycare were more likely to be obese (43% vs 26%,  $P = 0.03$ ). While maternal birthplace was not significantly associated with the children's leptin levels, Puerto Rican-born mothers were less likely to have children with hs-CRP above the mean (OR = 0.14, 0.02–1.10;  $P < 0.06$ ) compared with women born on the U.S. mainland. Leptin and hs-CRP levels were not significantly associated with sensitization to any of the measured inhalant

allergens. Neither leptin nor hs-CRP levels were associated with asthma morbidity markers at age 2.

**Conclusion:** Leptin was positively associated with female gender, BMI and obesity. Children in daycare were more likely to have higher leptin levels. Maternal birthplace (Puerto Rico) was inversely associated with hs-CRP in children, but not significantly associated with leptin.

Funding acknowledgment for project: NIEHS R01 ES10922.

#### ISEE-0323

##### Effect Modification of Levels of Heavy Metals by Hemochromatosis Genotype among Mother-Infant Pairs: The Tar Creek Birth Cohort

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**Background and Objective:** Exposure to heavy metals during windows of increased susceptibility such as fetal development can cause adverse growth and neurodevelopmental effects. Hemochromatosis (gene = *HFE*) is the most common form of excess adult onset iron accumulation disease and the presence of its gene variants can potentially modify the levels of other metals. The study objective was to assess potential effect modification of the association between maternal and fetal exposure to manganese (Mn) and lead (Pb) by two variants of the *HFE* gene (*H63D* and *C282Y*).

**Methods:** A birth cohort of mothers (304) and infants (278) residing around the Tar Creek Superfund Site in Oklahoma (USA) was studied. Maternal and umbilical cord blood Mn and Pb were measured at delivery and blood metal levels were examined in linear regression models stratified by genotype.

**Results:** Prevalence of the *HFE* *C282Y* and *HFE* *H63D* variants among mothers was approximately 13% and 30%, respectively, while 4% carried both variants. The corresponding values for infants were: 11%, 34% and 4%. Maternal blood Mn was a significant predictor of cord blood Mn among infants carrying at least one copy of either the *C282Y* or *H63D* allele ( $N = 113$ ,  $\beta = 0.77$ ; 95% CI: 0.40, 1.14) but not among wild-type infants ( $N = 165$ ,  $\beta = 0.26$ ; 95% CI: -10.01, 0.53). Conversely, wild-type mothers ( $N = 186$ ) had a higher effect of maternal blood on cord blood Mn ( $\beta = 0.62$ ; 95% CI: 0.33, 0.92) and Pb ( $\beta = 0.68$ ; 95% CI: 0.60, 0.77) versus those with any *HFE* variant ( $N = 118$ ) for Mn ( $\beta = 0.13$ ; 95% CI, -0.18, 0.43) and Pb ( $\beta = 0.37$ ; 95% CI: 0.23, 0.50). These observations did not change significantly after adjusting for maternal age and parity.

**Conclusion:** Among this population of mother-infant pairs, *HFE* variants modified the association between maternal and cord blood metal levels. Identifying susceptibility factors for increased metal exposure during pregnancy is important for protecting children from potential exposures.

#### ISEE-0324

##### MicroRNA-Related SNPs Modify the Association Between Black Carbon Exposure and Blood Pressure in the Normative Aging Study

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**Background:** Evidence suggests that black carbon (BC) from traffic pollution contributes significantly to particle-related cardiovascular effects but the underlying mechanisms are unclear. Micro-RNAs (miRNAs) are small non-coding RNAs involved in processes related to angiogenesis, inflammation, and endothelial cell function. However, whether miRNAs

mediate cardiovascular effects of particulate has not been examined. We hypothesized that associations between BC and systolic and diastolic blood pressure (SBP and DBP) would be modified by single nucleotide polymorphisms (SNPs) in genes related to miRNA processing.

**Methods:** We used mixed models with random intercepts and adjusted for potential confounders to examine longitudinal associations between BC and BP. Effect modification was assessed by 38 miRNA-related SNPs using dominant models of inheritance.

**Results:** 704 participants provided blood pressure measurements and DNA. Significant interactions with BC predicting both SBP and DBP were observed for rs1834306 in mir100. For example, a 1 SD increase in BC for rs1834306 was associated with 4.2% higher SBP (95% CI: 2.8, 5.5) in wild-type individuals and 2.1% higher SBP (95% CI: 1.3, 2.9) in subjects with the variant. BC was associated with 5.0% higher DBP (95% CI: 3.7, 6.4) and a 3.0% higher DBP (95% CI: 2.3, 3.8) respectively. For SBP models, interactions were also observed for SNPs in GEMIN4, RAN, and AGO1, while in DBP models, we observed interactions with SNPs in GEMIN3, and additional SNPs in GEMIN4. These associations remained significant after adjustment for multiple testing.

**Conclusions:** We observed independent associations between BP and BC and found that this association may be modified by SNPs related to miRNA processing. Interestingly, effects were particularly strong with SNPs in GEMIN4, which essential to pre-mRNA splicing and assembly of ribonucleoproteins.

#### ISEE-0326

##### Communicating with Americans about Food Recalls: Recommended Strategies

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**Background:** To investigate how to best communicate about recalls of contaminated foods, a national telephone survey examined how Americans learn about food recalls, their preferred channels for information, and what messages they say are most likely to motivate them to check their homes for recalled foods.

**Methods:** A nationally representative sample of 1,101 American adults was interviewed between 8/4/08 and 9/24/08.

**Results:** Consistent with prior research, the majority (66%) of Americans who had heard about a recent food warning had heard about it on television. Only a small percentage of the Americans with Internet access have ever visited a government website about food recalls (21%), and even fewer report that they currently receive email alerts about food recalls (8%). The majority of Americans reported that they would want personalized information if food that they had purchased was recalled. Seventy three percent said that they would want this on their receipts at the grocery store and 65% in an email. One-in-five respondents (20%) said they would be willing to pay for such a service, with a median price of \$20 per year suggested by respondents. When asked to rate the types of information that are most important for the media to include in stories about food recalls, the illnesses and symptoms caused by eating the recalled product and whether anyone has become ill from eating the product were rated as the most important. Similarly, respondents said that knowing how many people had been made ill by a food recall would be most likely to motivate them to check their homes for a recalled food product.

**Conclusion:** Before paying attention to more detailed information, Americans want to determine whether a food recall applies to them and the severity of the problem. Personalizing information based on previous purchase is a promising approach.

#### ISEE-0328

##### Short-Term Effects of Air Pollution on Exhaled Nitric Oxide in Diabetic Patients

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**Background and Objective:** Ambient particulate air pollution has been associated with biomarkers of pulmonary and systemic inflammation. In this study we examine if ambient particle levels are associated with exhaled nitric oxide (NO), a marker for pulmonary inflammation, in a sample of subjects with type 2 diabetes from the Boston Metropolitan area.

**Methods:** This analysis is based on data from the first 37 participants who completed an ongoing repeated measures study that started in September 2006. Breath samples were collected during bi-weekly clinic visits. Hourly fine particulate matter (PM<sub>2.5</sub>), sulfate (SO<sub>4</sub><sup>2-</sup>), Black Carbon (BC), and gases were measured at a central ambient monitoring station. Linear mixed models were used to examine the effects of an interquartile increase in air pollution on exhaled NO. The models contained random subject effects, fixed effects of gender, season, NO room air, and ambient pollution, and a first-order auto-regressive term.

**Results:** The number of visits per subject ranged from two to five, with a total of 170 exhaled NO measurements. Ambient particle levels on the days preceding the clinic visit were consistently associated with levels of exhaled NO. A 4.1 µg/m<sup>3</sup> increase in mean 48-hour PM<sub>2.5</sub> level was associated with an increase of 0.87 ppb (0.19 to 1.56), and a 1.8 µg/m<sup>3</sup> increase in mean 48-hour sulfate level was associated with an increase of 0.98 ppb (0.11 to 1.84) in exhaled NO. Associations with black carbon were similar. We found no associations between exhaled NO and ambient gases.

**Conclusion:** These results suggest that in this population of diabetic subjects increased ambient levels of particulate air pollution are associated with changes in airway inflammatory status as measured by exhaled NO.

This work is supported by funding from the NIEHS (ES-09825, RD-83241601).

#### ISEE-0329

##### Traffic-Related Pollutants and Inflammatory Markers in an Elderly Cohort: Veterans Administration Normative Aging Study

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**Background and Objective:** Previous studies suggest that traffic-related air pollution contributes significantly to cardiovascular effects, especially systemic inflammation indicated by blood markers such as fibrinogen, implicated in promoting atherothrombosis. This study investigates whether traffic-related air pollution is related to higher fibrinogen levels in the elderly, a suspected risk group.

**Methods:** We performed a longitudinal analysis to analyze associations between different traffic-related pollutants exposure and fibrinogen levels in 1348 elderly men participating to the Veterans Administration Normative Aging Study from 2000 to 2008. We used mixed effects models, adjusting for age, seasonality, body mass index, day of the week, temperature, smoking status, statin use, and diabetes. We investigate

relatively long term effects of exposure, from one week up to four weeks moving averages.

**Results:** We found associations of most traffic-related pollutants with fibrinogen. A one standard deviation increase in exposure was associated with a 2.8% increase in fibrinogen (95% CI: [0.249–5.349]) for black carbon (1 week moving average), a 6.0% increase (95% CI: [1.07–11.2]) for particle number level (3 weeks moving average), a 3.8% increase (95% CI: [1.12–6.5]) for NO<sub>2</sub> (1 week moving average). Only CO was not significant among traffic pollutants. In contrast, SO<sub>4</sub><sup>2-</sup>, a secondary aerosol, was not a significant predictor of fibrinogen.

**Conclusion:** We observed positive effects of traffic-related pollutants (BC, PN, NO<sub>2</sub>) on fibrinogen, but not of secondary sulfate. The strongest effect was with particle number, a marker of fresh traffic particles and of ultrafine particles.

#### ISEE-0334

##### Environmental Mycobacteriosis and Drinking Water: An Emerging Problem for Developed Countries

Elizabeth Hilborn, and Andrew Ghio, *US Environmental Protection Agency, Research Triangle Park, North Carolina, United States.*

**Background and Objective:** Rates of pulmonary environmental mycobacteriosis (EM) appear to be increasing among developed countries during the past 20 years. EM is caused by multiple species of pathogenic mycobacteria that have been recovered from soil, water, water aerosols, biofilms and drinking water. Humans acquire infection primarily from environmental sources. Drinking water is one documented source of exposure implicated in human EM colonization and infection, but overall, the epidemiology of EM is poorly characterized. Our goal is to summarize and describe the evidence to date of the risk of pulmonary EM from exposure to drinking water sources.

**Methods:** We performed a systematic review of the peer-reviewed literature. We included only those reports describing an epidemiologic and/or molecular association between human pulmonary EM and drinking water.

**Results:** We identified 43 reports of pulmonary EM with documented drinking water sources of exposure in North America, Europe and Japan. Seventeen (40%) of these were associated with nosocomial exposures; 10 isolates from drinking water, 7 isolates from processed or modified drinking water. Fifteen (35%) reports described hot tub exposures. Nine (21%) reports described isolation from home drinking water. Multiple species of mycobacteria were isolated.

**Conclusion:** Drinking water is a well-established source of EM. However, this review identified that many reports describe potential contamination events associated with drinking water quality that was modified after the original point of use; these include water processing, ice making machines, or drinking water further used for recreation or bathing. The extent of detection and reporting bias associated with these published reports is unknown. Population-based studies of individuals are needed to further characterize the risk of EM colonization and infection associated with drinking water exposures.

This is an abstract of a proposed presentation and does not necessarily reflect EPA policy.

#### ISEE-0337

##### Heat Waves, Impervious Surfaces, and Hospital Admissions among the Elderly in U.S. Cities

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**Background and Objective:** With global warming, heat waves will become more severe, and the elderly are especially vulnerable to heat. Understanding both personal and neighborhood-level vulnerability will

inform heat mitigation and adaptation strategies. We examine whether urban heat island potential, modeled as percent impervious surface within a zip code, modifies the association between heat waves and hospital admissions among the elderly in U.S. cities.

**Methods:** Medicare hospital admissions records (1992–2003) were obtained for New York City, Chicago, Los Angeles, Houston and Phoenix. A heat wave was defined as mean temperatures above the 95<sup>th</sup> percentile of summer temperatures for at least two days. A time-stratified case-crossover design was employed with an ozone term, interaction terms of heat wave with categories of income (2000 Census) and impervious surface (2001 National Land Cover Dataset) and a zip-code frailty term.

**Results:** In nested models for the Chicago zip codes using likelihood-ratio tests, models containing either income interaction terms ( $P = 0.00015$ ), impervious surface interaction terms ( $P = 0.000072$ ), or both ( $P = 0.0001$ ), improved fit compared to a model containing only heat wave and ozone terms. In Chicago, among individuals in the lowest income quartile and highest impervious surface quartile, the risk of hospital admission during a heat wave vs. not during a heat wave was 1.20 (95% CI, 1.11, 1.30). These interactions were not significant in any of the other four cities ( $P \gg 0.05$ ) or for cardiovascular or respiratory hospital admissions.

**Conclusion:** Neighborhood percent impervious surface may play an important role in heat vulnerability, but more refined exposure modeling may be needed to detect this association. Future research will explore modeling heat, impervious surfaces and income variables continuously; aggregate cities based on climatic region; and use other measures of the urban heat island potential, including vegetation and remotely sensed surface radiation.

#### ISEE-0338

##### Effects of Short-Term Exposure to Ozone on Alveolar Nitric Oxide

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**Background and Objective:** Exposure to ambient air pollutants has been shown to induce airway inflammation. Measurement of fraction of nitric oxide in exhaled air (FENO) enables the calculation of the production of alveolar NO which has been suggested as a marker of distal airway inflammation. The aim of the study was to estimate whether short-term exposure to O<sub>3</sub>, NO<sub>2</sub> and PM<sub>10</sub> was associated with an increase of alveolar NO, a possible marker of inflammation in distal airways.

**Methods:** In this cross-sectional study we investigated 1606 adults in the age 25 to 75 years living in Göteborg, Sweden. Examination included FENO at flow-rates of 50, 100 and 270 mL/s and blood samples and a respiratory questionnaire. Alveolar NO was estimated by using Tsoukias two-compartment model. Atopy was defined as a positive Phadiatop test. PM<sub>10</sub> and O<sub>3</sub> concentrations were measured at an urban background monitoring site and for cumulative mean exposure for 3, 24 and 120 hours were calculated. Ordinary least square regression was used to model the relation between FENO and alveolar NO and each of the studied pollutants, adjusted for potential confounding factors.

**Results:** We found that an increase of one IQR in the 24 hour and 120 hour cumulative average of O<sub>3</sub> (corresponding to 44.3 µg/m<sup>3</sup> and 25.4 µg/m<sup>3</sup>) was associated with an increase in alveolar NO of 1.6% (95% CI 0.5–2.6) and 2.0% (95% CI 0.9–3.0). The effect was most pronounced in non-smoking non-atopic subjects. Alveolar NO remained significantly elevated for five days after exposure. Exposure to NO<sub>2</sub> and PM<sub>10</sub> did not affect alveolar NO or FENO.



**Conclusions:** Exposure to ozone appears to give rise to a small increase in alveolar nitric oxide, a possible marker for airway inflammation in the distal airways.

#### ISEE-0343

##### Time Trends in Indoor Radon Concentrations in Sweden

Martin Tondel, Eva M Andersson, and Lars Barregard, *Section of Occupational and Environmental Medicine, Department of Public Health and Community Medicine, University of Gothenburg, Gothenburg, Sweden.*

**Background and Objective:** In many countries indoor radon exposure is a major health concern, due to the risk of lung cancer. In Sweden radon gas in dwellings emanate from the bedrock, soil, or building materials, e.g. lightweight alum shale concrete (banned in 1975). Swedish authorities encourage radon measurements and subsidise mitigation efforts. Regular measurements in randomly selected dwellings are necessary to estimate the possible reduction of radon levels and beneficial health impact.

**Methods:** Radon measurements were performed in random samples of the population in three municipalities and compared with similar data more than 10 years earlier. The same standardised method was used, i.e. solid alpha track detectors during the three winter months, together with questionnaires on residence characteristics. The participation rate was 70%.

**Results:**

**TABLE 1. Indoor Radon Measurements (Bq/m<sup>3</sup>)**

Municipality	n	AM	GM	Min-Max	95% CI (GM)	P (change in GM)
Lysekil 2001	93	166	84	30–2,050	67–105	0.43
Lysekil 1990	35	148	100	0–583	—	
Skovde 2004	106	146	75	4–2,851	60–94	<0.001
Skovde 1990	135	313	175	3–1,005	50–217	
Uddevalla 2005	67	46	30	3–129	24–38	<0.001
Uddevalla 1990	171	82	53	1–506	46–61	

Single-family houses had significantly higher indoor radon levels than block of flats.

**Conclusion:** Statistically significant reductions in radon concentrations could be seen in a 15 years period in two of the municipalities. The decreased levels could be explained by a relative increase in the number of new dwellings built on ground with low emissions of radon, and without alum shale concrete, and better ventilation in old houses. About 13% of the annual lung cancer cases should theoretically be avoided due to reduced exposure in Skovde and Uddevalla (population of 50,000 each) i.e. 4 cases per year.

#### ISEE-0344

##### Specific Chemical Components of Particulate Matter and Daily Mortality in a Japanese Urban City

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**Background and Objectives:** It is considered that the health effects of ambient particles vary by their chemical components and that this variation might contribute to regional heterogeneity of their effects. We

explored the short-term effects of each component of suspended particulate matter (SPM), particles of <10 µm in aerodynamic diameter with a 100% cut-off level, on mortality in a Japanese urban city during 2002–2004.

**Methods:** The concentrations of SPM components were measured in Sakai City, Osaka. We used mortality data obtained from the Ministry of Health, Labour, and Welfare of Japan. Meteorologic data were obtained from Japan Meteorological Agency. We used the generalized linear model to evaluate the association between daily mean concentration of each SPM component and daily mortality. Ambient temperature and relative humidity were adjusted for with natural splines. We repeated the same analyses after stratifying the data by season.

**Results:** From 2002 to 2004, 12,459 deaths were observed (daily mean mortality 11.4/day). The concentrations of nitrate, elemental carbon, and organic carbon were lower in summer. The concentrations in sulfate and ammonium did not show clear seasonal variation but tended to be higher in early summer. We found that an interquartile range increase in 3-day averaged concentration of nitrate (1.37 µg/m<sup>3</sup>) and sulfate (3.31 µg/m<sup>3</sup>) was associated with 3.0% and 4.4% increase in all-cause mortality, respectively. Elemental carbon and organic carbon were positively but insignificantly associated with all-cause mortality. In disease-specific analyses, we observed a significant association between cardiovascular mortality and sulfate (6.4%). The analyses stratified by season showed the different seasonal pattern in the effects of certain SPM components on mortality.

**Conclusions:** This study showed that certain components of SPM had effects on daily mortality. It may be necessary to take into account seasonal variation.

#### ISEE-0345

##### Integral Health Evaluation of Children Living in an Environment with Different Level of Air Pollution and Socioeconomic Conditions

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**Background and Objective:** In the recent years, during the transition to market economy, the ecological conditions in Bulgaria were alleviated due to the reduction and shutting down of a number of productions polluting the environment. Several trials showed marked improvement of spirometric indices in children living at reduced levels of air pollution. The socioeconomic situation at that time was characterized with higher rate of unemployment, deficient nutrition and a lot of stress. Having in mind that cardiopulmonary exercise test give integral evaluation of the functional reserve we aimed at measuring the functional capacity of two groups of children living in an environment with different level of air pollution and socioeconomic conditions.

**Methods:** The first group, consisting of 66 clinically healthy children, aged 13.30 ± 0.46 years (X ± SD), was living at higher mean year concentrations of TSPM, Pb, SO<sub>2</sub>, NO<sub>2</sub>, NH<sub>3</sub> than the second group (61 clinically healthy children aged 13.41 ± 0.50) belonging to families in which the parents had lower level of education. The cardiopulmonary test was carried out on treadmill TrackMaster™, (Jass Fitness Systems, USA) by our modification of the Balke protocol.

**Results:** The children in the second group had higher spirometric indices Tiffneau–89.87 ± 5.52% vs. 87.70 ± 5.80% (X ± SD); MEF50 pred–105.68 ± 20.61% vs. 97.55 ± 22.11% but lower functional capacity VO<sub>2</sub>max = 2049.17 ± 369.94 vs. 1590.25 ± 345.52 and also VO<sub>2</sub>max/kg = 24.29 ± 4.05 vs. 31.18 ± 3.18 ml.

**Conclusion:** Children belonging to families with lower socioeconomic status had reduced functional capacity.

#### ISEE-0347

##### **Informativeness of Some Hematological Indices for the Evaluation of Influence of Low-Degree Atmospheric Pollution on Health**

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**Background and Objective:** Considering that blood tissue is one of the most sensitive to changes in levels of atmospheric pollution, we set ourselves the aim of making comparative analysis of some hematological indices in clinically healthy children exposed to the influence of low-degree but of different levels atmospheric pollution.

**Methods:** In 1998 we investigated the first group—100 children at the age of  $12.68 \pm 0.56$  years ( $X \pm SD$ ) from Dimitrograd living at average annual levels of TSPM between  $0.312\text{--}0.089\text{ mg/m}^3$  and  $\text{SO}_2$  between  $166.90\text{--}3.30\text{ }\mu\text{g/m}^3$ ; The second group (94 children  $12.8 \pm 0.7$  y from the same schools), living at levels of pollution respectively  $0.206\text{--}0.066\text{ mg/m}^3$  (TSPM) and  $146.16\text{--}1.44$  ( $\text{SO}_2$ ), were investigated in 2003. For both groups we studied also the inactive forms of hemoglobin (methemoglobin, carboxyhemoglobin, sulphhemoglobin). All children were studied in the first decade of May in specialized laboratories of Medical University—Plovdiv.

**Results:** There were reliably lower levels of the erythrocytes ( $X \pm SD$ :  $4.52 \pm 0.37$  vs.  $4.77 \pm 0.41 \times 10^{12}/\text{l}$ ,  $P = 0.000$ ), hemoglobin ( $127.87 \pm 7.87$  vs.  $132.02 \pm 8.43\text{ g/l}$ ,  $P = 0.000$ ), thrombocytes ( $268.59 \pm 58.60$  vs.  $312.37 \pm 73.56 \times 10^9/\text{l}$ ) and higher number of leucocytes in children living at higher levels of atmospheric pollution ( $6.97 \pm 1.61$  vs.  $6.50 \pm 1.59 \times 10^9/\text{l}$ ,  $P = 0.042$ ). No statistically significant differences were found in the levels of inactive forms of hemoglobin between the two groups of children.

**Conclusion:** Prolonged exposure to low-degree atmospheric pollution suppresses hemopoiesis. Standard hematological tests are good indicator for health evaluation of the influence of low-degree atmospheric pollution but the inactive forms of hemoglobin as indices are not informative enough.

#### 5ISEE-0348

##### **Methodology for Integral Assessment of Physical Population Health**

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**Background and Objective:** The prevention of negative changes in human organisms is impossible without adequate estimations of the background environment and the general population health.

**Methods:** A unified procedure enabled the definition of the integral criteria describing the risks for biota and humans from harmful ecological factors, and the assessment of the physical health of the population was based on central health statistics. Morbidity rates for various illnesses characterising the physical health of the adult and child population in 24 regions and the Crimea were analysed, and maps of integral physical population health for 2002 and 2006 were prepared.

**Results:** The analyses showed that in 2002 and 2006 there were no regions with a “dangerous” state of health. A “critical” state of health was found in only one region (Vinnitsa) in 2002, whereas in 2006 four regions of “high” and “critical” levels of health damage were detected (Vinnitsa, Cherkassk, Dnepropetrovsk and Kharkov). In 2002 it was observed that a “conflicting” condition of population health was the most common occurrence (16 regions), and in 2006 it was that of “threatening” condition (12 regions). As a whole, the integral physical health of the child and

adult population in 2002 was estimated as “conflicting” (ICID = 0.436), whereas in 2006 it was “threatening” (ICID = 0.520).

**Conclusions:** The calculated data enabled:

- (i) the ranking of each region according to the status of population health;
- (ii) the identification of regions most hazardous to human health and which require the introduction of rehabilitation measures;
- (iii) the estimation of environmental conditions as per these parameters; and
- (iv) the identification of regions with favourable conditions for the rehabilitation of population health.

#### ISEE-0349

##### **Content of Toxic Elements in the Blood of Children from Ecologically Hazardous Regions in Bulgaria**

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**Background and Objective:** The aim of the present study is to analyze the content of toxic elements in the blood of children from a region with developed cement, chemical and energy production industry (coals with high ash and sulphur content). The pollution of the environment with toxic elements is a result of the fact that metal slag is used in production to improve the qualities of cement. Therefore, in samples of electrofilter dust, the content of Pb-1515 mg/kg, Cd-3.4 mg/kg, Cu-90 mg/kg, Zn-15240 mg/kg etc. has been found. Moreover, the dust released from burning coals in a thermal electric plant contains Pb, Cd, Cu, Zn, Co, Mn etc.

**Methods:** The content of Pb, Cd, Co and Zn in blood/serum was analyzed in 102 clinically healthy children at age  $12.68 \pm 0.56$  ( $X \pm SD$ ) y from Dimitrograd. As a control group 43 children ( $12.35 \pm 0.22$  y) were investigated from the village of Nova Mahala, situated in the mountains, faraway from major sources of air pollution.

**Results:** The lead in the blood of children from the town of Dimitrograd ranges from 28 to 262  $\mu\text{g/l}$ ,  $X = 92 \pm 4.9$  ( $X \pm SE$ )  $\mu\text{g/l}$ , 8.6% above 150  $\mu\text{g/l}$ , and in the blood of children from the control group 51 to 227  $\mu\text{g/l}$ ,  $X = 128 \pm 7.9\text{ }\mu\text{g/l}$ ,  $P > 0.05$ ; the levels of cadmium are between 0.1 and 3.2  $\mu\text{g/l}$ ,  $X = 0.6 \pm 0.05$  and between 0.4 and 2.6  $\mu\text{g/l}$ ,  $X = 1.38 \pm 0.08$  for those in the control group,  $P \leq 0.05$ .

**Conclusion:** Disturbingly high levels of lead and cadmium are present in the blood of children both from the polluted area and the control region. It is necessary to resolve the reason for the high level of lead content of the blood in the control group of children.

#### ISEE-0350

##### **Work Stress among Staff at a Medical Center in Southern Taiwan**

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**Objective:** The work stress among the staff at medical centers in Taiwan is high because of the large service volume, teaching loads, and research activities. Previous studies on this issue have been focused on doctors and nurses and left out other staff members. Therefore, we conducted a study to evaluate the overall work stress at a medical center.

**Materials and Methods:** We recruited workers working in a medical center in southern Taiwan between July 1 and August 31, 2007. Information on demographic characteristics was collected through a self-administrated questionnaire. Participants also reported habits of smoking, drinking, and regular exercise and completed a job content questionnaire.

**Results:** 1770 workers participated in this study. We observed positive associations between work stress and age, gender, education, work category, being in charge of patient care, shift work, and exercise (all with  $P < 0.01$ ). After adjusting for other factors, we found a work history of 1–5 years (adjusted odds ratio [AOR] = 1.80, 95% confidence interval [CI]: 1.14–2.84), a work history of 6–10 years (AOR = 2.13, 95% CI: 1.23–3.67), and a work history of >10 years (AOR = 2.69, 95% CI: 1.50–4.84) were independent risk factors of work stress. While age of 40–44 years (AOR = 0.46, 95% CI: 0.23–0.90), age >45 years (AOR = 0.47, 95% CI: 0.23–0.97), non-shift work (AOR = 0.65, 95% CI: 0.47–0.90), and working as a medical technologist (AOR = 0.61, 95% CI: 0.39–0.96) were protective factors.

**Conclusion:** At the medical center, work stress is associated with seniority, age, shift work, and job category. Therefore, different strategies should be applied to interventions for work stress control.

**Key words:** shift work, work stress, job content questionnaire.

#### ISEE-0351

##### A Study on the Noise Exposure and Hearing Loss of the Diesel-Electric Locomotive Maintenance Workers in Taiwan Railways Administration

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**Background and Objective:** According to previous results of our study, the diesel-electric locomotive showed the highest sound level compared with other locomotives of Taiwan Railways Administration (TRA). This investigation chose the Taipei Railway Workshop of TRA investigate the relationships between the noise exposure and hearing loss in the workers.

**Methods:** The study subjects were divided into an exposed group including the workers involved in horsepower test, engine inspection, electrical inspection and repair jobs, and a control group comprised of office administration staff. The sound pressure levels were measured in the workplace near workers by Sound Level Meter (Larson Davis Inc., 824). Moreover, the personal noise dose and hearing were measured by dosimeter (Larson Davis Inc., SPARK 706) and air conduction audiometer (Danplex, AS 42) for the exposed group and control group, respectively.

**Results:** Among the job categories, the horsepower test had the highest sound pressure level average (94.9 dB-A), followed by the engine inspection (81.9 dB-A), the electrical inspection (79.6 dB-A), and finally the repair job (72.6 dB-A). The average personal noise doses of an 8-hour work time of the four job categories were measured and are, in order, the horsepower test (268.4%), the engine inspection (152.6%), the electrical inspection (129.2%), and the repair job (28.7%). By the workers' audiometric tests, except for 4k, 6k Hz generally appearing in occupational hearing loss, both the exposed group and the control group had hearing loss in low audio frequency.

**Conclusion:** Based on Taiwan's labor safety and health regulations, the noise doses of the workers of horsepower test, engine inspection, and electrical inspection had already surpassed the standard working level. Although the TRA has implemented exposure time management to conform to the regulatory requirement, it should still pay attention to the hearing protection.

#### ISEE-0354

##### Environmental Pollution and Blood Lead and Cadmium Levels among Children Living around a Lead-Zinc Smelter Plant and Tailings-Pond in the Area of Kardzhali, Bulgaria

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**Background and Objectives:** The area of Kardzhali, Bulgaria, is contaminated with lead and cadmium aerosols from lead-zinc smelter

plant and tailings-pond. Our objectives were to investigate children's lead and cadmium blood levels (LCBL) and some haematological markers in exposed and control villages.

**Methods:** The study was conducted in 2008 in three villages—Ostrovitsa and Vishegrad (exposed villages) and Enchets (control village). In 60 children, aged between 7–11 years old, we determined LCBL and some haematological markers (red blood cells (RBC), haemoglobin, hematocrit). We compared the air contamination in the exposed and control villages, lead and cadmium blood levels and haematological markers in children.

**Results:** The lead and cadmium content in air was over the limited permissible concentrations (LPC). The concentration of lead was 0.8 mg/m<sup>3</sup> in Ostrovitsa, 0.9 mg/m<sup>3</sup> in Vishegrad and 0.13 mg/m<sup>3</sup> in Enchets. For cadmium the results were 0.045 mg/m<sup>3</sup>, 0.051 mg/m<sup>3</sup> and 0.011 mg/m<sup>3</sup> respectively. Among the children from Ostrovitsa and Vishegrad, the blood lead levels were statistically significantly higher (97 µg/L in Ostrovitsa, 128 µg/L in Vishegrad and 68 µg/L in Enchets;  $P < 0.001$ ). The cadmium content in children's blood was respectively (0.37 µg/L, 0.43 µg/L and 0.22 µg/L;  $P = 0.015$ ). Regarding levels of RBC, haemoglobin, and hematocrit, the data demonstrated that RBC levels were statistically significantly higher in children from Vishegrad ( $4.68 \times 10^{12}/L$ ), comparing with Enchets ( $4.46 \times 10^{12}/L$ ), whereas for hematocrit and haemoglobin the difference was not statistically significant.

**Discussion:** The air contaminated with lead and cadmium leads to a secondary pollution of the soil, underground waters contamination and the vegetables and animal products of local origin. The conducted bio-monitoring has shown close relations between LCBL and the contamination in the area. The study proved the necessity of monitoring process of all environmental factors and health risk assessment of the population with the object undertaking certain measures for improving the living environment.

#### ISEE-0355

##### Occupational Exposures and Pregnancy Outcomes among Nurses: A Systematic Review and Meta-analysis

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**Objective:** The overall aim of this meta-analysis was to synthesize the evidence of the relation between exposure to various occupational hazards (anaesthetic gases, strenuous working conditions and inconvenient work schedule, chemotherapy agents, and ethylene oxide) and the risk of adverse pregnancy outcomes among nurses, and further explore the reasons for heterogeneity among studies included in the analysis.

**Methods:** The authors performed a computer search of EMBASE and PUBMED from 1966 to January 2009 and also searched reference lists of reviews and eligible articles for all epidemiologic studies that have explored the relation between occupational exposures and adverse pregnancy outcomes among nurses.

**Results:** Ten studies explored the relation between anaesthetic gases and spontaneous abortion. Five studies examined the relation between chemotherapy agents and spontaneous abortion, 7 studies explored the relation between anaesthetic gases and general congenital malformation. And 3 and 4 studies examined the relation between preterm delivery and anaesthetic gases and strenuous working conditions respectively. Increased risk of spontaneous abortion (Odds ratio (OR) = 1.73, 95% confidence interval (CI): 1.60, 1.88) and congenital malformation (OR = 1.45, 95% CI: 1.06, 1.49) was associated with anaesthetic gases. But the relation between chemotherapy agents and spontaneous abortion was weak (OR = 1.28, 95% CI: 0.84, 1.94). Inconsistent and suggestive evidence of excesses was observed for the relation between preterm delivery and anaesthetic gases and strenuous working conditions.

**Conclusions:** There was evidence of association among occupational exposures and adverse pregnancy outcomes. Nevertheless, the findings



were complicated by the limited number of studies and inexplicable heterogeneity.

#### ISEE-0357

##### Environmental Exposures and Adult Brain Cancers

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**Background:** Adult gliomas continue to be aggressive with few known risk factors. This work focuses on assessing the risk of human exposures to animal neurocarcinogens in a case-control study.

**Methods:** An environmental questionnaire was constructed to assess human exposures to animal neurocarcinogens. Information including primary glioma cases ( $n = 111$ ) and friend controls ( $n = 197$ ) were obtained from two centers: Evanston Northwestern Healthcare and Duke University Medical Center. Data were obtained using a web-based survey allowing participants to work at their leisure. Chemical-specific exposure scores were constructed from a composite of questions. Preliminary analyses were conducted using conditional logistic regression to estimate odds ratios (ORs) and 95% confidence intervals for ordinal values of exposure scores, controlling for age and gender.

**Results:** Three compounds with ORs greater than 2.0 were identified: bis(chloromethyl) ether ( $P = 0.15$ ), vinyl chloride ( $P = 0.09$ ) and propylene imine ( $P = 0.02$ ). Vinyl chloride and propylene imine exposure score ORs became larger in subjects without a history of asthma/allergies. Comparing the highest to the lowest tertile of the vinyl chloride score, an OR of 4.5 (95%CI: 0.9–23) was estimated ( $P = 0.07$ ). As the propylene imine score was based on a limited set of questions, this score may be of limited validity. The odds ratios for several chemical scores (acrylamide, acrylonitrile, ethylene oxide, NOCs, glycidol, and 3,3-dimethylbenzidine hydrochloride) were elevated but unstable in the presence of asthma/allergy history, suggesting that a complex relationship may be present between environmental exposures and conditions affecting immune function.

**Conclusions:** Chemical exposure indices based on questionnaires of environmental exposures have limitations; however, they are useful in setting priorities for future research focusing on biomarkers of exposure and other molecular epidemiology tools.

#### ISEE-0358

##### Occupational Risks of Esophageal Cancer in Taiwanese Men

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**Background:** In Taiwan, esophageal cancer was the sixth leading cause of cancer death among men in 2006. Previous studies from our group have found several lifestyle risk factors for esophageal cancer; however, we have not studied extensively the possible associations between occupation and risk for this disease.

**Purpose:** The aim of this study was to explore the relationships between occupation and esophageal squamous cell carcinoma in Taiwan.

**Methods:** In a hospital-based case-control study, we administered interview questionnaires to 326 patients with esophageal squamous cell carcinoma and 386 matched controls. All subjects completed a questionnaire regarding occupation, substance use (smoking, alcohol drinking, and areca chewing) and demographic information. Relative risks for this disease were estimated by odds ratios (OR) with 95% confidence intervals (CI), based on conditional logistic regression, adjusting for potential confounders.

**Results:** We found concrete and construction workers and farm and garden workers to be at significant risk for esophageal squamous cell carcinoma (OR 5.143, 95% CI 2.34–11.33,  $P < 0.0001$  and OR 2.86, 95% CI 1.67 to 4.90,  $P < 0.0001$ , respectively). After adjusting for substance use, this association remained significant for farm and garden workers (AOR 2.22, 95% CI 1.08–4.54), but not for concrete and construction workers (AOR 2.14, 95% CI 0.78–5.80). The results of our linear trend analysis showed a significant relationship between esophageal cancer and how long one worked in farming and gardening as well as concrete and construction work (OR = 1.03, 95%CI 1.02–1.05,  $P = 0.0003$ ; OR = 1.09, 95%CI 1.04–1.14,  $P = 0.0004$ , respectively).

**Conclusions:** We conclude that farmers and gardeners may be at greater risk of esophageal squamous cell carcinoma than those working in other occupations in Taiwan. Over time, however, the risk of developing this disease increased for this occupation as well as for those working in concrete and construction.

#### ISEE-0360

##### Maternal and Umbilical Cord Blood Levels of Arsenic, Cadmium, Manganese, and Lead in Rural Bangladesh

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**Background and Objective:** In Bangladesh, the use of groundwater has led to widespread exposure to arsenic (As) and manganese (Mn). Airborne lead (Pb) levels are also high in Bangladesh with a 1999 survey reporting an annual average Pb concentration in PM<sub>2.5</sub> of 106 ng/m<sup>3</sup>. Cadmium (Cd) is also an environmental contaminant present in food such as rice. Exposure to metals during pregnancy may be associated with adverse perinatal health effects. The aim of this pilot study was to characterize metal levels in pregnant women and newborns residing in rural Bangladesh.

**Methods:** Metals were measured in maternal venous blood ( $n = 12$ ) and umbilical cord blood ( $n = 60$ ) using inductively coupled plasma mass spectrometry.

**Results:** The average concentration of As, Mn, Cd, and Pb in maternal samples collected from pregnant women in the first trimester was  $0.04 \pm 0.01$   $\mu\text{g As/dL}$ ,  $1.86 \pm 0.58$   $\mu\text{g Mn/dL}$ ,  $0.07 \pm 0.02$   $\mu\text{g Cd/dL}$ , and  $13.0 \pm 4.7$   $\mu\text{g Pb/dL}$ . The average metal concentration in umbilical cord blood was  $0.34 \pm 0.38$   $\mu\text{g As/dL}$ ,  $6.88 \pm 8.74$   $\mu\text{g Mn/dL}$ ,  $0.04 \pm 0.10$   $\mu\text{g Cd/dL}$ , and  $8.64 \pm 4.75$   $\mu\text{g Pb/dL}$ . Of these newborns, 35% had Pb levels  $\geq 10$   $\mu\text{g/dL}$ . Regional differences in Pb blood levels were observed in umbilical cord blood.

**Conclusions:** The results for cord Mn and Cd levels are much higher than those reported in other populations, suggesting excess exposure. While no cut-off point is established to define As, Mn or Cd poisoning, blood Pb levels  $\geq 10 \mu\text{g/dL}$  have been associated with adverse neurodevelopment including intellectual performance and neurobehavioral functioning in children. These results indicate that exposure to mixtures of environmental metals among pregnant women is widespread in rural Bangladesh. Furthermore, little is known about the effects of mixed metal exposure. As such, this population may benefit from interventions that address mixed exposures and research that addresses metal mixture exposure.

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**ISEE-0363****Association Between Ambient Air Pollutants and Fatal Coronary Heart Disease Among Renal Transplant Recipients**

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**Background and Objective:** A majority of published studies have focused on the impact of air pollution on the health of the general public and it remains to be determined which subpopulations may have heightened susceptibility. With highly prevalent traditional as well as nontraditional risk factors, renal transplant recipients may potentially be a sensitive subgroup. The purpose of this study was to evaluate the possible association between long-term exposure to air pollution and the risk of CHD mortality among renal transplant recipients.

**Methods:** This retrospective cohort study included 36,023 subjects identified through the US Renal Data System (USRDS), which included adult, renal transplant recipients, transplanted between 1997–2002, and living in the continental U.S.A. Monthly concentrations of  $\text{O}_3$ ,  $\text{NO}_2$ ,  $\text{SO}_2$ ,  $\text{PM}_{10}$  and  $\text{PM}_{2.5}$  were calculated from ambient monitoring data and interpolated to ZIP code centroids according to the residence of the renal transplant population. Time dependent Cox Proportional Hazard models were used to estimate the effect of air pollutants on risk of CHD mortality, while adjusting for potential confounders.

**Results:** The relative risk (RR) for fatal CHD with each 10 ppb increase in  $\text{O}_3$  was 1.38 (95% CI, 1.24–1.55) in the single pollutant model and 1.40 (95% CI, 1.25–1.57) in the two-pollutant model adjusted for  $\text{PM}_{10}$ . The relationship between  $\text{O}_3$  and risk of fatal CHD was strengthened after adjustment for each of the other pollutants. The pollutant with the strongest association with fatal CHD was  $\text{PM}_{2.5}$  adjusted for  $\text{O}_3$  (RR = 2.18, 95%CI, 1.46–3.27). A small and significant association was found for  $\text{SO}_2$ , but no association was found for either  $\text{NO}_2$  or  $\text{PM}_{10}$ .

**Conclusion:** The findings from our study could have potential implications for policies and regulations of air pollution.

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**ISEE-0364****Relation of Dampness to Sick Building Syndrome in Japanese Public Apartment Houses**

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**Background and Objective:** The effect of dampness on sick building syndrome (SBS) symptoms has not been fully investigated in Japan. The purpose of this study is to elucidate the possible effects of dampness on SBS symptoms among residents in Japanese public apartment houses.

**Methods:** A questionnaire was used to investigate the degree of dampness in public apartment houses in Asahikawa, Japan and its effect on SBS symptoms, involving 480 residents in 64 buildings. Dampness indicators were as follow: condensation on the windowpanes, condensation on the walls and/or closets, visible mold in the bathrooms, visible mold on the

walls, window frames, and/or closet, moldy odor, slow drying of the wet towels in bathrooms, water leakage, and bad drainage in bathrooms.

**Results:** The Status eight indicators for building dampness were as follow: 81.8% had condensation on the windowpanes; 40.6% on the walls and/or closet; 79.2% had visible mold in the bathrooms; 59.5% had visible mold on the window frames, walls, and/or closet; 61.2% had moldy odor; 63.4% had slow drying of wet towels in the bathrooms; 20.8% had water leakage during past five years; and 60.7% had bad drainage in the bathroom. All dampness indicators except for visible mold in bathrooms had significantly higher odds ratios (ORs) for all or any SBS symptoms after adjusted for age, gender, history of allergy disease, type of tenure (municipal or prefectural), population density. The dampness index, the number of positive dampness indicators was significantly related to all SBS symptoms after adjustment.

**Conclusion:** There are serious problems relating to dampness in Japanese public housing, which affects the health of residents. There is a need to educate the residents about the relationship between dampness and SBS, and building problems should be rectified.

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**ISEE-0365****Enhancing Heat Wave Health Warning Systems to Address Within-City Vulnerabilities: A Pilot Study in Wayne County, Michigan**

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**Background and Objective:** Heat waves are occurring more frequently, and have been associated with adverse health effects. Current Heat Wave Warning Systems (HWWSs) usually rely on the limited weather stations in local airports or other standardized stations, and are thus not able to identify the communities having higher heat exposures. This study explores options for better characterizing spatial variability of temperature within an urban area to enhance the usefulness of HWWS for protecting vulnerable populations.

**Methods:** A set of HOBOs (inexpensive temperature/relative humidity loggers) were deployed to seventeen sites in the yards of resident volunteers throughout Wayne County, Michigan. Measurements of temperature and relative humidity were collected at 5-minute intervals from August–October, 2008. In addition, temperature measurements at Detroit Metro Airport and Detroit City Airport were obtained for comparison with HOBO measurements.

**Results:** From August 9th to August 30th the mean temperature values of the 17 HOBOs ranged from 69.0 (°F) to 71.5 (°F), minimum values ranged from 46.9 (°F) to 53.3 (°F) and maximum values ranged from 91.3 (°F) to 97.0 (°F). The Kruskal-Wallis test results suggest that temperature measurements across sites have statistically significant differences. Airport station measurements during the same period have relatively higher minimum values and lower maximum values compared to the HOBO measurements. Spatial variation of the temperature based on land cover, built environment, proximity to water, and other meteorological parameters is being analyzed.

**Conclusion:** This study suggests that the minimum/maximum temperature measured at airport stations may over/under estimate population exposures due to differences in siting and spatial variation. It also implies that HWWSs should consider not only temperature measurements, but also the nature of the built environment, vegetation and other factors that contribute to spatial variations in temperature in order to protect vulnerable populations.

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**ISEE-0367****Arrange of Shift Schedule and Work Stress in Taiwan Nurses**

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**Background:** Shared governance in job arrangement of nurses is related to job satisfaction. Hence, we examined the associations of rotation schedule and autonomy in arranging rotation schedule with work stress among nurses in Taiwan.

**Methods:** The study recruited 458 female nurses working in shift-time schedule in Kaohsiung, Taiwan. In 2006, they answered a structured questionnaire, which included demographic characteristics, shift-work schedule, and work stress defined by the Effort-Reward Imbalance Model, in which the score of overcommitment  $\geq 17$  point is considered as high overcommitment and effort-reward ratio  $>1$  as effort-reward imbalance.

**Results:** Among these nurses, 51.0% were of high overcommitment and 38.6% were of effort-reward imbalance. Duration of night shift ( $<7$ , 7–14 and  $>14$  night shift) in past two months is not related with overcommitment and effort reward imbalance. Prevalences of high overcommitment were 52.1%, 46.6% and 55.5% respectively, and of effort reward imbalance were 36.9%, 37.4%, and 45.3%.

Percentages of high overcommitment and effort-reward imbalance were 64.2% and 65.0% in low/no satisfaction of rotation time group while only 27.3% and 24.2% in high satisfaction of rotation time group. Percentages of high overcommitment (61.9%) or effort-reward ratio  $>1$  (62.4%) were highest in the non-autonomy of schedule arrangement group, and only 34.8% and 18.2% in high autonomy of schedule arrangement group. Adjusted for other confounders, the lower/no satisfaction and non-autonomy were significantly associated with overcommitment and effort-reward imbalance. The OR of low/no satisfaction for overcommitment and effort-reward imbalance were 5.28 (95%CI: 2.65–10.9), 6.42 (95%CI: 3.1–14.0) and the OR of non autonomy of schedule arrangement were 7.63 (95%CI: 2.51–28.8), respectively.

**Conclusion:** In this study, we found that increased satisfaction and autonomy of rotation schedule arrangement are associated with lower job stress. This suggests that shared governance in shift schedule arrangement may improve job stress.

#### ISEE-0368

##### Ambient Air Pollution Exposure, Residential Mobility and Term Birth Weight in Oslo, Norway

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**Background and Objective:** Environmental exposure during pregnancy may have life long health consequences for the offspring and some studies have shown a negative association between maternal exposure to air pollution during pregnancy and offspring's birth weight. In these studies exposure was defined as exposure at the registered birth address without taking into account residential mobility and work addresses.

**Methods:** We used information obtained from the National Birth Registry of Norway (MBRN) to examine associations between ambient environmental exposure such as air pollution and temperature, and offspring's birth weight taking advantage of information on migration history and work address in a large population based cohort. A dispersion model was used to estimate

ambient air pollution levels at all residential addresses and work addresses for a total of 25 229 pregnancies in Oslo, Norway.

**Results:** Ambient exposure to nitrogen dioxide for the entire pregnancy was associated with a crude difference of 26.6 gram reduction in term birth weight when comparing children of the highest and lowest exposed mothers. The observed change was mainly seen among offspring of mothers that did not change residential address during pregnancy, and with previous pregnancies. The observed association was attenuated to a statistically insignificant level after adjustment for covariates known to influence birth weight.

**Conclusions:** The overall findings suggest no clear association between offspring's birth weight and traffic pollution exposure during the entire pregnancy. Sensitivity analyses indicated a possible confounding by parity, especially when examining mobility patterns. This could be of importance in future studies.

#### ISEE-0371

##### Mercury, Lead and Cadmium in Human Milk in Relation to Diet, Lifestyle and SOCIO-Demographic Factors in Madrid, Spain

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**Background and Objective:** Breastfeeding is the ideal way of nurturing infants, though it can be a source of exposure to toxicants. The presence of heavy metals in human milk has special interest due to their toxicity. Biomadrid is a descriptive biomonitoring study conducted in a sample of newborns and their parents from the general population of Madrid Region. Here we present Hg, Pb and Cd levels in breast milk and their association with the studied variables.

**Methods:** Breast milk was obtained from 100 women (20 ml). The study participants filled a questionnaire concerning sociodemographic factors, environmental exposures, life styles, tobacco smoking, ETS (environmental tobacco smoke) exposure, dietary habits, medical history (including current/previous pregnancies) and lactation periods. Samples were analyzed using Graphite Furnace-Atomic Absorption Spectrometry for Pb and Cd and Cold Vapor Atomic Absorption Spectrometry for Hg. Geometric means were calculated due to the lack of normality. A concentration equal to half of the detection limit was assumed for those samples with levels below the detection limit. Differences between geometric means were analyzed using multiple linear regression. Possible associations among high metal levels (values over the percentile 75) and the studied variables were analyzed using logistic regression.

**Results:** The mean contents of Hg, Pb and Cd in breast milk were 0.53 µg/dl, 15.56 µg/dl and 1.31 µg/dl, respectively. Women younger than 30 years and those in the upper tertile of fish and milk intake presented higher Hg levels. Lead concentration increased with ETS exposure at home and greater consumption of cereals and potatoes. Increased Cd levels were associated with tobacco smoking, laboral ETS exposure and eggs consumption.

**Conclusions:** Smoking and dietary habits were the main factors related to heavy metal levels in breast milk. Our results entails the need to survey these pollutants in milk. Unhealthy behaviours during pregnancy should be avoided.



## ISEE-0375

**Air Pollution and Low Birth Weight in an Industrialized City in Southeastern of Brazil, 2003–2006**

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**Background and Objectives:** Several studies have shown the association between outdoor air pollution and adverse pregnancy outcomes. This study investigated the association between low birth weight (LBW) and maternal exposure to outdoor air contaminants (PM<sub>10</sub>, SO<sub>2</sub> and O<sub>3</sub>) in an industrialized city in Rio de Janeiro, Brazil.

**Methods:** This population-based study comprised infants born in Volta Redonda, from 1<sup>st</sup> January 2003 to 31 December 2006 (n = 13,660). Birth data were obtained from National Information System on Live Births. Exposure information were provided by air quality monitoring system operated in the municipality. Date of birth was considered as basis to estimate maternal exposure to pollutants over each trimester of gestation. Logistic and linear models were employed to assess the contribution of air pollution to LBW. In both analyses we used LBW as a dependent variable and we adjusted for gestational length, place of birth, type of pregnancy, prenatal care, infant's sex, congenital abnormalities and maternal.

**Results:** Results indicate that the findings are similar to other studies. Adjusted odds ratios (OR) for LBW showed that second and third-trimester exposure to O<sub>3</sub> increased the risk for low birth weight (OR<sub>Second Trimester</sub> = 1.013, 95% CI = 1.003–1.024; OR<sub>Third Trimester</sub> = 1.016, 95% CI = 1.006–1.026), as well as exposure to PM<sub>10</sub> in second-trimester (OR = 1.036, 95% CI = 1.003–1.070). We observed a reduction in birth weight of 23.34 g (95% CI = –42.41; –4.29) due to interquartile increase of O<sub>3</sub> in third trimester of pregnancy. Dose-response relationships were observed between LBW and exposure to O<sub>3</sub> during second and third-trimester and between LBW and PM<sub>10</sub> during all the three trimesters of pregnancy.

**Conclusion:** Results show that maternal exposure to air pollutants may increase risk of low birth weight.

## ISEE-0381

**A Job and Environmental Exposure Matrix (JEEM) for a Case-Control Study on Prostate Cancer**

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**Background and Objectives:** Among the surrogate measures of exposure in epidemiology job exposure matrices (JEM) are often used. Currently available JEMs estimate occupational exposures to chemicals using only industry and occupation information (job title, job tasks, frequency of exposure to specific agents and intensity of exposure) in a semi qualitative-quantitative manner. The information for occupation and industry is obtained from a combination of self reports, expert assessment and measurements. The purpose of this study is to develop a new exposure matrix called the Job and Environmental Exposure Matrix (JEEM) that considers exposures on the job, at leisure activities and at place of residence.

**Methods:** A specifically designed questionnaire is used to collect information on industry, job and environment (sources of drinking water, dietary habits, residence in the vicinity of industries) for cases and controls. The exposures are assessed through expert evaluations. The cases are newly diagnosed prostate cancer patients and controls are men free of prostate related conditions and matched for age with the cases. The JEEM

is the sum of job exposure index (type of job coded according to SOC, type of substance, level of exposure and duration of exposure) and environmental exposure index (extra-occupational or leisure activity, residential exposure, type of substance, level of exposure and duration of exposure).

**Results:** The JEEM allows for the estimation of lifetime occupational and environmental exposures to predetermined chemicals. The job and environmental exposure indices are calculated from three-dimensional inputs from occupation/industry/environment, intensity and type of exposure and duration of exposure. The case-control study allows for assessment of sensitivity, specificity and predictive value of the JEEM in the role of JEEM in prostate cancer.

**Conclusion:** The JEEM for prostate cancer allows for calculation of exposure with high sensitivity and specificity and assessment of exposure as a non-significant risk factor for prostate cancer.

## ISEE-0383

**Residential Indoor Air Exposure to Polychlorinated Biphenyls**

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**Background and Objectives:** Inhalation is a potentially important pathway of exposure to polychlorinated biphenyls (PCBs), but very few studies have investigated the impact of residential airborne PCBs on body burden. Our objective was to assess the association between concentrations of PCBs in indoor air and in the serum of older, long-term residents near a Superfund hazardous waste site.

**Methods:** The study population consisted of 176 men and women 55 to 74 years of age who resided in the towns of Fort Edward, Hudson Falls, or Glens Falls, NY, USA, for 25 years or more. Participants were interviewed, and occupationally exposed persons were excluded. Each donated a 25 ml fasting sample of venous blood and a 24 hr indoor air sample from living space within their home for congener-specific PCB analysis.

**Results:** Twelve congeners were most frequently detected in both the serum and indoor air. Their sum in serum averaged 3.7 ng/g (wet weight), and in indoor air averaged 14.0 ng/m<sup>3</sup>. Multiple regression analyses revealed significant associations between air and serum concentrations of PCB-28 and 105 ( $P < 0.001$ ). Both are relatively lightly chlorinated congeners that readily volatilize. Stratified analyses indicated that these associations were strongest among persons whose blood was sampled within 20 days of when their air was sampled. The magnitude of the relationship also varied by season and by duration of residence, with respectively nine and 11 of the 12 congeners exhibiting significant associations when the samples were collected in the cool months or when the data were restricted to person who lived in their home for 39 years or more.

**Conclusion:** This study is among the first to demonstrate that levels of PCBs in residential indoor air can impact body burdens, especially for the more volatile congeners and among long term residents.

## ISEE-0387

**Components of Air Pollution Are Associated with Lower Cognitive Function among Healthy Adults in Los Angeles**

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**Background:** Evidence from multiple studies supports associations between ambient particulate matter (PM) air pollution and cardiovascular disease (CVD) and atherosclerosis, and between CVD, atherosclerosis and decreased cognitive function, yet data are sparse regarding the relationship between components of air pollution and cognitive function. While experiments in animals demonstrate neurotoxic effects of PM and ozone (O<sub>3</sub>), epidemiologic evidence is limited to one study among children in Mexico City that found associations between PM and decreased verbal and nonverbal abilities, and a recent study using NHANESIII data that reported associations between O<sub>3</sub> and reduced attention, short-term memory and coding abilities.

**Methods:** We examined cross-sectional associations between components of ambient air pollution [O<sub>3</sub>, PM<sub>2.5</sub> and nitrogen dioxide (NO<sub>2</sub>)] and six areas of cognitive function in healthy cognitively intact adults (n = 853, mean age 61 years). Air pollution exposures were assigned using a geographic information system that linked modeled O<sub>3</sub>, PM<sub>2.5</sub> and NO<sub>2</sub> concentrations measured by monitoring stations for the years 2000–2006 to residential addresses of participants. Cognitive function was assessed with a neuropsychological battery. A principal components analysis extracted five uncorrelated factors interpreted to represent five areas of cognition. A measure of global cognition was calculated.

**Results:** In multivariable generalized linear models adjusted for age, gender, race, education, income and mood, subjects with high or moderate levels of average 24-hour PM<sub>2.5</sub> had lower verbal memory compared to subjects with low levels of PM<sub>2.5</sub> exposure ( $\beta = -0.17$  [SE( $\beta$ ) = 0.09],  $P = 0.07$  and  $\beta = -0.18$  [SE( $\beta$ ) = 0.09],  $P = 0.04$ , respectively). These associations persisted and were only slightly attenuated when adjusted for subclinical atherosclerosis (for high PM<sub>2.5</sub>:  $\beta = -0.16$  [SE( $\beta$ ) = 0.09],  $P = 0.09$ ; for moderate PM<sub>2.5</sub>:  $\beta = -0.17$  [SE( $\beta$ ) = 0.09],  $P = 0.05$ ).

**Conclusion:** This study provides some support for an association between PM air pollution and decreased verbal abilities. We plan to increase our sample size in further analyses.

#### ISEE-0388

##### Modification of Temperature-Mortality Association in Summer by the Previous Winter Mortality in South Korea

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**Background and Objective:** Numerous studies in recent years have reported association between summer temperature and deaths in cities. However, in summer when a greater pool of vulnerable individuals leave, the heat-related mortality is little known. We aimed to explore how sensitive the heat-related mortality in summer is to mortality in the previous winter in 3 major cities, in South Korea.

**Methods:** In the study period from 1992–2007, summer and winter were defined as June–August and December–February, respectively. The statistical analysis was conducted in two steps. First, to investigate thresholds of the temperature-mortality curves in summer, we fitted piecewise log-linear models using AIC for the model-fitting criteria. Second, to investigate dependency of heat-mortality effects above the threshold on previous winter mortality, we incorporated indicators of mortality in winter as effect modifiers in the first step model.

**Results:** Estimated thresholds for  $\geq 65$  year old age group with two day (lag 0 and 1) mean temperature (27.4°C, 27.3°C and 23.2°C for Seoul, Daegu, and Incheon, respectively) were lower than those for all age groups (27.9°C, 28.1°C and 25.5°C, respectively). For summer mortality of all age group, a 1°C increment in temperature above the thresholds was associated with an increase of 10.57%, 8.55%, and 6.04% for low strata, 4.85%, 4.00%, and 2.63% for high strata of winter mortality in Seoul, Daegu, and Incheon, respectively ( $P$ -values for heterogeneity: 0.0081,

0.0142, and 0.0378, respectively). Those for  $\geq 65$  year old age group were 8.85%, 8.36%, and 3.88% for low strata, 7.75%, 5.14%, and 2.83% for high strata, respectively ( $P$ -values for heterogeneity: 0.5846, 0.0502, and 0.2651, respectively).

**Conclusion:** Our results show that low mortality in winter leads to higher mortality in the following summer. It suggests that the yearly variation of heat effect in summer should be reconsidered in public health program, especially in heat warning system.

#### ISEE-0389

##### Climatic Components of Seasonal Variation in Cholera Incidence

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**Background:** The mechanisms underlying seasonality of cholera remain poorly understood, despite long-standing recognition of clear seasonality. We aimed to quantify the contribution of climatic factors to seasonal variation in cholera incidence.

**Methods:** We investigated the association between weekly number of cholera patients in Bangladesh and seasonal and weather factors, using Poisson regression models. The contribution of each weather factor (temperature, high and low rainfall) to seasonal variation was estimated as the mean over seven years, for each week of the year of each weather term. Fractions of the number of cholera patients attributed to each weather factor, assuming all values were constant at their minimum risk levels throughout the year, were estimated for spring and monsoon seasons separately.

**Results:** Temperature predicts lower incidence of cholera in the first 10 weeks of the year; low rainfall predicts a peak in spring; and high rainfall predicts a peak during the monsoon. The risk predicted from all the weather factors combined showed a broadly bi-modal pattern, as observed in the raw data.

**Conclusions:** Seasonal variation in the number of cholera patients in Bangladesh could be partly explained by temperature and rainfall. The first and second peaks were substantially attributable to low and high rainfall, respectively, while low temperature explained the winter trough.

#### ISEE-0390

##### Comparison of Estimated Effects of Air Pollution on Human Mortality Calculated Via S-Plus and SAS

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**Background and Objective:** Estimated effects of pollution on human health are often measured via a model that is non-linear in time and weather and linear in the measure(s) of pollution. Researchers have employed both S-Plus and SAS software procedures to complete the estimation. Thus it is relevant to investigate the extent to which differences exist due to the software procedure employed.

**Methods:** Identical generalized linear models were developed in S-Plus and SAS for the effects of pollution on daily, non-accidental deaths in Atlanta, GA between 1998 and 2006. Various scenarios were examined using two age categories for decedents and five cause of death categories. Daily mortality counts are associated with smoothed time via cubic splines with 30-day knots, temperature and dew point smoothed with two knots (25<sup>th</sup> and 75<sup>th</sup> percentiles), day of the week indicators, and daily average of the current and prior day's measure of PM<sub>2.5</sub>. Three different

spline functions are used in the SAS GENMOD procedure to compare with S-Plus: manually constructed splines (c-spline); PROC TRANSREG spline function; and PROC TRANSREG p-spline function. The calculated  $PM_{2.5}$  coefficients and standard errors were compared using differences, ratios and ranks. S-Plus calculated values were rounded to the 4<sup>th</sup> decimal to conform with the precision in SAS reported values.

**Results:** Although the calculated  $PM_{2.5}$  coefficients and standard errors are quite close in magnitude (usually 4<sup>th</sup> decimal), some differ by  $\pm 50\%$ . Calculated estimates of  $PM_{2.5}$  coefficients via S-Plus and the three SAS spline functions are mixed. SAS calculated estimates of  $PM_{2.5}$  standard errors are generally larger than S-Plus. The most pronounced differences between SAS and S-Plus estimates occur when S-Plus calculates a negative estimated  $PM_{2.5}$  coefficient.

**Conclusion:** Although estimates calculated using S-Plus or SAS are quite close, further investigation is warranted to improve understanding of differences in estimated effects and/or standard errors.

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#### ISEE-0394

##### Exposure to Bisphenol A and Phthalates Affects Lung Function and Oxidative Stress in the Elderly

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**Background and Objective:** Endocrine disruptors have been reported to be related with adverse health effect. In this study, we evaluated the effect of bisphenol A (BPA) and di-(2-ethylhexyl) phthalate on lung function and oxidative stress in the elderly.

**Methods:** We recruited 411 persons aged more than 58-years old and obtained urine samples during two medical examinations. We measured urinary level of BPA, mono-(2-ethyl-5-hydroxyhexyl) phthalate (5-OH-phthalate) and mono-(2-ethyl-5-oxohexyl) phthalate (5-OXO-phthalate) as DEHP metabolites. Malondialdehyde (MDA) as an oxidative stress biomarker was also measured in urine samples.

**Results:** When we estimated the effect of exposure to the chemicals on lung function and oxidative stress using repeated analysis, the exposure biomarkers showed a negative relationship with lung function and a positive relationship with oxidative stress after being adjusted for age, sex, BMI, and cotinine level (BPA-FEV1/FVC,  $\beta = -0.145$ ,  $P$ -value = 0.170; BPA-FEF25–75%,  $\beta = -0.029$ ,  $P$ -value < 0.001; BPA-MDA,  $\beta = 0.024$ ,  $P$ -value < 0.001; 5-OH-phthalate-FEV1/FVC,  $\beta = -0.022$ ,  $P$ -value = 0.047; 5-OH-phthalate-FEF25–75%,  $\beta = -0.003$ ,  $P$ -value = 0.004; 5-OH-phthalate-MDA,  $\beta = 0.002$ ,  $P$ -value < 0.001; 5-OXO-phthalate-FEV1/FVC,  $\beta = -0.034$ ,  $P$ -value = 0.027; 5-OXO-phthalate-FEF25–75%,  $\beta = -0.004$ ,  $P$ -value < 0.001; 5-OXO-phthalate-MDA,  $\beta = 0.004$ ,  $P$ -value < 0.001).

**Conclusions:** Our study results suggest that exposure to bisphenol A and di-(2-ethylhexyl) phthalate decreases lung function and increases oxidative stress in the elderly.

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#### ISEE-0395

##### Impacts of Global Climate Change on Plant Food Allergens and Related Health Issues

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**Background and Objective:** Climate change has had, and will continue to have, many significant impacts on human health. One aspect of human health that has been highlighted in recent years as being adversely impacted by climate change is allergic disease. Much of this attention has been focussed on asthma, partly due to there now being many studies of climate change impacts on aeroallergens, particularly pollen. Of particular

note is a study demonstrating significant increases in the major allergen content of ragweed pollen as a function of rising atmospheric carbon dioxide concentration. The objective of this research is to examine the potential for climate change to have adverse impacts on the allergenicity of important plant food allergens.

**Methods:** In the absence of any previous research on climate change and plant food allergens specifically, research on the impacts of elevated atmospheric carbon dioxide concentration and/or temperature on other attributes of plant food allergen species were reviewed. In addition to this, experimental work at Macquarie University is examining the impacts of elevated atmospheric carbon dioxide concentration on peanut allergenicity.

**Results:** The results of previous research and preliminary results from this research suggest there is potential for climate change to have an impact on the allergenicity of plant food allergens such as peanut. With respect to this food in particular, results indicate that plants grown in elevated atmospheric carbon dioxide concentration show, amongst other things, significantly ( $P = 0.0001$ ) increased pod and seed numbers per plant compared to plants grown at ambient concentration.

**Conclusion:** Impacts of climate change on plant food allergens could have considerable impacts on associated allergic diseases, and pose a threat to global health. There is a great need for further research on this topic.

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#### ISEE-0396

##### Relations Between Antioxidant Status and Smoking Biomarkers

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**Background and Objective:** The relationship between cigarette smoking and cell damage is complicated where oxidative stress is involved. The aim of this study was to identify the relationship among the plasma nicotine metabolites, lipophilic antioxidants, and metabolic parameters for smokers and non-smokers.

**Methods:** This cross-sectional study recruited 100 subjects who visited the department of family medicine in Kaohsiung Medical University Hospital. Excluding the ineligible 14 cases, 46 smokers and 40 non-smokers were enrolled finally. Plasma nicotine metabolites, lipophilic antioxidants (including retinol, lycopene,  $\alpha$ -carotene,  $\beta$ -carotene,  $\delta$ -tocopherol,  $\gamma$ -tocopherol and  $\alpha$ -tocopherol), related metabolic parameters, and body compositions (including height, weight, body mass index, body fat, and waistline) were examined by comparison of means, correlations and regressions.

**Results:** The significant correlations among nicotine metabolites, age, gender, body compositions and plasma lipophilic antioxidants were noted. Nicotine metabolites, age, body height and body weight were factors closely associated with plasma antioxidants ( $P < 0.05$ ) by multiple linear regression. Levels of the  $\alpha$ -carotene,  $\beta$ -carotene,  $\gamma$ -tocopherol, and lycopene in smokers were lower than those in non-smokers ( $P < 0.01$ ). The plasma level of high-sensitivity C-reactive protein (hsCRP), which is a marker of high cardiovascular risk, was higher in smokers than in non-smokers ( $P = 0.003$ ).

**Conclusion:** We concluded that the lower plasma antioxidant levels and high hsCRP in smoking individuals may lead to lower protective efficacy compared with non-smokers. Further studies are warranted to support our hypothesis.

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#### ISEE-0397

##### Speciation Analysis of Arsenic Compounds in Healthy Human Urine by HPLC-ICP-MS for the Evaluation of the Occupational Inorganic Arsenic Exposure

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**Background and Objective:** In recent times the consumption of seafood has been increasing throughout the world. Seafood contains dimethylarsinic acid (DMA). For biological monitoring of the occupational inorganic arsenic (iAs) exposure of workers who habitually consume seafood, speciation analysis is preferable, and the sum of iAs and monomethylarsonic acid (MMA) is more suitable than that of iAs, MMA, and DMA. Therefore, we tried to establish a useful speciation analysis which is applicable to biological monitoring of the occupational iAs exposure.

**Methods:** We looked at 172 healthy male workers with a mean age of  $46.5 \pm 13.6$  yr (range 18–74 yr) living in Japan without occupational arsenic exposure. The urine samples collected at their regular medical examination were diluted five-fold with ultrapure water, filtered through a  $0.45 \mu\text{m}$ -membrane filter, and analyzed by HPLC-ICP-MS using an anion-exchange column of Dionex IonPac AS22 with mobile phase of  $20 \text{ mM NH}_4\text{HCO}_3$  (pH 10.0).

**Results:** The anionic condition gave successful separation for five arsenic species within 10 min. The limits of detection ( $\mu\text{gAs/l}$ ) were arsenite (AsIII), 0.3; arsenate (AsV), 0.2; MMA, 0.2; DMA, 0.3; arsenobetaine (AsBe), 0.4, respectively. Ninety-fifth percentile of AsV, AsIII, MMA, DMA, AsBe, the others and the sum of iAs and MMA concentrations in urine of 172 healthy subjects were 1.7, 5.4, 6.2, 109.2, 243.7, 23.7 and  $12.6 \mu\text{gAs/l}$ , respectively.

**Conclusion:** This column can completely separate iAs and the metabolites within 10 min, and use of a volatile buffer prevents the accumulation of salts on the ICP-MS interface, which results in less instrument downtime and less costly analysis. We propose the ninety-fifth percentile of sum of iAs and MMA concentrations measured by the anion-exchange column,  $12.6 \mu\text{gAs/l}$ , as background value of biological index of occupational iAs exposure for those who habitually consume seafood.

#### ISEE-0398

##### A Case-Control Study of Green Tea or Oolong Tea Consumption and Esophageal Squamous Cell Carcinoma in Taiwan

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**Background and Objective:** This study investigated the association between green tea or oolong tea consumption and esophageal squamous cell carcinoma (ESCC).

**Methods:** A total of 487 cases and 755 controls were enrolled. Controls were matched for cases on age. Information was collected on participants' living habits, including tea consumption. Green tea was used as the standard to estimate the total amount of individual catechin consumption. We stratified catechin consumption into three levels. Conditional logistic regression models were fit to subjects aged  $>40$  years men to evaluate associations between ESCC and tea catechin consumption.

**Results:** A significant inverse association between green tea or oolong tea consumption and ESCC risk was found. For the ESCC Taiwanese men with higher amounts of tea consumption ( $>300$  units of catechins), the adjusted odds ratio (OR) compared with the group without tea consumption was 0.7 (95% confidence interval (CI) = 0.5–0.9). After we adjusted for cigarette smoking, alcohol drinking and areca nut chewing status, the overall OR for all participants was 0.4 (95% CI = 0.3–0.6), indicating an inverse relation between large amounts of catechins and ESCC.

**Conclusion:** Sufficient consumption of tea catechins may reduce the risk of ESCC.

#### ISEE-0400

##### Health Effects of Indoor Environmental Quality on Healthcare Workers in a General Hospital in Taiwan

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**Background and Objective:** Poor hospital environmental quality may result in sick-building syndromes (SBS) among healthcare workers and patients. In 2007, we conducted a prospective study to evaluate the health effects of indoor environmental quality among healthcare workers in Taiwan.

**Methods:** We used air capture hood (Model 8373, TSI AccuBalance Plus) to evaluate the air change per hour for each unit. A self-reported questionnaire was used to assess the demographic data, environmental/occupational exposures, and SBS. SBS was classified into 5 sub-groups: eyes mucous membrane, upper-, lower respiratory track, skin, and neuropsychology status. In addition, skin prick tests (Multi-Test® II, Lincoln Diagnostics) for 14 allergens and lung function tests (Micro Loop of Micro Medical Limited) were used to assess the respiratory effects. Multiple linear- and logistic regression were applied to assess the association of interest, respectively; as well to adjust the potential confounders.

**Results:** 83.28% (513/616) of the workers agreed to participate in this study. The SBS prevalence's of eyes mucous membrane, upper-, lower respiratory track, skin, and neuropsychology status were 49.28%, 27%, 14.83%, 10.86% and 46.72%, respectively. 43.8% of the 152 workers were allergic to dust mites. The average FEV1 and PEF of the 189 lung function participants were  $2.42 \pm 0.5$  ml and  $361.97 \pm 75.31$  ml, respectively. After the adjustment for confounders, we found that "low air volume", "temperature too hot and moist", "uncomfortable chair", "air cleaners", "passive cigarette smoking", "overloading job" and "allergy to dust mites" were the risk factors of SBS. Workers who had been exposed to patients' blood, saliva or excrement in the workplace had higher risk of developing allergy, which may result in poor lung function.

**Conclusion:** To protect the healthcare workers, we suggest offering comfortable environments and re-evaluating the ventilation facility.

#### ISEE-0402

##### Transportation, Air Pollution and Physical Activities: An Integrated Health Risk Assessment Programme of Climate Change and Urban Policies (TAPAS)

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**Background:** This research aims at developing and populating a health impact assessment model to estimate health benefits and risks of urban policies, specifically active-transportation, that address climate change and also promote other health-related outcomes. Reducing vehicular travel is essential for climate change mitigation and shifting populations towards active-travel modes (cycling, walking) represents a promising strategy

with high potential for public health benefits. However, depending on local conditions, such strategies may also result in adverse health effects if implemented inappropriately. Currently there is no holistic framework, and related tools for policy makers to evaluate inputs and expected health impacts are lacking.

**Methods:** An integrated conceptual model to understand health implications of active transportation is being developed based on a review of the literature in relevant fields. Within this framework, we will then build a more specific computational model that addresses interactively travel behavior and selected health and environmental impacts in four case cities in Europe: Barcelona, Basel, Copenhagen and Paris.

**Results:** A conceptual framework of active-travel policies was developed. It identifies examples of potential benefits, such as increased physical activity leading to increased energy expenditure and fitness, enhanced mental health, and reduced vehicle emissions leading to improved air quality, as well as associated risks, such as potential increased inhalation of air pollution, exposure to UV radiation and traffic hazards. Where critical gaps are identified, primary data collection is planned to populate the model, including data on determinants of active-travel, and potential co-benefits and co-risks of mode shifts, in order to evaluate overall impacts. The most relevant indicators and policy scenarios will be assessed during a multidisciplinary workshop of stakeholders and experts.

**Conclusion:** A first broad assessment was made of implications of active-travel policies. Data collection efforts and toolbox development will ensue to aid decision-making for health-promoting urban policies.

#### ISEE-0405

##### Assessment of Short-Term Effects of Ambient Particulate Matter on Respiratory Mortality in Italian Cities

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**Background and Objective:** The impact of air pollution on morbidity and mortality is well established, especially for respiratory diseases. There are only few studies, however, that have evaluated the form of the exposure-response relationship and the role of individual effect modifiers. We studied the exposure-response relationship between daily PM<sub>10</sub> and respiratory mortality in Italy, and considered the potential effect modifiers. **Methods:** A case-crossover analysis was carried out in 35+ year old residents in 10 Italian cities who died from respiratory causes (ICD-9 codes 460–519) in 2001–2005. Daily data of PM<sub>10</sub>, NO<sub>2</sub> and O<sub>3</sub> were obtained for the same period. Individual information on socio-demographic characteristics and chronic conditions from previous hospital admissions were collected. A conditional logistic regression analysis was carried out in each city and the pooled association was estimated in a random-effect meta-analysis. The exposure-response relationship was explored using a meta-smoothing approach.

**Results:** There were 19,629 respiratory deaths (7.1% of natural causes). The risk of dying for respiratory causes increased by 2.29% (95% Confidence Intervals, CI, 1.03–3.58) for 10 µg/m<sup>3</sup> increase of PM<sub>10</sub> (lag 0–3). The strongest associations were observed for chronic obstructive pulmonary disease (COPD) (2.79%) and pneumonia (2.30%) both at lag 0–5. There was no evidence of a threshold in the exposure-response curve

and the relationship appeared to be linear. The PM<sub>10</sub> effect was not confounded by co-pollutants (NO<sub>2</sub> or O<sub>3</sub>). No statistically significant effect modifiers were detected although very elderly (85+ years), females and subjects with a chronic disease had the strongest effect.

**Conclusions:** We found a no-threshold linear effect of PM<sub>10</sub> on respiratory mortality in Italian cities. COPD and pneumonia showed the strongest association. Neither confounding from NO<sub>2</sub> was indicated nor a clear effect modification was found.

#### ISEE-0406

##### Odour Annoyance Near Waste Treatment Centres: A Population-Based Study in Finland

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**Background and Objectives:** Decomposition of biodegradable waste in municipal waste centres may produce odour emissions and subsequently cause discomfort to nearby residents. The public health importance of the resulting nuisance has not been sufficiently characterized. Our objective was to study the perception and annoyance of waste odour among residents in relation to distance from a large-scale source.

**Methods:** In 2006, we interviewed by telephone 1,142 randomly selected residents living within 5 km from the boundaries of five waste treatment centres. These centres were landfilling municipal waste and composting source-separated biowaste and/or sludge. The questionnaire consisted of 102 items on perceived nuisance and self-reported health during the preceding 12 months. Odds ratios (OR) and confidence intervals (CI) were calculated adjusting for sex and age.

**Results:** The proportion of respondents perceiving odour varied by centre and distance (<1.5 km: 66%–100%, 1.5 km ≤ 3 km: 13%–84%; 3 km ≤ 5 km: 2%–64%). The pooled OR for odour annoyance was 6.1 (95% CI 3.7–10) in the intermediate and 19 (95% CI 12–32) in the innermost zone compared with residents in the outermost zone. Odour annoyance was more affected by intensity than by frequency of odour perception.

**Conclusion:** The high level of odour perception and annoyance in residents living near waste treatment centres draws attention to the need to prevent odour nuisance constricting emission peaks and frequent emissions. Since odours may affect fairly distant residential areas, planning of the locations of waste treatment operations is essential.

#### ISEE-0408

##### Long- and Short-Term Air Pollution Exposure and Markers of Inflammation and Coagulation in a Population Sample from Stockholm

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**Background and Objective:** Exposure to elevated levels of ambient air pollutants can cause adverse cardiovascular effects through systemic inflammation and changes in coagulation balance. We aimed to investigate long- and short-term effects of air pollution exposure on serum levels of inflammatory (IL-6, TNF-α, and CRP) and coagulation (fibrinogen and PAI-1) markers of relevance for cardiovascular pathology.

**Methods:** We studied a population sample of 1028 men and 508 women aged 45 to 70 years from Stockholm, Sweden. Data on cardiovascular risk factors were collected from questionnaires. Blood samples were collected

at medical examinations. Long-term air pollution exposure was assessed using spatial modelling of traffic-related NO<sub>2</sub> and heating-related SO<sub>2</sub> emissions at each subject's residential addresses over retrospective periods of 1, 5, and 30 years. Short-term exposure was assessed as averages of rooftop measurements over 12 to 120 hours before blood sampling.

**Results:** Long-term exposures to both traffic-NO<sub>2</sub> and heating-SO<sub>2</sub> emissions showed a consistent association with elevated IL-6 levels. 30-year average traffic-NO<sub>2</sub> exposure was associated with 64.5% (95%CI 6.7–153.8%) increase in serum IL-6 per 28.8 µg/m<sup>3</sup> (corresponding to the difference between the 5<sup>th</sup> and the 95<sup>th</sup> percentile exposure value), and 30-year exposure to heating-SO<sub>2</sub> with 67.6% (95%CI 7.1–162.2%) increase per 39.4 µg/m<sup>3</sup> (5<sup>th</sup>–95<sup>th</sup> percentile value difference). The association appeared stronger in non-smokers, physically active people, and hypertensive persons. We observed positive non-significant associations of inflammatory markers with NO<sub>2</sub> and PM<sub>10</sub> during 24 hours before blood sampling.

**Conclusion:** Our results suggest that exposure to moderate levels of air pollution may influence serum levels of inflammatory markers.

#### ISEE-0410

##### Kinetics of PCBs and Other Selected Organochlorines in Eastern Slovak Children from Birth Until 45 Months of Age

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**Background and Objective:** Polychlorinated biphenyls (PCBs) are ubiquitous persistent pollutants whose role in developmental toxicity is of concern. Their kinetics in infants has not been thoroughly described yet.

**Methods:** A cohort study (1134 mother-infant pairs) was initiated in 2002, whereby organochlorines were measured in maternal and cord serum samples and in children at 6, 16, and 45-months using high resolution gas chromatography. The present analysis is based on a subgroup of 480 subjects living in Michalovce area.

**Results:** In mother serum the CB-153 concentration was 2.34 ± 1.92 (mean ± SD) and 1.70 (median) ng/ml and 224.2 ± 175.4 (mean ± SD) and 175.4 (median) ng/g lipids. In decreasing order, congeners CB 153, 180, 138<sup>+163</sup> and 170 were the major contributors to total PCB concentrations in serum. The highest sum of PCB serum concentration was at 6 months reflecting uptake through breast feeding. PCB sum levels decreased between the 6<sup>th</sup> and 16<sup>th</sup> month by 16% and from the 16<sup>th</sup> to 45<sup>th</sup> month by 9.7%. The most abundant pesticide in serum was pp-DDE, which peaked at 16 months of age. The cord and mother blood concentrations of all analytes correlated well except β-HCH. The ratios of cord:mother for means of analytes were higher than medians, except for pp-DDT, and they were <1 for sum of PCB congeners, CB 153, 138<sup>+163</sup>, DDE and HCB, indicating concentration equilibrium between lipids in mother and cord plasma. For less abundant congeners, DDT and β-HCH ratios were <1. The 6-month infant:cord ratios reflect uptake of organochlorines by breast feeding.

**Conclusion:** These unique longitudinal data are being used for exposure metrics (AUC, MRT) in association with various health outcomes. Further observation of the cohort is planned.

#### ISEE-0415

##### Assessment of Milk Products as a Brucellosis Transmission Factor in Kyrgyz Republic

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**Abstract:** The Kyrgyz Republic is a hyper-endemic area leading to a 2–10-fold increase in the brucellosis prevalence infection in the population of Central Asian Region countries. Today more than 99% of the livestock are kept in private small farms and there is a limited by coverage of vaccination and monitoring programs testing. As a consequence there has been an increasing trend in the incidence of brucellosis in small cattle farms.

**Aim of the Study:** To modify ring reaction for the assessment of sour cream as a brucellosis transmission factor.

Hygienic, epidemiologic and laboratory methods (ring reaction for detection of Brucella in milk) were used in the study.

High incidence of brucellosis in the human population and in animals with an increasing trend was found—the rate of increase in the human population over a 9 years period of observation was +292.6% (56.5 cases per 100,000 versus 19.3 cases per 100,000). Brucellosis occurs in all regions of the republic, in the present time it has lost its spring-autumn seasonality and occupational character—more than 54% of brucellosis infected persons are unemployed. In adults the highest incidence is in the age group 19–49 years and there is an increasing incidence in children. A direct association between the incidence of the human population and the incidence in oxen and small cattle was found. The main infection transmission factors are milk and milk products (73.3%). Out of 1219 samples 23 milk and sour cream samples were found positive.

The modified method of ring reaction is specific and sensitive in the testing of sour cream produced from ill cows. Results of the study have been used in the practice of Centers for Sanitary-Epidemiologic Surveillance, the Veterinary-Sanitary Evaluation Laboratory of the State Veterinary Department of the Kyrgyz Republic.

#### ISEE-0418

##### Radio-ecological Situation in Industrial Waste Dumps of the Kyrgyz Chemical and Metallurgical Plant

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**Abstract:** Under poor socioeconomic conditions people in many regions of the Kyrgyz Republic have to dig in domestic and industrial waste dumps in search of precious, nonferrous, rare earth metals and other industrial waste material. Working in a dump is associated with exposure to a great number of harmful environmental factors (meteorological, chemical, biological, radiological, etc.). The study was conducted with the support of the International Labour Organization in the framework of the international programme on elimination of worst child labour forms.

The radiological situation was studied through measurements of gamma radiation levels in the waste dumps of the Kyrgyz Chemical and Metallurgical Plant (KCMP) on the edge of the village Orlovka and near the Buurdin tailings site, with the aid of a radiometer SRP-68. Gamma radiation measurements taken in the villages Orlovka and Kashka were used as background.

The local population, including children, dug for scrap single-crystalline silicon in the waste dumps of KCMP in Kemin District, Chui Region. In the Buurdin tailings site, high levels of exposure gamma radiation dose presenting potential health threat to the population were found.

Gamma radiation levels in the areas of villages Orlovka and Kashka were within natural background levels. In the industrial waste dump near Orlovka gamma radiation levels in dig pits were 2 times above the background levels. In the industrial dump site near the Buurdin tailings site the radiation level was 23 times above the exposure limits. The areas of the dump sites did not meet radiation safety standards. Digging by the local population presents a threat to health and the environment.

Results of the study were used as a basis for developing legislation on banning digging in the areas of industrial waste dumps in the Kyrgyz Republic.



## ISEE-0420

## Coarse and Fine Particles and Daily Mortality in Nine French Cities

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**Background and Objective:** Short-term effects of particles on mortality have been consistently reported. Recent research strongly suggests that fine particles (PM<sub>2.5</sub>) play a substantial role in these effects, whereas results on coarse particles (PM<sub>10-2.5</sub>) are inconsistent. Our aim was to study the association between these two size fractions and daily mortality in nine French cities during the 2000–2004 period.

**Methods:** PM<sub>10</sub> and PM<sub>2.5</sub> measured at the same urban sites were used to compute daily mean levels of PM<sub>2.5</sub> and PM<sub>10-2.5</sub>. For each city, the association between both fractions of PM and daily number of deaths (for non-traumatic, cardiovascular and cardiac causes) was estimated, first in mono-pollutant models, then in two-pollutants models, using Poisson regression models controlling for confounding factors. City-specific results were combined using random effects models. Results are presented as excess relative risks (ERR, %) for an increase of the mean interquartile range of PM<sub>2.5</sub> (9 µg/m<sup>3</sup>) and of PM<sub>10-2.5</sub> (5 µg/m<sup>3</sup>).

**Results:** Mean levels of PM<sub>2.5</sub> and PM<sub>10-2.5</sub> varied from 13 to 19 µg/m<sup>3</sup> and from 6 to 9 µg/m<sup>3</sup> respectively across the cities. In mono-pollutant models, ERRs of non-traumatic mortality were significant for both size fractions: 1.3%, [95% IC: 0.9–1.7] for PM<sub>2.5</sub> and 1.0% [0.7–1.3] for PM<sub>10-2.5</sub>. In two-pollutant models, the association was almost similar for PM<sub>2.5</sub> (1.1% [0.7–1.5]) and slightly lower but significant for PM<sub>10-2.5</sub> (0.5% [0.2–0.9]). ERRs linking both PM<sub>2.5</sub> and PM<sub>10-2.5</sub> with cardiovascular and cardiac deaths were also significant and higher.

**Conclusion:** Our results contribute to a better understanding of health effects of particles according to their size. They suggest that the levels of both fine and coarse particles currently experienced in French cities are associated with short-term mortality.

## ISEE-0421

## Air Pollution and the Risk of Venous Thrombo-Embolism

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**Background and Objective:** Air pollution has been associated with increases of inflammatory markers, endothelial damage and changes in blood clotting factors such as platelet aggregation and thrombin generation. These mechanisms were studied as possible mediators of the air pollution effect on acute coronary heart diseases. Less is known about venous thromboembolism though it recognises the same pathogenetic mechanisms. Experimental studies on animals and humans suggest a rapid activation (within 24 hrs) of the pre-thrombotic mechanisms after air pollution exposure. Long-term exposure to PM<sub>10</sub> have been recently reported for deep vein thrombosis. We aimed at evaluating the association

between short-term exposure to air pollutants and venous thromboembolism (VTE) or pulmonary embolism (PE).

**Methods:** A case-crossover analysis was conducted in 5 Italian cities among residents hospitalised for VTE (ICD-9 codes, 451, 452, 453) or PE (ICD-9 code, 415.1) as principal diagnosis (2001–2005). Daily data of pollutants (PM<sub>10</sub>, NO<sub>2</sub>, O<sub>3</sub>) were obtained for the same period. Individual information on age, sex and high-risk clinical conditions of secondary VTE/PE were collected from hospital discharge registries. Conditional logistic regression analysis was performed in each city, controlling for time-dependent confounders and the pooled association was estimated in a random-effect meta-analysis.

**Results:** There were 5,104 emergency hospitalisations for VTE and 3,557 for PE. There was only a marginal increased risk of VTE: 0.71% (95%CI–1.54, 3.00) and 0.48% (95%CI–2.69, 3.75) for 10 µg/m<sup>3</sup> PM<sub>10</sub> and NO<sub>2</sub>, respectively (lag 0). On the other hand, PE admissions increased up to 1.41% (95%CI–0.95, 3.83) and 5.73% (95%CI–0.08, 11.89) for 10 µg/m<sup>3</sup> PM<sub>10</sub> and NO<sub>2</sub>, respectively (lag 0). No effects were seen for O<sub>3</sub>.

**Conclusions:** An effect of both particles and NO<sub>2</sub> was suggested on PE onset in Italian cities. The effects were acute (lag 0) as reported in experimental studies. The stronger effect of NO<sub>2</sub> may be explained by traffic-related pollution.

## ISEE-0422

## First Data about a Weight Conditions and Physical Activity Study in Catania Students

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**Background and Objective:** The issues around obesity and overweight youth are beginning to appear to be characteristics of a real epidemic in the world and are recognized as risk factors for several diseases in adults. The information on the epidemiological situation in Italy is still inadequate. One of the main conditions that promotes obesity is the sedentary life. It is becoming more apparent that children aged between 6 and 10 have increased sedentary behaviour. In fact, more than one child in five does not perform any physical activity. The purpose of this study is to assess obesity related to physical activity and sport conducted among Sicilian students aged between 10 and 14 years.

**Methods:** The students were interviewed by an anonymous, semi-structured and self-administered questionnaire. Self-reported height and weight were used to calculate BMI and to classify overweight and obese.

**Results:** The stature and weight conditions of 1,545 students showed that 45.3% of the young people are of normal weight, 6.6% are underweight, while 12.4% and 2.9% are respectively overweight and obese. During the three months preceding the study, 53.7% of students reported having done physical exercise to keep fit. Students spend an average of 35.2 min/day doing physical activity, and males were significantly more active ( $P < 0.0000019$ ) compared to females. 46.3% of students did not do any physical activity. 31.8% spent on average less than 30 min/day doing physical activity, and 21.9% did 30 or more minutes/day.

**Conclusion:** A large number of students are overweight or obese, often associated with having a sedentary lifestyle. We are confident that there are clear correlations between obesity and various pathological conditions in adults, and so we should insist on the correction of current lifestyles. The importance of this should lead to new work to produce a clearer overview on the current situation.

## ISEE-0423

**First Results about an *Ostreopsis Ovata* Monitoring along the Catania Coast (Sicily-Italy)**

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**Background and Objective:** Phylum dinoflagellates and diatoms are the most represented phytoplanktonic organisms and both can, if present in elevated densities, cause the "Harmful algal bloom". The WHO claims that the risk to human health, associated with the presence of toxic marine algae, is limited to a few species and to specific geographical areas. Therefore their recommendation is to conduct adequate plans for monitoring and surveillance, activities assessment and risk management alone in potentially affected areas without setting a limit. The aim of our study is to assess the presence of *Ostreopsis siamensis* and *Ostreopsis ovata* along the Catania coast (Sicily-Italy) during the period 2008–2009.

**Methods:** *Ostreopsis* was researched in summer 2008 by SEM (Scanning Electron Microscopy) after appropriate sample preparation. In the water column where macroalgae were sampled, *Vibrio fischeri* toxicity testing was carried out.

**Results:** Whilst in some macroalgae samples *Ostreopsis* was absent, in almost all a remarkable abundance of different species of diatoms were identified, while the water samples weren't toxic. In two macroalgae samples diatoms were absent and colonies of *Coolia monotis* (dinoflagellate species known to be producing toxins) were present, while water samples were toxic.

**Conclusions:** An interesting result is the abnormal presence of diatoms, in the samples taken near to industrial and urban wastewater, in the summer season. We hypothesize that the toxicity water samples can be attributed to the presence of *Coolia monotis*. Our partial results show that the problem of toxic algae is present in our seas, but unfortunately the current regulations for the allocation of coastal bathing waters and controlling the sanitation of the coastal marine environment have weaknesses regarding the control of the presence of dinoflagellates and their toxins. It represents an open issue of urgent public health definition.

## ISEE-0429

**The Incidence of *Listeria Monocytogenes* in Pasteurized and Unpasteurized (Raw) Milk in Two Districts of Albania During a Period of 3 Years (2006–2008)**

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**Abstract:** *Listeriosis*, a bacterial infection caused by *Listeria Monocytogenes*, is prevalent in newborns and immunocompromised adults, particularly in pregnant women as approximately one-third of *Listeriosis* cases occur during pregnancy. The bacteria are generally resistant to common food preservation methods. This study presents the first known case of *Listeria Monocytogenes* detection in Albania.

The study was conducted on the two largest dairy producing districts by periodically (3 years, 2006–2008) analyzing 240 milk samples, of which 168 unpasteurized (raw) milk samples from tanker trucks and 72 pasteurized bottled-milk samples. The isolation and identification of *Listeria monocytogenes* in milk samples was according to the ISO 11290–1 method. All pasteurized bottling milk samples (72) tested negative for *L. monocytogenes*. From the 168 unpasteurized (raw) milk samples, 22% (37 samples) tested positive for *L. monocytogenes*; and 78% (131 samples) tested negative.

The number of bacteria in the positive samples was based on the recommended (low) level of 100 cfu/mL. From the 37 positive samples; 2 samples contained 10 cfu/mL, under the recommended level, 28 samples

contained 100 cfu/mL on the recommended level, and 7 samples contained 1000 cfu/mL, much over the recommended level. The biochemical test of positive samples identified three stereotypes of *L. monocytogenes*.

In conclusion, pasteurization provides an effective method for short-term milk preservation, whereas the incidence of *L. monocytogenes* in unpasteurized (raw) milk is possibly the result of poor animal health and lack of hygiene in animal farms. The results and conclusions were used in recommending the improvement of hygiene in animal farms, periodic control of animal health and the improvement of existing legislation to the Ministry of Health and to the Ministry of the Agriculture.

## ISEE-0434

**Association Between Occupational Environment, Behavioral Factors, and Total Cardiovascular Risk**

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**Background and Objective:** In Slovakia there is well-developed chemical industry, but many workers are still working in unhealthy occupational environment. These conditions together with unhealthy behavior and/or nutrition could increase cardiovascular disease risk. The purpose of the study was to compare lifestyle characteristics, dietary habits and health determinants in relation to total cardiovascular risk in the exposed and unexposed samples.

**Methods:** 2,690 healthy employees in 18 different workplaces in Slovakia (44.9% men and 55.1% women) in the mean age  $41.5 \pm 9.6$  years were examined for cardiovascular risk factors (serum lipids level, blood pressure, overweight/obesity) and completed with a questionnaire on socioeconomic, demographic and behavioral factors, nutritional pattern, self reported health status, and mental health. Relative cardiovascular risk was calculated using SCORE chart after the projection to the age of 60. 393 subjects (53.7% men) exposed to different chemical pollutants in their workplaces were compared to unexposed subjects, chi-square and multiple linear regression analysis were performed.

**Results:** Exposed subjects were significantly younger (39.9 yrs vs. 41.6 yrs;  $P = 0.0003$ ), with lower educational level, they had higher physical and stress load at work (NS), worse mental health score ( $P = 0.0431$ ), and higher relative cardiovascular risk (OR = 1.30; 95%CI = 1.02–1.64;  $P = 0.0277$ ). They reported more often exposure to second hand smoke at work as well as in privacy and self-reported poorer health status. Linear regression analysis (adjusted for age) showed positive significant association among SCORE60 and chemical factors exposure ( $P = 0.0372$ ), stress load ( $P = 0.0021$ ), physical load ( $P = 0.0003$ ) second hand smoke exposure ( $P = 0.0000$ ), alcoholic beverages consumption ( $P = 0.0000$ ) and poorer health status ( $P = 0.0393$ ), and negative significant association with educational level ( $P = 0.0011$ ), fruit ( $P = 0.0001$ ) and vegetable ( $P = 0.0340$ ) consumption.

**Conclusion:** Our results point out the possible combined adverse effect of working conditions, lifestyle and/or nutritional habits to cardiovascular risk, mental health and self-reported health status.

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## ISEE-0435

**Efficacy of Succimer Chelation of Mercury at Background Exposures in Toddlers: Randomised Trial**

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**Background and Objective:** The aim of this work is to examine whether succimer reduces blood mercury concentration in children who participated in a clinical trial of chelation for elevated blood lead concentration.

**Methods:** We analyzed specimens for blood mercury from a multi-center, randomized, controlled clinical trial. The trial had been conducted in the 1990's in four US cities: Philadelphia PA, Newark NJ, Cincinnati OH, and Baltimore MD. There were 780 children aged 12–33 months with blood lead concentrations between 20 and 44  $\mu\text{g/dL}$ . Children were randomized within strata of clinical centers, body surface area, blood lead concentration and language to receive succimer or placebo. Treatment courses were 26 d in length. Depending on the blood lead concentration, children could receive up to three courses of treatment.

**Results:** After one week of treatment, organic mercury concentration decreased 2% (0.53 to 0.52  $\mu\text{g/L}$ ,  $P = 0.51$ ) in the placebo group but decreased 8% (0.52 to 0.48  $\mu\text{g/dL}$ ,  $P = 0.01$ ) in the succimer group. After three treatment courses (5 months), organic mercury increased 12% (0.52  $\mu\text{g/L}$  to 0.58  $\mu\text{g/L}$ ,  $P = 0.01$ ) in the placebo group but only 4% in the succimer group (0.48 to 0.50  $\mu\text{g/L}$ ,  $P = 0.51$ ). We constructed a likelihood ratio-type statistic to test for trend in the differences between the placebo and succimer groups, using isotonic regression techniques and bootstrap methodology; the  $p$  for trend was 0.02.

**Conclusion:** Succimer chelation for low level mercury exposure in children has statistically significant, but limited clinical efficacy, even with high doses for prolonged periods (supported in part by NIH intramural).

#### ISEE-0436

##### Consumption of Green Vegetables, GSTM1 Genotype and the Association of Air Pollution with Inflammatory Responses

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**Background and Objective:** It has been shown that cruciferous vegetable consumption and glutathione-S-transferase M1 (GSTM1) genotype are associated with detoxifying capacity. We investigated whether the associations between air pollution and inflammatory markers were modified by GSTM1 and green vegetable consumption.

**Methods:** In 1003 myocardial infarction survivors from six European cities, plasma fibrinogen and interleukin-6 (IL-6) levels were determined repeatedly ( $N = 5813$ ). Building a risk score, we assumed high risk in case of GSTM1 null and low vegetable consumption present in half of the study participants, and low risk as having at least one functional GSTM1 allele and a high vegetable consumption. The rest was classified as medium risk. City-specific analyses were conducted using additive mixed models adjusting for patient characteristics, time trend and meteorology and estimates were pooled using meta-analysis methodology.

**Results:** The main effect particles with a diameter  $<10 \mu\text{m}$  ( $\text{PM}_{10}$ ) on fibrinogen was a 0.6% increase (95%-confidence-interval (CI): 0.1–1.1%) per 5-day average of  $13.5 \mu\text{g/m}^3 \text{PM}_{10}$ . Persons, who are GSTM1 null (1.0% (95%CI: 0.3–1.8%)) and those not frequently eating green vegetables (0.9% (95%CI: 0.2–1.6%)) had larger responses, but these were not statistically significantly different from the remainders. In individuals with a high risk score we found a 0.8% change in fibrinogen mean per  $13.5 \mu\text{g/m}^3$  increase in the 5-day average of  $\text{PM}_{10}$  (95%CI: 0.2–1.5%),

whereas individuals at low risk showed no increase (0.1%; 95%CI: -0.8–0.9%) indicating a graded dose response.

**Conclusion:** The air pollution-inflammation response might be influenced by a combination of genetic disposition and green vegetable consumption. Isothiocyanates derived from glucosinolates present in cruciferous vegetables might induce detoxifying enzymes such as GSTM1 to enhance the detoxifying capacity.

#### ISEE-0439

##### Association Between Tobacco Smoke and Nutritional Behavior

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**Background and Objective:** The prevalence of smoking has been increasing in young people, especially in women. The effect of cigarette smoking on nutritional behavior has been discussed. The objective of our study was to compare the differences between nutritional behavior of smokers and non-smokers. The analysis was focused on specification of nutritional consumption in smokers.

**Methods:** During the years 1992–2007, 4,492 university students (35.3% men) were examined. There were 713 current smokers (20.8% men vs. 13.2% women;  $P < 0.001$ ) enrolled into the sample. The average daily cigarette consumption in men was  $8.3 \pm 6.1$  (in women  $5.8 \pm 4.6$ ) cigarettes/day and the duration of smoking was  $4.7 \pm 2.5$  and  $4.0 \pm 1.8$  yrs, respectively. 24-hour recall, frequency of selected commodities and foodstuffs preferences were used. T-test statistics and correlation analysis were performed.

**Results:** The frequency of daily meals is lower in smokers (3.7 vs. 4.1;  $P < 0.01$ ), they miss breakfast, snack or lunch. There was lower energy, proteins, carbohydrates, dietary fiber, minerals (calcium) and vitamins (vitamin C) daily intake, and significantly higher water consumption in smoking men and women. The total consumed food weight was higher in smokers (by 246 g in men; by 106 g in women). Smokers (men as well as women) consume less dairy products, fruit and vegetable than non-smokers. There were significant negative correlations among number of cigarettes/day and/or smoking duration and milk ( $r = -0.1768$ ;  $P < 0.05$ ), fruit ( $r = -0.1583$ ;  $P < 0.01$ ) and vegetable consumption in the sample of smokers. On the contrary, positive correlations were assessed among number of cigarettes/day and/or smoking duration and sugary beverages ( $r = 0.2028$ ;  $P < 0.05$ ) and alcoholic beverages ( $r = 0.1748$ ;  $P < 0.01$ ) consumption in the sample of smokers.

**Conclusion:** Our results point out the negative nutritional behavior in smoking men and women. The dietary habits were much worse in smokers, as well as poorer food choices, and higher alcohol consumption.

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#### ISEE-0440

##### Pollutant Chemicals, Thyrotropin, and Thyroid Hormone in Infants

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**Background and Objective:** Infants are exposed to chemicals that might interfere with thyroid function, such as perchlorate, thiocyanate, and nitrate. There are no studies available with individual measures of these chemicals and thyroid function in infants. We examined whether urinary perchlorate, nitrate, or thiocyanate is associated with urinary thyroxine (T4) and thyroid stimulating hormone (TSH) in infants. Because background perchlorate exposure has been associated with changes in



thyroid hormone levels in adults, we specifically examined whether perchlorate was associated with higher TSH in infants with low iodide and in infant girls, as was seen in US females over age 12 years.

**Methods:** The study was conducted at the Children's Hospital of Philadelphia, the Hospital of the University of Pennsylvania, and affiliated clinics, among 92 full term infants (47 males and 45 females) between birth and 1 year of age. We used data from the Study of Estrogen Activity and Development, which was a partly cross-sectional, partly longitudinal study designed to assess hormone levels of full term infants over the first 12 months of life. We analyzed urine samples collected in that study.

**Main Outcome Measures:** Urinary perchlorate, thiocyanate, nitrate, iodide, TSH and T4, and blood TSH and T4.

**Results:** In models with single chemical agents, infants with higher perchlorate had higher TSH and T4. In models with all three chemical agents, infants with low iodide and higher perchlorate had higher T4 and TSH; infants with higher urinary thiocyanate or higher urinary nitrate had higher urinary TSH and T4.

**Conclusions:** The association of perchlorate exposure with increased urinary TSH in infants with low urinary iodide is consistent with previous findings in females aged 12 and older. Higher thiocyanate and nitrate exposure is also associated with higher urinary TSH in infants. (Supported in part by the intramural research program of NIH.)

#### ISEE-0445

##### Field Evaluation of the Ogawa Diffusive Sampler for NO<sub>2</sub>/NO<sub>x</sub> in a Cold Climate

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**Background and Objective:** The Ogawa diffusive sampler is used for NO<sub>2</sub>/NO<sub>x</sub> measurements in ambient air monitoring networks. Field comparisons with reference monitors have been carried out in Texas and Michigan. The sampler is currently used in the ESCAPE project measuring spatial variation in 40 different areas in Europe. Aims; assess NO<sub>2</sub> and NO<sub>x</sub> uptake rates, and perform field comparisons with chemiluminescence monitors, in a cold climate.

**Methods:** Weekly parallel measurements of NO<sub>2</sub> (NO<sub>x</sub>) were conducted at 13(4) occasions in Umeå, Sweden and at 11(11) occasions at two sites in Malmö, Sweden (°C = 2.4–17.3). Nineteen(9) parallel measurements of NO<sub>2</sub> (NO<sub>x</sub>) were conducted at three sites in Umeå (°C = -0.3–(-13.8)).

**Results:** For temperatures above zero the mean sampling rate for NO<sub>2</sub> (NO<sub>x</sub>) was 8.69 (9.88) ml/min with a coefficient of variation of 14(16)% (N = 35(26)). The mean sampling rate for temperatures below zero was 7.04 (7.13) ml/min with a coefficient of variation of 16(12)% (N = 19(9)).

The mean difference between the NO<sub>2</sub> concentration estimated with Ogawa and with chemiluminescence was 0.6% (N = 54). The concentration of NO<sub>2</sub> fell between 10 and 54 µg/m<sup>3</sup>. Regression analysis of Ogawa versus the reference method for NO<sub>2</sub> showed a good agreement (R<sup>2</sup> = 0.85).

The mean difference between the NO<sub>x</sub> concentration estimated with Ogawa and with chemiluminescence was 0.3% (N = 32).

NO<sub>2</sub> (NO<sub>x</sub>) concentrations determined according to the Ogawa protocol differed from chemiluminescence by -4.9% and 23% respectively. The theoretical sampling rate was found to underestimate the nitrogen dioxide concentration with about 27%.

**Conclusion:** The sampler has shown to perform well for NO<sub>2</sub> in a cold climate. For NO<sub>x</sub> it is advisable to use our estimated uptake rate.

#### ISEE-0446

##### Secondhand Smoke and Physical and Mental Health of Non-smoking Mothers

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**Background and Objective:** According to the 2006 US Surgeon General's Report second-hand smoke causes premature death and disease in children and in adults who do not smoke. In this study we present the results of analyses exploring the independent association of household exposure to SHS and maternal physical and mental health among non-smoking mothers.

**Methods:** Nationally representative data from the 2000–2004 Medical Expenditure Panel Survey (MEPS) were utilized. The physical and mental health of mothers living with children <18 years who lived with 1 or more adult smokers (n = 3,344) were compared to the health of mothers living in households without adult smokers (n = 14,836). Medical Outcomes Short Form-12 (SF-12) Physical Component Scale (PCS) and Mental Component Scale (MCS) were used.

**Results:** 79.2% of all mothers are non-smokers, and 20.8% smoke. Among non-smoking mothers, 17.4% live in households with at least one adult smoker: 14.2% live with one adult smoker and 3.2% live with 2 or more smokers. The presence of an adult smoker as well as increasing number of smokers in the household are both significantly negatively associated with MCS and PCS scores in bivariate analyses (P < 0.001 for each). Adjusting for age, race, poverty category, marital status, education and occupation in logistic regression analyses, the presence of at least one smoker is independently associated with decreases of MCS (OR = 0.89, 95% CI = 0.80–0.99) and PCS score (OR = 0.81, 95%CI = 0.73–0.90). There is evidence of a dose response relationship with increasing number of smokers in the household both for the MCS and the PCS.

**Conclusions:** The results of the present study demonstrate impaired mental and physical health of non-smoking mothers who live with smokers. The risk is discernible with the presence of a single adult smoker in a household and increases with the number of smokers.

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#### ISEE-0447

##### Obesity of Children and Youth in Association with Psychosocial Factors of Family

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**Background and Objective:** The worldwide increase in obesity prevalence is an epidemic. Obesity in childhood is a risk for obesity and obesity related diseases in adulthood. The purpose of the study was to evaluate an association between body mass index (BMI) and obesity and selected family psychosocial factors.

**Methods:** We assessed overweight (BMI [kg.m<sup>-2</sup>] over 90th percentile) and obesity (BMI over 97th percentile) in children on the basis of 5th and 6th Slovak nationwide cross-sectional anthropometric surveys (1991, 2001) in representative samples (118,400 and 35,600 children and youth), 2 to 18-year-olds of both genders. Psychosocial data of families (education and occupation of parents, ethnicity and completeness of

family) were obtained by questionnaire. The programs Microsoft Excel and S-Plus were used for analysis.

**Results:** During the decade the mean value of BMI significantly increased only in 9 to 15-year-old boys ( $0.3\text{--}0.4\text{ kg.m}^{-2}$ ,  $P < 0.001$ ) and in 7–11 year-old girls ( $0.15\text{--}0.4\text{ kg.m}^{-2}$ ,  $P < 0.01\text{--}P < 0.001$ ); BMI mean value of boys in the age of 2–8 and 16–18 remain unchanged and in 12–18 year old girls was significantly decreased. Overweight and obesity was negatively associated with parental education. Significant negative relationships were identified between the incidence of overweight and maternal educational level in girls ( $P = 0.0025$ ). Multiple linear regression did not confirm a significant association with ethnicity (Romany children and adolescents) and completeness of family. Studied socio-economic factors acted together with other patterns in the family (nutritional, physical activities, etc.).

**Conclusion:** Although family social factors, particularly maternal educational level is related to children overweight, the associations vary according age and gender. Protection and promotion of children and youth healthy development requires optimal conditions based on knowledge of the interaction between the developing organism and influencing exogenous and endogenous factors.

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#### ISEE-0448

##### Is There an Association Among Road Traffic Noise Exposure and Cardiovascular Risk Score?

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**Background and Objective:** The harmful effect of noise on the human organism has been relatively underestimated for a long time. In contrast to some other environmental problems, noise pollution continues to increase, followed by an increasing number of complaints from the exposed residents.

The objectives of the present study were to assess the relations between community noise, especially from road traffic, and cardiovascular risk in the sample of young healthy individuals.

**Methods:** The study sample ( $n = 659$ ; 36.9% males, 63.1% females, university students, mean age  $22.83 \pm 1.58$  years) included a group exposed to road traffic noise ( $n = 280$ ,  $\text{Leq}_{24h} = 67 \pm 2\text{ dB(A)}$ ) and a control group ( $n = 379$ ,  $\text{Leq}_{24h} = 58.7 \pm 6\text{ dB(A)}$ ). Subjective response was determined by a validated noise annoyance questionnaire. Ten year cardiovascular risk of developing a CHD event was quantified using SCORE60, Framingham risk scoring (Framingham 10-year risk estimation and projection to age of 60) and the relative risk chart.

**Results:** Cardiovascular risk scores come out significant in the exposed group even after adjustment for personal and life style characteristics in both the Framingham score projected to age 60, SCORE60 (Adjusted odds ratio-AOR = 2.72 (95% CI = 1.21–6.15)) and the relative risk chart (AOR = 2.81 (95% CI = 1.46–5.41)). No significant difference in blood pressure and blood lipids were observed in bivariate analysis and crude comparisons between the high and low exposure groups. This finding could be explained by combination of risk factors (e.g. gender, cigarette smoking, systolic blood pressure, TC, HDL-C or atherogenic plasma index) in the cardiovascular risk score models and multifactoriality of the risk towards noise exposure.

**Conclusion:** In spite of many limitations, these findings highlight the association between road traffic noise and cardiovascular risk indicating the need for preventive measures to reduce road traffic noise in residential areas.

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#### ISEE-0451

##### Level of Noise in the Urban Environment in Kardzhali, Bulgaria

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**Background and Objective:** Problems associated with noise contamination exist in many settlements in Bulgaria. Our objective was to investigate the equivalent levels of noise (LN) and its trends in Kardzhali, with the aim of undertaking measure for health protection.

**Methods:** The study was conducted in the period 2001–2006. LN were measured in 24 stations, situated in zones with different noise contamination: streets with intensive automobile traffic (zone 1), streets close to industrial production with increased noise and train stations (zone 2), and living zones and zones requiring increased noise protection (zone 3). Measurements were performed using standard methodology with “Brüel & Kjær” apparatus. LN in different zones were compared between group and with permissible norms for respective zones: group 1–60 dB(A), group 2–70 dB(A) and group 3–55 dB(A).

**Results:** Monitoring of noise levels in Kardzhali demonstrated that during the period of investigation, zones 1 and 3 had higher mean equivalent LN comparing with permissible norms, respectively zone 1–68.4 dB(A) and zone 3–56.7 dB(A). For zone 3 mean equivalent LN were 68.6 dB(A), which was below the norms. The difference between LN in the three zones were statistically significant ( $P < 0.001$ ). For the duration of the study period there was no trend for a substantial increase or decrease of LN.

**Conclusion:** In Kardzhali, LN above permissible norms were detected both in the zone 1 and zone 3. In the zone 2, LN were below permissible norms. Noise contamination of Kardzhali was mainly due to automobile traffic. It is necessary to introduce urgent measures, like divergence of transit vehicles through ring-roads, introduction of one-way streets, maintenance of roads in good condition, construction of noise shields and other suitable equipments and facilities, planting and grassing, etc. The undertaking measures will lead to recovery and improvement of the living environment.

#### ISEE-0454

##### Relationships Between Brominated Flame Retardant Concentrations in House Dust and Serum Hormone Levels in Men

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**Background and Objective:** Human exposure to brominated flame retardants (BFRs) is widespread, occurring primarily through diet or contact with indoor dust. There is laboratory evidence of endocrine disruption in animals following exposure to BFRs, but human studies are limited. In this preliminary investigation, we examined the association between BFR levels in house dust and hormone levels in men.

**Methods:** We measured serum hormone levels and BFR concentrations in participant vacuum bag dust from 38 men recruited through a Massachusetts infertility clinic as part of an ongoing study of environmental exposures and male reproductive health. Statistical methods included the calculation of Spearman correlations among BFRs and between BFRs and serum hormone levels, and multivariable linear regression.

**Results:** There were strong correlations ( $r \geq 0.80$ ,  $P < 0.05$ ) among dust concentrations of brominated diphenyl ether (BDE) congener groups with a similar degree of bromination. Positive correlations were found ( $P \leq 0.05$ ) between several BDE congeners and serum levels of prolactin and total T3, and between bis(tribromophenoxy)ethane and total T3. Hexabromocyclododecane was positively correlated with free androgen

index (FAI) ( $r = 0.46$ ,  $P = 0.004$ ). Most of these relationships remained statistically significant or suggestive in multivariate linear regression models adjusted for age and BMI. There was a suggestive inverse association between BDE209 and testosterone when adjusting for age, BMI, and serum sex hormone binding globulin (SHBG) ( $P = 0.09$ ). When dust concentrations of BDE99 were combined with results from a previous analysis of 24 men from the same cohort ( $n = 62$ ), regression models adjusted for age, BMI, and dust analytical method showed positive relationships between BDE99 and serum estradiol, free T4, and SHBG ( $P < 0.05$ ). Inverse associations between BDE99 and follicle stimulating hormone ( $P < 0.05$ ) and FAI ( $P = 0.11$ ) were also found.

**Conclusion:** This study provides evidence of altered hormone levels in relation to BFR exposure and that house dust may be an important source of human BFR exposure.

#### ISEE-0462

##### Evaluation of the Impact of Measurement Error from Instrument Precision and Spatial Variability on Risk Ratio Estimates in an Air Pollution Epidemiology Time-Series Analysis

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**Background and Objective:** Measurement error is ubiquitous in air pollution epidemiology. We demonstrate how the magnitude of measurement errors associated with instrument precision and spatial variability can affect risk ratio estimates in a time-series analysis.

**Methods:** Daily counts of emergency department visits for cardiovascular disease (ischemic heart disease, dysrhythmia, congestive heart failure, and peripheral/cerebrovascular disease) were obtained from hospitals in Atlanta, USA during 1999–2004. Using measurements from stationary monitors, instrument precision and spatial variability were characterized for 12 pollutants. We chose a “reference” time-series of daily pollution measurements and used semivariogram estimates to add measurement error to the reference time-series via Monte Carlo simulation for each of the 12 semivariograms.

**Results:** Error from instrument precision had a small impact on the risk ratio estimates (mean estimates attenuated 0.7% to 3.9%). Incorporating spatial variability strongly attenuated the risk ratio estimates for primary pollutants  $\text{SO}_2$ , CO,  $\text{NO}_2$ ,  $\text{NO}_x$ , and elemental carbon (mean estimates attenuated 12.4% to 19.9%); modestly attenuated risk ratio estimates for  $\text{PM}_{10}$ , nitrate, ammonium, and organic carbon (mean estimates attenuated 5.4% to 6.8%); and slightly attenuated the risk ratio estimates for  $\text{PM}_{2.5}$ ,  $\text{O}_3$ , and sulfate (mean estimates attenuated 2.5% to 4.0%). Individual risk ratio estimates were not always attenuated; risk ratio estimates for 13.4% ( $\text{NO}_2$ ) to 30.5% ( $\text{O}_3$ ) of simulations were more extreme than the reference risk ratio estimate. For the primary pollutants, we observed a slight widening of the confidence interval estimates (3.1% to 7.6%) due to measurement error; this change was negligible for the other pollutants.

**Conclusion:** Risk ratio estimates and significance may be attenuated because of measurement error in ambient pollution concentrations, and this attenuation varies across pollutants. Because spatial variability in ambient concentrations may not directly indicate spatial variability in population exposure to ambient pollution, our results should be interpreted in the context of this limitation.

#### ISEE-0463

##### Acute Associations Between Ambient Air Pollution and Pediatric Asthma Emergency Department Visits in Atlanta, 1993–2004

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**Background and Objective:** We investigated effect modification by season and potential confounding by ambient pollen levels and circulating respiratory infections on short-term associations between ambient air pollutants and pediatric emergency department visits for asthma or wheeze.

**Methods:** Hospital-specific daily counts of emergency room visits for asthma or wheeze among children age 5–17 were collected from 41 Metropolitan Atlanta, USA, hospitals during 1993–2004 ( $n = 91,386$  visits). Three-day moving averages of central monitoring station ambient air pollution measurements were calculated for the criteria gases,  $\text{PM}_{10}$ , coarse PM,  $\text{PM}_{2.5}$ , and several  $\text{PM}_{2.5}$  components. Risk ratios for the warm season (May–October) and cold season (November–April) were estimated via Poisson generalized linear models so as to approximate a case-crossover analysis (matching on year, month, and lag 0 max temperature in Celsius) while accounting for overdispersion. We included a cubic polynomial for day-of-season; indicator variables for hospital and day of week; the daily count of upper respiratory infections among children age 5–17 (aggregated over hospitals); and three-day moving averages of dew point and minimum temperature. We also investigated confounding by ambient levels of several pollen species.

**Results:** We observed several significant positive associations during the warm season and few associations during the cold season. Ozone in particular was strongly associated with pediatric asthma emergency department visits in both seasons. In multipollutant models we observed evidence for effects of both ozone and traffic pollutants. Ambient pollen levels did not appear to confound these relationships. Risk ratio estimates tended to be closer to unity when we controlled for upper respiratory infections, although associations were present regardless.

**Conclusion:** Although we controlled tightly for temperature and temporal trends, we nevertheless observed several positive, statistically significant associations between ambient pollutants and pediatric emergency department visits for asthma and wheeze.

#### ISEE-0464

##### The Effects of Prenatal Exposure to PCBs and MeHg on Memory and Learning in School-Aged Children

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**Background and Objective:** Polychlorinated biphenyls (PCBs) and methylmercury (MeHg) are environmentally persistent neurotoxicants with adverse effects on neurodevelopment at high exposure levels. However, findings at lower level exposures are inconsistent.

**Methods:** 355 children, born between 1993–1998 to mothers residing near a PCB-contaminated harbor in New Bedford, Massachusetts, and participating in a longitudinal study of child development, were studied. Cord serum PCB and maternal peripartum hair mercury (a MeHg proxy) levels were measured to estimate exposure. Memory and learning abilities were assessed at age 8 years (range: 7–10 years) using the Wide Range Assessment of Memory and Learning (WRAML), age-standardized to a mean of 100 and standard deviation of 15. Associations with each WRAML index—Visual Memory, Verbal Memory, and Learning—were examined with multivariable linear regression, controlling for potential confounders and predictors of the outcome.

**Results:** While cord serum PCB levels were low and comparable to population-based background levels (mean: 0.3 ng/g serum; range: 0.01,



4.4), hair Hg levels were slightly higher than U.S. population norms (mean: 0.6 ppm; range: 0.1, 5.1). There was no significant association of PCBs with WRAML indices. However, in multivariable models, each ppm increase in hair Hg was associated with  $-3.3$  (95% CI:  $-5.8, -0.7$ ) and  $-2.5$  (95% CI:  $-5.2, 0.1$ ) respective decrements in Visual Memory and Learning indices. Stratified analysis suggested an adverse hair Hg effect on Verbal Memory but only among children with higher PCB levels ( $> 0.3$  ng/g serum, the upper tertile of the exposure distribution) with a  $-3.1$  (95% CI:  $-5.9, -0.3$ ) decline in Verbal Memory per ppm hair Hg in this group.

**Conclusions:** This study supports a relation of modest prenatal MeHg exposure with subsequent decrements in memory and learning at school age, and suggests potential enhancement of this association with modest elevations in prenatal PCB exposure.

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#### ISEE-0467

##### **Engaging a Hard-to-Reach Population in Environmental Epidemiology Research: Sampling and Recruitment of California's Hired Farm Workers**

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**Background and Objective:** Farm workers provide the majority workforce for California's labor-intensive agriculture, but little research has examined the etiology of poor health outcomes that occur disproportionately in this population. To understand occupational/environmental risks, it is critical to obtain representative study samples; however, this poses methodological difficulties. Farm workers are typically mobile, often do not speak English, have little education, may be of undocumented legal status and have complex occupational histories. Therefore, techniques for identifying and recruiting participants for epidemiological studies must utilize different strategies.

**Methods:** MICASA is a cohort investigation of occupational and environmental risks associated with health in 422 farm worker families residing in Mendota, CA. To obtain a representative sample, a two-stage sampling process was employed including identification of eligible census tracts and door-to-door enumeration. The enumeration of residential structures included houses, apartments, trailers and informal structures that housed farm workers. Enumerators visited each mapped dwelling and obtained basic information on residents.

**Results:** 2441 individuals living in 751 households were enumerated. 24% of households were comprised of unaccompanied males, and 9% had 2+ married couples. Among enumerated individuals, 86% engaged in farm work. 66% were men and 34% were women. 55% were Mexican born, 35% were from Central America and 10% were U.S. born. 70% of enumerated households participated in MICASA; 30% declined for reasons including no time, not interested, or don't want to share personal information. Comparisons between the enumerated and sample populations showed no differences by age, country of birth and years living in U.S.

**Conclusion:** Utilizing a local field team, working with a community advisory board, and involving the community were vital to achieving the research goals. While difficulties in accessing immigrant populations often account for the lack of research, innovative approaches can result in valid samples for epidemiologic study.

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#### ISEE-0469

##### **Modifiers of Short-Term Effects of Ozone on Mortality in the Eastern Massachusetts—A Case-Crossover Analysis at Individual Level**

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**Background and Objective:** Substantial epidemiological studies demonstrate associations between exposure to ambient ozone and

mortality. A few studies simply examine the modification of this ozone effect by individual characteristics and socioeconomic status, but socioeconomic status was usually coded at the city level.

**Methods:** This study used a case-crossover design to examine whether associations between ozone and specific cause deaths were modified by socioeconomic status coded at the tract or by individual characteristics at an individual level in the eastern Massachusetts, US with a period 1995–2002.

**Results:** A 10 ppb increase in the average of 8-hour ozone in the previous week was associated with 2.30% (95% confidence interval (CI): 0.97%, 3.65%), 2.32 (95% CI:  $-1.95, 6.78$ ), 5.64 (95% CI:  $-2.64, 14.63$ ), 1.43 (95% CI:  $-0.72, 3.64$ ), 0.33 (95% CI:  $-2.08, 2.80$ ), 0.84 (95% CI:  $-2.93, 4.75$ ) and 5.40 (95% CI: 0.06, 11.01) increases in all natural deaths, respiratory disorders, diabetes, cardiovascular diseases, heart diseases, acute myocardial infarction and stroke, respectively. We did not find any obvious evidence that the associations were significantly modified by socioeconomic status or individual characteristics although small differences of estimates across subpopulations were demonstrated.

**Conclusion:** The study found that the exposure to ozone was associated with specific cause mortality in the eastern Massachusetts during 1995–2002. There was no significant evidence that effects of ozone on mortality were modified by socioeconomic status and individual characteristics.

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#### ISEE-0470

##### **To Chlorinate or not to Chlorinate?: That Is the Watery Question**

David F Goldsmith,\* Erin Jones,\* and Tee L Guidotti,† *\*George Washington University, Washington DC, United States; and †Occupational + Environmental Health & Medicine, Washington DC, United States.*

**Background:** Water disinfection using chlorine compounds or disinfection byproducts (DBPs) has been a commonly used method for purification in the U.S. and other developed nations for the past 8 decades. The toxicology of chlorine and trihalomethanes DBPs is well studied, and chlorine is an effective disinfectant. We wanted to contrast chlorine and other disinfection methods for efficacy and infection prevention capacity.

**Methods:** A review of the Medline and Toxline literature published after 1995 returned numerous epidemiologic studies demonstrating weak associations between DBPs and some cancers, and more recently evidence of modest associations with birth defects and spontaneous abortions. Little risk information was detected for alternative disinfection methods.

**Synthesis:** Alternative methods of disinfection such as UV radiation, chloramines, ozone and paracetic acid are as effective as chlorine DBPs at disinfecting the water at the point of purification. However, the non-specific biocidal activity of chlorine products demands the meticulous control of the concentration levels. In contrast with chlorine products, these alternative methods do not continue to disinfect water downstream from the site of purification. Because municipal water distribution systems are not watertight, especially in older cities (of the U.S.), this presents a risk-risk tradeoff, contrasting acute versus chronic illnesses.

**Summary:** Currently, the risk of not using a method that will disinfect the water all the way through the system to the point of consumption outweighs the low risk of adverse chronic health defects from exposure to chlorine DBPs. Alternatives to chlorine compounds must demonstrate equivalent efficaciousness before widespread adoption. Although chlorine compounds have known toxicity, their use has demonstrated biocidal properties throughout urban water supplies. Adoption of nonchlorine methods can lead to higher possible infectious disease risks.

## ISEE-0472

**Global Climate and Environmental Change: Adaptation Strategies for Food and Water**

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**Background:** Global Climate and Environmental change have an impact on microbiological and chemical food and water risks through different pathways such as increased temperature, precipitation changes, ocean warming and acidification, changes in salinity, flooding, droughts, desertification, ecological changes etc. These climate impacts are exacerbated by anthropogenic environmental degradation.

The objective of this study is to identify adaptation strategies and policies to address the impacts of climate and environmental change on food and water safety in different geographical regions.

**Methods:** This study systematically reviews the impacts of global climate and environmental change on food, water and environmental health issues and identifies exemplary adaptation strategies from case studies in different climatic regions.

**Results:** Infectious food and waterborne diseases such as diarrheal syndromes, salmonellosis are associated with increased temperatures. Higher densities of *Vibrio* spp. in seafood are related to higher ocean temperature and changes in salinity. Increased risk of zoonosis is due to changes in pathogen survival, carriers and vectors and in the ecosystems. Contamination with biotoxins such as mycotoxins or marine toxins are affected by climate related changes in the Tropics and in small islands. Chemical food and water contamination are affected by of climate change. Ocean warming facilitates methylation of Hg and subsequent uptake by fish. Soil, water and food contamination with PCBs and dioxins is associated with extreme weather events, such as inland floods (e.g. Europe) or severe droughts such in the Aral Sea, where combined impacts of agriculture mis-management and desertification have resulted in serious health and socio-economic impacts.

**Conclusions:** There is a need for the development of integrated adaptation and mitigation strategies to address the impacts of global environmental change in water and food safety. Case studies in the Sub-Sahara, Arctic, Bangladesh, Aral Sea and Europe provide exemplary adaptation strategies that could be applied in similar climatic regions.

## ISEE-0474

**The Impact of Farming Occupation on Prostate Cancer Survival**

James Gomes,\*† *\*Health Science Program,, Faculty of Health Sciences, University of Ottawa, Ottawa, ON, Canada; and †McLaughlin Center for Population Health Risk Assessment, Institute of Population Health, University of Ottawa, Ottawa, ON, Canada.*

**Background and Objectives:** Age, ethnicity and family history are strongly believed to be the main etiological risk factors of prostate cancer. However, the evidence on the role of other factors such as lifestyle and dietary factors and occupational and environmental exposures in initiating and promoting prostate cancer is still inconclusive. The purpose of this study was to examine the natural history of prostate cancer among men with farming and non-farming backgrounds and associate the disease characteristics and survival to occupational and environmental exposures in farming.

**Methods:** The required information was extracted from medical charts of prostate cancer patients. A total of 8486 medical charts were reviewed and information on primary occupation, tumour characteristics, age and prostate specific antigen (PSA) at the time of diagnosis, method of diagnosis, first treatment options and age at death if applicable was extracted.

**Results:** The age (mean  $\pm$  standard deviation) at diagnosis for farmers ( $72.4 \pm 7.4$  years) was significantly ( $P < 0.0001$ ) higher compared to that

of non-farmers ( $69.5 \pm 7.9$  years). Median PSA level at the time of diagnosis of cancer for farmers at 23.5 ng/ml was higher compared to that for non-farmers at 19.5 ng/ml. At diagnosis 79% of the farmers had well differentiated and moderately well differentiated tumours compared to 82% of non-farmers. Among farmers 63% were diagnosed with a tumour at stage A or B compared to 68% of non-farmers. None or hormonal therapy was the first line of treatments provided to 47% of farmers compared to 39% of non-farmers. The age (mean  $\pm$  standard deviation) at death for farmers ( $78.95 \pm 7.82$  years) was significantly higher than that of non-farmers ( $75.81 \pm 8.75$  years).

**Conclusions:** Farmers were diagnosed at a later age and were initially kept under watchful waiting or treated hormonally. Farmers also died at a later age ( $P < 0.001$ ) but survived less ( $P < 0.001$ ) than the non-farmers.

## ISEE-0478

**The Environmental Impact of Dietary Choice and Agriculture in California**

Hal Marlow, *Loma Linda University, Loma Linda, CA, United States.*

**Background and Objective:** Food demand influences agricultural production. Modern agricultural practices have resulted in polluted soil, air and water, eroded soil, dependence on imported oil, and loss of biodiversity. The goal of this research is to investigate the environmental impact of pesticide and fertilizer application, water consumption, and energy used to produce commodities for a vegetarian and nonvegetarian diet in California. The working assumption is that greater number and amount of inputs are associated with greater environmental impact. The literature supports this notion.

**Methods:** To accomplish this goal, dietary preferences were quantified using the Adventist Health Study and state agricultural data were collected and applied to commodity production statistics. These data were used to calculate the difference in consumption patterns between the two diets and indices to compare the environmental impact associated with inputs for the two dietary patterns.

**Results:** The results show the Adventist vegetarian diet required 5.41 times less water, 2.48 times less primary energy, 12.9 times less fertilizer, and 1.4 times less pesticides than did the Adventist nonvegetarian diet.

**Conclusion:** It is clear that the production of a SDA nonvegetarian diet required the inputs of significantly greater amounts of water, primary energy, fertilizers and pesticides when compared to the SDA vegetarian diet. The greatest contribution to the differences came from the consumption of animal products, eggs, broilers, and beef in the diet. From an environmental perspective, what a person chooses to eat makes a difference. Viewed from the individual lens, the difference in the dietary choices of the SDA vegetarian, nonvegetarian and average American do not appear to support profound conclusions. However, with the added perspective of time and numbers the differences become quite pronounced and may have the potential for tremendously different impacts to the environment.

## ISEE-0482

**Interaction Between Organophosphate Exposure and Serum PON1 Activity on Thyroid Hormones in Mexican Greenhouse Workers**

Marina Lacasaña,\*† Miguel Rodríguez-Barranco,\* Clemente Aguilar-Garduño,\*‡ Julia Blanco-Muñoz,§ Inmaculada López-Flores,†\* Oscar A Pérez-Méndez,¶ Ricardo Gamboa-Ávila,¶ Susana Bassol,\* and Mariano E Cebrian,†† *\*Andalusian School of Public Health, Granada, Spain; †CIBER of Epidemiology and Public Health (CIBERESP), Granada, Spain; ‡Andalusian Observatory of Environmental Health, Granada, Spain; §National Institute of Public Health, Cuernavaca, Morelos, Mexico; ¶National Institute of Cardiology, Mexico DF, Mexico;*

**\*\*Autonomus University of Coahuila, Torreon, Coahuila, Mexico; and ††CINVESTAV, Mexico DF, Mexico.**

**Background and Objective:** Little is known on potential effects of organophosphate (OP) pesticides on the thyroid function in humans. Paraoxonase (PON1) enzyme is involved in detoxification of OP pesticides. Therefore, it could be expected that people with a low PON1 activity have an increased susceptibility to OP. We conducted a longitudinal study to evaluate the effect of interaction between OP exposure and serum PON1 activity on human thyroid hormones.

**Methods:** A total of 137 men (18 to 52 years old) agreed to participate in this study during the rainy season and 85 of them accepted during the dry season as well. A general questionnaire, urine and serum samples were taken a day after pesticide application.

We analyzed urine dialkylphosphates (DAP) and serum TSH, total T3 and T4 by gas chromatography and immunoassays, respectively. Serum PON1 activity towards phenylacetate, paraoxon and diazoxon were determined as described previously by Richter and Furlong 1999 and serum p,p'-DDE levels by gas chromatography.

We calculated total molar quantities (mmol/L) of dimethyl DAP and diethyl DAP. The effect of interaction between DAP levels and serum PON1 activity on TSH, T3 and T4 levels was evaluated using Generalized Estimated Equation (GEE) models adjusted by potential confounders including serum p,p'-DDE.

**Results:** A significant interaction was found between serum PON activity towards paraoxon and diazoxon and dimethyl DAP on TSH levels ( $P = 0.09$  and  $P = 0.05$ ) respectively. For each increment in one logarithmic unit of the dimethyl DAP levels we observed a decrease in the variation percentage of TSH together with serum paraoxonase activity and diazoxonase activity increase (last quintile: 21.8% vs first quintile: 35.8% and last quintile: 22.0% vs first quintile: 38.9%, respectively).

**Conclusion:** These results suggest a higher effect of OP on thyroid function in men with lower serum PON1 activity.

#### ISEE-0483

##### Interaction Between Organophosphate Exposure and Serum PON1 Activity on Hypophysary and Male Sexual Hormones in Mexican Greenhouse Workers

Marina Lacasaña,\*† Clemente Aguilar-Garduño,\*‡ Julia Blanco-Muñoz,§ Miguel Rodriguez Barranco,\* Beatriz Gonzalez-Alzaga,\* Susana Bassol,¶ Mariano E Cebrian,\*\* Ricardo Gamboa,†† and Oscar Perez-Mendez,†† \*Andalusian School of Public Health, Granada, Spain; †CIBER of Epidemiology and Public Health (CIBERESP, Granada, Spain; ‡Andalusian Observatory of Environmental Health, Granada, Spain; §National Institute of Public Health, Cuernavaca, Morelos, Mexico; ¶Autonomus University of Coahuila, Torreon, Mexico; \*\*CINVESTAV, Mexico DF, Mexico; and ††National Institute of Cardiology, México DF, Mexico.

**Background and Objective:** Previous studies have found that organophosphate (OP) may act as endocrine disruptors. Paraoxonase1 (PON1) hydrolyzes the active metabolites of OP insecticides. People with a low PON1 activity have demonstrated an increased susceptibility to OP. The objective of this study was to evaluate the effect of interaction between OP exposure and serum PON1 activity on male hormone profile.

**Methods:** A longitudinal study was conducted from July 2004–May 2005. A total of 137 men (18–52 years old) agreed to participate during the rainy season and 85 of them accepted again during the dry season. A general questionnaire, urine and blood samples were taken a day after pesticide application. Urine dialkylphosphates (DAP) were analyzed by gas chromatography. Serum samples were analyzed for FSH, LH, testosterone, estradiol, inhibin B and prolactin by immunoassay. Serum PON1 activity towards phenylacetate, paraoxon and diazoxon were determined as described by Richter and Furlong 1999, and serum p,p'-

DDE levels by gas chromatography. Molar quantities (mmol/L) of dimethyl DAP and diethyl DAP were calculated. The interaction effect between DAP levels and serum PON1 activity on serum hormones levels was evaluated using Generalized Estimated Equation models adjusted by potential confounders including serum p,p'-DDE.

**Results:** A significant interaction ( $P = 0.05$ ) was found between diazoxonase activity and SDAP on inhibin B levels. We observed a decrease in the percentage of variation of inhibin B for each increment in one unit of the logarithm concentration of âDAP together with diazoxonase activity increase (last quintile: -14.7 vs first quintile: -6.4%). The effect of interaction between dimethyl DAP and paraoxonase activity on testosterone was near to statistical significance ( $P = 0.06$ ). No significant interaction was observed between serum PON1 activity and DAP levels on the other hormones.

**Conclusion:** We found an effect of interaction between OP exposure and PON1 activity on serum inhibin B and testosterone levels.

#### ISEE-0484

##### Association Between Organophosphates Pesticides Exposure and Reproductive Hormone Profile in Male Greenhouse Workers

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**Background and Objective:** Organophosphates pesticides (OP) are considered endocrine disruptors because of their capacity to block or activate hormone receptors and/or alter hormone metabolism.

The main objective was to assess the relationship between urinary DAP levels and hypophysary and male sexual hormones in Mexican greenhouse workers.

**Methods:** A longitudinal study was conducted from July 2004–May 2005. A total of 137 men (18 to 52 years old) agreed to participate in this study during the rainy season (July and October 2004) and 85 of them accepted during the dry season as well (December 2004–May 2005). A general questionnaire, blood and serum samples were taken a day after pesticide application.

Urine dialkylphosphates (DAP) were analyzed by gas chromatography and serum FSH, LH, testosterone, estradiol, inhibin B and prolactin by enzymatic immunoassay. Serum levels of p,p'-DDE were analyzed by gas chromatography and serum PON1 activity towards phenylacetate, paraoxon and diazoxon were determined as described by Richter and Furlong 1999.

Molar quantities (mmol/L) of dimethyl DAP and diethyl DAP were calculated. We used multivariate Generalized Estimated Equation (GEE) models to assess those associations adjusted by age, state of residence, body mass index, years working in greenhouses, paraoxonase and arylesterase activity, and p,p'-DDE levels.

**Results:** The results of this study showed a positive association between urinary dimethyl DAP and serum FSH levels ( $\beta = 0.152$ ;  $P = 0.001$ ), prolactin ( $\beta = 0.115$ ;  $P < 0.001$ ) and a negative association with testosterone ( $\beta = -0.108$ ;  $P = 0.01$ ). A negative association was also observed between diethyl DAP and testosterone ( $\beta = -0.245$   $P = 0.001$ ) and inhibin B ( $\beta = -0.297$ ;  $P = 0.045$ ) and a positive association with prolactin ( $\beta = 0.222$ ;  $P < 0.001$ ). No association was observed between urinary DAP levels and the remaining hormones.

**Conclusion:** Organophosphate exposure do alter hypophysary and male hormonal profile independently of other well known endocrine disruptors such as p,p'-DDE.



## ISEE-0485

**Association Between Cotinine and Metals in Maternal and Cord Blood in Non-Smoking Mothers**

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**Background and Objective:** Environmental tobacco smoke (ETS) contains over 4000 compounds, including numerous heavy and trace metals such as arsenic, lead, cadmium, and selenium. Smokers have been reported to have higher blood lead and cadmium levels than do nonsmokers. The objective of this study was to explore the association between cotinine and metals in maternal and umbilical cord blood in non-smoking mothers.

**Methods:** The study population consisted of 328 postpartum women collected from four hospitals and clinics in northern Taiwan. We interviewed them by a structured questionnaire after delivery and collected maternal and umbilical cord blood at birth. Cotinine in blood as an indicator of ETS was analyzed by using HPLC-MS/MS and the metals were analyzed by Agilent 7500 C inductively coupled plasma mass spectrometry (ICP-MS). We examined the association between cotinine and  $\log_{10}$  transformed metal levels by linear regression models.

**Result:** After adjusting for maternal age and education, there were negative association between cadmium ( $\beta \pm SE = -0.00005 \pm 0.0011$ ,  $P$ -value = 0.961), antimony ( $\beta \pm SE = -0.00026 \pm 0.0007$ ,  $P$ -value = 0.689) and barium ( $\beta \pm SE = -0.00414 \pm 0.0025$ ,  $P$ -value = 0.095) and cotinine in maternal blood. In umbilical cord blood, a negative association was found for antimony ( $\beta \pm SE = -0.00113 \pm 0.0005$ ,  $P$ -value = 0.020) while positive associations were shown for thorium ( $\beta \pm SE = 0.00237 \pm 0.0011$ ,  $P$ -value = 0.028) and uranium ( $\beta \pm SE = 0.00307 \pm 0.0015$ ,  $P$ -value = 0.046).

**Conclusions:** Although cotinine were associated with some metals in blood, environmental tobacco smoke may not be the major source of metals in the non-smoking population.

## ISEE-0488

**Relationships Between Inhalation Exposure, Urinary and End Exhaled-Breath Biomarkers Among Jet Fuel Exposed Air Force Personnel**

Kristen Smith,\*† Susan Proctor,† and Michael McClean,\* *\*Boston University School of Public Health, Boston, MA, United States; and †US Army Research Institute of Environmental Medicine, Natick, MA, United States.*

**Background and Objective:** Jet propulsion fuel 8 (JP8) and similar jet fuels are widely used by the US military and commercial airline industry, resulting in widespread occupational exposures that could potentially cause adverse neurological health effects. The objectives of this study were to characterize JP8 exposure by examining exhaled-breath biomarkers between a priori designated exposure groups and assessing relationships with both inhalation exposure and urinary biomarkers.

**Methods:** Air Force (AF) personnel ( $n = 24$ ) were recruited from an active USAF base into low, moderate, and high a priori designated exposure groups. Exhaled-breath samples were collected over three consecutive work-days and analyzed for benzene, toluene, ethylbenzene, xylene (BTEX), hexane, and naphthalene. Urine samples were collected concurrently and analyzed for 1- and 2-naphthol. Breathing-zone air samples were collected over the work-shift and analyzed for total hydrocarbons (THC), BTEX, and naphthalene. Linear mixed effects models were used to evaluate the exposure data.

**Results:** The geometric mean post-shift exhaled-breath concentrations for participants in the low, moderate, and high exposure groups were  $<6.5$   $\mu\text{g}/\text{m}^3$ , 9.0  $\mu\text{g}/\text{m}^3$ , and 10.4  $\mu\text{g}/\text{m}^3$  for hexane; results for BTEX were similarly ordered. Exhaled-breath naphthalene concentrations were excluded from the analyses due to a low limit of detection. In post-shift

exhaled breath samples, exposure group was a significant predictor of hexane ( $P = 0.01$ ), ethylbenzene ( $P < 0.0001$ ), m/p-xylene ( $P < 0.0001$ ), and o-xylene ( $P < 0.0001$ ) with levels increasing across the low to high exposure groups. In pre-shift exhaled breath samples, exposure group was also a significant predictor of ethylbenzene ( $P = 0.01$ ), m/p-xylene ( $P = 0.005$ ), and o-xylene ( $P = 0.01$ ). Post-shift exhaled-breath hexane and BTEX measurements were weakly to moderately correlated with THC measured in personal air ( $r = 0.1$ – $0.5$ ) and moderately correlated with post-shift urinary 1- and 2-naphthol ( $r = 0.4$ – $0.6$ ).

**Conclusion:** Exhaled-breath concentrations increased across the low to high a priori designated exposure groups and were correlated with urinary biomarkers.

## ISEE-0489

**Effects of Household Use of Cleaning Products on Birth Weight**

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**Background and Objective:** Associations between frequent use of household chemicals during pregnancy and wheezing and diarrhoea in offspring have been reported, but there are no studies on the effects of such exposures on birth weight (BW). The aim of this study is to assess the association between the use of domestic cleaning products during pregnancy and BW.

**Methods:** In the Spanish longitudinal INMA-Sabadell birth cohort study, 619 pregnant women were followed from the first trimester of pregnancy until delivery. Birth outcomes were obtained from clinical records of 617 newborns ( $\geq 34$  weeks of gestation). The use of cleaning products in the home was obtained from an interviewer-led questionnaire administered at the third trimester of pregnancy. Associations between the use of cleaning products and BW were evaluated using multivariable linear regression models adjusting for sex, gestational age, mother's height, weight and number of previous pregnancies.

**Results:** The median BW was 3288g (interquartile range 2970 to 3520g). The most commonly used cleaning products were glass cleaners (77%), bleach (74%), furniture polishes (42%) and ammonia (25%). Women who used bleach had newborns with a higher BW (mean difference 87g; 95%CI 17 to 152). Similar results were found for ammonia (mean difference 60g; 95% CI -11 to 130). The association between bleach and BW remained apparent after additional adjustment for tobacco smoking during pregnancy, maternal education and employment in cleaning work (mean difference 71g; 95%CI: -3 to 146) and showed a dose-related trend (mean difference 62 and 96g for frequency of cleaning  $\leq 1$  and  $> 1$  time/week, respectively). Other products were not associated with BW.

**Conclusions:** Household use of bleach during pregnancy was associated with a higher BW. We hypothesise that a higher degree of disinfection of the living environment could be beneficial for foetal development.

## ISEE-0492

**Initial Enrollment of Asthmatic Children in a Woodstove Intervention Study**

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**Background:** This study utilizes in-home woodstove interventions to assess the impact of indoor biomass smoke on asthmatic children. Initial enrollment efforts, methodologies, and the descriptive characteristics of the first cohort of participants are described here.

**Methods:** Asthma screening surveys were administered to school children ( $n = 1,185$ ) to identify subjects. Baseline indoor air sampling and health measures were conducted during the winter of 2008/09. Air sampling

included 48-hour continuous monitoring of PM<sub>2.5</sub> mass in the common area and the child's bedroom, as well as monitoring of particle counts and the collection of PM<sub>2.5</sub> quartz filters for organic compound analyses. Health measures included Pediatric Asthma Quality of Life Questionnaire (PAQOL), peak flow monitoring, exhaled nitric oxide, and symptom diaries.

**Results:** Fifty-one students indicated that they had current asthma and lived in a home with a woodstove. Of these, 12 subjects (age 11 to 17, 75% female) were enrolled for the first year of the study. Mean (sd) PAQOL composite scores on a scale of 7.0 were 4.7 (1.0). There was a positive association between PAQOL scores and average percent predicted morning FEV<sub>1</sub> and peak flow. PAQOL scores were not associated with symptoms frequency or inhaler use. Mean (sd) PM<sub>2.5</sub> concentrations in the common area and the child's bedroom were 41.1 (33.2)  $\mu\text{g}/\text{m}^3$  and 34.8 (28.4)  $\mu\text{g}/\text{m}^3$ , respectively.

**Conclusions:** Baseline measures have successfully been collected on the initial cohort of subjects. Each subject/home will be randomized to an intervention arm, and follow-up measures will occur in the subsequent winter. Change in PAQOL is the primary outcome of interest for the 108 subjects targeted for this study. Initial pre-intervention measures suggest that there is room for clinically relevant improvement in these scores.

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#### ISEE-0493

##### **A Calcium Supplementation That Reduced Lead Concentration in Pregnant Women Is Associated with a Positive Effect on Length of Their Offspring the First Year of Life**

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**Background and Objective:** Prenatal lead exposure is associated with adverse effects that can last throughout early life; one is impaired physical growth. In a previous study, a 1200 mg/d calcium supplementation during pregnancy was associated with a significant reduction of maternal blood lead concentrations. The objective was to estimate the association of calcium supplementation (1200 mg/d) during pregnancy and lactation as an inhibitor of lead toxicity in mothers and the growth of their offspring during the first year of life.

**Methods:** We combined data from a randomized, controlled, double blind clinical trial of pregnant women residing in the Mexico City, who were recruited between 2001 and 2003, and an observational cohort of pregnant women from the same population recruited between 1997 and 1999 with the same inclusion criteria. Children were classified as supplemented if their mothers were assigned to receive Ca during pregnancy and lactation ( $n = 161$ ) and as non-supplemented if they received placebo or belonged in the observational cohort ( $n = 323$ ). Both cohorts were followed up until 12 months postpartum. Blood lead (atomic absorption spectrometry) and anthropometry were measured at 3, 6 and 12 months of age in 484 children from both cohorts. Linear regression models with robust standard errors were fitted to estimate the effect of lead and calcium supplementation on length.

**Results:** After adjusting for age, sex, weight, maternal height and breastfeeding, length of infants in the supplemented group was in average 0.35 cm greater than that of infants who did not receive the supplement ( $P = 0.038$ ), independently of the child's blood lead concentration.

**Conclusion:** Our results suggest that calcium supplementation during pregnancy can lead to improved physical growth of offspring, which may be caused at least partially by inhibition of the toxic effects of lead on the fetus.

#### ISEE-0494

##### **Prenatal Exposure to Low Molecular Weight Phthalates and Autistic Social Impairment**

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**Background and Objective:** Prenatal phthalate exposure has been shown to affect thyroid and sex hormone metabolism. These findings suggest the possibility that phthalates may also interfere with hormone-sensitive aspects of neurodevelopment. Both fetal testosterone levels and thyroid hormone have been implicated in the etiology of autism spectrum disorders (ASD). We investigated the association between prenatal phthalate exposure and subclinical autistic symptomatology in a prospective birth cohort.

**Methods:** The Mount Sinai Children's Environmental Health Study enrolled a multiethnic prenatal population from 1998–2002 ( $n = 404$ ). Third trimester urines were analyzed for phthalate metabolites, which were grouped by molecular weight into monoester metabolites of high ( $>250$  Daltons) molecular weight (HMW) and low ( $<250$  Daltons) molecular weight (LMW). At the 8 year visit, mothers ( $n = 153$ ) completed the Social Responsiveness Scale (SRS), a questionnaire designed to identify characteristics of ASD, including problems with interpersonal behavior, communication, and repetitive/stereotypic behaviors. The SRS is validated for use in the general population.

**Results:** In adjusted generalized linear models, increased log-LMW concentrations were associated with poorer SRS scores ( $B = 1.53$ , 95% CI 0.26–2.80,  $P$ -value: 0.02). SRS treatment subscale scores were also significantly poorer for cognition ( $B = 1.43$ ,  $P = .03$ ), communication ( $B = 1.80$ ,  $P = .01$ ) and awareness ( $B = 1.29$ ,  $P = .03$ ), but not for Mannerisms or Motivation. There were no associations for HMW phthalates, which have lower exposure levels.

**Conclusion:** Prenatal phthalate exposure was associated with evidence of social impairment in a healthy, urban population. Impaired social functioning is a prominent feature of multiple behavior and developmental disorders, including autism spectrum disorders. These results extend our previous finding of abnormalities in neonatal behavior in relation to prenatal phthalate exposure. Our study was limited by a small sample size and substantial attrition between birth and follow-up.

#### ISEE-0495

##### **Fungi on Air-Conditioning Cooling Coils and Drainage Pans, Identified with Polymerase Chain Reaction Assays**

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**Background and Objective:** Building-related symptoms have been increased among workers in office buildings with air-conditioning (AC), relative to those in buildings without AC, in every study reported to date, from countries around the world. Available evidence suggests a hypothesis: unrecognized microbial growth occurs commonly on wet AC surfaces, emitting into the indoor air large quantities of microbial fragments smaller than spores, and producing in susceptible occupants a mild, subclinical immunologic response related to hypersensitivity pneumonitis. Little or no identification has been available of microorganisms on wet AC surfaces, especially using non-culture-based assays. We analyzed pilot samples from surfaces of cooling coils and drainage pans in a well-maintained AC system in a U.S. office building without evident health complaints from occupants.

**Methods:** We used nylon-flocked and polyurethane swabs to sample wet AC surfaces on cooling coils and drainage pans during the warm season. DNA was extracted from swabs, pooling multiple swabs for some samples. Mold-specific, quantitative polymerase chain reaction (MQPCR) assays, developed by the U.S. EPA, were used to identify up to 48 fungal

species. Results were estimated as cells per swab, for each of two fin and two coil samples.

**Results:** Nine fungal species were identified in at least one sample. Two *Cladosporium* species were found in all four samples (range, 123–5,121 cells/swab). *Aureobasidium pullulans* was found in both pan samples (977 and 46,430 cells/swab). Other fungi were found only in single samples, including *Aspergillus parasiticus* at 24 million cells/swab in one coil sample.

**Conclusion:** Assays identified, on AC pans or coils, multiple organisms previously linked to both hypersensitivity pneumonitis and allergies (e.g., *Aureobasidium pullulans*, *Cladosporium* spp, *Aspergillus parasiticus*). Results are consistent with hypotheses; however, any related exposures and health effects in this building, or from wet AC surfaces in other buildings, remain to be demonstrated.

#### ISEE-0496

##### Lipid Peroxidation and Oxidative Status in Metal Foundry Workers

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**Background:** Foundry plants have various treatment processes for reclaiming bentonite-bonded molding sands, which consist of silica sand, coal dust and clay. Two main procedures take place in a foundry: sand molding and metal casting. Sand molding includes core sand and binder, core making and then the casting process. After casting cooling, shakeout and cleaning, the metals and sand with silica are recovered. Silica particles and metals are important occupational hazards in foundry workers, and exposure may result in DNA damage and lipid peroxidation through oxidative stress.

**Methods:** This study aimed to compare oxidative damage by measuring the levels of plasma malondialdehyde (MDA), urinary 8-hydroxydeoxyguanosine (8-OH-dG) and DNA migration in workers at 2 foundry plants (exposure group) and in town hall employees (control group) in central Taiwan. Air samples for metals analysis in the workplace were also collected to assess the health risk to foundry workers.

**Results:** Significantly higher MDA levels (4.28 versus 1.64 mM), DNA migration (6.63 versus 1.22), and 8-OH-dG levels (5.00 versus 1.84  $\mu\text{g/g}$  creatinine) were found in exposure group compared with the control group. Higher levels of these parameters were also found in workers involved in manufacturing than in workers involved in administration. Higher air dust concentrations were found in manufacturing departments (0.99  $\text{mg/m}^3$ ) than in administrative departments (0.34  $\text{mg/m}^3$ ). The health risk assessment on metals exposure showed that the cancer risk for Cd, Cr and Ni were all above  $1 \times 10^{-6}$ .

**Conclusion:** The workers at foundry plants (exposure group) have significantly higher plasma MDA, DNA damage and 8-OH-dG than town hall employees (control group). Meanwhile, it is not negligence that administrative workers in foundries are also likely to be exposed to heavy metals emitted from the foundry operating process.

#### ISEE-0497

##### Relationships of Personal Exposure to Temperature, Relative Humidity and Fine Particles with Outdoor Temperature

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**Background and Objective:** Exposure to extreme temperatures and airborne particles occur often simultaneously and can both affect the respiratory and cardiovascular health. Thus, they can be confounders for each other in epidemiological time series studies. Generally, outdoor temperature has been used as an estimate for individual temperature exposure. In this study, longitudinal associations between outdoor temperature and personal environmental temperature, relative humidity (RH) and particles are reported for the heating season.

**Methods:** Personal exposure to temperature, RH and fine particles ( $\text{PM}_{2.5}$ ) were repeatedly measured (4–11 times) over a 24h time period with a 1-min resolution in 43 elderly non-smoking heart disease patients during the heating season in Kuopio, Finland. In addition, personal daily exposure to combustion particles (indicator  $\text{PM}_{2.5}\text{-Abs}$ ; absorption coefficient) as well as concentrations of outdoor  $\text{PM}_{2.5}$  and  $\text{PM}_{2.5}\text{-Abs}$ , and outdoor temperature were used in the analysis. Spearman correlation coefficients (r) between outdoor and indoor variables were analyzed for each individual separately and then the median was taken.

**Results:** Outdoor temperature varied from  $-22$  to  $+4$  °C during the measurements. As expected, the correlation between outdoor and personal 24h average temperature was low for most individuals ( $r = 0.14$ ), but outdoor temperature described reasonably well the daily minimum 1-min temperature exposure ( $r = 0.50$ ), especially for individuals who spent more than 1h outdoors ( $r = 0.77$ ). High median correlation ( $r = 0.80$ ) was observed between central site temperature and personal exposure to RH. There was a weak negative correlation between outdoor temperature and personal exposure to  $\text{PM}_{2.5}$  and  $\text{PM}_{2.5}\text{-Abs}$  ( $r = -0.25$  and  $r = -0.32$ , respectively).

**Conclusions:** During heating season, associations between outdoor temperature and the daily personal exposure to temperature,  $\text{PM}_{2.5}$  and  $\text{PM}_{2.5}\text{-Abs}$  were weak. The minimum temperature the subjects were exposed to while outdoors and the daily personal exposure to relative humidity on daily level were related to the daily outdoor temperature.

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#### ISEE-0499

##### Spatial Distribution of Air Pollution by $\text{NO}_2$ and Mortality in Small Areas of Valencia City, Spain

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**Introduction:** The MEDEA Project studies the socioeconomic and environmental disparities in mortality in small areas in different Spanish cities. The objective of this work is to analyze the relationship between mortality and nitrogen dioxide ( $\text{NO}_2$ ) in Valencia.

**Methods:** The study population included residents in Valencia during 2002–2003. We analyzed mortality by tumors, cardiovascular diseases (cerebrovascular–CBD and ischemic heart disease -IHD) and respiratory diseases using census tract as the unit of analysis. Outdoor  $\text{NO}_2$  was monitored in 100 sites of the study area in February and November, 2002, and April, 2004, using passive samplers. Universal kriging was used to predict exposures in sites which were not monitored, scoring the method's precision by means of cross-validation. For each census tract, the  $\text{NO}_2$  levels were obtained as the average of the predictions inside the census tract. A socioeconomic score was built for each geographical unit. We analyzed the relationship between  $\text{NO}_2$  and mortality for men and women using a Bayesian spatial hierarchical model, adjusting for socioeconomic level.



**Results:** The mean estimated NO<sub>2</sub> levels were 51.2 µg/m<sup>3</sup> (SD: 5.7). The NO<sub>2</sub> cutoff points for quintiles were: 45.9; 49.3; 52.3 and 56.5. For men, we found a significant relationship between NO<sub>2</sub> levels and IHD mortality with a relative risk (RR) of 1.23 (95% Confidence Interval–CI–95%: 1.06–1.43) for the fifth quintile when compared with the first one. RRs for the second, third and fourth quintile compared with the first one were: 1.07 (0.94–1.21), 1.01 (0.88–1.15), and 1.14 (0.99–1.31), respectively. We found no significant association with other causes or for mortality.

**Conclusions:** We have used a method that permits assessing NO<sub>2</sub> levels by small area. NO<sub>2</sub> levels were associated with IHD in men but not with other causes of death. No relationship was observed among women.

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#### ISEE-0502

##### Cumulative Internal Dose of Uranium in Workers Close to Phosphogypsum Waste Piles

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**Background and Objectives:** Huelva city inhabitants have shown concern in the last decades before the environmental impact and the possibility of health effects due to the proximity of a chemical and metal industry park and phosphogypsum waste piles. Despite the existence of an air pollution surveillance system in the area, and the availability of studies that have characterized the pollution within the phosphogypsum waste piles, there are no studies on the bioaccumulation of pollutants related to the phosphogypsum waste piles in subjects working in their proximity.

**Methods:** Cross-sectional epidemiological study design. We recruited 125 volunteer chemical and metal industry workers from different geographical areas in Spain. We analyzed the internal cumulative dose of uranium 238 in 51 of them (46 men) in washed toenail samples via ICP-MS following microwave assisted acid digestion. 32 volunteers worked in the chemical and metal industry next to the phosphogypsum waste piles, and 19 volunteer workers worked in the chemical and metal industry of other study areas without a phosphogypsum pile nearby.

**Results:** 14 (44%) out of 32 workers next to the phosphogypsum waste piles showed traces of uranium 238 in toenails, for none (0%) of the 19 volunteer workers from the other study areas without a phosphogypsum pile nearby ( $P = 0.0007$ ; Chi square test). None of the 14 workers with traces of uranium worked for the companies that generate the phosphogypsum waste materials.

**Conclusion:** Our results suggest that working nearby the phosphogypsum waste piles and/or into the industrial park of Huelva city might contribute to the bioaccumulation of uranium 238. As the sample size is small, and we did not take into account the possible contribution of dietary factors, results should be interpreted with caution.

#### ISEE-0503

##### Potential Environmental Exposure to Heavy Metals and Neurobehavioural Performance in Children 9–11 Years Old. An Explorative Study

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**Background and Objectives:** Chemical, mining and metal industries are a potential source of environmental exposure to heavy metals such as

lead, methylmercury and arsenic, which are recognized causes of neurodevelopmental disorders in children.

Our objective was to explore the association, in children 9–11 years old, between residence in an area potentially polluted with heavy metals and neurobehavioral performance.

**Methods:** We conducted a cross-sectional epidemiological study. Thirty boys and thirty girls, 9–11 years-old, were recruited from public schools from cities in the Huelva province (a heavily industrialized area). Children were matched by age ( $\pm 4$  months) and sex with 15 boys and 15 girls from public schools from cities without relevant industrial activity in other Andalusian provinces (Sevilla and Jaén). Neurobehavioural performance was assessed with the Behavioral Assessment and Research System using Spanish instructions.

General Linear Models were used, adjusted for age, sex, social class, number of daily hours on multimedia activities, and the exposure variable (residence in a potentially polluted area) to predict each of the neurobehavioral outcome variables.

**Results:** No differences on neurobehavioral performance were found when all children from the Huelva province were classified as potentially exposed and children from the other provinces as unexposed. However, when we classified the children as living less than 1 km from an area with industrial or more than 1 km away, significant differences were found. Children living less than 1 km away, had lower scores on Finger Tapping ( $P = 0.03$ ), Symbol-Digit ( $P = 0.07$ ) and Continuous Performance ( $P = 0.02$ ) than those living further away.

**Conclusion:** Our results suggest that residence in close proximity to an area with industrial activity (<1 km) is associated with deficits in neurobehavioral performance among 9–11 years-old children.

#### ISEE-0510

##### Use of Errors-in-Variables Regression Models for Studies with K-X Ray Fluorescence Bone Lead Measurements

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**Background and Objective:** Chronic lead exposure is a risk factor for numerous diseases. In-vivo measurement of bone lead by K-X ray fluorescence (KXRF) is the preferred marker of chronic lead exposure. Unfortunately, KXRF estimations have considerable measurement error, and ignoring it yields effect estimates biased toward the null hypothesis. Errors-in-variables regression (EIV) allows for correction of measurement error based on the reliability of predictor variables. The objective was to compare by Monte Carlo simulations, results obtained using EIV regression versus those obtained by the standard procedure (Ordinary Least Squares [OLS]).

**Methods:** We simulated a 10,000 subject dataset with variables representing plasma Pb concentrations (outcome), bone Pb concentration and individual imprecision, bone resorption rate, and covariates. We performed 10,000 simulations with the individual bone Pb measurement error varying with a variance equal to the square of the individual imprecisions; in each simulation we estimated the relationship between bone Pb, its interaction with bone resorption and the outcome using EIV and OLS. The obtained distributions of the main effect and interaction estimates were compared using the squared root of the Mean Squared Error (RMSE) criterion.

**Results:** Simulations show that EIV estimates are better than those obtained by OLS using the RMSE criterion; the main effect estimates' RMSE were 0.006 and 0.040 for EIV and OLS respectively, the interaction estimates' RMSE were 0.0001 for EIV and 0.0004 for OLS. EIV estimates yielded larger standard errors than OLS estimates, however EIV t-values were

comparable and even slightly larger since beta coefficients were also much farther from the null value than those of the OLS approach.

**Conclusions:** Relatively simple statistical tools that greatly correct for measurement error, which are available in standard statistical software, are very useful for obtaining nearly unbiased estimates of the effect of bone Pb as measured by KXRF.

#### ISEE-0511

##### Traffic-Related Elemental Carbon Exposure and Lung Function among Schoolchildren from Mexico City

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**Background and Objective:** Vehicular traffic is a major source of air pollution and different studies have documented the relationship between air pollution and respiratory health. However few studies have examined the association between elemental carbon exposure and lung function in schoolchildren. This study assesses the association of short-term traffic-related elemental carbon exposure and lung function among schoolchildren from Mexico City.

**Materials and Methods:** We studied a cohort of 158 asthmatic and 50 non-asthmatic school-age children, followed an average of 22 weeks. Spirometric tests were conducted every 15 days during follow-up. We conducted 207 elemental carbon measurements in public schools and the association between lung function and elemental carbon exposure were analyzed using linear mixed effects models.

**Results:** The mean of elemental carbon light absorption levels was 94.7 Mn-1 (standard deviation 55.7). The elemental carbon exposure was significantly associated with an  $-0.60$  ml decrease (CI 95%:  $-1.2$  to  $-0.01$ ) in FEV<sub>1</sub> and  $-1.10$  ml decrease (CI 95%:  $-2.1$  to  $-0.04$ ) in FEV<sub>25-75</sub> in asthmatic schoolchildren. In non-asthmatic children the FEV<sub>1</sub> decrease significantly  $-0.9$  ml (CI 95%:  $-1.8$  to  $-0.08$ ) and the FVC  $-1.5$  ml (CI 95%:  $-1.9$  to  $-0.1$ ).

**Conclusion:** Exposure to elemental carbon resulted in a decrease in lung function in both asthmatic and non-asthmatic schoolchildren.

#### ISEE-0513

##### Single Nucleotide Polymorphism (SNP) Analysis of Metallothionein 2A Gene in White and Black Females

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**Background:** Genetic factors may be responsible for up to 10% of the variability in tissue cadmium concentrations. The expression and regulation of metallothionein proteins, which absorb and sequester cadmium, may contribute to the genetic variation observed in cadmium uptake and metabolism. The aim of the study was to determine the frequency of the A and G alleles at rs28366003 which lies in the 5' promoter-region of MT2A in white and black females.

**Methods:** We gathered 1.0 ml saliva samples using Oragene DNA/Saliva kits on 298 White or Black adult females. Volunteers were recruited using an University of Missouri mass email announcement to faculty, staff and students and with recruitment at targeted venues in Nov 2008. The University of Missouri (UM) Research Animal Diagnostic Laboratory (RADIL) extracted the DNA. The UM Animal Genomics Laboratory performed allele-specific PCR to genotype SNP rs28366003.

**Results:** Of the 291 participants (Black = 142; White = 149), the average yield of DNA extracted from the saliva samples was 23.4 mg. The samples, quantitated on a spectrophotometer, achieved an average 260/280

optical density reading of 1.61. The G allele's frequency was 1.1% for Blacks and 6.4% for Whites ( $P < 0.0006$ ; Fisher's exact test).

**Conclusion:** Recruitment strategies successfully obtained saliva specimens from the Black and White female population in one month. DNA extracted from human saliva samples is sufficiently high in quality and yield to allow whole genome analysis by high density SNP analysis and to perform hundreds of individual PCR reactions. The genotyping approach employed here is much less expensive than other methods of generating genotypes for only a few SNP loci (e.g., pyrosequencing) and is very robust.

#### ISEE-0515

##### Predisposed to Low Basal Air Pollution Level Increases Hospitalization Risk for Cardiovascular Diseases

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**Background and Objective:** Studies have suggested an association between increased air pollution and hospital admissions for cardiovascular disease (CVD). However, there has been no study investigating if increased air pollutant levels cause the same hospitalization risk for patients predisposed to different basal exposure categories, low or high. Therefore, this study aimed to evaluate if basal exposure level differentially affected hospital admissions for CVD.

**Method:** Cases were defined as patients admitted to hospitals for the first time with primary diagnoses of acute myocardial infarction, angina pectoris, occlusions of precerebral and cerebral arteries, and transient cerebral ischemia between 1996 and 2006 in Taipei, Taiwan. A time-stratified approach was used to select case self-referent days as the days falling on the same day of the week within the same month of the index day. The self-referent air pollutant level was recognized as each patient's basal exposure level. The risk for CVD admission was determined using a case-crossover approach, stratified by basal exposure levels and controlling for potential confounding variables.

**Results:** On cool days ( $<23^{\circ}\text{C}$ ), the OR for those patients with basal PM<sub>10</sub> exposure level  $\leq 41 \mu\text{g}/\text{m}^3$  was 3.28 per  $10 \mu\text{g}/\text{m}^3$  increase (95%CI 3.14–3.43). However, the OR for those with basal PM<sub>10</sub> level  $>41 \mu\text{g}/\text{m}^3$  was 1.003 (0.995–1.011). Similarly, hospitalization risks for those with basal CO level  $\leq 1.1\text{ppm}$  per 1ppm increase (OR 1.23, 1.22–1.24) or O<sub>3</sub> level  $\leq 17\text{ppb}$  per 10ppb increase (OR 3.53, 3.21–3.89) were greater than those with basal CO level  $>1.1\text{ppm}$  or O<sub>3</sub>  $>17\text{ppb}$ . For the two-pollutant model, all of them remained significant in combination with each of the other four pollutants.

**Conclusion:** Our results demonstrate that the hospitalization risk for patients with low basal exposure levels was significantly higher than that for patients with high basal exposure levels. The pathological significance should be discussed.

#### ISEE-0518

##### Ecological and Human Biomonitoring in Taranto, an Italian Contaminated Site

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**Background and Objective:** The area around Taranto, in southern Italy, is a site identified for environmental remediation, because of documented soil/water contamination. Both the urban area and the surroundings are affected by a large industrial facility, including one of the largest European steel factories, a petrol refinery and a cement plant. In the context of a surveillance program, launched in response to public and scientific concern in relation to industrial emissions of dioxins and dioxin-like polychlorinated biphenyls (PCBs), an ecologic monitoring survey was

carried out aimed at evaluating the extent of contamination of human food and animal foodstuff produced locally.

**Methods:** A total of 41 farms located within 10 km radius of the industrial setting were included in the survey; 125 samples of food matrices (cow/sheep/goat milk and dairy products, sheep/goat muscle, liver and fat, chicken eggs and vegetables) were collected from March to October 2008, and analysed for dioxins and PCBs.

**Results:** In 32 samples (26%) of food matrices collected from 8 farms (20%) the concentration of dioxins and PCBs exceeded current limit values. The maximum exceeding levels (dioxins + PCBs) varied from  $31.2 \pm 3.7$  pg-TEQ/g-fat in milk, to  $228.8 \pm 30.4$  in liver and to  $37.1 \pm 5.6$  in adipose tissue. Congener profiles of both dioxins and PCBs were very similar among samples, providing evidence for a single shared source of contamination.

**Conclusion:** Results from this survey indicate a substantial level of contamination and allowed the identification of locations most at risk, where the food chain is affected. These findings are of concern, as Taranto province is rich of farms producing traditional local food products. A surveillance program aimed at evaluating the body burden of dioxins and metals in a sample of farmers employed in the 41 locations is in progress and will aid to evaluate the impact of the industrial emissions in the area.

#### ISEE-0519

##### Sources of Indoor Air Pollution and Respiratory Problems During the First Year of Life of the Children of the INMA-Valencia Cohort

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**Background and objective:** Exposure to indoor air pollutants during the first years of life may increase the risk of developing respiratory diseases. The aim of this study is to analyze the association between the presence of sources of indoor air pollution and respiratory problems in children during their first year of life.

**Methods:** The INMA birth cohort is a population-based study with the aim of evaluating the effects of exposure to environmental pollutants and diet on foetal and childhood health and development. Information from the 703 children who reached one year of life taking part in the project was collected by making questionnaires. We collected data about heating and cooking methods and about respiratory health of the children: bronchiolitis, pneumonia and bronchitis ever diagnosed by a paediatrician. Potential confounders were considered: sex, season of birth, preterm and low birth weight, breastfeeding, parental asthma, country of origin, educational level, social class, number of cohabitants, furry pets, humidity, carpets, redecoration, tobacco smoke exposure from the mother and nursery school attendance. We studied the association between respiratory problems and heating and cooking methods by means of multivariate logistical regression models.

**Results:** During their first year of life, 19.14% of the children had had an episode of bronchiolitis. Electricity was used for cooking in 34.38% of homes, natural gas in 30.10% and butane gas in 22.54%. Multilevel analysis showed a significant association between the method of cooking and bronchiolitis ( $P = 0.096$ ) Odds Ratio (OR) 1.16 Confidence Interval 95% (CI 95%) (0.53–2.51) for natural gas vs. electricity; OR 3.56 CI 95% (1.12–11.3) for butane gas vs. electricity.

**Conclusions:** Electricity was the main method used for cooking. The use of gas sources for cooking increased the risk of bronchiolitis, with a clear association for butane gas use.

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#### ISEE-0520

##### Different Risks of Traumatic and Non-Traumatic Injuries Attributable to Temperature in Seoul, Korea

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**Background and Objective:** Several studies reported that the occurrence of injury has seasonality and the fluctuation depends on temperature. Although the injury occurs from various factors, many studies on injury have been focused on specific diseases or sports. In addition, there were little studies on the effect of temperature on occurrence of injury. Therefore, the aim of this study is to evaluate the association between daily counts of sub-categories of injury such as traumatic and non-traumatic injuries and daily mean temperature.

**Methods:** Data on injury were derived from the emergency ambulance delivery database of the National Emergency Management Agent (NEMA) in Korea from 2006 to 2008. We counted daily ambulance delivery according to four categories, such as total injury, traumatic and non-traumatic injuries as well as total disease. The classification of injury was based on International Classification of External Cause of Injury (ICECI). The generalized additive models (GAM) were used to examine the association between the daily counts of ambulance delivery by four categories and the mean temperature, controlling for confounding factors such as relative humidity, national holidays, and long-term trends.

**Results:** The daily counts of total injury, traumatic injury, non-traumatic injury and total disease showed strongly seasonality. We found that rate ratio (RR) of daily counts of total injury was 1.0047 (95% CI = 1.0033–1.0063) corresponding to 1°C increase of mean temperature. The RR of non-traumatic injury (1.0114, 95% CI = 1.0095–1.0132) was much higher than of traumatic injury (1.0022, 95% CI = 1.0004–1.0041), even controlling for confounding factors. The association between total disease and temperature was also significant (RR = 1.0061, 95% CI = 1.0048–1.0074).

**Conclusion:** The occurrence of injury, attributable to temperature, were different depending on whether the type of injury is traumatic or non-traumatic. The effect of temperature on non-traumatic injury was higher than traumatic injury.

#### ISEE-0521

##### Air Pollution and Hospitalization for Respiratory Infections in Children: Differential Contribution of Basal Exposure Level

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**Background and Objective:** Many studies have suggested the association between increased air pollution and adverse respiratory hospitalization risks. However, there has been no study investigating if increased air pollutant level causes different hospitalization risk for patients predisposed to different basal exposure categories, low or high. Therefore, this study was to evaluate if basal exposure levels could differentially affect hospital admissions for respiratory infections in children, in Taipei, Taiwan.

**Method:** Cases were patients admitted to hospitals for the first time with primary diagnoses of acute bronchitis, bronchiolitis, viral pneumonia, pneumonia, and bronchopneumonia between 1996 and 2006. Case self-referent days were defined as the days falling on the same day of the week within the same month of the index day. Self-referent pollutant level was used to define each patient's basal exposure level. The risk for hospital admission was determined using a case-crossover approach,



stratified by basal exposure levels and adjusted for potential confounding variables.

**Results:** On cool days ( $< 23^{\circ}\text{C}$ ), the ORs for patients with basal  $\text{PM}_{10} \leq 41 \mu\text{g}/\text{m}^3$ ,  $\text{CO} \leq 1.1\text{ppm}$  or  $\text{O}_3 \leq 17\text{ppb}$  were 3.24 (95% CI 3.10–3.38), 1.37 (1.35–1.39) or 2.78 (2.53–3.06), significantly greater than those for patients with basal  $\text{PM}_{10} > 41 \mu\text{g}/\text{m}^3$ ,  $\text{CO} > 1.1\text{ppm}$  or  $\text{O}_3 > 17\text{ppb}$ . For the two-pollutant model, all of them remained significantly associated with hospital admissions.

**Conclusion:** Our results demonstrated that increased  $\text{PM}_{10}$ , CO or  $\text{O}_3$  produced significantly greater hospitalization risks to those patients predisposed to lower basal exposure level, compared with those to higher basal exposure level. We will further explore the pathological significance of this finding with an animal study.

#### ISEE-0524

##### Close Relations Between Exhaust Levels Outside Home and the Prevalence of Annoyance

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**Background and Objective:** Air pollution from traffic may cause airway irritation and annoy many more than those suffering from airway disease. However, the exposure-response relationships are not well studied with objective exposure data.

We wanted to study the association between modeled levels of traffic pollution outside home and the prevalence of perceived pollution-related problems.

**Methods:** A questionnaire survey was conducted in 2008 in four areas of Sweden; Göteborg, Stockholm, Umeå and Uppsala, as part of the GA2LEN study. A random sample of 45,000 adults (age 16–75 years) was invited and 26,983 completed the questionnaire. In addition to the core questions, we added questions on various exposures, perceived annoyance and health problems. Home addresses were geocoded. Traffic pollution exposure at home was calculated as nitrogen dioxide ( $\text{NO}_2$ ) and nitrogen oxides ( $\text{NO}_x$ ) using validated dispersion models and a resolution of 50 meters. These dispersion models covered most parts of the study area. In logistic regression models we adjusted for city and potential determinants such as age.

**Results:** Pollution levels have been calculated for the participants from Göteborg, Stockholm, Umeå and Uppsala. The calculated annual mean concentration of  $\text{NO}_x$  at home was  $16 \mu\text{g}/\text{m}^3$  and the range was  $127 \mu\text{g}/\text{m}^3$ . The odds ratio for perceiving outdoor air in the neighborhood as daily irritating was 1.042 (95% CI 1.034–1.052) per  $\mu\text{g}/\text{m}^3$ . The odds ratio for perceiving vehicle exhaust very annoying was 1.104 (95% CI 1.095–1.113).

**Conclusion:** In this large study with detailed exposure information we find precise and strong associations between perceiving air pollution as irritating and exhaust as annoying. A  $10 \mu\text{g}/\text{m}^3$  increase of  $\text{NO}_x$  was associated with 52% increase in the odds for perceiving outdoor air in the neighborhood as daily irritating and 169% increase in the odds for being very annoyed by vehicle exhaust.

#### ISEE-0525

##### Effects of Exposure to Metal-Rich Air Particles on miR-222 and miR-21 in Occupationally Exposed Subjects

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**Background:** Inhalation of air particles and their metal components has been related to hypertension and cardiovascular disease in epidemiology studies. Metal components of air particles may contribute to cause hypertension and cardiovascular disease by promoting oxidative stress, due to decreased nitric oxide availability, inflammation, and modified vascular response. MiRNAs are highly conserved, non-coding small RNAs that regulate gene expression on the post-transcriptional level. miR-222 is an important regulator of pro-angiogenic endothelial cell function. miR-21 might be an important modulator of vascular disease and vessel remodelling.

**Objective:** To identify effects of exposure to metal-rich particulate on miR-21 and miR-222 expression in workers of an electric furnace steel plant with well characterized exposure.

**Methods:** We measured miR-21 and miR-222 expression in blood RNA obtained from 63 workers on the first day of a workweek (baseline) and after three days of work (post exposure). The relative expression of miRNAs was measured by real-time PCR using RNU48 as endogenous controls. Relative quantification of miRNA expression was calculated using the  $2^{-\Delta\Delta\text{Ct}}$  method. We determined individual exposure to inhalable particles and metals for all subjects.

**Results:** We found under-expression of miR-222 ( $\Delta\text{mean} = 1.9$ ;  $P = 0.002$ ) and miR-21 ( $\Delta\text{mean} = 1.1$ ;  $P = 0.05$ ), in post exposure measure when compared to baseline. Such decrease was negatively associated with exposure to airborne lead level for miR-222 expression ( $\beta = -2.75$ ,  $P = 0.01$ ) while no association between miR-21 and exposure to airborne particles and metals was observed.

**Conclusions:** Individuals exposed to inhalable metal-rich particles showed decreased expression of miRNAs related with cardiovascular functions.

#### ISEE-0526

##### Exposure to Noise from Personal Music Players for High School Students

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**Background and Objectives:** Personal music players are increasingly used by adolescents. The objective of the study was to measure the noise exposure of students attending a secondary school (Québec; Canada) from their personal music player.

**Methods:** Students (age: 14–17) were asked to answer a questionnaire concerning exposure to noise during leisure activities and listening habits of personal music players. It was offered to those who used a personal music player to measure the noise from their device. The measures of noise in dBA were performed with the Symphony software. Using the listening habits documented, the equivalent continuous noise for 8 hours ( $\text{LA}_{\text{eq},8\text{h}}$ ) was estimated. Variables of interest (age, sex ...) were compared according to a  $\text{LA}_{\text{eq},8\text{h}}$  of 80 dBA and a  $\text{LA}_{\text{eq},8\text{h}}$  of 85 dBA using  $\chi^2$  tests or Fisher's exact test. Trends were tested using Mantel Haenszel  $\chi^2$  test.

**Results:** Of 164 students who responded to the questionnaire, 141 (86%) used a personal music player. Of these, 124 (88%) agreed to measure the noise of their device. The average  $\text{LA}_{\text{eq},8\text{h}}$  from the personal music player was 82.59 dBA (range: 51.45–110.34). Respective proportions of 60% (75/124) and 42% (52/124) of subjects were exposed to levels of noise above a  $\text{LA}_{\text{eq},8\text{h}}$  of 80 dBA and 85 dBA. There was no relationship between sex and dose of noise, however there was a significant trend to a decrease in exposure with age. Overall, students who were most exposed to noise of their personal music player reported tinnitus more often.

**Conclusion:** Efforts should be made to inform young people and their parents on the harmful effects of noise on hearing and of the importance to limit the noise from personal music players.

#### ISSE-0530

##### Short-Term Exposure to Ozone and Mortality in Three Mexican Cities: Results from the ESCALA Project

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**Background and Objective:** ESCALA (Estudio de Salud y Contaminación del Aire en Latinoamérica) is a multi-city time-series study funded by HEI that examines the association between exposure to outdoor air pollution and mortality. The objective is to examine the effect of exposure to Ozone (O<sub>3</sub>) (8-hr max. moving average) on selected causes of mortality and subgroups defined by cause and age in three Mexican cities: Mexico City Metropolitan Area (MCMA), Monterrey and Toluca.

**Methods:** Poisson regressions were used to fit the time-series data (1997–2005). Time trends, seasonality, temperature and humidity were adjusted by natural spline functions with specific degrees of freedom per year. To assess association between exposition and risk death, single lag models were fitted. We evaluated the single-effect of the exposure on the same day of the event and from 1-to-5 days lagged exposure.

**Results:** Single lag models showed that a 10 ug/m<sup>3</sup> increase of O<sub>3</sub> (8-hr max. moving average) was significantly associated with increase of mortality. For total deaths, all ages, the increase in MCMA was 0.17% (lag1; 95%CI: 0.093%, 0.24%); for Monterrey the increase was 0.68% (lag3; 95%CI: 0.45%, 0.90%); and for Toluca it was 0.22% (lag0; 95%CI: -0.22%, 0.66%). In individuals >65 years, for MCMA the increase was 0.25% (lag1; 95% CI: 0.17%, 0.34%); for Monterrey it was 0.87% (lag3; 95%CI: 0.44%, 1.31%); while for Toluca it was 0.26% (lag2; 95%CI: -0.29%, 0.81%). For cardiovascular mortality in individuals >65 years, the increases in MCMA was 0.22% (lag1; 95%CI: 0.07%, 0.38%); in Monterrey it was 0.90% (lag3; 95%CI: 0.43%, 1.37%), whereas for Toluca it was 0.12% (lag2; 95%CI: -0.92%, 1.16%).

**Conclusions:** These results confirm the relationship between mortality and short-term exposure to O<sub>3</sub>, and provide further evidence of the adverse health effects of O<sub>3</sub> in Mexico. Differences on the effects depend on the size of the cities, population heterogeneity and O<sub>3</sub> exposures.

#### ISSE-0533

##### Determinants of Blood Cadmium, Lead, Arsenic, Uranium, Mercury and Molybdenum Levels among Pregnant Women in Crete, Greece

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**Background and Objectives:** Exposure to toxic metals during pregnancy may have detrimental effects on fetal development, in particular the central nervous system. We investigated into the major sociodemographic, dietary and lifestyle determinants of blood concentrations of Cd, Pb, As, U, Hg and Mo among pregnant women from Crete, Greece.

**Methods:** Blood drawn from 50 pregnant women, randomly selected from the population of the mother-child birth cohort "Rhea", was analyzed for

the total concentrations of a number of toxic elements, using ICP-MS after high-pressure microwave-assisted acid digestion. Extensive questionnaire data on dietary fish intakes, smoking habits and self reported exposure to secondhand smoke was collected. Linear regression models were applied, adjusting for potential confounders.

**Results:** The mean levels of Cd, Pb, As, U, Hg and Mo were 0.45 ng/ml, 10 ng/ml, 0.49 ng/ml, 0.047 ng/ml, 1.5 ng/ml and 0.59 ng/ml, respectively. Ethnicity was a strong determinant of blood metal concentrations, as non-Greek women were found to have lower concentrations of Hg (coef -0.58,  $P < 0.001$ ) and As (coef -0.66,  $P = 0.022$ ) but higher concentrations of Pb (coef 0.15,  $P = 0.033$ ) in comparison to women of Greek ethnicity, controlling for age. Current smoking status was related to higher concentrations of Cd (coef 0.45,  $P < 0.001$ ;) and a tendency for higher As (coef 0.33,  $P = 0.090$ ) and Hg (coef 0.18,  $P = 0.090$ ) after adjusting for ethnicity and education. Blood As concentrations were also found to be associated with exposure to secondhand smoke in public venues (coef 0.54,  $P = 0.039$ ) and to the number of sources of second hand smoke exposure (coef 0.55,  $P = 0.025$ ). Overall dietary fish intake was not found in the regression analysis to modify serum heavy metal concentrations.

**Conclusions:** Ethnicity as well as active and passive smoking were the main determinants of blood concentrations of Cd, Pb, As and Hg among pregnant women in Crete, Greece.

#### ISSE-0536

##### Preterm Birth and Bisphenol A Concentrations in Mexico City: A Pilot Study

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**Background and Objectives:** Preterm birth rates are increasing worldwide, which poses an important public health problem. Research on the role of environmental contaminants, including bisphenol-A (BPA), on the complex etiology of preterm birth remains relatively unexplored. We investigated the association of preterm delivery with BPA urinary concentrations in a preliminary nested case-control study.

**Methodology:** Total (free + conjugated) BPA concentrations were measured in third trimester urine samples collected from 30 non-smoking women who delivered preterm (<37 weeks gestation) and 30 non-smoking controls (≥38 weeks gestation) of similar age, body mass index (BMI), and education from an ongoing Mexican birth cohort study. We compared geometric mean BPA concentrations between cases and controls using Student's t-test, and calculated odd ratios (OR) for preterm birth associated with a natural log transformed (ln)-unit increase in BPA while adjusting for potential confounding variables (marital status, infant gender, delivery mode, and gestational age at time of urine sample) using multivariable logistic regression. Urine samples with non-detectable BPA concentrations (20% of samples) were assigned a value equal to one-half the limit of detection (LOD = 0.4 µg/L).

**Results:** Geometric mean BPA concentrations were 1.20 µg/L in the preterm birth group compared to 0.66 µg/L in controls ( $P = 0.01$ ). When correcting urine samples for dilution using specific gravity (SG), BPA concentrations were 1.23 µg/L among cases and 0.88 µg/L among controls ( $P$ -value = 0.11). Elevated odds for preterm birth were observed for an ln-unit increase in uncorrected (adjusted OR = 2.3; 95% CI 1.2–4.5) and SG-corrected (adjusted OR = 1.8; 95% CI 0.9–3.7) BPA concentration.

**Conclusions:** To our knowledge, this is the first study to report exposure to BPA among pregnant women in Mexico. Our findings warrant further research on the relationship between exposure to BPA and preterm birth.

## ISEE-0537

## Climate Change and Infectious Disease in South Korea

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**Background and Objective:** With its widespread environmental and human health impacts, climate change has become a global issue. This study estimated marginal temperature effect on five infectious diseases (tsutsugamushi fever, malaria, shigellosis, leptospirosis, and vibrio vulnificus sepsis) caused by climate change.

**Methods:** This study used National Health Insurance utilization data to calculate the prevalence rate of infectious disease and the nationwide Automatic Weather System during 2005–2007 in South Korea.

In this study we took several steps. First, we calculated the prevalence rate of five infectious disease during 2005–2007. Second, we developed a statistical model to explore the relationship between temperature and the prevalence of infectious disease by time. Third, we estimated the future prevalence rate of infectious disease using the estimated model.

**Results:** During the study periods, the prevalence of infectious disease ranked tsutsugamushi fever (22.1 per 100,000 persons), malaria (11.7 per 100,000 persons), shigellosis (6.2 per 100,000 persons), leptospirosis (1.2 per 100,000 persons), and vibrio vulnificus sepsis (1.2 per 100,000 persons) by order. Based on the three years prevalence, the study estimated the expected number of diseases due to unit degree increase of temperature. On average, the prevalence of five infectious diseases was expected to increase by 4.27%. The impact of climate change was ordered tsutsugamushi fever (5.98%), leptospirosis (4.07%), malaria (3.40%), vibrio vulnificus sepsis (3.29%), and shigellosis (1.81%).

**Conclusion:** Despite the severity of the impact of climate change, strategies and research required in this regard are only in their beginning stages in South Korea. As one of the most prominent and prompt preparations, vector-borne diseases attracted the popular attention and the first step of involvement started to estimate the burden of future events. We hopefully expect this study will contribute to the development of adaptation plan.

## ISEE-0543

## Smoking During Pregnancy Is Associated with Higher Dietary Intake of Polycyclic Aromatic Hydrocarbons (PAHs)

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**Background and Objective:** Recent studies suggest prenatal exposure to polycyclic aromatic hydrocarbons (PAHs) may be associated with adverse reproductive outcomes. Other than tobacco smoke and occupational exposures, diet is the main source of human PAH exposure. However, little is known about dietary intake of these compounds among pregnant women. This study aimed to estimate dietary intake of total PAHs and benzo(a)pyrene (BaP), identify the main dietary sources of these compounds and characterize factors associated with higher intakes among women with different tobacco smoke exposure during pregnancy.

**Methods:** Data came from the Spanish INMA (Environment and Childhood)-Sabadell cohort of 657 women recruited during the first trimester of pregnancy. Dietary exposure to total PAHs and BaP was calculated combining food consumption data and estimated PAH concentrations in food items. One-way ANOVA was used to identify significant differences in intake among non-smokers, passive or active smokers. Multivariable linear regression was used to assess whether tobacco smoke exposure, reproductive history, and socioeconomic indicators were related to higher intakes.

**Results:** Mean dietary intakes of BaP and PAHs were significantly higher among smokers (0.225 and 10.200  $\mu\text{g/day}$  respectively) and passive smokers (0.220 and 9.385  $\mu\text{g/day}$ ) than non-smokers (0.200 and

8.883  $\mu\text{g/day}$ ) ( $P$ -value < 0.001). In all women, major contributors to total PAHs were processed meats, shellfish, and cereals/potatoes. For BaP, after dairy products, the major contributors were vegetables and fruits in passive and non-smokers, vs. shellfish and processed meats among smokers. Active and passive smoke exposure and lower educational level were associated with higher PAH intakes.

**Conclusion:** Women who smoked actively or were exposed to passive smoke had higher exposure to dietary PAHs during pregnancy due to their higher intake of processed meats and shellfish. Given that tobacco smoke is an additional route of PAH exposure, the added dietary burden in these women is of concern.

## ISEE-0544

## Integrated Environmental Health Impact Assessment of Three Drinking Water Contaminants

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**Background and Objective:** Four integrated environmental health impact assessments were carried out to assess the health impacts attributable to three non-microbial drinking water contaminants in England & Wales: arsenic, trihalomethanes (THMs) and nitrates. Health outcomes of interest were bladder cancer (for arsenic and THMs), small for gestational age (for THMs) and methaemoglobinemia (for nitrates). The work was designed to test methodologies developed in the INTARESE project (Integrated Assessment of Health Risks of Environmental Stressors in Europe).

**Methods:** Causal diagrams were assembled of the full chain between contaminants in drinking water and burden of disease, via epidemiological measures of exposure-response. Monte Carlo simulation techniques were used to calculate distributions of attributable excess risk and attributable excess cases of disease. Qualitative and quantitative techniques were used to analyse uncertainties in the assessment, particularly focusing on scoping and model structure, transportability and reliability of exposure-response functions, timing of causal relationships, and efficacy of using drinking water monitoring data to reflect exposure.

**Results:** The lowest number of excess cases of disease was reported for nitrates and methaemoglobinemia; the highest was for THMs and small for gestational age. Uncertainties in all assessments were considerable and, in many cases, were not directly quantifiable. Lack of plausible exposure-response data in the nitrates assessment resulted in extremely uncertain results. Scoping and model structure were seen to be linked closely with characterisation of available exposure-response data.

**Discussion:** Recommendations were given for development of the assessments including their extension to other countries and regions, investigation of alternative policy scenarios relating to source water, incorporation of latency into cancer assessments, and inclusion of private supplies.

## ISEE-0547

## Lifestyle, Physical Burden and Anxiety in Pregnant Women and Recurrent Pregnancy Loss

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**Background and Objective:** A few environmental factors such as cigarette smoking or alcohol use have been shown to affect pregnancy outcomes. However, lifestyle and mental stress are conflicting. The aim of this study is to elucidate the associations between lifestyle or mental stress and recurrent pregnancy loss (RPL).

**Methods:** This case-control study was performed in the city of Sapporo, Japan, during the years 2003–2006. We conducted a self-administered questionnaire survey to 113 women with a history of RPL and 480 women whose pregnancies end in live births, who were obstetrically managed in the Hokkaido University Hospital. The questionnaire provided information on their diet, smoking, alcohol use, sleep, feeling of physical burden of daily housework or job, home environment as well as the State-Trait Anxiety Inventory (STAI). We calculated the score of the trait anxiety (A-Trait) and the state anxiety (A-State) scales of STAI. We performed t-test, ANCOVA, chi-square test or logistic regression analysis to examine whether there were any differences or associations.

**Results:** Before the recent pregnancy, 22 women with RPL (19.6%) were smokers, whereas 123 control women (25.9%) were smokers ( $P < 0.05$ ). During the recent pregnancy, however, eight women with RPL (7.2%) continued smoking, whereas 56 control women (11.8%) continued it ( $P > 0.05$ ). The mean (SD) daily sleeping hours of the women with RPL and controls were 6.9 (0.9) and 6.7 (1.2) hours, respectively ( $P < 0.05$ ). There were no significant differences in daily intake of caffeine, isoflavone, the score of A-Trait and A-State and home environment between them ( $P > 0.05$ ). On the other hand, the women with RPL had stronger feeling of physical burden of daily housework or job at the first trimester than controls ( $P < 0.05$ ).

**Conclusion:** Our findings suggested that lifestyle at the first trimester of pregnancy might be associated with RPL.

#### ISEE-0551

##### Investigating the Transferability of Land Use Regression Models Between Two Countries – GB and the Netherlands

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**Background and Objective:** Land use regression (LUR) models have increasingly been applied for air pollution mapping at typically the city level. The observed differences in the models may be due to artefacts of data and methodology or may reflect underlying differences in source or dispersion characteristics. More standardised methods using common data sets could be beneficial. We compared the structure and performance of LUR models for NO<sub>2</sub> and PM<sub>10</sub>, developed with a consistent protocol in GB and Netherlands using different datasets.

**Methods:** Models were constructed on the basis of 2001 annual mean concentrations from all routine measurement sites from the national air quality networks. Predictor variables used for modelling related to traffic, population, land use and topography. Three sets of models were developed for each country. First, predictor variables derived from data sets common to both countries were used to develop baseline models. Second, the baseline models for GB were calibrated for NL, and vice versa, to explore transferability. The third model was developed using the best possible predictor variables for each country.

**Results:** The performance of models based upon common data was only slightly worse than models optimised with local data. Models transferred from one country to the other country performed substantially worse than the models developed specifically for that country, consistent with differences in model structure between countries even when models were developed with a common dataset. In both countries, the performance of the NO<sub>2</sub> models was substantially better than the PM<sub>10</sub> models.

**Conclusion:** Care is needed both in transferring models across different study areas, and in developing large inter-regional LUR models. In general, therefore, it is likely to be preferable to use locally optimised models for the purpose of air pollution mapping and exposure assessment.

#### ISEE-0552

##### The Atherosclerosis and Risk of Cardiovascular Consequences of Air Pollution (ARCA) Project. Study Design and Preliminary Data

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**Background and Objective:** Besides being recognized as a relevant risk factor for respiratory and neoplastic diseases, air pollution is emerging as an important determinant of atherosclerosis and cardiovascular diseases. The main outcome of this study is to investigate the relationship between air pollution and cardiovascular disease in a large cohort of subjects enrolled in Taranto, Italy. The first step of the enrollment campaign regards subjects highly exposed to air pollution, and here we present preliminary data for this study group.

**Methods:** Up to 2000 workers at the largest steel-works in Italy, ILVA, Taranto, Italy, are undergoing a comprehensive assessment covering the following domains: sociodemographic data, health status, physical activity level, working history, medical diagnoses, drugs, nutritional status, cardiovascular and respiratory signs, and laboratory analyses. The following instrumental work up is also performed: 12-lead electrocardiogram, 24h electrocardiography, echocardiography, flow-mediated dilation (FMD), carotid echocolor Doppler, spirometry. The first follow-up is scheduled within 3 years. Since the recruitment is ongoing, here we present descriptive data about the first 352 subjects enrolled.

**Results:** The mean age of this group is  $40.1 \pm 10.3$  years. The prevalence of selected abnormal cardiovascular markers is as follows: FMD  $< 5\%$  = 89.8%; c-reactive protein (PCR)  $> 5$  mg/l = 20.2%; deceleration time  $> 200$  cm/sec = 19.0%; E/A ratio  $< 1$  = 12.2%; microalbuminuria  $> 20$  mg/l = 7.4%; intima-media thickness (IMT)  $> 0.09$  = 6.8%.

**Conclusion:** The prevalence of selected markers of atherosclerosis and cardiovascular disease is distinctly high in this group of young-adult subjects highly exposed to air pollution. The final database of the ARCA project will provide further insight into the mechanisms underlying these findings.

#### ISEE-0553

##### Cord Blood Toxicants and Neurodevelopment of Infants from INMA-Valencia Cohort, Spain

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**Background and Objective:** Fish are the main source of omega-3 fatty acids, which are essential for neurodevelopment. However, fish are also

the main route of exposure to neurotoxic pollutants such as mercury or polychlorobiphenyls (PCBs). The objective of this study was to determine whether total mercury (T-Hg) and PCB concentrations in cord blood were associated with children's mental and psychomotor development at 12 months of age.

**Methods:** T-Hg and 7 PCB (PCB 28, 52, 101, 118, 138, 153, 180) concentrations were measured in total blood or serum cord samples, respectively. Psychomotor and mental development was assessed with the Bayley Scales of Infant Development. Fish intake during pregnancy was assessed by a food frequency questionnaire. Robust linear regression analyses were used to evaluate the influence of mercury (cut-off: 22 µg/L) and PCB exposure on neurodevelopment (n = 442), adjusting for fish intake and other potential confounders.

**Results:** The median concentrations of T-Hg in cord samples was 9.8 µg/L, finding concentrations >22 µg/L in 17%. Median concentration of sum of 7 PCBs was 0.44 ng/mL. We found no significant association between exposure to T-Hg >22 µg/L and Mental Development Index (MDI) ( $\beta = -0.21$ ;  $P = 0.244$ ) or Psychomotor Development Index ( $\beta = 0.14$ ;  $P = 0.350$ ) scores. We found a 0.87 point decrease in MDI with each 10-fold increase in PCB 118 (mean = 0.05 ng/mL), although the association was only marginally significant ( $P = 0.078$ ).

**Conclusion:** Prenatal T-Hg exposure was elevated but was not associated with neurodevelopment. Concentrations of PCB 118 were marginally associated with delays in neurodevelopment. Future analysis will include data from the other INMA cohorts.

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#### ISEE-0554

##### Mortality in the Proximity of a Nickel/Copper Smelter in Finland

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**Background and Objective:** Long-term exposure to particulate matter (PM) air pollution increases mortality, but the specific role of metals in PM remains unclear. We conducted a register-based cohort study to investigate cause specific mortality near a nickel/copper smelter in Harjavalta, Finland.

**Methods:** The study cohort consisted of 33,790 people living within 18 km from the smelter in 1980. Person-years and deaths from 1981 to 2005 were aggregated into 250 m × 250 m grids according to subjects' place of residence. Nickel concentration in humus in 1996 was selected as an indicator for long-term exposure to PM air pollution from the smelter. Four exposure zones (about 0–2, 1–5, 4–9 and 7–18 kilometers from the smelter) were defined on the basis of the interpolated nickel map. We calculated relative risks (RR) and 95% confidence intervals (CI) for mortality in the three exposed zones (N = 3200–5000) using the Rapid Inquiry Facility (RIF). The least exposed group (N ~ 22000) was used as a reference. The analyses were adjusted for sex, age, and socio-economic status.

**Results:** The RRs of mortality by increasing exposure among men were 0.93 (0.80–1.07), 1.19 (1.04–1.36), and 1.14 (0.98–1.32) for diseases of the circulatory system, and 2.57 (1.11–5.06), 3.55 (1.84–6.21), and 2.72 (1.09–5.61) for diabetes mellitus. The respective numbers among women were 1.02 (0.90–1.16), 1.15 (1.02–1.31), and 1.11 (0.96–1.29), and 1.03 (0.50–1.90), 1.26 (0.63–2.26), and 1.78 (0.95–3.04). The exclusion of the smelter workers did not materially change the findings.

**Conclusion:** Environmental exposure to PM air pollution containing a complex mixture of metals may have increased the mortality from cardiovascular diseases and diabetes mellitus near the nickel/copper smelter.

#### ISEE-0555

##### Association Between Particulate Air Pollution and Systemic Inflammation in Persons with Ischemic Heart Disease

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**Background and Objective:** Persons with cardiovascular disease are vulnerable to the effects of particulate air pollution (PM) on health. Systemic inflammation has been suggested to mediate the effects of PM on cardiovascular health. Our aim was to evaluate the association between outdoor levels of PM and systemic inflammation among ischemic heart disease patients.

**Material and Methods:** Daily levels of fine particles (PM<sub>2.5</sub>; diameter < 2.5 µm), coarse particles (PM<sub>10</sub>-PM<sub>2.5</sub>; diameter 2.5–10 µm) and particle number concentration (PNC) were measured at a central outdoor measurement site in Kotka, Finland, between November 2005 and May 2006. Absorption coefficient (Abs) an indicator of elemental carbon was determined to obtain an estimate of combustion derived particles. Concurrently with the air pollution measurements, subjects with coronary heart disease were followed for 6 months with biweekly clinical visits. Blood levels of interleukins -8 and -12 (IL-8 and IL-12), C-reactive protein (CRP) and fibrinogen (Fb) were determined to be used as indicators of systemic inflammation. Associations between PM and the levels of Fb and log-transformed levels of IL-8, IL-12 and CRP were analyzed using generalized additive models adjusting for apparent temperature.

**Results:** Daily average concentrations of PM<sub>2.5</sub> and PNC were 8.3 µg/m<sup>3</sup> and 5000 cm<sup>-3</sup>, respectively. PM<sub>2.5</sub> was positively associated with CRP and IL-12. Effect estimates for interquartile increases in PM<sub>2.5</sub> were 30.4% (1-day lag, 95% confidence interval (CI) 4.2–56.6%) for IL-12 and 5.0% (5-day avg., 95% CI 1.0–9.1%) for CRP. In addition, coarse particles were positively associated with Fb, PNC with IL-8, and Abs with IL-12 and CRP.

**Conclusions:** Even low levels of ambient PM are associated with systemic inflammation, a risk factor for coronary heart disease.

#### ISEE-0557

##### Bioclimatic Discomfort Conditions and Emergency Calls

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**Background and Objective:** The association between high temperatures and increased mortality and morbidity is well recognized and documented especially among elderly, and many heat/health watch warning systems have been setting up in many countries. We analyzed the effect of adverse bioclimatic conditions using emergency assistance calls which are collected using the same protocol within a unique database in Emilia-Romagna Region (in northern Italy).

**Methods:** We analyzed daily data of emergency calls of nine chief towns in Emilia-Romagna from 2002 to 2006 Summer seasons. We selected only calls related to natural and indoor trauma causes, with a stratification by age classes. Bioclimatic discomfort conditions were defined using mean daily apparent temperature. A Generalized Additive Model on daily counts of emergency calls has been fitted to bioclimatic conditions for each town, taking into account the confounding effects of air pollution (in terms of PM<sub>10</sub>, NO<sub>2</sub>, O<sub>3</sub> concentrations; mono-pollutant models), seasonality, holidays and week-ends. The relationship between daily emergency calls and apparent temperature has been approximated with linear splines.

**Results:** High values of apparent temperature are associated with an increase in the emergency calls in all towns. Increases in emergency calls vary from 1 to 2% for every unit of apparent temperature over 24°C, controlling for PM<sub>10</sub>. This relationship is statistically significant with the only exceptions of the two less populated towns. Similar results are observed controlling for O<sub>3</sub>.

**Conclusion:** This study reports an association between high temperature and emergency calls; this relationship is statistically significant. This result is of particular interest for planning emergency assistance. In addition, taking into account the real-time availability of emergency call data, they can be very useful in surveillance plans of health population conditions.

#### ISEE-0559

##### Impact of Socio-Economic State on the Prevalence of Allergic and Respiratory Symptoms and Diseases and in Hungarian Children Population

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**Background and Objective:** The study is related to the Regional Priority Goal III of the Children Environmental Health Action Plan (CEHAPE): to reduce asthma and allergy by lowering air pollution. The aim was to assess the relationship between the prevalence of allergic and asthmatic symptoms and chronic bronchitis in 3rd grade schoolchildren and social deprivation on settlement level in Hungary.

**Methods:** In a cross sectional study all children in 3<sup>rd</sup> grade classes in 2726 schools of Hungary were invited. The questionnaires completed by the parents gave information on the children's current respiratory or allergic symptoms, presence of chronic bronchitic symptoms and on doctor diagnosed allergy. The response rate was 76.4%.

The socio-economical state of the population on settlement level was characterised by deprivation index computed from factors like income, rate of education, unemployment, single parents, large families, density of housing, and car ownership from census data. The association between deprivation and the spatial distribution of symptoms and morbidity was studied by "risk analysis" tool of Rapid Inquiry Facility (RIF) software. The settlements were grouped into deprivation quartiles, morbidity rates as well as risks were calculated for each quartile.

**Results:** A significant upward trend was observed in the risk of morbidity due to bronchitis and asthmatic symptoms (<12 months) in both genders and in case of allergy (RR for boys: least deprived area: 0.64 95%CI:0.61–0.67; most deprived area: 1.87 95%CI:1.75–2.00) by degrees of deprivation.

**Conclusion:** This ecological study suggests that allergic, asthmatic and bronchial symptoms in children are more frequent in socially deprived areas of the country. In order to protect children's respiratory health, it is not enough to lower the level of indoor and outdoor air pollution, but the social state of the population should be improved as well.

The study was funded by EUROHEIS2 project (No2006126).

#### ISEE-0560

##### Association of Cadmium with Human Breast Cancer

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**Background and Objective:** Cadmium is a known human carcinogen based on findings of lung cancer in exposed populations. A more controversial target site for cadmium is the human mammary gland, for which some studies indicate a link between cadmium exposure and cancer. Some authors suggest that cadmium is a new environmental estrogen that mimics the effects of estradiol in estrogen-responsive breast cancer cell lines. In order to assess an association of cadmium with human breast cancer, we examined cadmium concentration in urine and breast tissue of patients with breast cancer and non-malignant breast tumour.

**Methods:** Cadmium was analyzed in the samples of urine and breast tissue of 57 breast cancer patients and 50 benign tumour patients. Two samples of breast tissue from each patient, i.e. tumour and some healthy tissue close to tumour were taken for the analysis. Cadmium was determined by atomic absorption spectrometry (Perkin-Elmer, Zeeman 3030). Estrogen receptors (ER) determined by immunohistochemical assay.

**Results:** The mean cadmium concentration in breast cancer patients was 53.4 ng/g (95% CI = 42.2–64.6) for tumour sample and 20.1 ng/g (95% CI = 14.4–25.9) for healthy breast tissue sample ( $P < 0.001$ ). In benign tumour patients the figures were following: 37.2 ng/g (95% CI = 23.3–51.1) and 32.1 ng/g (95% CI = 17.5–46.5) ( $P = 0.449$ ). Cadmium concentration found in the sample of malignant tumour differed significantly from that in the sample of benign tumour ( $P < 0.001$ ). Significantly higher concentration of cadmium determined in breast cancer patients with positive ER compare to that with negative ER (67.5 ng/g 95% CI = 48.7–86.2 vs. 42.5 ng/g 95% CI = 28.6–56.4,  $P = 0.035$ ). There was a positive correlation between cadmium in the samples of breast tumour and urine ( $R = 0.3$ ,  $P = 0.01$ ). In breast cancer patients cadmium in urine correlated with number of cigarettes smoked during lifetime ( $R = 0.7$ ,  $P = 0.02$ ).

**Conclusion:** The data obtained show a possible relationship between cadmium and breast cancer.

#### ISEE-0561

##### Prenatal Exposure to Mercury, Fish Consumption During Pregnancy and Associated Factors in Four Spanish Birth Cohorts (INMA Project)

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**Background and Objective:** High prenatal exposure to mercury (Hg) has been related with neurodevelopmental deficits in children. Fish consumption is the main source of Hg exposure. Our objective is to assess total Hg (T-Hg) exposure in newborn and associated factors in 4 cohorts of the Spanish Environment and Childhood (INMA) Project.



**Methods:** Study population included 1,888 mother and child pairs from 4 areas of Spain, i.e. Asturias (340), Gipuzkoa (533), Sabadell (461), and Valencia (554). T-Hg concentration in cord blood was determined by atomic absorption spectrometry. Information on socio-demographic characteristics, occupational history, and life-style was obtained through 3 questionnaires completed in the 1<sup>st</sup> and 3<sup>rd</sup> trimester of pregnancy. Fish intake was assessed by a food frequency questionnaire at 3<sup>rd</sup> trimester that included eleven items for fish intake. ANCOVA was used for multivariate analysis.

**Results:** T-Hg levels were below LOD in 89 samples (4.7%). Geometric mean (interquartile range) for each cohort was 10.8 µg/L (6.6–18.8), 7.5 (5.1–12.0), 6.3 (4.1–10.0), and 9.5 (5.3–18.0), respectively. Sixty-eight percent of samples showed T-Hg levels above the EPA reference dose equivalent (5.8 µg/L). The mean daily fish intake was 73 g/day; white fish, canned tuna, and big oily fish provided the main contribution to fish intake. Statistically significant increases of 12.5, 7.6, 6.7 and 3.4% in T-Hg levels were observed for 100 g/week increase in the intake of big oily fish, white fish, canned tuna and the remaining fish, respectively.

**Conclusion:** We found elevated T-Hg levels in cord blood in Spain similar to other high consumption populations. It is necessary to develop actions to prevent high prenatal exposure to mercury including guidance to pregnant women in making prudent dietary choices as well as public health control of Hg concentration in marketed fish.

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#### ISEE-0563

##### Climate and Atopic Disease in Children in Temperate Countries in Europe and North America

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**Background:** Although atopic diseases exhibit strong seasonal patterns, there is only weak evidence that climate per se is a determinant of the variation in prevalence of wheeze between populations. Previous studies that reported an association between climate factors and wheeze did not take into account other environmental hazards or potential confounding factors. We investigated the impact of climate factors (temperature and humidity) on the prevalence of symptoms of atopy-related diseases such as asthma and eczema in children.

**Methods:** We used the PATY combined cross-sectional dataset of respiratory health in children in 10 countries in Europe and North America to investigate the effect of long term climate factors (temperature, relative humidity) on three outcomes: wheeze, woken by wheeze and itchy rash. Study-specific odds ratios for associations with climate factors were estimated using logistic regressions with area-level random effects, controlling for ambient air pollutant exposures and individual risk factors. Mean effects were estimated using meta-analysis.

**Results:** Climate exposure had no effect on the prevalence of wheeze or itchy rash. Controlling for NO<sub>2</sub> or PM<sub>10</sub> did not strongly confound the overall associations between symptoms and climate variables. Climate factors did not modify observed associations between air pollution and children's health.

**Conclusions:** The prevalence of wheeze or itchy rash is unlikely to be determined by the outdoor climate within mid to high latitude countries in North America and Europe.

#### ISEE-0565

##### Case-Control Study of Behavioral and Environmental Factors Associated to Congenital Malformations in Cali, Colombia

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**Background and Objective:** A hospital based surveillance system in Cali, Colombia, identified time and space clusters of congenital malformations (CMF). Public concern was raised about the potential role of an open dump close to poor areas of the city where most of CMF are reported. We evaluated behavioral and environmental factors potentially associated to CMF.

**Methods:** A case-control study was carried out including cases of CMF potentially associated to environmental factors with normal cariotyping (mainly vascular disruption defects, neural tube defects, and hydronephrosis). Starting in May 2007, we included a total of 70 cases and 140 normal controls with similar conception date ( $\pm 2$  weeks). A questionnaire with demographic, behavioral, nutritional, and medication intake information was applied. In addition, hair samples of mothers were taken and analyzed by flame atomic absorption spectrometry to determine periconceptional levels of metals, namely cadmium, lead and zinc.

**Results:** Cases were more likely than controls to prefer smoking, use of recreational drugs (i.e. marijuana and cocaine), and intake of misoprostol, a drug to induce abortion. A higher proportion of cases with cadmium levels above the standard cut-off point were also found.

**Conclusion:** Multiple exposures to pollutants, in addition to those coming from the open dump site in Cali, have been found in these poor communities as sources of exposure. Behavioral factors, including the use of recreational drugs, smoking, and the periconceptional exposure to sub therapeutic doses of abortion drugs may interact in the etiology of CMF.

#### ISEE-0568

##### DNA Methylation Impacts on Cognitive Decline in a Cohort of Elderly Men

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**Background and Objective:** Environmental exposures have been associated with both epigenetic mechanisms and decrements in cognitive function. Epigenetic phenomena regulate the normal function of cells, including neurons, while epigenetic dysregulation has been identified in cognitive function disorders. The role of DNA methylation on changes in cognitive function over time has not been investigated. The objective of the current study was to evaluate whether DNA methylation in repetitive elements widely represented across the human genome is associated with changes in cognitive function in normal aging individuals.

**Methods:** A longitudinal cohort study was conducted in the context of the Normative Aging Study (Boston, USA) among 646 community-dwelling elderly men who underwent a battery of cognitive tests and who also had DNA methylation measurements. We used mixed effects models to assess the association between repeated measurements of scores on a battery of

cognitive tests over time and DNA methylation in Alu and LINE-1 (long interspersed nucleotide element-1) repetitive elements. Cognitive testing was performed from 1993 through 2007 and a total of 1,659 observations were included in the final analysis.

**Results:** The mean age of participants at baseline visit was 67.7 (SD = 7) years and the mean number of years of education was 14.4 (SD = 2.7). In multivariable models, a statistically significant greater decrease on a working memory test score (digit span backward test) over time with increasing LINE-1 DNA methylation ( $b = -0.019$ ,  $P = 0.0397$ ) was found. A decline in performance over time was observed on the majority of the tests as DNA methylation increased but the associations did not reach statistical significance.

**Conclusion:** Higher levels of DNA methylation in LINE-1 repetitive elements may adversely affect cognitive function, particularly in the working memory domain.

#### ISEE-0569

##### Noise and Air Pollution Correlation and Its Determinants in the City of Girona

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**Background and Objective:** Traffic-related noise and traffic-related air pollution have been associated with cardiovascular disease (CVD). A high ambient correlation between them in traffic conditions may entail that studies investigating the effects of air pollution on CVD are confounded by noise and vice versa. Few studies have investigated this correlation—none in Spain— and results differ among cities. We investigate the contribution of 16 potentially relevant factors such as urban land-use, distance to road or traffic intensity to this correlation in the city of Girona, where a large investigation of chronic effects of air pollution and noise on CVD takes place (REGICOR-AIR).

**Methodology:** Nitrogen dioxide (NO<sub>2</sub>) was used as a surrogate of traffic-related air pollution. Outdoor monthly measurements were conducted with Palmes samplers at 64 locations around Girona in May 2008. All sites were geocoded and an annual traffic noise mean value was derived from a validated noise map (2005; model NMPB routes 96 recommended by the EU). Backward stepwise linear regression models including traffic and land-use markers were fitted both for estimates of annual means of NO<sub>2</sub> and for noise.

**Results:** Noise and air pollution were correlated with  $r = 0.64$  (Pearson). The variables in the models explained 45% of the variability of the NO<sub>2</sub> concentrations and 79% of the variability of noise levels. Some determinants related to traffic and street layout differed between NO<sub>2</sub> and noise. Common determinants were building density and traffic intensity. These two determinants explained 34% and 59% of the variability of NO<sub>2</sub> and noise, respectively.

**Conclusions:** Due to the relatively high correlation between noise and NO<sub>2</sub>, characterization of the two will be very important in our attempts to disentangle the effects of noise and air pollution. We will further evaluate whether correlations differ in different areas of the city or in sub-groups of locations defined by traffic-related factors.

#### ISEE-0570

##### Social and Physical Environmental Factors and Maternal Mental Health

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**Background and Objective:** Associations between the physical environment and adult mental health have been documented. Studies, however, have failed to account for social factors that affect mental health and that may be correlates of deteriorated environments. We examined associations among maternal mental health, intimate partner violence (IPV), and housing quality in the Fragile Families and Child Wellbeing Study (N = 2115).

**Methods:** Maternal reports of IPV were obtained shortly after delivery and when the children were 12 and 36 months of age. At the 36-month assessment, interviewers rated indoor housing conditions, including housing deterioration (e.g. peeling paint, holes in floor) and housing disarray (e.g. dark, crowded, noisy house). Mothers also reported on housing hardships (e.g. moving repeatedly, difficulty in keeping house warm). A screening for depression and generalized anxiety was obtained from questions derived from the Composite International Diagnostic Interview–Short Form (CIDI-SF) administered to mothers during the 36-month assessment. Scores from the CIDI-SF provided probable diagnoses of major depressive and generalized anxiety disorders consistent with DSM-IV diagnostic criteria.

**Results:** In this sample of women (55% Black, 23% Hispanic) 17% reported IPV, 16% were classified as having probable depression and 5% as having probable generalized anxiety. In adjusted analyses, depression was independently associated with women experiencing chronic IPV (1.94 95%CI: 1.1, 3.3), housing instability (1.72 95%CI: 1.3, 2.2), and housing disarray (1.28 95%CI: 1.0, 1.6). Housing instability (3.31 95%CI: 2.2, 5.0) and chronic IPV (2.9 95%CI: 1.4, 6.0) were also associated with increased odds for generalized anxiety. In stratified analyses, a greater effect of chronic IPV on depression was noted among women living in disarrayed or deteriorated housing and among women experiencing housing hardship.

**Conclusions:** Our understanding of the relationship between the physical environment and mental health may be improved by considering aspects of the physical environment and the social environment together.

#### ISEE-0571

##### Risk of Low Birth Weight in Relation to Trihalomethane Concentrations in Public Water Supply: A National Study Using Multiple Data Sources

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1. We investigated the association between low birth weight (LBW), defined as < 2500g, and Trihalomethanes (THM) concentrations in tap water across 12 water companies in England and Wales.
2. Routinely collected THM data were modelled using a hierarchical mixture model. The modelled data were weighted for the final trimester, categorised and linked to births data via the postcode of the maternal residential birth address.

Births data were obtained from two sources over the 2 year study period, 2000–2001.

The Millenium Cohort Study (MCS) yielded 10,770 singleton live births and contains detailed individual level data such as maternal age, gestational age, smoking status and ethnicity. The gestational age enabled the splitting of the outcomes into pre-term and full-term LBW.

The National Births Registry (NBR) gave 982,000 births over the same period, from which, for computational reasons, a random sample of 100,000 was taken. The NBR data, however, only contained maternal age data.

A Bayesian hierarchical model was used in order to jointly analyse the MCS and NBR data. The model follows Molitor et al. JRSSA 2008 and incorporates two submodels, one for the imputation of the split

between pre- and full-term births and one for the imputation of the missing individual covariates smoking and ethnicity. In addition, random effects were added to the hierarchy in order to allow separate exposure effects for the 12 different water companies.

- Analyses were conducted to investigate the relationship between total THMs and LBW using the MCS and NBR datasets separately and also the combined datasets.

No associations were found with pre-term births. For full-term births, there was evidence to suggest an association, the strength of which depended on model assumptions.

- Information on gestational age is essential to our understanding of the relationship between THMs and LBW.

#### ISEE-0573

##### Prevalence and Predictors of Elevated Hair Metal Levels among Preschool Children and Women from Montevideo, Uruguay

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**Background & Objective:** The extent of human exposure to multiple heavy metals is not well described in many developing countries. Metal exposures may place children and reproductive-age women at increased risk of adverse health outcomes. We examined the prevalence of elevated metals levels in women and children from Montevideo, Uruguay.

**Methods:** We collected hair samples, demographic and health information from 222 children (5–45 months) and their mothers (15–47 years) in a community based study. Hair samples were analyzed for lead (Pb), cadmium (Cd), manganese (Mn), and arsenic (As) using IC-PMS.

**Results:** 180 children had sufficient quantity of sample for analysis, but 7 (4%) and 43 (24%) had undetectable Cd and As levels, respectively. Mean  $\pm$  SD metal levels (ppm) were: Pb  $17.64 \pm 17.43$ , Mn  $2.16 \pm 2.25$ , Cd  $0.28 \pm 0.53$ , As  $0.15 \pm 0.15$ . 23.7% of children had metal levels above median of the distribution. 165 maternal samples were analyzed; 10 were below detection limit for Mn and Cd, and 62 for As. Mean  $\pm$  SD metal levels in mothers' hair were: Pb  $7.12 \pm 9.06$ , Mn  $2.24 \pm 2.61$ , Cd  $0.12 \pm 0.15$ , As  $0.06 \pm 0.06$ . Correlations between maternal and child levels ranged 0.39–0.52 ( $P < 0.01$ ). Among demographic and health characteristics, we investigated predictors of elevated hair metal levels. In children, older age was associated with lower Pb and Cd levels ( $P < .05$ ). Girls had significantly lower As levels ( $P = .005$ ) but did not differ on other metals. Current or history of anemia was associated with higher child hair Mn levels ( $P < .05$ ). Higher maternal education but not employment was associated with lower Pb, Mn and As levels in children ( $P < .05$ ). Among women, higher socioeconomic status was associated with lower Mn, Cd and As but not Pb levels.

**Conclusion:** Both reproductive-age women and preschool children in Uruguay are exposed to multiple heavy metals. Sources of exposure should be investigated to reduce potential for adverse health effects in this population.

#### ISEE-0574

##### Estimating Long-Term Exposure to Outdoor Air Pollution at the Interurban Scale in an Ontario Cohort Study

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**Background:** We conducted detailed exposure assessments in support of an ongoing Ontario cohort study of long-term air pollution among 646,000 adults identified from the Canadian T1 family tax file (T1FF) database.

**Methods:** We made use of average daily concentrations of CO, NO<sub>2</sub>, SO<sub>2</sub>, O<sub>3</sub>, and TSP measured between 1982 and 2004 at fixed-site monitoring stations across Canada and the northern US. We also made use of summertime estimates of concentrations of PM<sub>2.5</sub>, at a scale of 0.1°, determined from aerosol optical depth measured from 2000–4 by the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Terra/Aqua satellites.

The interurban assessment, which is primarily for between-city comparisons, was conducted at two levels. First, we estimated exposures from 1982–2004 by assigning city-specific annual averages of CO, NO<sub>2</sub>, SO<sub>2</sub>, O<sub>3</sub>, and TSP to subjects residing in 10 cities in Ontario. Second, we derived annual mean concentrations of these five pollutants at subjects' annual addresses (six-character postal codes) using inverse distance weighting. We restricted interpolation to home locations within 50 km from each monitoring station. For PM<sub>2.5</sub>, exposures were estimated by matching the subjects' postal-code addresses to the MODIS-derived concentration surface.

**Results:** Over the 23-year follow-up period, annual mean concentrations of CO, NO<sub>2</sub>, SO<sub>2</sub>, and TSP decreased by approximately 35%, 26%, 55%, and 12% in the 10 cities, respectively, and annual mean concentrations of O<sub>3</sub> increased by 30%. The rank orderings of city-specific annual averages were essentially unchanged. This suggested geographic coherence of these secular trends at the interurban scale.

**Conclusion:** There were important temporal variations of ambient pollution in Ontario between 1982 and 2004; however, the changes of concentrations of ambient pollution occurred similarly across cities in Ontario.

#### ISEE-0575

##### Estimating Retrospectively Exposures to Outdoor Air Pollution at the Intraurban Scale in an Ontario Cohort Study

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**Background:** We assessed retrospectively intraurban exposures in support of an ongoing cohort study in Ontario of long-term air pollution among 646,000 adults identified from the Canadian T1 family tax file (T1FF) database.

**Methods:** We assessed exposures at addresses of subjects (six-character postal codes) in 1982, as listed on the T1FF file, who lived in Hamilton, Toronto, and Windsor, Ontario using: 1) small-scale concentrations of NO<sub>2</sub> in 2002 which were determined from land-use regression models based on dense exposure surveys conducted that year; 2) land use and vehicular traffic (1982 and 2002); and 3) average daily concentrations of NO<sub>2</sub> measured at monitoring sites (1982 and 2002).

For each city separately, we extrapolated to 1982 the land-use regression maps developed in 2002 as follows: 1) annual mean concentrations from monitoring sites were regressed against spatial characteristics of land use and traffic in 1982 and 2002, respectively; 2) the residuals from the regression models were interpolated using inverse distance weighting; 3) point-by-point concentrations were estimated by adding the interpolated residuals to the linear predictors from these regression models; 4) ratios of estimated annual concentrations between 1982 and 2002 were calculated at every location; and 5) the land use regression map in 2002 was multiplied by these ratios to obtain small-scale concentrations of NO<sub>2</sub> in 1982.

**Results:** The annual mean concentrations of NO<sub>2</sub> in Hamilton, Toronto, and Windsor decreased between 1982 and 2002 by 30%, 16%, and 30%,



respectively. The reductions were not spatially homogenous; in Toronto, for example, the highest decline occurred in the central areas (~20%) as compared to the periphery of the city (~5%). Detailed maps will be presented.

**Conclusion:** The ambient concentrations of NO<sub>2</sub> decreased over time. There were important spatial variations in the reductions within cities and accounting for this will improve the accuracy of estimates of relative risk.

#### ISEE-0578

##### Contribution of Food Borne Exposure to Arsenic and to Biomarker Levels

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**Background and Objectives:** Limited data exist on the contribution of food borne sources of arsenic to total exposure levels.

**Methods:** We analyzed data from a population-based study in New Hampshire, a region with arsenic-containing drinking water from bedrock aquifers. Participants (n = 961) completed a validated >100 item food frequency questionnaire along with a structured personal interview, and provided toenail and household tap water samples. We computed regression models for toenail arsenic that included age, sex, smoking, season, total calories, and water intake and each of the individual food variables. Analyses were conducted overall, and stratified by drinking water arsenic concentrations (<1 ug/L versus >1 ug/L). We further examined associations between foods related to toenail arsenic and indices of arsenic metabolism in urine.

**Results:** In our preliminary analysis, several food items were found to contribute to toenail arsenic, including those found in previous studies. Of the a priori foods, intake of white rice was modestly related to toenail arsenic (one sided  $P < 0.10$ ), whereas intake of brown rice was related to toenail arsenic among individuals with low (<1 ug/L) arsenic in their drinking water ( $P < 0.001$ ). Also of interest was the association between dark fish intake and distribution of urinary arsenic metabolites (e.g., %MMA and MMA/DMA).

**Conclusion:** Our findings suggest a potentially important role of dietary sources of inorganic arsenic exposure, and rice in particular, especially among those with low water concentrations. We plan to apply these methods to a newly initiated pregnancy cohort in New England in which dietary data, maternal hair, maternal and infant toenails, maternal and cord blood and other biological samples will be collected.

#### ISEE-0580

##### Association Between Consumption of Nitrate-Contaminated Water and Time to Pregnancy (TTP) Among Fertile Women

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**Background and Objective:** Nitrates are one of the pollutants in drinking water, produced in part by the excessive fertilization of fields and the inadequate management of the manure generated by livestock farmers. Evidence showing a consistent pattern of association between nitrates and adverse reproductive outcomes have been inconsistent and rare. The objective of this study was to analyze the association between nitrate levels in drinking water and Time to Pregnancy (TTP) among fertile women (in months).

**Methods:** A cross sectional survey with retrospective collection design based on a questionnaire was conducted among female personnel who lived in small towns in the Comarca Lagunera, Mexico. Time to pregnancy (TTP) for first pregnancy was used to estimate the fecundability. After exclusions, 181 women remained for analysis. The fecundability Odds Ratios were calculated with a discrete time analogue of Cox's proportional hazard model.

**Results:** TTP mean, in months, in three different nitrate levels offers great differences (2.7, 3.2 and 4.2 months respectively). In the final multivariate model, the main predictor is the nitrate level adjusted by maternal age at first pregnancy and, marginally, maternal coffee consumption and paternal smoking habit. Fecundability OR (fOR) for level 2 and 3 were 0.78 (CI<sub>95%</sub> 0.38–1.55) and 0.53 (CI<sub>95%</sub> 0.26–1.05).

**Conclusion:** The reduced fecundability in relation with different water levels of nitrates is slightly marginal, but with a clear tendency towards association and it is worth further study for precising specific damage. Future studies examining semen quality and characteristics of menstrual cycle are needed.

#### ISEE-0581

##### Anogenital Distance in Children with Genitourinary Disorders: A Pilot Study

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**Background:** Anogenital distance (AGD is defined as the distance between the anterior base of the penis and anus in males. Decreased androgen exposure in utero leads to the development of a shortened AGD, hypospadias, cryptorchidism, and other male genital abnormalities in animal studies. In humans, it is unknown whether a shortened AGD is associated with genital abnormalities.

**Objectives:** To measure AGD in a pilot study of male children with disorders associated with insufficient androgenization and male children without any medical disorders.

**Methods:** AGD measurements were obtained using a dial caliper in male infants (N = 54) under 32 months of age recruited from the Seattle Children's Hospital pediatric urology clinics. We collected demographic data on weight, height, race/ethnicity, and age. Multiple regression analysis was used to compare AGD in cases and controls.

**Results:** AGD was easily measured among cases: hypospadias (N = 17), cryptorchidism (N = 16), other genitourinary abnormality (N = 13) and controls (N = 8). In multiple regression analyses, AGD (in millimeters) was smaller among case groups (hypospadias -0.81, 95% Confidence Interval (CI) -6.6, 5.02; cryptorchidism -1.5, 95% CI -7.3, 4.4; other abnormality -2.6, 95% CI -8.7, 3.5) compared to controls, but results were not statistically significant.

**Conclusion:** Our results mirror those of animal studies in which AGD is smaller among individuals with genitourinary disorders associated with

decreased androgenization, but results are limited due to sample size, particularly among the control group. We are currently conducting AGD measurements to improve sample size and power. If these findings are confirmed, AGD may represent a new clinical biomarker of decreased androgenization in humans.

#### ISEE-0582

##### The Relationship Between Human and Bovine *Schistosoma Japonicum* Infections at the Household and Village Level in Southwest China

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**Background:** Bovines have been implicated as important reservoirs for the parasite, *Schistosoma japonicum*, which can cause liver disease in humans. Cows and water buffalo are frequently used for agricultural activities and can shed the parasite in their stool which may pose infection risks to their owners and community members.

**Methods:** We examined the relationship between human and bovine infections in 43 villages in Sichuan province, China where schistosomiasis reemerged after declining below detectable levels. We tested 2313 people and 508 bovines for *S. japonicum* infection using the miracidial hatching test and, in humans, the Kato-Katz thick smear procedure. Heads of household were interviewed about bovine ownership, socio-economic indicators and other risk factors. Bovine village infection prevalence was defined as the prevalence of infection outside each person's home. Models adjusted for within village correlation using generalized estimating equations.

**Results:** *S. japonicum* infection prevalence was 8.0% in humans and 13.4% in bovines. Bovine ownership was common: 41.1% of households owned one or more. Bovine infection did not differ by age, sex or whether the animal was a water buffalo or a cow. Individuals who owned infected bovines had a greater odds of infection than individuals who did not, controlling for human age, socio-economic status, county of residence and bovine village infection prevalence (OR: 2.2, 95% CI: 1.1–4.4). Bovine village infection prevalence was also associated with human infection risk: a 10% increase in bovine infection prevalence was associated with a 1.3 greater odds of human infection (95% CI: 1.1–1.6), controlling for human age, SES, county and infected bovine ownership.

**Conclusions:** Infected bovines indicate increased infection probability for their owners as well as community members. Schistosomiasis control measures should incorporate testing of all people in a village upon detection of bovine infections and vice versa.

#### ISEE-0585

##### Air Pollution and Risk Factors Related to Respiratory Illness in Schoolchildren in the Niger-Delta

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**Background and Objective:** Association of childhood respiratory illness with air pollution has been widely reported in developed but not in developing countries. Warri and its surrounding municipal areas in Delta State, Nigeria is the location of petrochemical complexes and the region has long standing issues of industrial and traffic pollution, socio-economic deprivation and ill-health of its residents. This study was aimed to investigate association between self-reported respiratory symptoms and exposure to ambient air pollution and other risk factors in 7–14 years old school children in and around Warri town.

**Methods:** A cross-sectional questionnaire survey was carried out among 1,397 school children of low socio-economic status. Exposure to air pollution was assessed by self-reported measures as well as objective methods including traffic counts, distance of schools to major streets, particulate matter and carbon-monoxide measurements. Associations between health and risk factors were examined at individual and ecological level in a multiple regression analysis.

**Results:** Road traffic was associated with increased risks of wheeze, night cough and phlegm in the last 12 months. Suggestive associations were found between overcrowding and wheeze and nose problems; owning pets and nose problem and diagnosed asthma; and environmental tobacco smoke and phlegm and nose problem, after adjustment for other explanatory variables. When viewed in terms of the pollutant mix from different sources, at the aggregate level, there was a relatively consistent suggestion of higher rates of health outcomes in areas classified as being more polluted than those classified as being relatively unpolluted.

**Conclusion:** The effects of multiple risk factors on school-age children in the Niger-Delta are indicative of possible additional effects of ambient air pollution especially on respiratory symptoms, over and above any attributable to personal and household effects. These are of public health importance and merit practicable interventions.

#### ISEE-0586

##### Fine Particulate Air Pollution and Asthma in Adults

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**Background and Objective:** Relationships between chronic exposures to air pollution and various respiratory health outcomes have yet to be clearly articulated for adults. Recent data from nationally representative surveys suggest increasing disparity by race/ethnicity regarding asthma-related morbidity and mortality. The objectives of this study are to evaluate the relationship between exposure to fine particulate matter (PM<sub>2.5</sub>) on the prevalence of adverse respiratory outcomes for black and white adults using modeled air pollution and health outcome data and to examine potential differences in PM<sub>2.5</sub> sensitivity across race/ethnicity.

**Methods:** Adult respondents from the 2002–2005 National Health Interview Survey (NHIS), a U.S. annual nationally representative household interview survey, were linked to annual kriged PM<sub>2.5</sub> data from the USEPA AirData system. Logistic regression was employed to investigate the relationship between increases in ambient PM<sub>2.5</sub> concentrations and self-reported prevalence of current asthma status and asthma attacks. Models included terms for relevant health (body mass index, sex and age), behavioral (smoking and exercise), demographic (race/ethnicity and urbanicity) and resource-related (income, insurance and education) covariates. Stratified analyses were conducted to determine whether sensitivity to exposure varied by race/ethnicity.

**Results:** Of nearly 110,000 adult respondents, approximately 8,000 and 4,000 reported current asthma and recent attacks, respectively. Overall, odds ratios (OR) for current asthma (0.97 (95% Confidence Interval: 0.87–1.07)) and recent attacks (0.90 (0.78–1.03)) did not suggest an association with PM<sub>2.5</sub>. Stratified analyses revealed significant associations for non-Hispanic blacks [OR = 1.73 (1.17–2.56) for current asthma and OR = 1.76 (1.07–2.91) for recent attacks] but not for Hispanics and non-Hispanic whites.

**Conclusion:** Non-Hispanic blacks may be at increased sensitivity of asthma outcomes from PM<sub>2.5</sub> exposure, although this finding may be due to difficulties in classification of exposures and outcomes, other confounding factors that were uncontrollable in the present study, or a combination of these.

## ISEE-0588

**Infant Respiratory Mortality due to Air Pollution in 3 Large Brazilian Cities: Results from the ESCALA Project**

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**Background and Objectives:** There is evidence that air pollution can affect infant health but studies examining this association usually lack power due to small number of events. We evaluated the effect of air pollution on infant mortality in 3 large urban centres in Brazil: Sao Paulo (11 million inhabitants), Rio de Janeiro (6 million) and Porto Alegre (1.5 million) which have considerably large infant populations.

**Methods:** Time series using Generalized Additive Models (GAM) in Poisson regression were used. Time trends, seasonality and meteorological factors were adjusted by natural splines. Indicator variables of the weekdays and holidays were used to account for the short term cyclic fluctuations. Single lag and distributed lag models were fitted to particulate matter (PM<sub>10</sub>) and ozone (O<sub>3</sub>).

**Results:** Mean levels of PM<sub>10</sub> in these cities varied from 44.8 µg/m<sup>3</sup> in Rio, 41.9 µg/m<sup>3</sup> in Sao Paulo and 29.6 µg/m<sup>3</sup> in Porto Alegre, while for O<sub>3</sub> values were 21.6 ppb in Rio, 46.3 ppb in Sao Paulo and 14.1 ppb in Porto Alegre. The percentage increase in infant (<1) mortality due to respiratory diseases for a 10 µg/m<sup>3</sup> increase in PM<sub>10</sub> was 9.09% (2.68 to 15.90) for Rio de Janeiro and 0.46% (0.38 to 0.55) for Sao Paulo. For a 10 µg/m<sup>3</sup> increase in O<sub>3</sub> we observed an increase of 0.16% (0.08 to 0.24) in Rio. Effects on infant mortality due to lower respiratory infections (LRI) were only observed in Rio de Janeiro with an increase of 8.30% (1.39 to 15.68). No consistent effects were observed in Porto Alegre.

**Conclusion:** These results provide further evidence of the effects of air pollution on infants and are consistent with studies carried out in other large urban centres.

## ISEE-0589

**Hemoglobin and Family Characteristics of Preschool Children with Elevated Blood Lead Concentrations from Montevideo, Uruguay**

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**Background & Objective:** Elevated blood lead concentrations (BPbs) have been identified in Uruguayan children but sources and predictors of exposure remain understudied in this population. In 2007 we carried out lead and hemoglobin screening in capillary blood of 222 preschool children (5–45 months) from Montevideo to determine the extent of lead exposure and identify predictors of elevated BPbs.

**Methods:** We recruited children through flyers, radio spots, and letters to child and healthcare centers. We used LeadCare Analyzer to determine BPbs and a HemoCue analyzer to determine hemoglobin levels. Parents completed a brief questionnaire about the family and the child's health.

**Results:** Mean BPb was 9.0 ± 6.0 (range 1–35.6) µg/dL, with 32.9% of children having levels ≥10 µg/dL. Mean hemoglobin concentration was 10.5 ± 1.5 g/dL, with 44.1% having levels < 10.5 g/dL. Child age was positively associated with BPb ( $P < .05$ ). Anemic children had 2.4 µg/dL higher BPb than non-anemic children and were 1.9 times more likely to have BPb ≥ 10 µg/dL ( $P < .05$ ). Children who put fingers and toys in their mouth tended to have higher BPbs than children who did not, by 0.8 µg/dL ( $P < .1$ ). Maternal age less than 20 years ( $P < .05$ ), less education ( $P < .05$ ), father's job with potential risk of lead exposure

( $P < .1$ ), and fewer family possessions ( $P < .01$ ) were also associated with higher child BPb.

**Conclusion:** Pediatric lead exposure is a public health problem in Uruguay, with a large proportion of children experiencing elevated BPbs at a very young age. However, blood lead testing is not routinely part of pediatric visits.

## ISEE-0593

**Bystander Agricultural Pesticides Exposure and the Risk of Adverse Reproductive Outcomes: A Review of the Literature**

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**Background and Objectives:** Over the last decade, there has been growing concern about the possible health effects including a number of adverse reproductive outcomes from pesticides exposure for people living near agricultural field—so called “bystander exposure”. This systematic review evaluates the current epidemiological evidence on the association between bystander pesticide exposure and birth outcomes including congenital malformations, still birth, intrauterine growth retardation, low birth weight, preterm birth and spontaneous abortions.

**Methods:** We identified and reviewed twenty five bystander exposure studies using a systematic search of the main scientific databases and other approaches for the period of 1950 to 2007. Study methodologies and main results were summarized and tabulated according to the year of study and type of adverse reproductive outcome studied. The studies described and then evaluated for their level of evidence for reproductively toxicity in humans.

**Results:** Overall, there is some evidence for a relationship between bystander pesticide exposures and adverse birth outcomes, but the strength of the evidence varies between outcomes. The evidence is suggestive of an association between bystander pesticide exposure and congenital malformations, but due to some limitations, such as weaknesses in the exposure assessment and the possibility of chance or confounding bias, further studies are needed. For the other birth outcomes (still birth, IUGR, low birth weight, preterm birth and spontaneous abortion), the evidence as yet are inadequate to infer association, but the available evidence justifies further studies.

**Conclusion:** There is some evidence for a relationship between bystander pesticide exposures and adverse birth outcomes, but further study is needed using improved exposure assessment methodologies to assess the risk, if any.

## ISEE-0595

**Increased Cancer Mortality and Incidence among Residents Near a Petrochemical Complex in Taiwan**

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**Background and Objective:** The No. 6 Naphtha Cracking Complex has 66 plants for oil refining and chemical manufacturing and a coal fired power plant and is the largest one in Taiwan. This study aimed to assess the cancer mortality and incidence for residents living around this petrochemical complex before and during its operation.

**Methods:** The study areas included six townships located within 10 km of the complex, the exposed area, and their respective comparison township which located >10 km and upwind from the complex and was matched on the level of urbanization. Age-standardized mortality rates and incidence rates for total and specific cancers were estimated for these townships before and during different production periods, using year 1999 as the beginning of manufacturing processes with volatile organic compounds emissions from the complex.



**Results:** The standardized mortality rates for total cancers and lung cancer in the production<sub>year4-6</sub> period were significantly higher than those in the production<sub>year1-3</sub> period, and the standardized mortality rates for liver cancer were significantly higher than those in the respective comparison townships before and during the production periods in two exposed townships. In five exposed townships, the standardized incidence rates for total cancer during the production periods were significantly higher than those before the production period. The standardized incidence rate for acute myeloid leukemia in the production<sub>year4-7</sub> period was significantly higher than that in the production<sub>year1-3</sub> period in the township where the complex located. The standardized incidence rates for liver cancer in two exposed townships and acute myeloid leukemia in one township were significantly higher than those in their respective comparison townships during the production periods.

**Conclusion:** The mortality of total, lung and liver cancers and the incidence of total cancer, liver cancer and acute myeloid leukemia were significantly increased in the exposed areas near the petrochemical complex.

#### ISEE-0599

##### Impact of Improved Air Quality During the 1996 Atlanta Olympic Games on Cardiovascular and Respiratory Emergency Department Visits

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**Background:** Substantial evidence supports an association between ambient air pollution and acute cardiovascular and respiratory morbidity. There is increasing interest in evaluating whether actions taken to reduce air pollution levels will result in reduced morbidity. This study capitalized on a unique opportunity to evaluate the impact of a local, short-term intervention effort to reduce traffic in Atlanta during the 1996 Summer Olympic Games (July 19, 1996–August 4, 1996).

**Methods:** Air pollution levels both inside and outside of Atlanta were examined during the Olympic and surrounding time periods. Emergency department (ED) visits were examined to evaluate changes in usage patterns. ED visits for respiratory and cardiovascular conditions were examined in relation to the Olympic time period using Poisson time series analysis adjusting for time trends and meteorological conditions.

**Results:** Ozone levels were approximately 30% lower during the Olympic period compared to the four weeks before and after the Olympics; however, we observed similar reduction in ozone levels throughout other locations in the Southeastern United States. Overall daily traffic counts in Atlanta were not substantially reduced during the Olympics; peak morning rush hour counts were somewhat lower during the Olympics compared to weeks before and after. We observed little or no evidence of reduced ED visits during the Olympic time period; the estimates were sensitive to choice of analytic model and to method of adjusting for temporal trends.

**Conclusions:** This study provides little or no evidence that pollution levels or ED visits were substantially impacted by efforts to reduce traffic during the Olympic time period. The design of the study was limited by the small number of days in the intervention and its retrospective nature.

#### ISEE-0600

##### A Study on the Effect of Ambient Fine Particles on Peak Expiratory Flow Rates of Children

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**Background & Objectives:** This study was conducted to investigate and assess children's lung function decrement in association with exposure to ambient fine particles in Seoul.

**Methods:** The study group consisted of the fourth grade children in a primary school located in Seongbuk-district, Seoul. We monitored ninety two children for PEFR three times a day by peak expiratory flow meter from 25 June to 19 July, 2007. However, each student's lung function, FVC and FEV<sub>1</sub>, were measured on the first day. In addition, mass concentrations of PM<sub>10</sub>, PM<sub>2.5</sub> and number concentration of particles (PNC) were measured everyday for 25 days.

**Results:** The values showed  $1.97 \pm 0.30$ L in FVC,  $1.81 \pm 0.25$ L in FEV<sub>1</sub> and  $327.25 \pm 43.91$ L/min in PEFR. The mean concentrations of PM<sub>10</sub>, Coarse (coarse particle mass, PM<sub>10</sub>-PM<sub>2.5</sub>), PM<sub>2.5</sub> and PNC were 42.41, 15.45, 26.96 ug/m<sup>3</sup> and 7,672  $\pm$  3,498 particles/cm<sup>3</sup>.

PEFR was decreased 7.028 L/min in PM<sub>10</sub>, 4.628 L/min in coarse and 6.040 L/min at one day before exposure (Lag 1) to daily IQR(Inter quartile range) increases of ambient fine particles ( $P < 0.05$ ). According to the distance from a main street to residential areas, we classified this study group into three; A (more than 100M), B (50–100M) and C (near within 50M) group. Daily mean PEFR was  $330.63 \pm 35.82$  L/min in group A,  $331.14 \pm 42.21$  L/min in group B and  $313.72 \pm 38.82$  L/min in group C. Group C showed lower value than group A and B in daily PEFR ( $P < 0.05$ ).

**Conclusion:** In the study for the investigation of the relationship between pulmonary function and ambient fine particles, it showed a significant decrease of the next day's PEFR (Lag1) by the increase of PM<sub>10</sub>, Coarse and PM<sub>2.5</sub>.

Daily mean PEFR was lower in students living nearby the roadside, which can be affected by particulates from traffics easily than in students in residential areas far from the roadside.

#### ISEE-0601

##### Epidemiological Study in an Area Contaminated by Chromium, Arsenic, Mercury and Boron in Tuscany Region (Italy)

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**Background:** The Cecina river valley, in Tuscany, is characterized by environmental chromium contamination; Cr(VI) concentrations in ground and surface waters exceeds the WHO limit for drinking water. Boron, arsenic, mercury contaminations, of natural or industrial origin, pesticides use, and waste landfilling are causes of community concern.

**Objective:** To investigate health status of population residing in the polluted area.

**Methods:** A large environmental database was built collecting soil and drinkable water data from public and private sources.

Cancer and non-cancer causes of mortality, hospitalization and malformation groups of residents in municipalities included in the study area over 1980–2006 were considered. Standardized Mortality/Hospitalization Ratios (SMR/SHR) and Bayesian Mortality/Hospitalization Ratios (BMR/BHR) were calculated. Cluster analysis using the Spatial Scan Statistics was performed. To understand knowledge, awareness and risk perception a qualitative survey through interviews was carried out among local administrators, public sector technical personnel and NGOs representatives.

**Results:** Statistically significant mortality excesses resulted for circulatory diseases in men (Obs = 1788, SMR = 1.06) and women (Obs = 2111, SMR = 1.10), colon cancer in women (Obs = 44, SMR = 1.38), stomach cancer in men (Obs = 42, SMR = 1.43).

Statistically significant hospitalization excesses resulted for respiratory diseases in men (Obs = 585, SHR = 1.15), chronic respiratory diseases in women (Obs = 88, SHR = 1.71), digestive diseases in men (Obs = 766,

SHR = 1.13) and women (Obs = 565, SHR = 1.13), lymphohematopoietic diseases in women (Obs = 217, SHR = 1.15).

Clustering analysis and BMRs/BHRs confirmed the evidence from SMRs/SHRs.

Other mortality/hospitalization excesses for specific cancers were observed in some subareas.

The awareness of environmental problems was found to be high in the area, with significant differences in deliveries/consequences: NGOs, with a low level of confidence towards public bodies, were critical about future management. Relationship with media was generally good, indicating a positive attitude from the public.

**Conclusions:** The results are useful to plan advanced environmental and epidemiological studies, to open dialogue with local representatives, to promote future remediation activities and to enforce recommendations.

#### ISEE-0603

##### Measuring the Acute Health Effects of Dust Storms: A Matched Analysis

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**Background and Objectives:** Transcontinental sandstorms are frequent in the eastern Mediterranean basin, with southeasterly winds transporting dust from the Sahara desert. The resulting ambient particulate matter is a potential health hazard for exposed populations. We aimed to quantify the extent of acute cardiac and respiratory health effects attributable to sandstorms in an Eastern Mediterranean region.

**Methods:** Continuous air quality monitoring is carried out by the Israel Ministry of Environmental Protection. We identified all sandstorm days (SSDs) for the period between January 2006 and December 2008. For each of these "case" days, we selected 2 non-sandstorm control days from the previous and the subsequent fortnights, matching them for day of the week. The number of emergency department (ED) visits for acute cardio-respiratory conditions at a regional medical center was counted for each SSD and its matched control days. SSD counts were compared to mean matched counts using the paired t-test.

**Results:** 48 SSDs and 96 matched control days were identified during the 3-year study period. Mean cardio-respiratory ED patient load on SSDs was  $32.67 \pm 11.39$  visits, compared to a mean of  $29.07 \pm 5.33$  on matched control days ( $P = 0.04$ ). This represents a relative increase of 12.4% over the expected patient load. In absolute terms, and based on our medical center's estimated catchment population, this represents an increase of approximately 1.8 ED visits per 100,000 for each SSD, or 2,160 excess cases annually in Israel.

**Conclusion:** Sandstorms are a significant risk factor for acute cardio-respiratory syndromes, with a substantial impact on ED patient load in our region. This finding underlines the importance of the Ministry of Environmental Protection's pre-storm warning system, which appeals through the mass media to predisposed persons to remain indoors on SSDs. Future research should be focused on measuring the impact of sandstorms on community clinic patient load.

#### ISEE-0605

##### Husbands' Drinking Behavior as a Risk Factor of Wives' Health-Related Quality of Life during the Postpartum Period

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Taiwan; §Chang Jung Christian University, Tainan County, Taiwan; ¶National Taiwan University Hospital, Taipei, Taiwan; and \*\*National Cheng-Kung University Hospital, Tainan, Taiwan.

**Background and Objective:** It is well known that husbands' alcoholic drinking has adverse effects on women's physical and mental health or even family violence. Evidence is limited in the association between husbands' alcohol drinking and women's health-related quality of life (HRQOL), especially for postpartum women. The objective of this study is to investigate the association between husbands' alcohol drinking and wives' HRQOL during the postpartum period.

**Methods:** We used multistage stratified systematic sampling to recruit 24,200 pairs, postpartum women and newborns, from the Taiwan national birth register in 2005. A structured questionnaire was successfully administered to 87.8% of the sampled population. Subjects undertook a home interview 6 months after their deliveries between June 2005 and July 2006. The Medical Outcomes Study 36-item Short-Form (SF-36) was used to measure the quality of life of the women with their husbands' alcohol drinking behavior.

**Results:** After controlling for the potential confounders, there were significantly gradual decreases in wives' scores on the SF-36 scales other than physical functioning along with the increase in frequency of husbands' alcohol drinking. There were significantly gradual decreases in wives' scores of SF-36 scales other than physical functioning and role-physical along with the increase in frequency of husbands' alcohol drinking either in primiparous or multiparous women.

**Conclusions:** Our study adds evidence supporting the adverse effect of husbands' alcohol drinking on women's health as measured by the SF-36 HRQOL. However, the limitation that this study was cross-sectional in design should be considered. Further longitudinal follow-ups are needed to better understand this complex relationship between husbands' alcohol drinking and wives' quality of life.

#### ISEE-0606

##### Change in Residential Proximity to Traffic and Risk of Death from Coronary Heart Disease

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**Background and Objectives:** Several epidemiologic studies have demonstrated that residential proximity to traffic is associated with accelerated coronary atherosclerosis and increased risk of coronary events. This study was aimed to investigate whether change in residential proximity to traffic was able to alter the risk of death from coronary heart disease (CHD).

**Methods:** This population-based cohort study was conducted in the greater Vancouver metropolitan region, Canada. All residents aged 45–85 years who resided in the study region for at least 5 years (exposure period) and without previous CHD at baseline were included. CHD deaths during a 4-year follow-up period were identified using hospitalization and death records. Residential (postal code) proximity to traffic was calculated using a geographic information system. The data were modeled using multivariate logistic regression.

**Results:** A total of 450,283 participants with complete demographic and residential proximity information were enrolled. Compared to the participants consistently living far from traffic (>150m from a highway or >50m from a major road) during the exposure period and the follow-up period, those consistently living close to traffic (≤150m from a highway or ≤50m from a major road) were 29% (95% CI 1.18–1.41) more likely to die from CHD during the follow-up period after adjustment for baseline age, sex, pre-existing diseases (diabetes, COPD, or hypertensive heart disease), and neighborhood socioeconomic status. For those who moved away from traffic during the exposure period, there was a non-significant

14% increase in the risk of CHD death (95% CI 0.95–1.37) during the follow-up period; whereas for those moving closer to traffic, the risk increased 20% (95% CI 1.00–1.43).

**Conclusions:** This study confirmed previous findings that living close to traffic was associated with increased risk of coronary death. Importantly, this study revealed that change in residential proximity to traffic was able to alter the risk of coronary death.

#### ISEE-0608

##### Elementary School Indoor Environmental Exposures and Airway Inflammation in Children with Asthma

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**Background and Objective:** Schools are potential settings for student exposure to environmental asthma triggers, but the health impact of such exposures is undetermined. This study quantified levels of indoor allergens, particulate matter (PM<sub>2.5</sub>), ventilation, and indoor climate factors in western Washington State elementary schools. Relationships between the most prevalent environmental exposures and short-term changes in airway inflammation in children with asthma were investigated.

**Methods:** Forty-five children with non-steroid-treated asthma from 42 schools across 9 public school districts participated. Offline fractional exhaled nitric oxide (FE<sub>NO</sub>), a biomarker of airway inflammation, was measured in breath collected from each participant at home on a weekend and subsequently twice at school (morning and afternoon). During the school visits, floor dust was vacuum sampled and PM<sub>2.5</sub>, carbon dioxide (CO<sub>2</sub>), temperature, and relative humidity were measured in each child's primary classroom. Cat, dog, mouse, rat, three dust mite, and two cockroach allergens were measured in the dust with antibody-based ELISAs. Multivariate linear regression models analyzing the environmental exposure-school afternoon FE<sub>NO</sub> associations controlled for home or school morning FE<sub>NO</sub>.

**Results:** Classrooms frequently had inadequate ventilation (82% with peak CO<sub>2</sub> >1,000 ppm). School-day average PM<sub>2.5</sub> ranged from 6 to 41 µg/m<sup>3</sup>. Dog, cat, and mouse allergens were detectable in most classrooms (93%–100%), while the three dust mite allergens were detectable at varying frequencies (18%–70%). Increasing allergen or PM<sub>2.5</sub> concentrations were not significantly associated with within-child increases in FE<sub>NO</sub> over the school day or between the weekend home and afternoon school day breath collections.

**Conclusion:** Indoor asthma triggers at the concentrations measured in these WA classrooms were not significantly associated with short-term inflammatory effects in participating children with asthma. Research into health impacts of children's environmental exposures in different settings, including schools, should help target asthma trigger-reduction efforts.

#### ISEE-0610

##### Material Deprivation Index for Confounding Control in Environmental Epidemiology in Italy

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**Background and Objective:** To validate the national material deprivation index to be used in environmental epidemiology investigations in Italy.

**Methods:** 2001 Census data, car data from Italian Automobile Club, and mortality data 1999–2001 from National Statistical Institute were used. The dataset was built at municipality level (8101 municipalities) and randomly split into three equal parts: exploratory, model building, validation samples. Factor analysis was used to explore the relationship among 18 socio-economic indicators. The 18 candidate indicators were chosen from literature. Confirmatory factor analysis was based on the

models developed in the exploratory phase. Predictive performance on mortality, all causes, was assessed by standard epidemiological methods.

**Results:** Phase 1. Three main factors were retained. Education, population age structure and family composition were highly correlated with the first component (over 70%); unemployment and crowding were moderately correlated with the second component (around 50%); civil status was weakly correlated with the third component (below 50%). The national index was calculated as the sum of unemployment, education, crowding, house tenure and family composition.

Phase 2. Confirmatory factor analysis showed a reproducibility over 70%. Classifying the municipalities by quintiles of the index given by summing up factor scores and quintiles of the national material deprivation index showed an agreement of 52% (weighted-kappa).

Phase 3. The standardized mortality ratios by quintiles of the factor scores and quintiles of the national material deprivation index were almost identical: SMR ranged from 1.00 to 1.08 in the first case and 0.99 to 1.07 in the second.

**Conclusion:** A national material deprivation index based on 2001 census was constructed at municipality level for the whole of Italy. The index showed moderate agreement (weighted-kappa 52%) and almost perfect predictive performance with factorial scores. The index of material deprivation can be used to control confounding in environmental epidemiology investigations.

#### ISEE-0611

##### A Tobit Model to Address the Instrumental Limit of Detection in the Study of Blood Cadmium and Peripheral Arterial Disease in US Adults

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**Background and Objective:** Traditional approaches to handle limits of detection (LOD), such as replacing concentrations < LOD by the LOD/2 or LOD/√2, may underestimate true associations and artificially deflate standard errors. We imputed blood cadmium levels < LOD using a predictive Tobit model for truncated data to assess the association between blood cadmium and peripheral arterial disease (PAD).

**Methods:** The study population included 6458 US adults ≥40 years of age from the National Health and Nutrition Examination Survey (NHANES) 1999–2004. The LOD for blood cadmium was 0.3 µg/L in 1999–2002 and 0.2 µg/L in 2003–2004; 21.7% and 13.5% of the study participants had levels < LOD, respectively. Blood cadmium values were predicted based on known determinants (sex, smoking, cotinine, urine cadmium and others) using linear models with posterior distributions obtained by Markov Chain Monte Carlo with Gibbs sampling. Simulated values >LOD were rejected. For individuals < LOD, the median of the subject-specific posterior distribution of predictions was imputed. Multivariable logistic models for the association of blood cadmium with PAD imputing cadmium < LOD from the Tobit model were compared to traditional cadmium imputations based on LOD/√2.

**Results:** The LOD/√2 was 0.21 µg/L in 1999–2002 and 0.14 µg/L in 2003–2004. The median (IQR) of imputed blood cadmium levels < LOD for the 2 periods were 0.22 (0.20, 0.24) µg/L and 0.15 (0.14, 0.16) µg/L, respectively. After imputation, normality for the histograms of log-cadmium distribution in the study sample improved. The dose-response curves modeling the odds-ratio (OR) for PAD by blood cadmium levels using restricted quadratic splines showed higher variability in the range of observations < LOD, and greater magnitude of the OR across the whole range of observations.

**Conclusion:** Tobit models for truncated data can improve the estimation of the dose-response relationship in epidemiologic studies with a large number of measures < LOD.



## ISEE-0614

**The Temporal Association Between Air Pollution and Asthma Syndromic Illness Counts in New York City Is Modified by Neighborhood Traffic Density**

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**Background and Objective:** Asthma morbidity is temporally associated with daily variation in central site air pollution measures and spatially associated with socioeconomic factors such as poverty and environmental factors such as residential proximity to traffic. We used New York City Department of Health and Mental Hygiene (NYCDOHMH) near-real-time syndromic illness surveillance data on daily emergency department (ED) to evaluate the extent to which neighborhood characteristics modify the temporal relation of asthma to ambient air quality. The analysis was part of a project to model acute health outcome indicators of weather and air pollution across a large city with neighborhoods that may vary in their vulnerability to the exposure impacts.

**Methods:** Daily asthma ED syndromic illness counts for children (age 5–17) during the years 2002–2006 were analyzed for their associations with fine particles (PM<sub>2.5</sub>), nitrogen dioxide, and ozone. We used the average of daily measurements from multiple monitors within a 20-mile radius of the geographic center of New York City. Zip code specific Poisson regression models adjusted for smooth functions of temporal trends, immediate and delayed temperature, and day of week. The second-stage random effects meta-regression model included available zip code level census data (socio-economic status and race) and estimated traffic density as vehicle miles per unit area.

**Results:** All of the pollutants were positively significantly associated with asthma ED counts. The combined percent excess PM<sub>2.5</sub> risk for 115 zip codes was 3.8% (95%CI: 1.5, 6.2) per 10 µg/m<sup>3</sup> increase in the average of 0- and 1-day PM<sub>2.5</sub>. In the second stage model, traffic density was the most significant effect modifier of the PM<sub>2.5</sub>-asthma association, increasing the excess risk estimate by 44% per one standard deviation of traffic density.

**Conclusion:** Sub-area stratified time-series analysis was feasible using asthma ED data. Traffic density modified PM<sub>2.5</sub>-asthma association.

## ISEE-0616

**Pooled Analyses of Polychlorinated Biphenyls (PCBs) Exposure and CYP1A1 Genetic Polymorphisms on Breast Cancer Risk**

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**Abstract:** An increased risk of breast cancer for women with high polychlorinated biphenyl (PCB) body burden has not been established, however, there is emerging evidence that the association between PCB exposure and breast cancer risk is modified by variants in the CYP1A1 gene. To further examine this relationship we pooled and analyzed data from five existing studies with PCB measurements and CYP1A1 genotypes.

We assembled five datasets, consisting of 1838 breast cancer cases and 1989 controls. Pooled odd ratios (ORs) and 95% confidence intervals of breast cancer were assessed for PCB quartiles. CYP1A1 polymorphisms (CYP1A1\*2C, CYP1A1\*2A) and the interaction between PCB levels and

these SNPs were estimated using logistic regression. Analyses were stratified European American (EA) or African American (AA), and menopausal status.

In pre-menopausal EA women the odds of breast cancer was almost 1.6 times greater in women with the low versus high PCB levels. This effect was reversed in AA women, such that AA women show a 1.3 increase in odds of breast cancer associated with high versus low PCB levels. The only genetic effect of significance was seen in post-menopausal EA women with the CYP21A1\*2C variant, who were found to have a 1.5 fold increase in odds of breast cancer. The combined effect of PCB levels and CYP1A1 genotypes on breast cancer demonstrates a significant interaction between high PCB and the CYP1A1\*2C variant in postmenopausal EA women ( $P = 0.026$ ), causing a two fold increase in odds of breast when compared to women with common allele and low PCB levels. There was no significant interaction with CYP1A1\*2A.

These analyses demonstrate that PCB body burden modifies the odds of breast cancer in AA and EA women differently and that the association between PCBs burden and breast cancer may be modified by CYP1A1\*2C polymorphisms among EA postmenopausal women.

## ISEE-0618

**Calcium and Vitamin Intakes and Colorectal Cancer—Results from a Large Population Based Case-Control Study in Canada**

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**Background and Objective:** Epidemiologic studies have been inconclusive in demonstrating the protective effects of vitamin D and calcium intakes in relation to colorectal cancer (CRC). The objective of this study is to examine such effects through a population based case-control study in Canada.

**Methods:** We analyzed data from a population-based case-control study of more than 4,000 participants from two Canadian provinces (Ontario, ON and Newfoundland and Labrador, NL). Cases were pathologically confirmed new CRC patients aged 20–74 years during 1999–2003 (NL) and 1997–2006 (ON). Controls were a sex and age-group matched random sample of the population in each province. Intakes of calcium and vitamin D were derived from a food frequency questionnaire (FFQ). Calcium and vitamin D were categorized into quartiles based on the distribution among the study population with lowest quartile as referent group. Multivariate logistic regression analysis was used to examine the association between these factors and risk of CRC after adjusting for a set of potential confounding factors. Tests for trend were used to assess dose-response relationships.

**Results:** Total dietary calcium and vitamin D intakes were significantly associated with lower CRC risk. However, these associations were statistically significant in women only with corresponding ORs of 0.49 (0.26–0.92) and 0.68 (0.49–0.94), respectively. Similar associations were also observed for calcium and vitamin from supplements. Stratified analyses suggest that the use of calcium and vitamin D supplements had greater protective effects for those with lower dietary intakes.

**Conclusion:** Calcium and vitamin D intakes are associated with a reduced risk of CRC in NL population. Our study suggests that the beneficial effects of vitamin D and calcium in reducing CRC risk were more pronounced in women. Further research is warranted to explore the gender differences observed in this study.

## ISEE-0619

**Pickled Meat Consumption and Colorectal Cancer (CRC): A Case-Control Study in Newfoundland and Labrador, Canada**

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**Background & Objective:** The age-standardized incidence rate of colorectal cancer (CRC) in Newfoundland and Labrador (NL) is 86/100,000, which is considerably higher than the national average of 62/100,000 and gives NL the highest incidence rate of CRC in Canada. Many epidemiological studies have found associations between dietary factors and CRC. The primary objective of this paper was to assess the presence and strength of the association, if one exists, between the intakes of total pickled and/or red meat, and the prevalence of CRC in study participants.

**Methods:** This case-control study of 1204 participants, all residing in NL was part of a larger multi-center study on colorectal cancer. A personal history questionnaire and food frequency questionnaire were used to collect retrospective data from 518 individuals diagnosed with CRC between 1999 and 2003, and 686 controls. Food frequencies were then converted to consumption in grams/day. The intakes were ranked and divided into tertiles. Unconditional multivariate logistic regression was used to examine the possible association between pickled meat intake and CRC diagnosis while controlling for possible confounding.

**Results:** Pickled meat consumption was found to be associated with an increased prevalence of CRC (OR = 2.12,  $P < 0.0001$ ), the odds ratios increasing with each tertile of consumption, suggesting a dose-response effect. No significant association was observed between the consumption of red meat and CRC.

**Conclusion:** The results suggest that the intake of pickled meat may be a risk factor for CRC in NL. This association may be explained in part by the presence of n-nitroso compounds in the pickled meats consumed. N-nitroso compounds are known carcinogens, and it has been suggested that nitrite compounds, such as the sodium nitrite contained in pickled meat, can be converted to n-nitroso compounds when added to food.

## ISEE-0620

**Professional Exposure to Organophosphorus Insecticides, Paraoxonase (PON1) Polymorphisms, and Parkinson's Disease (PD) among French Agricultural Workers**

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**Background:** Professional pesticide exposure has been associated with PD. Paraoxonase (PON1) is involved in the metabolism of organophosphorus insecticides (OPs). PON1 has been studied in PD with conflicting results. PON1 expression and activity are modulated by 2 promoter (−161 C/T, −107 G/A) and 2 non-synonymous (Q192R, L55M) polymorphisms. We studied the relation between PD, OPs exposure, and PON1 polymorphisms in the setting of the Mutualité Sociale Agricole, the French social security for farm owners/helpers and other workers in the agricultural area.

**Methods:** In the TERRE case-control study (1998–1999), 247 cases from 62 French districts with recently diagnosed PD were compared to 676 matched controls. Detailed pesticide data were collected by occupational physicians; questionnaires were reviewed by a panel of experts. DNA were collected and genotyped for the rs705381 (−161C/T), rs705379 (−107G/A), rs854560 (L55M), rs662 (R192Q) polymorphisms and an additional SNP (rs854565) that has been associated with Alzheimer's

disease. Analyses of pesticides were restricted to men (138 cases, 377 controls) who were considerably more frequently exposed than women.

**Results:** There was no association between PD and any SNP overall. In men, the OR increased with the number of polymorphic L55M alleles ( $P = 0.03$ ). PD was not associated with OPs overall (OR adjusted for age, gender, district, smoking = 1.3 [0.7–2.3]). Joint effect analyses in men effects yielded the following results: M-/OP-: OR = 1.0 (reference); M-/OP+: OR = 3.1 (1.1–9.2); M+/OP-: OR = 3.1 (1.3–7.8); M+/OP+: OR = 2.4 (0.9–6.3) (interaction OR = 0.4 [0.2–0.9],  $P = 0.03$ ).

**Conclusion:** We detected a complex pattern of interaction suggesting that (i) the L55M polymorphism was associated with PD among subjects not exposed to OPs, (ii) professional OPs exposure was associated with PD among subjects not carrying the L55M polymorphism and (iii) the association between PD and OPs disappeared among L55M carriers. These findings show that the relation between PD, PON1, and OPs is more complex than previously thought.

## ISEE-0621

**Tobacco Use and Colorectal Cancer: A Population-Based Case-Control Study in Newfoundland and Labrador, Canada**

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**Background and Objectives:** The relationship between colorectal cancer (CRC) and tobacco use has been inconsistent in previous epidemiological studies. Newfoundland and Labrador (NL) has both the highest incidence rate of colorectal cancer and smoking prevalence in Canada. The objective of this study was to examine if and how CRC is associated with smoking in this population.

**Methods:** Newly-diagnosed colorectal cancer cases identified in the Newfoundland Cancer Registry in 1999–2003 were frequency-matched by age and sex with controls selected from the residents in Newfoundland and Labrador through random digit dialing (RDD). A total of 702 cases and 717 controls consented to participate in the study and completed a set of self-administered questionnaires. Measures of tobacco use include type of tobacco, age of initiation of smoking, years of smoking, cigarettes pack years, and years since abstinence from smoking. Covariates include demographic variables, medications, chronic conditions, alcohol consumption, physical activity, food, vegetables and fruits. The odds ratios were estimated in multilevel logistic model for adjusted associations after controlling for potential confounding factors.

**Results:** There was 39% and 113% higher risk of colorectal cancer among former and current smokers than non-smokers (OR: 1.39 and 95% CI: 1.02–1.91; OR: 2.13 and 95% CI: 1.39–3.26). The risk of colorectal cancer tended to increase significantly with cigarette smoking years, amount of cigarettes smoked daily, cigarette pack years and the risk significantly decreased with years of abstinence from smoking cigarettes. Our study also suggests a synergistic effect between smoking and alcohol drinking and smoking seems to have a stronger effect on CRC among drinkers than non-drinkers.

**Conclusion:** Cigarette smoking increased the risk of colorectal cancer in NL population. The risk of colorectal cancer for cigarette smoking varies by drinking status and sex.

## ISEE-0623

**Statistical Explorations of Possible Effects from a Partial Mediating Variable—Comparisons Between OLS and SEM Methods with Simulated Data**

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**Background and Objective:** Confounding and mediating factors are commonly used and easily confused concepts in epidemiological studies. It is not uncommon that in published work mediating are often treated as if they were confounding factors. Thus, correctly specifying and examining the three types of variables are of paramount importance in statistical modeling and interpreting scientific findings. The objectives of this study were to: 1) explore the inter-relationships among the three factors and 2) to examine the extend to which the effect of the true effect of variable X on Y is under-estimated using a conventional confounding control approach for a partial mediating factor M.

**Methods:** Assume all three variables have standard normal distributions  $\sim N(0, 1)$ . A large random sample ( $N = 10,000$ ) was generated to obtain stable parameters. Y, M and X were used to represent outcome, mediating and primary predicting variables, respectively. Both OLS regression and structural equation modelling (SEM) were used. The simulated true effects (expressed as correlation coefficients) of X on Y were fixed between 0.3 and 0.5.

**Results:** OLS regression and SEM analyses give similar parameter estimates for the effect of M on Y ( $b_{ym} \gg l_{ym}$ ). With respect to the effect of "X" on "Y", OLS can only estimate the direct effect of X on Y ( $b_{yx} \gg l_{yxd}$ ), not the overall effect ( $l_{yx} + l_{yxi}$ ). Even though the specified overall effect ( $r_{yc} = 0.3$ ) is not changed for the simulation,  $b_{ym}$  and  $l_{ym}$  decrease as the correlation between X and Y increases. Contrarily, the M mediated indirect effect ( $l_{yc} + l_{yxi}$ ) of X on Y increases as the correlation between X and Y increases.

**Conclusion:** Since epidemiological studies are often interested in several potential risk factors, the "adjusted each other" approach may result in underestimation for some risk factors when partial mediating factors are present.

#### ISEE-0624

##### Systematic Observations of Health Damaging Factors in Informal Neighbourhoods in Aleppo, Syria-A Pilot Study

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**Background and Objectives:** Systematic social observation is a method to evaluate pathways by which neighbourhood environments impact health. This method has mainly been used in developed country settings. In Aleppo (population 2,500,000) informal settlements occupy about 45% of the city's inhabited area and are home to one million people. Informal settlements are neighbourhoods built without planning and for which environmental statistics are not available. The objective of this study was to pilot a context specific procedure and method to systematically assess characteristics of urban informal neighbourhoods relevant to health and wellbeing.

**Methods:** An observational instrument was developed based on a literature review, observations in informal neighbourhoods and interviews with a purposive sample of key informants. The observational instrument measured land use (housing and industry); environmental quality and the social environment. The unit of observation (the spatial scale at which neighbourhood characteristics may differ) was identified as 100 meters of the right hand side of a street. The pilot study took place in Shaikh Maksoud, the largest informal settlement in Aleppo. We identified key pointers using a Garmin Global Positioning System and downloaded the waypoints into Google Earth Plus. Observation points were selected randomly.

**Results:** The achieved sample comprised of twenty one random points, each consisting of three units of observations. We found big variability in the quality of the environment between the points of the observation within the same neighbourhood. For example, the eastern part had a high industrial-residential mix and the worse environmental quality. The best conditions were observed in the parts closer to the border with the formal area. The main challenge for adapting the methodology was to define the unit of observation.

**Conclusions:** Systematic social observation can be a useful method in studies of health and place in developing countries.

#### ISEE-0625

##### The Cardiovascular Disease Indices of Sleep-Disordered Breathing among Professional Drivers

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**Introduction:** Obstructive sleep apnea (OSA) is the most common form of sleep-disordered breathing which has been frequently observed in long-distance professional drivers because of work-related obesity and/or long duration of sitting position. Recent studies postulated the relationship between OSA and cardiovascular disease of hospital-based patients. The objective of this study was to investigate the relationship between OSA severity and indices of cardiovascular disease among professional drivers.

**Methods:** Seven hundred and seventy active long-distance professional drivers were recruited as subjects in this study. Previous study had demonstrated that the oxyhemoglobin desaturation index (ODI) has a high correlation with apnea-hypopnea index, the gold standard for OSA. Thus, ODI tested by pulse oximetry was used to estimate the OSA severity. OSA was defined as ODI > 5/hour and ODI > 15/hour and ODI > 30/hour were representing moderate and severe OSA. High sensitivity C-reactive protein (hs-CRP) and total homocysteine (tHcy) were used as bio-monitoring indices of cardiovascular disease among professional drivers in this study.

**Results:** Two hundred and twenty seven drivers had potential OSA and there were 36 and 7 drivers with moderate and severe OSA, respectively. No significant correlation was found between tHcy and the degree of severity of OSA. However, the hs-CRP levels of moderate and severe OSA drivers were 2.1 and 1.9 mg/L, significant higher than normal and mild OSA drivers. Moreover, a significant correlation was found between ODI and hs-CRP levels ( $P < 0.01$ ).

**Conclusion:** A high prevalence of OSA (29.5%) was found among professional drivers in this study. Significant correlation was revealed between ODI and hs-CRP levels, indicating that OSA might increase the risk of cardiovascular disease in professional drivers.

#### ISEE-0626

##### Insecticide Use by Sheep Farmers in Great Britain for the Control of Blowfly Strike

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The abolition of compulsory dipping against blowfly strike (ovine cutaneous myiasis) in approved insecticides in 1992, allowed farmers total flexibility in their choice of ectoparasite management program. Some of the licensed products now available to the farmers being harmful to the operator's health as well as the environment, the aim of this paper was to examine the methods used for the control of sheep blowfly strike using data from questionnaire survey returns provided by 966 sheep farmers in Great Britain, based on the period between March 2003 and February 2004. Overall, 91% of participants treated prophylactically with insecticides against blowfly strike; 39% treated twice and 11% more than 3 times in the year. Insect Growth Regulators were the most commonly chosen product (40%), largely the IGR cyromazine. Overall 12% of farmers opted to dip their sheep in organophosphate insecticide against fly



strike and 2% of farmers reported applying inappropriate products to their sheep for the control of strike, such as ivermectin or “drenches”. The results show that insecticides remain the primary tool used by almost all farmers to prevent strike and that the type of insecticides used and means of application have altered dramatically over the past 15 years. However, the prevalence of strike has remained almost unchanged over this period. The results also show that OPs are still in use, despite concerns about possible chemical and acute neurological diseases in operators if not used correctly. This is especially worrying, as despite most farmers having treated prophylactically against the disease, the prevalence was still very high, which led to suspect that the insecticides were applied incorrectly during prophylaxis. This misuse leading to unnecessary damage to the operators health and the environment.

#### ISEE-0627

##### Feasibility of a Canadian Land Use Regression Model for PM<sub>2.5</sub> Exposure Assessment

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**Objectives:** CAREX Canada, the national occupational and environmental carcinogen surveillance unit, is estimating the populations' exposure to fine particulate matter air pollution (PM<sub>2.5</sub>). PM<sub>2.5</sub> has been associated with a wide range of health effects and is a significant public health concern due to high exposure prevalence. In Canada, it is difficult to determine population exposure estimates due to a large geographic area and relatively few fixed site monitors. Here we explore the utility of a national PM<sub>2.5</sub> model, using readily available data, to predict PM<sub>2.5</sub> for exposure assessment.

**Methods:** The 136 NAPS PM<sub>2.5</sub> monitoring stations operating in Canada during 2006 were used to create the model. Predictive variables, including land use, meteorology, vehicle and industrial sources, population density and satellite data, were derived in a geographic information system for each monitoring site. Industrial sources included both large emitters registered in the National Pollutant Release Inventory (NPRI) and small emitters identified through Dunn and Bradstreet marketing database, which incorporates all public and private businesses in Canada. A five year average summer PM<sub>2.5</sub> value derived from MODIS/MISR satellite data was also used to capture large-scale PM<sub>2.5</sub> differences.

**Results:** The preliminary model explained 52% of PM<sub>2.5</sub> variance and incorporated MODIS/MISR satellite data, total tonnes of NPRI emissions within 5km, density of roads within 50km, total precipitation at nearest monitor and a latitude variable. MODIS/MISR satellite data alone predicted 42% of PM<sub>2.5</sub> variance. Spatial autocorrelation was detected in the model residuals (Moran's I = 0.51, 95%CI: 0.43–0.58) likely due to urban/rural differences.

**Conclusion:** This research incorporates traditional and innovative (satellite data and micro emissions) variables to predict PM<sub>2.5</sub> at a national scale. While more work is needed to account for urban/rural variation, the national PM<sub>2.5</sub> land use regression modeling approach holds promise for PM<sub>2.5</sub> exposure assessment.

#### ISEE-0628

##### Fish Consumption in an Area with High Incidence of Birth Defects in Cali, Colombia

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**Background:** Clustering of rare birth defects (BD) in a poor area of Cali, Colombia, are reported since 2004, when a hospital-based registry was

implemented (ECLAMC). Cases cluster in a poor and large “comuna” of the city (7.2%), near to a polluted river (Cauca river) and the municipal dump site.

**Objective:** To characterize fish consumption in a group of childbearing age women, 15–34 years of age, in a community with clustering of BD.

**Methods:** We developed a descriptive study of knowledge and practices about fish consumption. A multistage sampling strategy was used to select women with local health promoters. We applied a questionnaire to 380 non-pregnant women living >6 months in the community, and asked for consumption frequency and seasonality, fish types and origin, and perceived health effects. Additionally, we characterized chicken, meat and pork consumption, water use and local crop related practices. Fish species reported by women were analyzed using graphite furnace atomic absorption spectrometry methods to determine metals.

**Results:** Women included were young (75% < 28 years) and most of them had no affiliation to social security (45%). They reported a high frequency of fish consumption: 43.7% at least weekly, 79.5% at least once in a year. Consumption is higher (67.8%) in April (Easter), and 11.4% reported consumption of Cauca river fishes. Women reported that fish may only cause short term gastrointestinal effects. Water for consumption comes exclusively from the municipal distribution network and practices related to crops were infrequent. We analyzed two types of fish species: fishes that eat sediment and predator fishes. In both species we found Cd, Hg and Pb, with Pb levels above FAO recommendations.

**Conclusions:** Consumption of local fish is a potential route of exposure to pollutants during pregnancy, mainly Pb. Other exposures routes/pathways may interact with fish consumption.

#### ISEE-0629

##### Indoor Air Quality and Employees' Health Information in Two Intensive Care Units

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**Background and Objectives:** Indoor air quality can be affected by pollutants generated outdoor. In hospitals this situation has been insufficiently investigated.

**Methods:** We analyzed two intensive care units located at a same hospital, measuring air pollutants and weather variables inside and outside these units. Automatic monitors were used to measure PM<sub>2.5</sub> while passive samplers were adopted to measure both NO<sub>2</sub> and O<sub>3</sub>. A questionnaire of symptoms was applied to the employees.

**Results:** In unit 1, the mean value of indoor PM<sub>2.5</sub> was 40.0 µg/m<sup>3</sup> (SD = 43.9) while outdoor measure reached 28.4 µg/m<sup>3</sup> (SD = 18.3) ( $P < 0.01$ ). Also, it was two fold higher than indoor PM<sub>2.5</sub> in unit 2. For NO<sub>2</sub>, outside values were higher than those measured inside and, in unit 1, this difference was statistically significant ( $P < 0.01$ ). Ozone measurements in both outside and inside ICU 2 were higher (five fold) than those observed in ICU 1 ( $P < 0.01$ ). From 18 investigated symptoms, tiredness or fatigue (66%), tension and irritability (65%), pain in back shoulders or neck (65%), headache (62%), runny nose (50%), sneezing (41%), sore and dry throat (30%), difficulty of concentrating (29%), nausea and upset stomach (27%), dry and itchy skin (23%), depression (15%), and cough (15%) were the most reported. Frequencies of symptoms were similar in both units and among professional groups.

**Conclusions:** Our results showed that isolation between indoor and outdoor environments through air conditioning systems may vary allowing high indoor concentrations of fine particles and infiltration of gases. Moreover, frequencies of respiratory symptoms and others of different diseases were higher than those reported in the specific literature.

## ISEE-0631

**Surveillance of Environmental Pesticide Exposure in Canada**

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**Background/Objective:** Some of the most extensively used pesticides in Canada's agricultural industry are classified as "possibly" carcinogenic by the International Agency for Research on Cancer (IARC). However, information on population exposure to these pesticides is extremely limited. The objective of our study is to apply a new pesticide exposure assessment technique to conduct Canada-wide surveillance of environmental pesticide exposure.

**Methods:** A province-specific crop exposure matrix is being developed for Canada to identify uses of 14 pesticides (IARC "possible" carcinogens) to provide estimates on the prevalence of use. This information is used to classify the probability of environmental exposure to a specific pesticide as being 'high', 'moderate' or 'low'. Geographic information systems (GIS) and Statistics Canada boundary data are used to identify high agricultural activity areas within sub-provincial regions. Using GIS and National Census of Population data, the population currently residing within each agricultural activity area is determined.

**Results:** As an example, results for environmental exposure to phenoxy herbicide 2,4-D in Ontario are presented. Ontario has 46 high agricultural activity areas, with estimated prevalence of 2,4-D use ranging from 38–99%. Agricultural areas were classified into three probability of exposure groups based on the tertile distribution of the prevalence of 2,4-D use estimates ('high' exposure area if >90% use; 'moderate' exposure area if 70–90% use; 'low' exposure area if < 70% use). Approximately 3.1 million people live in Ontario agricultural areas and are at risk of 2,4-D exposure. Population estimates by agricultural area exposure group are approximately: 292,000 (9.5%) people in 'high' exposure areas, 984,000 (32%) people in the 'moderate' exposure areas, and 1.8 million (58.5%) people in 'low' exposure areas.

**Conclusion:** This surveillance information will be used to geographically identify high risk pesticide exposure populations; it will also have an essential role in hazard surveillance, risk assessment and epidemiologic research.

## ISEE-0633

**Spatial Modeling of Personalized Exposure Dynamics: The Case of Pesticide Use in Small-Scale Agricultural Production Landscapes of the Developing World**

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**Background and Objective:** Pesticide exposure is a global health issue with the largest impacts in the developing countries where residential and small-scale agricultural areas are often integrated and pesticides sprayed manually. To reduce health risks from pesticide exposure approaches for personalized exposure assessment (PEA) are needed. A conceptual framework to develop a spatial individual-based model (IBM) prototype that allows for PEA of farm-workers conducting small-scale agricultural production is described and exemplified for a rural part of Colombia, South America.

**Method:** The conceptual model integrates spatial dynamics in the contaminant distributions in the environment with patterns of movement and activities performed on an individual level under different safety conditions. PEA is conducted for simulated individuals based on different measures of magnitude, frequency and duration of exposure. The sensitivity of PEA to variations in movement patterns or pesticide applications patterns is examined by scenario simulation.

**Results:** Our experiments demonstrate a high sensitivity of individual exposure estimates to varying patterns of pesticide application, varying individual patterns of movement, as well as changing safety conditions. This is indicated by the observed variation in estimates of magnitude, frequency and duration of exposure over the model runs for each individual as well as between individuals.

**Conclusions:** The developed prototype model for PEA in the described agricultural setting, which is based on the presented conceptual framework, demonstrates the influence of individual patterns of movement, safety conditions, and dynamic contaminant distributions. The presented approach furthers the understanding of the contribution of agricultural pesticide use to exposure in similar agricultural production landscapes of many developing countries and could be useful for public health intervention strategies. Further research is needed to fully develop an operational version of the model.

## ISEE-0634

**Independent Effect of Polycyclic Aromatic Hydrocarbons and Ambient Temperature on Oxidative Stress in the Elderly**

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**Background and Objective:** Exposure to PAH is known to be associated with oxidative stress, but weather variables such as temperature have not been evaluated well in terms of oxidative stress. The purpose of this study was to investigate the interaction between exposure to PAH and ambient temperature on oxidative damage.

**Methods:** A total of 155 elderly aged over 65 years in Seoul, Gangnung and Chungju, Korea were enrolled from June 2007 through September 2007. We measured urinary 1-OHP and 2-Naphthol for exposure to PAH and urinary 8-OHdG and MDA for measurement of oxidative stress for 8 times.

We obtained weather data such as temperature and humidity for that time. Other individual characteristics such as age, sex, height, and weight were obtained by questionnaires and physical measurements completed at the beginning of the study.

**Results:** Mean ages of subjects were 78.65 (SD 37.47), 69.37 (SD 22.68) and 72.39 (SD 31.41) in three areas. The median values of biomarkers were 1.232 g/L (MDA), 7.054 ng/mL (8-OHDG), 0.412g/L (1-OHP) and 9.213g/L (2-Naphthol). The mean values of MDA and 8-OHDG increased with temperature after adjustment for potential confounders. 1-OHP and 2-Naphthol also significantly associated with urinary MDA levels and 8-OHDG levels ( $P < 0.05$ ). Temperature and 1-OHP or 2-Naphthol were found to be independently associated with urinary MDA levels after adjusting for age, sex, height, weight, date, visit number, area, diet, urinary cotinine, and alcohol drinking.

**Conclusion:** These results suggest that exposure to PAH affect lipid peroxidation and oxidative DNA damage for the elderly and temperature is another independent factor for causing oxidative stress.

## ISEE-0635

**Respiratory Effects in Schoolchildren Exposed to Industrial Sources of Particulate Material (PM)**

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**Background and Objective:** Northern Cali, Colombia, limits has a large industrial zone producing steel, batteries and metals. According to previous reports, high levels of  $PM_{10}$  ( $96.07 \mu g/m^3$ ) and lead ( $1.77 \mu g/m^3$ ) may reach population living in the area. The aim is to assess effects of air

pollutants from industrial sources in respiratory health of schoolchildren, 6–14 years old, in northern Cali.

**Methods:** A cross-sectional study was conducted in an area likely to be exposed to industrial pollutants in northern Cali (i.e., distance and wind direction) and in a control area. We simultaneously measured daily atmospheric concentrations of  $PM_{2.5}$  in two schools of corresponding study areas during three months and determined the prevalence of respiratory symptoms and lung function in children. In addition, we characterized daily variations in  $PM_{2.5}$  concentrations and, using regression models, assessed the association with health effects.

**Results:** The maximum levels of  $PM_{2.5}$  during the monitoring were presented in the exposed area with a maximum of  $69.95 \mu g/m^3$ . Mean concentrations of  $PM_{2.5}$  were higher in the exposed area when compared with the control area ( $43.5 \mu g/m^3$  vs.  $30.4 \mu g/m^3$ ). Correspondingly, we found a higher prevalence of runny nose, nasal itching, cold, shortness of breath with exercise and wheezing in children of the exposed area. A positive association was found between exposure and respiratory symptoms like runny nose (OR: 3.01; CI 95%: 1.46–6.22), nasal itching (OR: 3.59; CI 95%: 1.75–7.36), shortness of breath with exercise (OR: 1.47; CI 95%: 0.44–4.89) and wheezing (OR: 1.64; CI 95%: 0.79–3.39). Consistently, we found objective evidence of lung function effects in children.

**Conclusion:** Residence in the northern urban area of Cali exposed to pollutants of an industrial zone is associated to a higher risk of upper airway and broncho-obstructive respiratory symptoms.

#### ISEE-0636

##### The Effect of Prenatal Lead Exposure on Child's Body Mass Index (BMI) from Birth to 5 Years of Age

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**Background and Objective:** Perinatal lead exposure has been related to early childhood deficits in stature but inconsistently with weight delays. Mixed findings could reflect different mechanisms affecting growth in child stature and body habitus. Two epidemiologic studies have suggested that lead may be associated with higher body mass index (BMI) in infants and children, but study designs limited inferences about timing of exposure. Taking advantage of a birth cohort in Mexico City, we are studying the impact of pre- and post-natal lead exposure on child BMI.

**Methods:** Maternal patella and tibia lead (a proxy for prenatal lead exposure) were measured within 1-month postpartum using *in vivo* K-x ray fluorescence. Socio-demographic and anthropometry data were obtained by trained interviewers at birth, 1, 3, 7 months postpartum and every 6 months thereafter until child age of 5 years. Time since birth was modeled using splines to capture the non linear BMI trajectories between birth and 5 years. Patella lead was categorized into high and low using the median as the cutoff ( $9.170 \mu g Pb/g$ ). Another set of models were then fit solely between 2 and 5 years.

**Results:** Mean patella lead was  $10.45 \mu g Pb/g$  (SD = 12.8). Mean blood lead among 724 children during the 5-year period was  $3.9 \mu g Pb/g$

(SD = 3.62). After 2 years old, children with lower levels of patella lead had a greater rate of increase in BMI over time than those with higher levels (though these results were only statistically significant for girls;  $\beta = 0.149 kg/m^2\text{-year}$ , SE = 0.056,  $P = 0.008$ . For boys:  $\beta = 0.035 kg/m^2\text{-year}$ , SE = 0.048,  $P = 0.466$ ).

**Conclusion:** Our results do not support a clear effect of lead on body habitus in early childhood. Additional follow-up is required to see if early life exposure may result in body habitus changes that are not manifest until past 5 years of age.

#### ISEE-0640

##### The Prevalence of Diabetes Mellitus Among Male Police Officers Aged 30–59, in the Military Police of Teresina City, Piauí State, Brazil

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**Background and Objective:** Diabetes mellitus (DM) is a metabolic disease characterized by hyperglycemia and by glycosuria, resulting from disorders in the insulin secretion and/or in its action. The objective of the study was to estimate the prevalence of DM among the male police officers, working in the city of Teresina, Piauí state.

**Methods:** A cross-sectional study was carried out in a random sample of 562 male police officers aged 30–59, working in Teresina. The inquiry was carried out from December 2007 to March 2008. The selected individuals were interviewed, and the variables regarded identification, demographic data and health conditions, as well as capillary glucose.

**Results:** Individuals who had capillary glucose results under 100mg/dl were considered normal, whereas those between 100–125 mg/dl underwent the glucose oral tolerance test, those between 126–199 mg/dl underwent plasmatic glucose and those who presented higher levels were considered diabetic and referred to medical assistance. Weight, height and abdominal circumference were measured. The results indicated 28 (5.8%) as being diabetics, from these, 17 (3.5%) cases were diagnosed by tracking and 11 (2.3%) with a previous diagnosis. The Decreased Glucose Tolerance was 8.0% in the group studied. The analysis of potential risk factors for DM showed a significant increase of the prevalence with age, and an inverse and significant association with education, while the other variables presented a positive association, with no statistical significance. In the logistic regression, only the variables age and education remained in the model, indicating that the likelihood of being diabetic increased 10% for each increase of 1 year of age, and it was 3.7 times higher in those who had less formal education.

**Conclusion:** The results support the implementing of preventive actions and measures in controlling the disease, aiming at preventing its appearance and complications.

#### ISEE-0642

##### Frame Work for the Monitoring of Exposure to Environmental Pollutants and Health Effect of Inhabitants in Major Industrial Complexes in Korea

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**Background & Purpose:** Cross-sectional studies of environmental health have been conducted in Korea since 1980. In 2003, the National Institute of Environmental Research (NIER), Korea launched a project to monitor environmental health exposure of residents of major industrial complexes in Korea to the pollutants, starting with Ulsan. The framework of the study was to evaluate and monitor health effects associated with low-level but long-term exposure to environmental pollutants.

**Method:** At each monitoring area, survey period is 20 years, which consists of three phases; the establishment of surveillance system and data



base during first five years, introduction of molecular biology with the evaluation and accountability assessment during second five years and final phase for strategic evaluation of environmental policies and risk communication during ten years.

Each survey at each complex uses identical questionnaires and unified methods for medical checkup, sampling and analysis basically. Biological samples such as blood and urine are collected and then preserved in the central sample bank.

**Result:** The Ulsan Industrial Complex became the first monitoring area where the project started in 2003 and Sihwa-Banwol (2005), Gwangyang (2006), Pohang (2006), and Yeochon (2007) also joined the survey according to "Environmental Health 10 years Master Plan in Korea." In addition, Cheongju and Daesan are supposed to be added to the list in 2009. On the other hand, two comparative areas, Gangnung and Choongju were chosen and added.

At each area, more than 1,000 residents are surveyed every year. Pb in blood, Cd, inorganic As, Hg in urine samples, and VOCs and PAHs in blood are analyzed.

**Conclusion:** The goal of this survey is to prevent adverse effects of pollutants from industrial complex and to protect residents' health in the complexes. Surveys at each area will continue for 20 years and, now, Ulsan is in the second phase. Improving public awareness over environmental hazard will be additional purpose of this project.

#### ISEE-0644

##### The Changes in Ozone Concentration and Its Implications Following Precursor Reductions in Southern Taiwan from 1999 to 2008

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**Backgrounds and Objective:** An air pollution fee was collected by the Taiwan Environmental Protection Administration (TEPA) in 1995, and several air pollution control measures were taken to improve the air quality in Taiwan. In order to understand the air quality improvement in Taiwan, we collected the monitoring data during the last 10 years (1999–2008) from southern Taiwan, where the ratio of unhealthy air quality condition is highest, for analyzing.

**Methods:** The monitoring data from Siaogang (SG, in an urban area of Kaohsiung city, nearby the industrial area) and Chajou (CJ, in a rural area of Pingtung, located in the down-wind area of SG) were collected in this study, which focuses on the concentration variation of ozone ( $O_3$ ) and the precursors (nitrogen oxides ( $NO_x$ ), non-methane hydrocarbons (NMHCs)) during this period of time.

**Results:** Both the daily mean  $O_3$  and the exceedance of daily maximum hourly  $O_3$  greater than 120 ppb at rural site are higher than those at urban site. The results show that the concentration of the  $O_3$  precursors ( $NO_x$  or NMHCs) and the daily maximum hourly  $O_3$  at both urban and rural sites decreased significantly in the last 10 years. However, the daily mean  $O_3$  concentration increased year by year. It could be affected by the reduced  $NO$  titration effects and increasing background  $O_3$  concentrations in the Northern Hemisphere.

**Conclusion:** The concentration of primary pollutants decreased significantly, while the secondary pollutant, the daily mean  $O_3$  concentration, increased year by year. It implies that after the reduction of various primary pollutant concentrations, the issue of how to effectively reduce the  $O_3$  pollution becomes important. Since there's no health threshold for ozone concentrations, an investigation of the possible adverse effects of the increasing  $O_3$  concentration on the public should be carried out in the near future.

#### ISEE-0646

##### Prenatal Exposure to ETS and Infantile Neurodevelopment

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**Background and Objective:** Numerous health outcomes of children's exposure to maternal smoking have been reported, including increased rates of low birth weight, infant mortality and respiratory infections. However, much less is known about the consequences of secondary smoke during fetal development. The aim of this present study was to investigate the possible association of prenatal exposure of environmental tobacco smoke (ETS) and neurodevelopment.

**Methods:** Data from the Mother and Children's Environmental Health (MOCEH), a multi-center birth cohort study were used. The ETS exposure during pregnancy was assessed by questionnaire interview. We classified pregnant women reporting exposure to ETS from family, neighborhood or colleagues during pregnancy as the ETS exposed group. When offspring were 6 months, the Bayley Scales of Infant development were administered. We used multivariate regression to examine the neurobehavioral effect of prenatal exposure to ETS.

**Results:** Before adjustments for confounding, ETS exposed children during pregnancy were found to be associated with significant decrease in Mental Development Index (MDI) at 6 months of age. In multiple regression analyses, we controlled for area, child's age, sex, parity, birth weight, maternal age, intelligence, BMI, paternal education, and income. There was a statistically significant difference in mean MDI scores between children whose mother's were exposed to ETS and those of mothers who were not exposed between 2.6 and 6 months of age. We could not find a significant association between prenatal ETS exposure and Psychomotor Development Index (PDI) scores after adjustment for confounders. On the other hand, postnatal ETS exposure was not related to concurrent developmental status.

**Conclusion:** This study suggested that the passive smoking during pregnancy may have an adverse effect on neurodevelopment of infants. Further research is needed to investigate the long-term effects of passive smoking on child's development.

**Acknowledgement:** This study was supported by the Ministry of Environment, Republic of Korea.

#### ISEE-0651

##### Prenatal Personal VOCs and Outdoor $NO_2$ Exposure Effects on Birth Outcome and Infant's Atopic Dermatitis at 6 Month: MOther and Children's Environmental Health (MOCEH)

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**Background and Objective:** Many epidemiologic studies investigated the association between air pollutants and adverse infantile health outcomes. We aimed to explore the associations among socio-demographic, previous obstetric factors, air pollutant's exposure, birth weight, and infantile atopic dermatitis.

**Methods:** Among 1,286 pregnant women enrolled in MOCEH study during 2006–2009, personal TVOC and HCHO exposures were measured in 205 of dwellings by passive samplers for 24 hours. To estimate outdoor NO<sub>2</sub> exposure, we matched the air monitoring data with participants' addresses. After that, period specific average of exposure was calculated for each trimester and whole pregnancy period. Participants answered questionnaires and delivery information was obtained from medical record by trained nurses. We excluded the case of twin, abortion and censoring before delivery.

We performed Chi-square test, multiple linear regression and logistic regression analysis for assessing associations among air pollutants (TVOC, HCHO and NO<sub>2</sub>), birth weight, and infantile atopic dermatitis as health outcomes. (SAS9.1).

**Results:** HCHO exposure showed positive relationship with the number of cohabitants, using humidifier, and not operating ventilation-fan when cooking, but negative relationship with house age. In case of not using air-cleaner and detached kitchen with living room, TVOC concentration was significantly higher than others.

Birth weight was significantly decreased by TVOC ( $\beta = -58.25$ ,  $P = 0.04$ ) and HCHO ( $\beta = -103.64$ ,  $P = 0.05$ ) after controlling maternal age, gestational age, family income, parity, newborn's gender and residential factors. Also reduced birth weight was shown by elevated NO<sub>2</sub> ( $\beta = -5.33$ ,  $P = 0.009$ ). In addition, higher concentration ( $\geq 75^{\text{th}}$  percentile) of personal HCHO and outdoor NO<sub>2</sub> during fetal period increased the risk of diagnosis of atopic dermatitis at 6-month infant (OR = 3.12; 95% CI 1.03–9.39, OR = 2.54; 95% CI 1.17–5.53, respectively).

**Conclusion:** We suggest that exposure to TVOC, HCHO or NO<sub>2</sub> during pregnancy may have an adverse effect on health outcomes in childhood as well as fetal development.

#### ISEE-0654

##### Serum Levels of Folic Acid, Nutritional Folic Acid Consumption and Reported Adherence with Folic Acid Supplementations among Pregnant Women

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**Background and Objective:** Folic acid (FA) taken adequately reduces the risk of open neural tube defects. Israeli Ministry of Health recommends daily dose of 400 mcg of FA by women of childbearing age with emphasis on 3 preconception months and first trimester of pregnancy. This study examined: 1) serum level of FA among Jewish and Bedouin pregnant women; 2) reported adherence with recommended FA supplementations; 3) association between serum level of FA and reported adherence with FA supplementations.

**Methods:** Cross-sectional study. 260 low SES women (134 Jewish and 126 Bedouin) who began pregnancy follow-up in antenatal Maternal and Child clinic in desert of southern Israel during 2005–2006, were included. After giving written informed consent, women were interviewed regarding their socio-demographic status, obstetric history and adherence with FA supplementations. Assessment of dietary consumption of FA was carried out in Jewish women using food frequencies questionnaire. Serum levels of FA were obtained.

**Results:** Serum level of FA was higher in Jewish ( $15.0 \pm 6.5$  ng/ml) than in Bedouin ( $9.6 \pm 5.3$  ng/ml) women,  $P < 0.001$ . 27% of Bedouins women had a marginal FA deficiency (serum level  $< 6$  ng/ml), compared with 7% of Jewish women ( $P < 0.001$ ). 77.6% of Jewish and 38.4% of Bedouin reported consuming FA supplementations ( $P < 0.001$ ). Mean nutritional FA consumption in Jewish group was  $354 \pm 195$  mcg/day (recommendation of 600 mcg /day). 18.5% of women were found to both consume less than 600 mcg /day and show poor compliance to FA supplementations. From multivariate linear regression model, independent risk factors for lower FA serum level were: reported non-adherence with FA supplementations, Bedouin origin, younger age, higher order of present pregnancy and higher gestational age ( $P < 0.001$ ,  $P = 0.018$ ,  $P = 0.002$ ,  $P = 0.005$ ,  $P = 0.004$ , respectively).

**Conclusions:** Development of strategies to increase awareness about FA supplementation using at childbearing age and environmental changes such as fortification methods is urgent in low SES populations.

#### ISEE-0658

##### The Effect of Maternal Residential Factors of Indoor PM Exposure on Pregnancy Outcome: MOthers and Children's Environmental Health (MOCEH)\*

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**Background and Objective:** Several studies have reported relationship between air pollution and adverse birth outcomes. However, most of researches did not deal with residential factors research for PM exposure. Therefore, the aim of this study is to evaluate the relationship between maternal residential factors of indoor PM exposure and pregnancy outcomes.

**Methods:** We collected the eligible data of 1286 pregnant women from three collaborating centers metropolitan area (Seoul), industrial area (Ulsan), and medium-sized urban area (Cheonan). The questionnaire was composed of residential factors, environmental exposure and general characteristics. We measured indoor air pollution data such as PM<sub>10</sub> and PM<sub>2.5</sub> for 271 houses. We used t-test, ANOVA, and multiple linear regression analyses to assess the associations between residential factors and the level of PM. We performed multiple linear regression analysis for the relationship among residential factors, indoor PM concentration, and pregnancy outcomes adjusting for maternal age and education, baby gender and birth weight, house age, factory distance, and gestational age.

**Results:** Indoor PM<sub>10</sub> was increased by decreasing room number of house ( $\beta = -9.18$ , SE = 4.42) and increasing house age ( $\beta = 0.93$ , SE = 0.40), and presence of pet ( $P = 0.05$ ). Indoor PM<sub>2.5</sub> was increased when use of humidity ( $P = 0.02$ ). Gestational age in simple linear regression model was decreased by indoor PM<sub>10</sub> ( $\beta = -0.01$ , SE = 0.00) and PM<sub>2.5</sub> ( $\beta = -0.01$ , SE = 0.00), respectively. In multiple linear regression model after adjusting for maternal age, education, baby gender, and maternal BMI, family number, room number, the gestational age was decreased by PM<sub>10</sub> ( $\beta = -0.01$ , SE = 0.00) and PM<sub>2.5</sub> ( $\beta = -0.02$ , SE = 0.01), respectively.

**Conclusion:** We found that indoor PM exposure was related to room number of house, house age, absence of pet, and use of humidity. Also PM exposure during pregnancy decreased gestational age. These results suggest guide line for pregnant women to prevent by elimination for risk factors during pregnancy.

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#### ISEE-0659

##### Residential Exposure to Electromagnetic Fields and Risk of Amyotrophic Lateral Sclerosis in Reggio Emilia, Italy

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**Background and Objective:** The etiology of amyotrophic lateral sclerosis (ALS) is still unknown. Some epidemiologic studies suggest a relation between occupational exposure to electromagnetic fields (EMF) and increased ALS risk, while very little data is available about the possible role of EMF residential exposure. We investigated this issue in an Italian community through a population-based case-control study.

**Methods:** We calculated the area around the high-voltage power lines in the Reggio Emilia municipality, northern Italy, with estimated magnetic field exposure above 0.1  $\mu$ T, adding 20 m to the distance from the power lines predicted by the model to account for geocoding inaccuracy. We retrieved new cases of ALS diagnosed among residents in Reggio Emilia municipality between 1995 and 2006, using several data sources such as death certificates, clinical records, hospital discharge registers and drug prescriptions. We randomly selected four controls for each case, matched for year of birth and sex, and we collected information about their residence in the 35 years prior to ALS diagnosis. All this information was included in a Geographical Information System to calculate disease risk associated with EMF exposure.

**Results:** The final study population included 42 cases and 168 controls. ALS risk associated with antecedent residence in the exposed area was 1.8, 1.9, 1.8 and 1.6 at 35, 20, 10 and 0 years before diagnosis, respectively. However, all estimates were statistically very unstable due to the low number of exposed subjects (6 controls and 3 cases 20 years before disease onset).

**Conclusion:** Though these results might indicate an excess risk of ALS among residents exposed to EMF from high-voltage power lines, limitations of the study, particularly the small number of exposed subjects, suggest the need to further investigate this issue in larger populations.

#### ISEE-0663

##### Trihalomethanes and Semen Quality in England and Wales

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**Background and Objective:** Disinfection by-products (DBPs) have been associated with adverse semen outcomes in laboratory animals. Of the DBPs, there is stronger evidence for the bromo- and chloro-acetic acids, while that for trihalomethanes (THMs) is heterogeneous. However, two small epidemiological studies have found no association between DBPs and adverse semen outcomes in humans. In a large case-control study, we investigated the association between individual and total trihalomethanes (TTHM) and low motile sperm concentration (MSC) in six water regions in England and Wales between 1999 and 2002.

**Methods:** Men were recruited from 13 fertility clinics in 9 centres across England and Wales between 1999 and 2002. THM concentrations in water zones were linked to data on semen quality for 647 cases and 936 controls, based on the men's residence at the time the semen sample was obtained. Low MSC was calculated relative to time since last ejaculation. TTHM levels were categorized as low ( $< 35.71 \mu\text{g/l}$ ), medium ( $35.71\text{--}49.86 \mu\text{g/l}$ ), or high ( $49.87\text{--}95 \mu\text{g/l}$ ).

**Results:** Preliminary analyses using a crude measure of THM exposure (annual average THM) found no increased risk associated with TTHM. There were some excess risks found with the individual THMs.

**Conclusion:** Our preliminary findings are inconclusive. Further analyses will use quarterly THM exposure data weighted to the time of sampling for more precise exposure, and adjust for potential confounders.

#### ISEE-0664

##### Telomere Length and Particulate Matter Exposure in Steel Workers

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**Background and Objective:** Shortening of telomeres is a marker of biological aging that has been related with cancer, cardiovascular diseases, and ambient particle exposure. However, other conditions inducing oxidative-stress and inflammation cause telomere lengthening, possibly due to cell maturation and proliferation of inflammatory cells. Telomere length is maintained by telomerase, which is induced by methylation in its promoter.

We investigated the effects of exposure to airborne particulate matter (PM) on leukocyte telomere length (LTL), telomerase expression, and telomerase promoter methylation in blood DNA from foundry workers exposed to a wide range of PM level.



**Methods:** We measured relative LTL and telomerase expression using RT-PCR in 63 male foundry workers on the first day of a workweek (T0) and after three days of work (T1). We measured telomerase promoter methylation through PCR-Pyrosequencing. Individual exposure to PM was estimated using area measurements and time-activity records.

**Results:** LTL was significantly increased after three days of work (T1: Mean = 1.43, SE = 0.07) compared with the baseline measurement (T0: Mean = 1.22, SE = 0.04;  $P$ -value < 0.001). In T1 samples, LTL was positively associated with PM<sub>10</sub> and PM<sub>1</sub> levels in unadjusted ( $\beta$  = 0.26,  $P$  = 0.002 and  $\beta$  = 0.25,  $P$  = 0.04), as well as in multivariate regression models ( $\beta$  = 0.27,  $P$  = 0.002 and  $\beta$  = 0.28,  $P$  = 0.02) adjusting for age, BMI, smoking and cigarettes/day. Telomerase expression was significantly decreased between the beginning and the end of time work (T0: Mean = 1.68, SE = 0.11; T1: Mean = 1.33, SE = 0.10;  $P$ -value < 0.001), and this decrease was associated with lower levels of telomerase promoter DNA methylation (T0: Mean = 92.9 %5mC, SE = 0.21; T1: Mean = 92.5, SE = 0.21;  $P$ -value = 0.02).

**Conclusion:** Our results show that short-term exposure to metal particles, at variance with previous data on ambient particles, causes rapid changes in blood LTL, potentially reflecting clonal expansion and selection of inflammatory cell types. Telomerase expression was decreased in post-exposure samples possibly as a result of lower telomerase promoter methylation.

#### ISEE-0666

##### A Methodological Approach for the Definition of the Urban Heat Island in Rome and Possible Use for the Evaluation of the Impact of Heat waves on Mortality

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**Background:** High temperatures have an impact on health however, few studies have addressed the heterogeneity in the impact within urban areas. Ambient temperatures vary considerably within cities and this phenomenon is typically known as urban heat island (UHI). The objective of the present study was to define the UHI in Rome using satellite data and ambient temperatures during summer. The UHI indicator can be used to assess the spatial variation in the impact of heat on health within the urban area of Rome.

**Methods:** AATSR satellite data for the period 2003–2006 were used to define the UHI in Rome with a spatial resolution of 1 km × 1 km. The urban area of Rome covers about 300km<sup>2</sup>. Cloud-free days were derived combining satellite data and cloud cover observations. A regression model was developed to derive air temperatures from land surface temperatures (LST) for all the urban area. The UHI intensity was calculated as difference between rural and urban temperature values during the evening.

**Results:** The UHI phenomenon identified in Rome was similar in all the 60 cloud-free days considered, suggesting the robustness of our indicator. The warmest areas were concentrated around the urban core extending to the east of the city, with LST values on average +2–3°C higher than the rural area. The UHI indicator accurately discriminated the cooler vegetated areas within the city. This indicator was used to analyze the differential impact of heat on mortality during heat waves in Rome for the period 2003–2006. Mortality and socio-economic status data, by census tract of residence, are considered to identify “hotspot” which are more at risk during heat waves due to the UHI effect. Air pollution data and dispersion models were also considered.

**Conclusion:** Results from this analysis can be used in public health to intensify prevention measures in at risk areas during heat waves.

#### ISEE-0670

##### Acute Health Effects of Commuters' Exposure to Air Pollution

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**Background and Objective:** People spend a significant amount of time in traffic, during which they are exposed to high levels of air pollution. Very few studies measured acute health effects after exposure in traffic. The TRAVEL study was designed to study exposure and related acute health effects of people commuting by bike, car and bus.

**Methods:** From June 2007 till June 2008 volunteers repeatedly travelled for two hours by bus, car or bike on a fixed route in the city of Arnhem. During the commute we measured the PM<sub>10</sub> concentration using Harvard Impactors and Particle Number Count (PNC) using a portable condensation particle counter (TSI CPC3007). Soot was measured on the PM<sub>10</sub> filter using a smoke stain reflectometer. Before and six hours after exposure we measured nitrogen oxide in exhaled air (FeNO) and high-sensitivity C-reactive protein (CRP) plasma levels in the volunteers.

**Results:** During the 47 measurement days we collected 357 pre and post health measurements of 34 healthy, non-smoking, adult volunteers. Two hour mean exposure to PNCs ranged from 14000 to 91000 particles/cm<sup>3</sup> (mean 40000 particles/cm<sup>3</sup>), PM<sub>10</sub> exposure ranged from 16 to 423 µg/m<sup>3</sup> (mean 54 µg/m<sup>3</sup>), and soot exposure from 1.6 to 31 ± 10<sup>-5</sup>/m (mean 7.2 ± 10<sup>-5</sup>/m).

FeNO levels were on average 19 ppb, the difference in post and pre FeNO ranged from -35 to 10 (mean: -1.5 ppb). CRP levels were on average 1.21 mg/L, the difference in post and pre CRP ranged from -2.4 to 6.5 (mean: 0.0 mg/L).

Using mixed model analysis, we found no associations between exposure to PNC, PM<sub>10</sub> and soot and differences in post-pre levels of FeNO and CRP.

**Conclusion:** Commuters' exposure to PNC, PM<sub>10</sub> and soot was not associated with FeNO, a marker of airway inflammation, and plasma CRP, a marker of systemic inflammation.

#### ISEE-0671

##### Assessment of the Precursors of Heme Biosynthesis in Biological Media of Breast Cancer Patients

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**Background and Objective:** Regulation and control of heme/porphyrin biosynthesis is very important for therapy of cancer. Some experimental studies found an increased level of protoporphyrin IX in human breast cancer cells. We tried to assess the precursors of heme biosynthesis in biological media of patients with breast cancer and benign tumour.

**Methods:** Delta-aminolevulinic acid (delta-ALA) in urine and delta-aminolevulinic acid dehydratase (delta-ALAD) activity in blood of 57 breast cancer patients and 28 benign breast tumour patients were measured by spectrophotometry.

**Results:** The mean delta-ALA concentration in urine was 17.16 µmol/g creatinine (95% CI = (15.15–19.16) for cancer patients and 12.86 µmol/g creatinine (95% CI = 10.65–15.07) for benign tumour patients ( $P$  = 0.01). The figures for delta-ALAD were 39.16 U/L (95% CI = 36.68–41.64) and 39.01 U/L (95% CI = 35.21–42.82), respectively ( $P$  > 0.05).

**Conclusion:** Our findings show that heme/porphyrin biosynthesis in breast cancer patients is affected more than in benign tumour patients. The mean

concentration of delta-aminolevulinic acid in urine of cancer patients is significantly higher than that in benign tumour patients.

#### ISEE-0675

##### Urinary Disease Morbidity and Mortality in a Population Environmentally Exposed to Cadmium and Other Nephrotoxic Metals

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**Background and Objectives:** Exposure to cadmium and other nephrotoxic metals may cause damage to the urinary system. Food is the main source of cadmium exposure in non-smokers. A lead/zinc smelter in Avonmouth (southwest England) was a major source of environmental cadmium for over 70 years. Emissions from the site may have led to increased cadmium exposure in the local population through inhalation of contaminated air and the ingestion of home-grown vegetables and house dust. A previous study carried out in the area showed a positive dose-response relationship between urinary cadmium and a biomarker of kidney tubular damage.

**Methods:** A validated air dispersion model was used to define high, medium and low exposure groups within the vicinity of the smelter. Routinely collected data were used to assess non-malignant urinary disease morbidity and mortality using the southwest England region as the reference. Relative risks for sub-groups of urinary disease were also calculated. Analyses for men and women were carried out separately and results were adjusted for age and socioeconomic status.

**Results:** The results show a significant trend in urinary disease mortality over exposure categories in women ( $P = 0.02$ ) and a significantly increased risk in the highest exposure group (RR 1.48 (95% CI 1.09–1.96)). For urinary disease morbidity the results show a significantly increased risk across all exposure groups for both sexes with relative risks in the highest exposure group of 1.33 (1.26–1.4) and 1.48 (1.41–1.56) for men and women respectively. The analysis for urinary disease sub-groups also show significantly elevated risks including a relative risk of 3.26 (3.07–3.46) for bladder dysfunction in women.

**Conclusions:** An excess risk of urinary disease mortality and morbidity support the need for measures to reduce environmental cadmium exposure in the Avonmouth area.

#### ISEE-0677

##### Using an Integrated Food Chain Model as an Instrument to Derive Health-Based Threshold Values for Atmospheric Deposition of PCDD/F and DL-PCBs

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**Background and Objective:** In Flanders, human exposure to PCDD/F and DL-PCBs is relatively high, as reflected by food and blood levels. One of the sources is atmospheric emission and subsequent transfer throughout the food chain. We established health-based thresholds for atmospheric deposition of PCDD/F and DL-PCBs, by combining (i) transfer from air and soil to crops and cattle and (ii) fixed levels in non-farm related food products.

**Methods:** We used the XtraFOOD model describing the full chain from farm level emissions over food concentrations to human exposure. The model combines a variable component covering environmental transfer and a fixed component for imported or non-farm food products, such as fish. Exposure is calculated by age, using Belgian food consumption data. Model inputs are environmental levels (air & soil concentrations, atmospheric deposition) and chemical properties (physicochemical, transfer factors).

**Results:** Predictions by the XtraFOOD model are validated against reported food and exposure levels. Predictions at background deposition and soil levels reveal an intake of 122 pg WHO-TEQ/day for women. Consumption of fish, followed by milk products and red meat dominate exposure. Taking into account the TWI (14 pg WHO-TEQ/kg.week, EUSCF), a critical deposition value of 8.2 pg TEQ/m<sup>2</sup>.day as a yearly average for PCDD/F and DL-PCBs was calculated based on the maximum EU legislation fish levels (fixed values). Using measured fish concentrations, a critical value of 1.9 pg TEQ/m<sup>2</sup>.day was calculated, which is lower than the background deposition in Flanders.

**Conclusion:** Integrated chain models are valuable instruments for deriving health-based environmental quality standards. Model validation is essential for reliable application. When deriving environmental quality standards, one should take into account the contribution of sources not related to the compartment under consideration, as these can contribute significantly to exposure, thus reducing the proportion of the acceptable intake that can be assigned to the compartment.

#### ISEE-0680

##### Is Transition from Nomadic to Sedentary Lifestyle an Important Social Determinant of Child Health?

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**Background and Objectives:** Nomadic communities – one of the types of underprivileged populations – still lags the furthest behind in every field of progress. We were able to monitor changes in the health status of Bedouin children over a 25 year period of transition from a semi-nomadic life style to sedentarism in desert area of southern Israel.

**Methods:** Systematic review of articles published on the health of Bedouin children in the Negev as well as summarizing data routinely collected by the Israeli Central Bureau of Statistics and the Regional Medical Office of the Ministry of Health.

**Results:** Among the Bedouin Arab population of the Negev Infant Mortality Rates have decreased from 30.9 per 1000 live births in 1979 to 8.5 per 1000 in 2008. A striking decrease in vaccine-preventable infectious diseases in the Bedouin population was found. The data show marked decrease in the proportion of Bedouin children who born with low birth weight from 15% in 1980–1981 to 8.9% in 2006. In 1986 the proportion of 1 year old children with short stature was 38.2% but this decreased to 19% in 1999. In 2006, 17.5% of Bedouin women were exclusively breast-feeding their infants at 6 months of age while another 61.4% were still breast-feeding with supplements. All these changes were temporally associated with the transition of over 60% of Bedouin the population from a semi-nomadic life style to permanent settlements which was started in 1978 and is continuing up to the present.

**Conclusions:** The results have implications for the inclusion of transition from nomadism to a sedentary existence as social determinant of health which leads to improving in child health.

#### ISEE-0681

##### Acute Effects of Air Pollution in Brindisi, 2003–2005. Is the Answer Blowing in the Wind?

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**Background and Objective:** Brindisi (south of Italy, 90,000 inhabitants) is an industrial town with different sources of air pollution. Industrial sites are near the coast, to SE of the conurbation and include: two power plants, a petrochemical plant, other industries and one of the largest European coal power plant. Other environmental impacting activities are: local traffic and highway (W), the harbour (E) and the airport (N).

In a previous study we found positive associations between:

1. daily  $PM_{10}$  levels and both mortality (natural and cardiovascular causes) and Hospital Admissions (HA, cerebrovascular causes);
2. daily  $NO_2$  and both mortality (natural and cardiovascular causes) and HA (cerebrovascular, cardiac and respiratory) in specific groups.

Climatology shows wind directions from NW to NE as prevailing (more than 50%), strongest in velocity and usually associated to low pollutants concentration. Intense winds from S are also frequent, being associated with higher PM concentration. Lower wind intensities and highest  $NO_2$  are associated to E and W sectors.

In this study we evaluate the role of the daily wind direction as effect modifier on the acute effects on HA, 2003–2005.

**Methods:** Case-crossover design and conditional logistic regression were applied. Models include as confounders mean temperature, relative humidity, influence epidemics, summer decrease of resident population, holidays and were stratified by prevalent wind directions at the pollutants same time-lag.

**Results:**  $PM_{10}$  and  $NO_2$  are adversely associated to daily cardiac, cerebrovascular and respiratory HA when wind blows from southern, eastern and western sectors. For both pollutants, significant not adverse effects on HA were found when wind blows from northern quarter.

**Conclusion:** The high risks observed in the presence of a Southern wind suggest an important role of the industrial area in determining acute health effects. Further analyses are on going to evaluate the role of the Saharan outbreaks in the risk observed in correspondence of SSW-W wind direction.

#### ISEE-0687

##### Ozone and Mortality in Fifteen British Conurbations: Is the Effect Worse on Hot Days?

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**Background and Objective:** Acute associations between ozone and mortality are largely established, but evidence is sparse on interactions between effects of ozone and heat. We sought to assess effects of ozone on mortality in Britain, and whether these are worse on hot days.

**Methods:** Short-term effects of summer ozone on mortality were estimated using data from 15 conurbations in England and Wales (1993–2003). Two-day means of daily maximum 8-hour ozone were entered into a case-crossover model, controlling for  $PM_{10}$ , natural cubic splines of temperature, and other factors. Interaction terms were added to assess whether ozone effects increased on ‘hot days’, when the 2-day mean temperature exceeded the 95th percentile.

**Results:** Adverse ozone effects occurred in nearly all conurbations. The mean mortality rate ratio under a linear model was 1.003 per  $10 \mu g/m^3$  ozone increase (95% CI 1.001–1.005), though there was evidence against linearity in the direction of the threshold at about  $50 \mu g/m^3$ . In London

and some other conurbations, ozone effects increased significantly on hot days, and the mean interaction rate ratio was 1.004 (1.000–1.008,  $P = 0.04$ ) per  $10 \mu g/m^3$  ozone increase on a hot day. This was reduced in some sensitivity analyses, though remaining significant in London. The mean mortality rate ratio for a ‘hot day’ effect itself was 1.04 (1.03–1.05). Ozone and hot day effects were strongest among the elderly, and for respiratory mortality. Ozone-heat interaction was strongest for respiratory mortality, and among those aged 0–64. Ozone effects occurred at concentrations below current guidelines.

**Conclusion:** Ozone and heat showed significant, independent effects on summer mortality, particularly among the elderly and for respiratory mortality. There was some evidence that ozone effects were worse on hot days.

#### ISEE-0693

##### Estimate of Burden of Disease Attributable to Climate Change in South Korea

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**Background and Objective:** It has been widely recognized that climate changes are posing for human health. On the other hand, the burden of diseases from climate change has not been studied actively. The aim of this study was to estimate the burden of five infectious diseases attributable to climate change.

**Methods:** The burden of five infectious diseases—leptospirosis, malaria, shigellosis, vibrio vulnificus sepsis, tsutsugamushi fever—due to climate change was estimated by using DALY (Disability Adjusted Life-Year). For the calculation of the DALYs, the following parameters were estimated: prevalence rate, disability weight and duration of each disease. To estimate the prevalence rate of infectious diseases, this study used National Health Insurance utilization data and the nationwide Automatic Weather System during 2005–2007 in South Korea.

**Results:** When considering future population change, the burden of disease varied to age groups and the type of diseases. Absolute amount of disease burden was higher in the adults, but those of children and young adults (under 35) relatively increased due to decrease of population size of those groups. The order of future burden of disease was estimated tsutsugamushi fever, malaria, shigellosis, vibrio vulnificus sepsis, and leptospirosis. The DALYs of tsutsugamushi fever, malaria, shigellosis, vibrio vulnificus sepsis and leptospirosis was 1.7314, 0.4493, 0.2480, 0.1514, 0.1478, respectively when the yearly average temperature increased 1 degree Celsius.

**Conclusion:** Despite the significance of the burden of disease due to climate change, strategies and researches required in this regard are only in their beginning stages in South Korea. As one of the most prominent and prompt preparations, burden of disease attracted the popular. The findings were expected to contribute to priority setting and effective resource allocation in public health policy.

#### ISEE-0694

##### Association of Fine and Coarse Particles with Mortality in Canary Island Cities Affected by Saharan Dust Intrusion

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**Background and Objective:** The special environmental features of the Canarian cities, with high  $PM_{10-2.5}$  levels, natural in origin because the proximity of African deserts, offer a unique opportunity to a deeper



analysis of the short-term relation between different particulate fractions and health. Our objective is to assess the impact of  $PM_{2.5}$  and  $PM_{10-2.5}$  on total mortality, and mortality due to heart and respiratory diseases, examining the shape of the relation of size-classified PM with mortality.

**Method:** 2001 to 2004 was the period under study. For each PM sized fraction and mortality outcome, a regression analysis was performed and lagged effects, up to 5 days, were examined. After assessing the linearity in the relationship, a piecewise linear analysis for exploring the existence of possible thresholds was carried out.

**Results:** PM levels were moderately high but with extremely elevated levels during episodes, i.e.  $PM_{2.5}$  rose maxima of  $200 \mu g/m^3$  and did  $PM_{10-2.5}$  around  $400 \mu g/m^3$  in both cities.  $PM_{2.5}$  was clearly associated with heart disease mortality and  $PM_{10-2.5}$  with respiratory mortality. A non-linear relationship shape arise with some flattening in RR estimates for the relation of  $PM_{2.5}$  with heart disease mortality, and some suggestion for a threshold in the relation of  $PM_{10-2.5}$  with respiratory mortality.

**Conclusion:** We found a robust short term impact of  $PM_{2.5}$  on heart disease mortality in Canary cities.  $PM_{10-2.5}$  may play a relevant role in harmful particulate effect on respiratory mortality. Given the frequency of African air mass intrusions in Canary Island, and also extended areas along the world, these results have to be considered in order to lay the foundations to air quality regulations, surveillance and interventions to adequately protect the health of the population.

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#### ISEE-0698

##### Chronic Renal Failure and Urinary Tract Cancer in Chinese Herbalists: Implications for the Safety Issues of Herbal Medicine

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**Background and Objective:** Since an outbreak in Belgium in 1992 aristolochic acid (AA) nephropathy, a progressive renal interstitial fibrosis, has been reported in the world, where urothelial carcinoma have also been detected frequently. Numerous ingredients known or suspected to contain AA are used in herbal medicine. However, we did not know whether Chinese herbalists take any risk of kidney and urinary tract diseases.

**Methods:** We obtained the insurance information for the occupational union of Chinese herbalists from the Bureau of Labor Insurance. This study population consisted of 2,919 males and 3,335 females from 1 March 1995 to 31 March 1999. We linked Chinese herbalists to the catastrophic illness/injury certificates from the Bureau of National Health Insurance in the same time period. We calculated certificate rates of various diseases during the study period for Chinese herbalists and the general population aged 15 years old or more. Then we evaluated age-adjusted relative risks for the study population compared with the general population.

**Results:** Crude rates of chronic renal failure and kidney cancer in male Chinese herbalists were 61.7 and 13.7 per 10,000 persons and the age-adjusted relative risks were 2.48 ( $P < 0.05$ ) and 3.81 ( $P = 0.10$ ), respectively. For female herbalists, crude rates of chronic renal failure and kidney and bladder cancers were 93.0, 21.0, and 12.0 per 10,000 persons and the age-adjusted relative risks were 4.13 ( $P < 0.0001$ ), 9.32 ( $P < 0.01$ ), and 5.86 ( $P < 0.05$ ), respectively.

**Conclusions:** Our present findings give a strong support for the hypothesis that kidney and urinary tract diseases in Chinese herbalists related to the long-term exposure of AA-containing herbal medicines which may be compatible with Balkan endemic nephropathy. Further actions should be carried out to ensure the safe use of herbal medicine in the world.

#### ISEE-0699

##### Subjective Noise Annoyance and Road Traffic Noise Exposure in Munich: Results of Questionnaire Data and Noise Mapping

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**Background and Objective:** In surveys road traffic is the most often mentioned source of noise annoyance. Objective noise exposure determines noise annoyance only partially. The objective of this study was to assess the traffic noise exposure and annoyance of families in Munich and to identify further determinants of noise exposure.

**Methods:** Noise annoyance in the family's home, variables of socioeconomic position and housing conditions were assessed 2006 and 2007 with a self-administered questionnaire in a survey of parents of children aged 5 to 7 years in Munich, Germany. Data on road traffic noise exposure (LDEN and LNight) at the child's address were obtained from the noise map of Munich according to the EU Directive on Environmental Noise.

**Results:** Parents of 1305 children (66%) completed the questionnaire. Complete address data of 1063 children were obtained and linked to the noise map data (82% of children with questionnaire). Mean LDEN was 50.2 dB(A) (range 34.8–81.4 dB(A)), mean LNight was 41.2 dB(A) (range 25.7–72.1 dB(A)). 16% of the parents felt moderately to highly annoyed due to road traffic noise during daytime, 7% during nighttime.

Parents with a high noise exposure significantly indicated higher annoyance due to noise. Mean LNight levels were 40 dB(A) for no, 47 dB(A) for moderate, and 59 dB(A) for very high noise annoyance. Children in relatively poor and non-German households have a higher noise exposure. Adverse housing conditions like living at a main streets and frequent freight traffic in the residential area are associated with higher noise exposure.

**Conclusion:** The road traffic noise exposure in families in Munich is high both during day and nighttime. Adverse housing conditions and low socioeconomic position are associated with higher noise exposure and annoyance. Noise exposure clearly influences noise annoyance. Thus annoyance can be used as an indicator for actual noise exposure.

#### ISEE-0704

##### Food Security and Emerging Infectious Diseases: The Unsustainable Case of the Andes-Amazon Region, due to Large Scale Crop Production and Global Trade Policies

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**Background and Objectives:** Food security embraces, among other dimensions, food production and distribution, which are related to changes in land-use and cover and biodiversity, therefore in the epidemiology of infectious diseases. The ongoing infrastructure development policies for the region, allowing increasing international commerce (especially the exportation of Soya-bean from Brazil to Asia), include the paving of the 1,000 miles "Pacific Highway", as well as the resulting 2,500 miles of hydro-ways from the building of hydroelectric dams. The vicious cycle (roads and dams building–LUCC through logging/forest fires–biodiversity loss) affect vectors' ecology and bring people, vectors, and wild reservoirs into overlapping areas, fostering the (re)emergence of vector-borne diseases. This work was aimed at assessing these linkages and understanding this complex process to help breaking this vicious cycle.

**Methods:** Case Study methodology enabled the investigation to retain the characteristics of real-life events and coped with the situation in which there were multiple variables of interest and sources of evidence – such as documentary sources, interviews, analysis of changes in land use and cover and in the region's epidemiology – while assessing what can be learned to mitigate societal suffering and environmental loss when developmental policies are aimed at promoting food production and trade.

**Results:** The (re)emergence of American Cutaneous Leishmaniasis and Bartonellosis (Carrion Disease) are two seminal examples of how infectious diseases in the Andes-Amazon Region can be linked to LUCC and to biodiversity loss from deforestation, road paving and dams building, fostered by distant food production and distribution.

**Conclusion:** It is fundamental to make explicit the linkages between “development” policies, LUCC, forest and biodiversity losses, and, ultimately, food security, if we are to increase the awareness about ecosystem services to regulate the (re)emergence of infectious diseases.

#### ISEE-0705

##### Acrylamide Contents in the High-Temperature Processed Taiwanese Traditional Foods

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**Background and Objective:** Acrylamide (AA) is an animal carcinogen, and can cause formation of DNA adducts and mutations. AA has been reported present in high-temperature processed food. Daily intake of AA from consumption of foods has been of great concerns worldwide. AA contents in western foods have been reported, particularly in French fry and potato chips with high levels. AA contents in few Eastern foods were reported. The objective of this study was to survey the AA contents in Taiwanese fried foods so that the daily intake of AA from food consumption can be assessed to lay the foundation to study the potential health effects of AA in high-temperature processed foods.

**Methods:** Total more than 400 samples of 107 fried foods were collected for analysis of AA using liquid chromatography coupled with tandem mass spectrometry.

**Results:** AA contents in traditional high-temperature processed Taiwanese foods vary from few ppb several hundreds of ppb, and much less than those in French fries and potato chips analyzed.

**Conclusions:** These data would be critical for future studies and health risk assessment on the potential health effects caused by daily consumption of high-temperature processed foods in Taiwan.

#### ISEE-0706

##### On the Sources of Ambient Respirable Particles Laden with Trace Metals: An Investigation of Extensive Sources of Aerosol with High Fractions of Transition Metals in New York City

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**Background and Objectives:** In earlier work based on PM<sub>2.5</sub> speciation network data in and near New York City (NYC), we showed that nickel (Ni) concentrations were much higher in NYC than in nearby states, and that NYC levels, but not those in nearby states, were much higher in the winter than in summer. However, all of the speciation sites in NYC were in the northern half of the city. In one of our concentrated ambient particle (CAPs) exposure studies using a murine model, Ni was shown to be an important component of ambient air PM<sub>2.5</sub> that was significantly associated with increased heart rate (HR) and decreased HR variability

(HRV). Several recent epidemiological analyses show consistent effects, suggesting that Ni is an important effect modifier for mortality associated with PM<sub>2.5</sub> exposure.

**Methods:** In order to determine the distributions of Ni and other PM<sub>2.5</sub> components within NYC, we collected 8 weeklong filter samples at 11 sites throughout NYC in both winter and summer, and measured the concentrations of the elements by x-ray fluorescence (XRF). The resulting data, together with speciation network site data, were used to construct seasonal average concentration isopleth maps for Ni, vanadium (V), and other elements.

**Results:** Ni was much higher in Bronx than in Brooklyn, and much higher in winter than in summer. The highest winter concentrations observed under ambient conditions were similar to those from CAPs studies that show HR and HRV effects in mice. We will provide an analysis of ~33 other elements measured, including tracers of traffic (e.g. elemental carbon, Pb, and Zi), resuspended road dust (Fe, Si, Mn, Al, and Ti), and biomass burning (elemental carbon, K, and Ca).

**Conclusions:** Spatial variability of chemical components of fine aerosol is highly variable in NYC, which has important implications for ambient exposure studies.

#### ISEE-0711

##### Using GIS to Model Pesticide Exposure at the Small-Area Level in England

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**Background and Objective:** Current studies investigating the health effects of exposure to environmental contaminants are often limited by the aggregated nature of the data available from routine monitoring sources. In the case of pollution from agriculture, for example, the health risks often remain poorly understood. Dasymeric mapping is one technique, often used in population modelling and remote sensing, to overcome these limitations. This GIS-based approach, however, has been little used in epidemiological studies, or for health risk and impact assessment. This work demonstrates dasymeric mapping for disaggregating agricultural pesticide data (available only at the county level in England) to derive exposure estimates for population-level studies.

**Methods:** Dasymeric mapping, an areal interpolation technique, incorporates covariates to disaggregate data to a finer resolution by modelling the underlying spatial patterns in the phenomena of interest. County regression models were developed for broad pesticide groups (herbicides, insecticides and fungicides) and 11 crop categories on the basis of agricultural statistics, land cover and soils data. The 33 individual models were then applied to the relevant predictors calculated at the ward-level and summed to provide herbicide, insecticide, fungicide and total pesticide usages (kg active ingredient/ha) for wards across England.

**Results:** Regression models were developed for most pesticide group and crop combinations. Models for herbicides generally performed better than those for insecticides and fungicides. The comparison between county and ward-level exposure distributions across England, based on intersection with postcode headcount data, is presented.

**Conclusion:** Preliminary investigations employing a GIS-based approach to model small-area pesticide usage where only aggregate statistics are available, show promise. This method will be further developed to provide proxies for pesticide exposure in epidemiological and health impact studies.

#### ISEE-0714

##### A Flexible Modelling Framework to Investigate the Delayed Effects of Environmental Stressors

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**Background and Objective:** There are well-developed flexible distributed lag models for linear exposure-response relationships and flexible exposure-response relationships for simple lag models, but rarely are these two complexities modelled together. We present and illustrate a flexible class of models to represent simultaneously non-linearity in the shape of the exposure-response relationship and its temporal structure—complexity in particular typically seen in temperature-mortality associations.

**Methods:** Our general framework for distributed lag non-linear models (DLNM) rests upon the construction of “cross-basis” variables. These are a combination of two sets of basis functions to model the shape of the relationship along (a) the space of the predictor and (b) the lag dimension of its effect, respectively. Each basis can be chosen from a wide range, including linear, polynomial, step-function, threshold, or spline. We illustrate this approach using NMMAPS temperature and mortality data for New York in the period 1987–2000.

**Results:** A model using natural cubic splines for both temperature and lag dimensions suggests very different temperature-mortality curves at different lags: a roughly hockey-stick shape reflecting a sharp heat effect at lag 0 moving to a varying asymmetric “U” shape across medium (3–10) lags with an increasingly dominant cold effect and a shallow inverted “U” by lag 14, diminishing to non-significance by about four weeks.

**Conclusion:** DLNMs provide a unified framework which includes most of the models used so far to describe the effect of environmental stressors and more flexible ones. The illustration confirms the long lag of effects of cold and shorter for heat, with some evidence of harvesting at extreme temperatures. These models offer the opportunity to investigate complex relationships including composite patterns of delayed non-linear effects and harvesting.

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#### ISEE-0718

##### Effects of Exposure to Hexavalent Chromium on Male Electroplating Workers

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**Background and Objective:** Hexavalent chromium (Cr(VI)) compounds are extensively used in the electroplating industry. Exposure to Cr(VI) in the workplace may result in the generation of highly reactive oxygen species, and the consequent oxidative stress promotes the development of cancer. This study discusses two oxidative stress markers, urinary 8-hydroxy-2'-deoxyguanosine (8-OHdG) and malondialdehyde (MDA), in workers who are exposed to (Cr(VI)) in electroplating factories.

**Methods:** The study participants were 230 non-smoking male workers, comprising 105 Cr(VI) exposed workers, and 125 control group workers at 12 electroplating factories in Taiwan. Urinary chromium (Cr) was adopted to provide an internal dose of Cr(VI). Urinary 8-OHdG was employed as an oxidative DNA damage marker, and urinary MDA was used as an lipid peroxidation marker. Urinary Cr was detected by graphite furnace atomic absorption spectrometry. Urinary 8-OHdG and MDA concentrations were measured using HPLC/MS/MS and HPLC, respectively. The relationship between workers' urinary 8-OHdG and Cr levels, and that between their MDA and Cr levels were both estimated using multiple linear regression models.

**Results:** Geometric mean urinary levels of Cr, 8-OHdG and MDA in workers who had been exposed to Cr(VI) consistently exceeded those in control subjects. Urinary 8-OHdG concentrations were significantly positively correlated with urinary Cr concentrations ( $P < 0.001$ ). Urinary MDA concentrations were not significantly correlated with urinary Cr concentrations ( $P > 0.05$ ). Urinary 8-OHdG more sensitively reflects

oxidative stress in workers upon exposure to Cr(VI) than does the urinary MDA biomarker.

**Conclusion:** Exposure to Cr(VI) leads to an increased risk of oxidative DNA injury among electroplating workers.

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#### ISEE-0719

##### Challenges Associated with Reducing Malnutrition and Diarrheal Disease in Children in Developing Countries

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**Background and Objective:** Malnutrition is a significant global health concern, particularly in children under the age of five. The causes of malnutrition are varied and include inadequate food, inability to absorb nutrients (e.g. diarrheal disease), and low diet diversity. In the Millennium Village of Sauri located in western Kenya, food production has increased and diversified and basic health care has improved but the nutritional status of many children is still poor. This pilot study seeks to improve child nutritional status by integrating food production and nutrition with access to clean drinking water, hygiene education, and community participation.

**Methods:** A pilot study was conducted in fifty households with children under the age of five in the village of Sauri, western Kenya. Changes in five outcomes were targeted: crop and livestock diversity, diet diversity, household water quality, prevalence of children's underweight, and diarrheal disease prevalence before and after the introduction of nutrition and hygiene education and household water treatment.

**Results:** Analysis of baseline data revealed that 66% of the household drinking water samples had fecal coliform contamination and 60% of the springs were contaminated with fecal coliform. Twenty-five percent of the households reported that at least one child under five had diarrhea in the previous week. Crop diversity was relatively high in farmer fields with an average of 14.6 edible plants per farm. Diet diversity was intermediate, with a diet diversity score of 3.9 when based on seven food groups.

**Conclusion:** Opportunities exist for intensive education on nutritional benefits of different food groups and the importance of improved hygiene and household treatment and protection of drinking water. Application of a watershed approach to identify the threats to water quality and encouraging the community to be involved in the protection of springs will support the long-term sustainability of source protection efforts.

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#### ISEE-0721

##### Impacts of Climate on the Incidence of Scrub Typhus

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**Background and Objectives:** Scrub typhus is a vector-borne zoonotic disease caused by *Orientia tsutsugamushi*. This organism is transmitted by infected trombiculid mites, *L. pallidum* and *L. scutellare*. It is widely distributed in the Australasian regions and parts of the Palearctic, including eastern Asia. The incidence of Scrub typhus in Korea has shown increasing trend during last decades. This study was conducted to find relationship between the incidence of disease and climate elements.

**Subjects and Methods:** We examined all cases of Scrub typhus from 2004 to 2008 which have been reported to Center for Disease Control and Prevention, Korea. We assessed the correlations between the incidence of Scrub typhus and climate elements obtained from Korea Meteorological Administration.

**Results:** Region that vector mites, *L. pallidum* was predominant had shown high negative correlation between the incidence and relative humidity of late summer and early autumn season. The mean of winter daily minimum temperature had shown weak positive correlation with disease incidence in the region *L. scutellare* was predominant.



**Conclusion:** Natural environment including climate conditions could affect the development and survival of larva mite. Climate change may have an effect on increasing trend of Scrub typhus. Our results show the possible evidences that the incidence of Scrub typhus is affected by climate elements changed by global warming.

#### ISEE-0722

##### Atopy Prevalence on 33 Allergens among Industrialized Area Residents in Gyeonggi-do, Korea (2007)

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**Background and Objective:** Atopic dermatitis, which is increasing rapidly as shown in many studies, is thought to be related with environmental factors including exposure opportunities increase on various pollutants and indoor allergens (especially dust mites) as recurring, inflammatory and chronic dermatitis (Leung DYM, 1999). Atopic dermatitis, which is associated with genetic and environmental factors with mostly beginning through infant stage, is increasing especially in industrialized countries. This study was conducted to compare atopy prevalence of indoor, outdoor and animal allergens and to investigate positive rates of each 33 allergens and atopy prevalence by sex and age.

**Methods:** 981 (M 422, F 559) industrialized area residents between July and August 2007 were involved in skin prick test and was interpreted as positive when the mean wheal size formed by allergen was larger than 3 mm and larger than histamine size. Atopy was defined when skin reaction to one or more of 33 allergens was positive.

**Results:** Atopy prevalence among 981 industrialized area residents was 41.8%. When the data were analyzed by sex, positive rate of males was 41.94% and that of females was 40.61%. When the data was analyzed by age, positive rate of the 20–29 age group was the highest (48.00%). In males, positive rate of the 50–59 age group was the highest (56.25%). In females, positive rate of the 20–29 age group was the highest (50.00%). According to positive rate of 33 allergens, D. Farinae 22.63%, D. Pteronyssinus 22.32% were the highest and then Mugwort 5.30% as outdoor allergen, Cockroach 3.67% as indoor allergen were the next in order.

**Conclusion:** Atopy prevalence was increasing more and more in industrialized area residents. D. Farinae, D. Pteronyssinus and Cockroach as indoor allergens, Mugwort, Meadow as outdoor allergens and Cat epithelium as animal allergens were the major causes of atopy. Urgent preventive strategies are needed through continuous studies.

#### ISEE-0723

##### Estimating Traffic Exposure in Primary Care Service Areas

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1. Numerous spatial referenced health data are collected by Primary Care organisations (General Practices in Britain). However, their utility for environmental epidemiology is limited because they are not linked to environmental data. One of the main challenges for this record linkage is dissimilar spatial units used to collate such data. We aim to estimate traffic exposure per General Practice (GP) based on the distribution of registered patients by GP and traffic flow data.
2. We obtained the postcodes of approximately 430,000 patients per year for the period of 2002–2006. We used kernel analysis to estimate the patients' density per GP and then created contour lines that contained the 95%, 98% and 99% of the points used to generate the kernel density estimate for each.

Monthly traffic flows from 50 monitoring sites were analysed spatio-temporally using spline interpolation. The output of spline models was validated and we then used correlation and regression to assess the relationship between predicted and observed values of traffic flows.

3. We used the contours representing the 98% probability density distribution to define the boundary of 64 GP service areas per year, giving a total of 320 areas.

The degree of correlation between the interpolated traffic flows and observed flows ranges from 88% to 92%. There was also a significant relationship between the interpolated and observed traffic flows.

Finally, we estimated 3,520 monthly traffic exposures by summing the predicted traffic flows per GP service area.

##### Conclusions:

- Kernel analysis can create representative GP service areas that will be useful for spatial analysis of GP data.
- Interpolated traffic flows produce a continuous map, which allows the analysis of traffic flows per GP service area.
- Overall, the estimation of traffic exposure of patients registered per GP can be used to investigate the relationship between traffic exposure and various health outcomes.

#### ISEE-0726

##### Blood Lead and Mercury Level Changes and Improvement of Attention Deficit Hyperactivity Symptoms in School-Aged Children

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**Background and Objective:** Because blood lead has been associated with attention deficit hyperactivity disorder (ADHD), we examined whether improvement of ADHD symptoms correlates with lower blood lead or mercury levels among children involved in the Children's Health and Environmental Research (CHEER).

**Methods:** CHEER is a prospective cohort study of children who were first grade elementary school at baseline from 10 Korean cities. Of 2,722 first grade children who participated in the 2006 survey, 1,949 children were followed up in the 2008 survey (follow-up rate, 71.6%). We examined the relationship between changes of blood lead and mercury level and ADHD symptoms assessed using the Dupaul's parental scale.

**Results:** Prevalence of ADHD was decreased from 12.3% in 2006 to 9.2% in 2008. Blood lead level was decreased from 1.8 ug/dl in 2006 to 1.6 ug/dl in 2008 among the same children while blood mercury was slightly increased from 2006 to 2008. Of 1,710 who did not have ADHD symptoms in 2006, 87 children (5.1%) were reported as having ADHD symptoms in 2008. Of 239 children who had ADHD in 2006, 147 children (61.5%) were reported as not having ADHD in 2008. Blood lead levels were decreased amongst children whose ADHD status changed

from positive in 2006 to negative in 2008 ( $P = 0.01$ ) while changes in blood lead levels amongst the other children were not significant. Blood mercury levels were also significantly lower among children whose ADHD symptoms changed from positive to negative during the two years. The findings were not altered after considering children's age, gender, residential area and household income, which might influence the changes in blood levels of lead or mercury as well as ADHD symptoms.

**Conclusion:** Lower blood lead and mercury levels is associated with ADHD symptom improvement which may have important implications in children's environmental health.

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#### ISEE-0727

##### Analysis of Spatio-Temporal Patterns of Short-Acting $\beta_2$ Agonists Prescribing

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**Background and Objective:** The two most common chronic respiratory diseases are asthma and Chronic Obstructive Pulmonary Disease (COPD). The monitoring of which and their determinants remains a challenge both for developed and developing countries. In England, short-acting  $\beta_2$ -agonists is the most often prescribed drug for asthma and COPD, of which 93% is represented by the drug salbutamol. We aim to investigate the monthly salbutamol prescribing in relation to air pollution and deprivation. The spatial units of analysis represent primary health care service areas, called General Practices (GPs).

**Methods:** We accessed monthly data of salbutamol prescribing from 64 GPs at Northeast of England, for 2002–2006. The data follow a seasonal pattern, as factors like cold air and pollen can exacerbate symptoms of asthma and COPD. Therefore, we first modelled prescribing against temperature using a frequency domain model to account for the seasonal variation in temperature. The estimated area-wide average of salbutamol prescribing was then applied to the statistical model that assesses the relationship of prescribing to air pollution and deprivation. We used a mixed-effects statistical model that is appropriate when data share the same classification factor such as GP.

**Results:** A static regression model was tested against a dynamic model and the later was proved to be suitable for estimating the area wide average of salbutamol prescribing. We evaluated possible time-lags in responses of medication prescribing to temperature with best results provided by the 7-days lag. This output was used as offset to the mixed effects model, the results of which show a positive significant relationship between salbutamol prescribing, air pollution and deprivation.

**Conclusions:** The use of mixed-effects model with offset provides realistic representation of the relationship we assess, as allows to both handle data grouped per GP and account for the effect of area-wide seasonal variation of temperature.

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#### ISEE-0729

##### Long-Term Exposure to Residential Noise and Air Pollution and Risk of Cardiovascular Diseases in Oslo, Norway—Project Design and Exposure Assessment

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**Background and Objective:** Long-term exposure to road traffic and aircraft noise has been reported to be associated with increased risk of myocardial infarction and hypertension. Road traffic is the main source of both noise and air pollution. Air pollution has also been linked to cardiovascular morbidity and mortality. So far, the knowledge about the relative importance of these traffic-related exposures for developing cardiovascular diseases is rather limited.

The aim of the project is to study the association between residential transport-related noise and the risk of cardiovascular morbidity and mortality by simultaneously controlling for residential nitrogen dioxide ( $\text{NO}_2$ ) as indicator of traffic-related air pollution. This presentation will describe the project design, with focus on exposure assessment.

**Methods:** A population-based cross-sectional study “The Oslo Health Study” (HUBRO) was performed in 2000–2001. About 46% ( $N = 18,770$ ) of the invited subjects answered a questionnaire and underwent a physical examination. Blood pressure, serum total cholesterol, serum HDL cholesterol and serum triglycerides were measured. In 2009 “The Oslo Health and Environment study” will send a questionnaire to the population invited to HUBRO that lives in Oslo in 2009 ( $N = 28,000$ ). This follow-up study will collect information on noise annoyance, noise sensitivity, sleep disturbances and bedroom orientation along with self-reported cardiovascular diseases, symptoms and potential confounders. The data will be linked to different health registries including the Death registry of Norway.

Transport-related noise will be assessed for each participant's home addresses during 1992–2006. The noise indicator  $L_{\text{den}}$  (day-evening-night) will be calculated outside the most exposed façade and  $L_{\text{night}}$  will be assessed outside the bedroom façade of each house using a Geographical Information System model.  $\text{NO}_2$  will be assessed using the EPISODE dispersion model for the same addresses and time period.

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#### ISEE-0730

##### Environmental Tobacco Smoke, Active Smoking and Breast Cancer Risk: Synthesis of Current Evidence Implicates a Risk

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**Background and Objective:** Three authoritative reviews of active smoking and breast cancer have been published since the year 2000, but only considered data published up until 2002. They found suggestive but conflicting evidence, as has been the case historically. Since 2002, at least 40 more original epidemiologic studies have been published on smoking and breast cancer, including two major reports on ETS and breast cancer and at least six meta-analyses. The objective was to provide an up-to-date synthesis of the evidence regarding ETS, active smoking and breast cancer risk.

**Methods:** Assessment of the weight of evidence from epidemiologic studies, meta-analyses, toxicological studies and current understanding of biologic mechanisms.

**Results:** Among women who have never smoked, three meta-analyses have found increases of 60 to 70% for breast cancer risk among premenopausal/women under age 50 with regular, long-term exposure to ETS. Among smokers, recent studies, in particular several cohort studies, have added to the weight of evidence suggesting 10–30% increases in risk associated with higher pack-years of smoking, longer duration of smoking, smoking before first full-term pregnancy and early age of smoking commencement. Three recent meta-analyses have found 35% to 50% increases in breast cancer risk for long-term smokers with N-acetyltransferase 2 (NAT2) slow acetylation genotypes. The most recent and thorough of these analyses included pooling of individual data from 9 studies and an associated meta-analysis of 13 studies and identified relative risks among women with NAT2 slow acetylator genotype of 1.44 (95% CI 1.23–1.68) and 1.49 (95% CI 1.08–2.04), respectively, associated with the highest categories of pack-years of smoking.

**Conclusions:** Research published since 2002 has substantially strengthened the weight of evidence in support of an increased risk of breast cancer among women who smoke and increased risk for long-term exposure to ETS among never-smokers.

#### ISEE-0732

##### Association of Consumption Frequency of Different Food Items with Food Allergy among 7–11 Year Old Children in Hungary

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**Background and Objective:** In Hungary, parent-completed environmental health questionnaire surveys were made from 1995 to 2002 in 29 towns and more than 80 villages among 7–11 year old children. The goal of this analysis was to assess the association of consumption frequency of different food items with food allergy in this age group.

**Methods:** Logistic regression analysis was used by STATA 9.02, adjusted to gender, age, settlement, breast feeding, mother's education, serious lower respiratory tract disease in age of 0–2 years, parents' allergic disease and dampness/mould in the flat.

**Results:** Consumption of bakery products with soy was associated with higher prevalence of food allergy (OR = 1.32, 95% CI = 1.02–1.73), as well as that of brown/rye bread (OR = 1.54, 95% CI = 1.20–1.99), while the consumption of white bread was associated with decreased prevalence (OR = 0.47, 95% CI = 0.32–0.70). Consumption of cow milk was apparently associated protectively with food allergy (OR = 0.25; 95% CI = 0.16–0.40). The most probable explanation of this phenomenon is that milk allergic children do not drink milk. Fruit consumption was associated protectively with food allergy also (OR = 0.34, 95% CI = 0.15–0.76); however, the above explanation can not be excluded, either. The cause of higher food allergy prevalence attributed to consumption of vitamins and/or trace elements (OR = 1.50, 95% CI = 1.11–2.02) can be confounding with respiratory diseases.

**Conclusion:** Consumption of bakery products with soy, of brown/rye bread and of vitamins had associations with harmful effect on food allergy, while consumption of white bread, cow milk and fruit had associations with protective effect on it. However, the explanation of these phenomena is not entirely clear. Moreover, cross-sectional studies are not expected to prove causal relationships. Further investigations have to answer these questions.

#### ISEE-0733

##### The Effects of Components of Fine Particulate Matters on Hospitalization in Seoul, Korea, 2003–2006

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**Background and Objective:** The importance of particle matter (PM) among air pollutants is recognised and the health consequences of PM exposure have been proven to be more serious because of the changes in the constituents of air pollutants. However, there are few evaluation studies on health effects of PM<sub>2.5</sub> using the fraction of each constituent of PM<sub>2.5</sub>. In this study we investigate the association of various constituents of PM<sub>2.5</sub> with hospital admissions for cardiovascular diseases in Seoul, Korea from 2003 to 2006.

**Methods:** The association between constituents of PM<sub>2.5</sub> and hospital admissions for cardiovascular diseases was analyzed by season, gender, and age using a generalized linear model with natural cubic splines. Separate models were applied stratified by gender and age.

**Result:** PM<sub>2.5</sub> mass and several components were associated with hospitalizations for cardiovascular diseases. For example, for a 3-day lag, rate of hospitalization for cardiovascular disease increased by 1.98% (95% Confidence Interval: 1.00, 2.97), 1.72% (0.79, 2.67), 2.88% (1.70, 4.07),

1.17% (0.36, 2.00), and 1.06% (0.40, 1.73) for PM<sub>2.5</sub>, EC, OC, NO<sub>3</sub>, and SO<sub>4</sub> by inter-quartile range, respectively. We also found effects were modified by gender and age, and the effects were greater in winter seasons.

**Conclusion:** This study provides evidence that the effects of PM<sub>2.5</sub> on hospitalization for cardiovascular disease vary by constituents of PM<sub>2.5</sub> and season, increasing during the winter seasons.

#### ISEE-0740

##### Long-Term Breastfeeding and Neurodevelopment at 14 Months: Which Factors Could Explain This Relationship?

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**Background and Objective:** Although breastfeeding increases organochlorine transfer to infants, it has been found to be beneficial for the neurodevelopment of the child. Several mechanisms have been proposed to explain these benefits. This study aims to assess the role of three possible mediators: long-chain polyunsaturated fatty acids (LC-PUFAs) levels in colostrum, mother-child attachment, and maternal factors such as intelligence quotient (IQ), education level, and social class in the link between breastfeeding and children's neurodevelopment at 14 months.

**Methods:** In the Spanish INMA (Environment and Childhood)-Sabadell birth cohort, 657 women were recruited during the 1st trimester of pregnancy. At 14 months, mental and psychomotor development with Bayley Scales of Infant Development was assessed in 561 children, as well as mother-child attachment and maternal IQ. Full breastfeeding was defined as exclusive breastfeeding in addition to infrequent feeds of water or juice. Information about maternal education level and social class were obtained by questionnaire. Maternal organochlorine levels during the 1st trimester of pregnancy were measured by GC-MS and LC-PUFAs in 352 colostrum samples by fast gas chromatography. Multivariable linear regression models were performed.

**Results:** Only very long-term full breastfeeding (> 6 months) was associated with higher infant mental score (6.44 points, 95% confidence interval 1.79–11.08). At smaller durations there was no trend. No relationship was found with psychomotor development scores, although  $\alpha$ -linolenic/linoleic acid ratio, maternal education, IQ, and social class were associated with mental development scores ( $P$ -value < 0.02). Adjustment for these variables did not confound the association between long-term full breastfeeding and mental development score. Mother-child attachment score and maternal organochlorine levels were not associated with development scores.

**Conclusion:** Both the lack of any association for breastfeeding less than 6 months and the lack of any confounding in the effect of long breastfeeders suggest that non measured social or environmental variables may explain higher mental development among very long breastfeeders rather than breastfeeding itself.

#### ISEE-0741

##### GSTM1 Modify the Effect of Cord Blood Cotinine on Neurodevelopment at Three Days of Age

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**Background and Objective:** Maternal exposure to environmental tobacco smoke (ETS) has been reported to be associated with children's neuro-behavioral development but there have been few studies investigating the genetic susceptibilities to maternal ETS exposure during pregnancy on children's neurodevelopment. The potential health effects are still unclear. The aim of this study was to explore the modification effect of metabolic gene polymorphisms and cord blood cotinine levels on children's neurodevelopment at three days of age.

**Methods:** The study population was 117 mother-infant pairs who gave birth in Taiwan between August 2004 and January 2005 from Taiwan Birth Panel Study. We interviewed them using a structured questionnaire before delivery, collected umbilical cord blood at birth, and performed the Neonatal Neurobehavioral Examination-Chinese Version (NNE-C) after birth within three days. The NNE-C scale consisted of three parts: behavioral responses, tone and motor patterns, primitive reflexes, and each part contains nine items to test by trained physical therapists. The higher the score is, the poorer the child's performance. The cotinine in cord blood was used as an indicator of environmental tobacco smoke and was analyzed by using HPLC-MS/MS. The detection limit of this method was 0.05 ng/mL. CYP1A1 MspI, CYP1A1 Ile462Val, GSTT1 and GSTM1 were identified from infant's DNA. Multiple linear regression models were used to explore the effect of ETS exposure and gene interaction on early child neurodevelopment.

**Results:** High cord blood cotinine exposure combined with a GSTM1 polymorphism was associated with a negative NNE-C score ( $b \pm SE = -1.14 \pm 0.47$ ,  $P$ -value = 0.016) and a negative primitive reflexes score ( $b \pm SE = -1.97 \pm 0.87$ ,  $P$ -value = 0.025).

**Conclusion:** It can be concluded that the GSTM1 metabolic gene can modify the effect of maternal exposure to ETS on early child neurodevelopment.

#### ISEE-0743

##### Effect of Personal Exposure to Indoor Air Pollution from Solid Fuel on Lung Symptoms and Function in Women: An Exposure-Response Analysis from the Guatemala Woodstove Randomised Control Trial

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**Background and Objective:** Indoor air pollution (IAP) from solid fuel has been linked to 1.5 million deaths annually; in adults primarily due to chronic obstructive pulmonary disease and lung cancer. To investigate the exposure-response relationship between IAP and lung disease in adult women, data from RESPIRE Guatemala for personal CO exposure, lung symptoms and function were analysed over 18 months.

**Methods:** Women recruited to RESPIRE ( $n = 504$ ) were randomised to receive an improved stove (intervention) or carry on using open fire (control). Follow up at 6, 12 and 18 months took measurements of lung symptoms (questionnaire), lung function (spirometry: FEV1, FVC and FEV1/FVC ratio) and CO (exhaled breath). Also 48 hour personal CO was assessed using passive diffusion tubes and information was collected on environment, demographic and biological characteristics and behaviour. Random effects regression, adjusting for covariates and time, was used for the analysis of CO (breath and tubes-In transformed) on lung symptoms and function.

**Results:** Following adjustment, lnCO (breath) increased the risk of phlegm (OR = 2.02; 95%CI = 0.78, 5.26), chronic phlegm (OR = 2.24; 95%CI = 0.61, 8.17), cough and phlegm (OR = 2.36; 95%CI = 0.82, 6.84) and chronic cough and chronic phlegm (OR = 2.26; 95%CI = 0.49,

10.47), although none achieved statistical significance. However, a significant decrease in FEV1 was found with increasing lnCO (breath): -39 mls (95% CI = -11 mls to -65 mls). No relationship was found between CO (tube) and lung symptoms and function.

**Conclusion:** The effect on FEV1 of 1 unit decrease in lnCO (equivalent to exposure reduction delivered by the intervention) is consistent with smoking reduction literature. Large within- relative to between-person variation makes characterising exposure in epidemiology demanding. Of the two measures, CO (breath) provided the strongest association with lung function decline; this is likely to reflect a mixture of short and longer term variation in exposure and lung function.

#### ISEE-0745

##### Effect of In Utero Exposure to Manganese on the Birth Outcome

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**Background:** Manganese (Mn) is a naturally occurring element, and low levels of Mn in water, food, and air are ubiquitous. The research objective was to find causal relationship between prenatal exposure Mn level and birth to babies' birth outcome (height, weight, biparietal circumference, period of gestation). Our objective was to compare birth outcome as independent predictors of Mn level in mothers.

**Methods:** We recruited 177 pregnant women (whole blood manganese in material) and their infants who were born at 37–43 weeks of gestation from birth cohort (Mothers and Children's Environmental Health, MOCEH). The relationship between maternal blood Mn level and birth outcome was evaluated with linear multivariate regression. To test the overall effect of maternal exposure to Mn during pregnancy and birth outcome data, we used the SPSS (14.0, SPSS Inc.) general linear model.

**Results:** After except for prematurity (< 37 weeks), a total of 130 mother-infant pairs completed this portion of the study. After adjustment for confounder of infant birth outcome, including maternal age, education and marital status, dinking, environmental tobacco smoke (ETS), parity and infant gender. Mn levels in blood were significantly and inversely associated with the birth outcome data.

**Conclusion:** Prenatal manganese levels constitute an independent risk factor for impaired in infants' birth outcome status. Prenatal manganese exposure has an adverse effect on birth outcome. These results suggest the need to study further early captured by measuring prenatal Mn exposure and established health guidelines for prenatal Mn exposure criteria.

#### ISEE-0747

##### Prevalence of Blood Diseases in the Estuary of Santos, Brazil

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**Background and Objective:** The Estuary of Santos, in São Paulo State, is one of the most polluted areas in Brazil. Tons of environmental contaminants like toxic metals, organochlorine compounds, dioxins and furans, among others substances have been released in the environment in a densely populated area. We estimated and compared the prevalence of blood diseases in exposed and non-exposed populations to environmental contaminants in the region of Santos Estuary.

**Methods:** We adopted a cross sectional study. Estimates of contamination in the Estuary region were done by the São Paulo State Environmental Agency. A structured and pre-tested questionnaire was applied to 820 families in each one of the five studied areas: four of them in the Estuary region and one in a control area without evidences of environmental contamination but with the same socioeconomic profile of the contaminated ones. We estimated the proportion of blood diseases (ICD 10: C91–C95; D50–D77), in those areas and tested differences among them and between the whole contaminated area and the control area using the test for comparing two proportions and adopting a significance level of 5%. This study is part of a major study carried out to identify both exposure and effects indicators of diseases related to the contaminants observed in the Estuary Region.

**Results:** The prevalence of blood diseases was higher among residents of Estuary region (11.0%) when compared to the control area (6.5%) and the difference was statistically significant ( $P = 0.000$ ). When families with previous occupational exposure to any contaminant were excluded from the analysis the prevalence among Estuary inhabitants (9.0%) remained higher than among the controls (6.1%) ( $P = 0.000$ ). Also, the prevalences of blood diseases differ among contaminated areas.

**Conclusion:** Living in an environmental contaminated area by industrial residuals increases the risk of blood diseases.

#### ISEE-0748

##### Adverse Health Effect of Radiofrequency Exposures from Weather Radar System

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**Background and Objective:** The health effect of radiofrequency has been a public concern for years. To improve the quality of data, the Center Weather Bureau set up four Doppler radar stations in Taiwan. In order to assess the health effects of radiofrequency exposures from weather radar system, we conducted this study to evaluate the associations between weather radar system and the mortality of the residents living in the two areas (Areas I and II) where the radar stations are located.

**Methods:** The all-cause mortality of residents near the radar stations was studied over the period 1997–2006. We compared the data between five years before and five years after the weather radar system was established. For comparing the mortality rates between the periods, we calculated the standardized mortality ratios (SMRs) using the mortality observed in the five-year period before the establishment of the radar station as the reference.

**Results:** The SMR of the over-all mortality was 0.94 in Area I, 0.88 in Area II, and 0.89 in Taiwan as a whole. The SMR of all malignant neoplasma mortality combined was 1.05 in Area I, 0.97 in Area II, and 0.98 in Taiwan. The SMR of all leukemia mortality combined was 1.61 in Area I, 1.21 in Area II, and 0.99 in Taiwan. The death rates of leukemia in residents in the exposure areas increased in the recent five years.

**Conclusion:** During a 10-year period of observation, we found mild increase in the mortality of leukemia in residents living in areas with radar station. However, in order to take the latent period of cancer into account, further follow-up is needed. In addition, the correlations between

the mortality of leukemia and distance from the radar stations should be evaluated using further subdivisions of unit population, such as a village.

#### ISEE-0750

##### PAISARC (+) Project: Atmospheric Pollution, Social Inequalities, Asthma and Cardiac Risk: Influence of Neighbourhood Context

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**Background and Objective:** We previously carried out 2 studies where ambient air pollution was modelled on an hourly basis for 5 years in our study area, the Greater Strasbourg (France). Results were used in case-crossover analyses of the relationship between ambient air pollution levels and the risk of asthma exacerbation on the one hand and the onset of myocardial infarction on the other, at a very small scale ecological basis, taking into account population deprivation strata built on a locally-validated deprivation index. However, a host of recent literature shows the importance of taking into account neighbourhood effects when assessing these complex relations. We underwent re-examination of our risk estimates taking into account the neighbourhood effects.

**Methods:** We retrieved data on factors that may be relevant in assessing the influence of neighbourhood in relation with asthma exacerbation and myocardial infarction onset. These factors were census data (including various social variables such as being born abroad, house density), income, social allowances, distance to health care providers, public transportation network or retail outlets, noise, local violence, proximity to sport facilities, parks and other neighbourhood physical characteristics. Those data were mapped using ArcGIS. We desegregated area variables, such as provided by the national 1999 census available statistical unit.

**Results:** We superimposed the different GIS layers and constructed maps, allowing a first examination of possibly i) redundant information on a graphical basis, therefore guiding further analyses for building the most parsimonious model of neighbourhood influences, and ii) providing a basis to choose the best trade-off with regards to grid cell size.

**Conclusion:** This work will ground the construction of new spatial indicators of deprivation, taking into account spatial autocorrelation, including neighbourhood influences, that will be used for the reanalyses of previously produced risk estimates.

#### ISEE-0753

##### Longitudinal Measures of PCBs and Thymus Size in Infants

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**Background and Objectives:** Polychlorinated biphenyls (PCBs) are widespread environmental pollutants, despite having been banned for more than 20 years. Animal studies of PCB toxicity have demonstrated their immunotoxic effects, which include thymic atrophy and suppressed immune responses. We examined the association between pre- and postnatal PCB exposures and the estimated thymus volume in infants from eastern Slovakia, a highly contaminated region, at birth, 6 and 16 months of age.

**Methods:** Women were enrolled at delivery and blood samples were collected at this time and from the child at around 6 and 16 months of age for analysis of 15 PCB congeners and selected pesticides. Through

interviews we obtained socio-demographic characteristics, lifestyle factors, and breastfeeding duration; we abstracted medical records for delivery variables and child's growth. Thymus volume was calculated using ultrasound measurements of maximal transverse diameter (width) and largest sagittal area (length) at birth and again at approximately 6 and 16 months. The association between natural log thymus volume and natural log PCB (summed) concentration was estimated using linear regression, adjusted for potential confounders.

**Results:** Thymus volume increases from birth to 6 months, peaks a few months later, and then declines. Higher PCB exposure was accompanied by smaller thymus volume, with the greatest reduction at the 6 month visit [24.3% for PCB increment from 10th to 90th percentile] and slightly smaller reductions at delivery [8.5%] and at 16 months [14.6%]. Male and Romani infants had significantly greater thymic size [10.6% and 3.1% respectively], and child's weight was the strongest predictor of thymic volume. Alcohol and smoking resulted in reduced thymic volume of 3.3% and 2.9%, respectively.

**Conclusions:** The association of prenatal and early postnatal PCB exposure with reduced thymic size to at least the 16th month of age may reflect and/or result in impaired immunologic development.

#### ISEE-0756

##### GIS-Based Exposure to Traffic-Related Air Pollution During Pregnancy and Neurodevelopment at 14 Months

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**Background and Objective:** Air pollution effects on children's neurodevelopment have recently been assessed. However, these studies are based on small samples. Our study aims to assess the effects of traffic-related air pollution exposure during pregnancy in children's neurodevelopment at 14 months.

**Methods:** In the Spanish INMA (Environment and Childhood)-Sabadell birth cohort, 657 women were recruited during the 1st trimester of pregnancy. NO<sub>2</sub> and benzene, toluene, ethylbenzene, m, p-xylene and o-xylene (BTEX) were measured at 57 sampling sites with passive samplers between April 2005 and March 2006. Land-use regression (LUR) models were developed for each pollutant using geographic data as predictor variables and then applied to predict outdoor air pollution levels at each cohort address. LUR estimates were temporally-adjusted using daily levels of NO<sub>2</sub> measured at a fixed monitor. For 520 pregnant women we obtained 9-month average exposures as well as trimester specific exposures for each pollutant. Information on parental socio-demographic characteristics, occupational history, and life-style was obtained by questionnaire. At 14 months, mental and psychomotor development with Bayley Scales of Infant Development was assessed. Multivariable linear regression models were performed.

**Results:** Exposure during pregnancy ranged from 17.6 to 66.7 µg/m<sup>3</sup> for NO<sub>2</sub> and from 3.0 to 29.5 µg/m<sup>3</sup> for BTEX. Among the different periods of exposure, exposure of both pollutants only during the 3rd trimester of pregnancy showed a negative association with mental development score, although not statistically significant ( $\beta = -0.24$ , 95% confidence interval: -1.49, 0.97 and  $\beta = -0.37$ , 95% confidence interval: -2.42, 1.69 for each increase in 10 µg/m<sup>3</sup> of NO<sub>2</sub> and BTEX, respectively).

**Conclusion:** We did not find an effect of exposure to NO<sub>2</sub> and BTEX during pregnancy on children's neurodevelopment at 14 months. This lack of significant findings at an early age suggests that prenatal exposure to air pollution could have undetectable effects when general cognition is starting to be conformed.

#### ISEE-0757

##### German Surveys on Environment and Health for Children Provides Data for Training Programs on Environmental Health for Health Care Providers

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**Background and Objective:** The development of an environment-related health surveillance system is a main achievement of the German National Environmental Health Action Program (NEHAP). This system includes the German Environmental Survey for Children (GerES IV) that is performed in co-operation with the German Health Survey for Children and Adolescents (KiGGS) conducted by the Robert Koch-Institute 2003–2006. The GerES IV provides a set of profound data on the environmental exposure of children in Germany, whether the Health Survey take the focus on allergies, obesity etc. These representative data may support the implementation of projects in the field of environmental health.

**Methods:** We report on the implementation of an upgrade course "prevention for children and youth" for nurses and medical assistants working in offices and clinics with the focus on E & H and its linking to the results of the surveys.

**Results:** The training program increases pre-existing knowledge, which includes the field of:

- methods and didactics
- interaction between children, adolescents and their families
- the preventive medicine and the environmental health medicine
- coordination and organisation of preventive medicine in the clinic

Our curriculum of 84 h is now official certified by the Federal Medical Association, with more than 400 participants since 2003 until now.

**Conclusion:** The paediatric clinic is an important setting for health promotion, because in Germany regular of the preventive medical checkups for children are well accepted and offer a unique opportunity to reach over 90% of all children.

Regular evaluation during and after the courses, which were conducted by the members of the German Network for Children's Health and Environment, prove the high quality of this curriculum.

#### ISEE-0758

##### Acute Platelet Responses to Ambient Particulate Matter

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**Background and Objective:** Increases in ambient particulate air pollution (PM) have been associated with acute cardiovascular events over the following few hours and days in epidemiologic studies. Within 1–2 hours of intratracheal instillation of ultrafine PM, acute prothrombotic changes indicative of platelet activation have been corroborated in rodent models. We hypothesized that inhalation of ambient fine PM (PM<sub>2.5</sub>) leads to increases in platelet activation over the next few hours and days.

**Methods:** We measured blood platelet surface activation markers in 37 healthy human subjects during 1–3 clinic visits per subject, 1 week apart (n = 85 measurements). Specific monoclonal antibodies (PAC1, CD62p, CD42b, and CD36) and flow cytometry were used to determine the mean fluorescence (MF) of each of four platelet surface markers. Using mixed regression models, we estimated the change in MF of each platelet marker



associated with ambient PM<sub>2.5</sub> concentration in the previous 24 hours, as well as moving averages out to 144 hours.

**Results:** Each 7.56  $\mu\text{g}/\text{m}^3$  increase in PM<sub>2.5</sub> concentration in the 24 hours before the clinic visit was associated with a significant 0.34 unit (95% CI = 0.00, 0.68) increase in PAC1 and 2.45 unit (95% CI = 0.16, 4.75) increase in CD42b, with similar size changes related to PM<sub>2.5</sub> over the previous 48 hours. Estimated PAC1 and CD42b changes for the longer moving averages were smaller and non-significant. Nonwhites had an approximately 50% greater PAC1 change than whites, but there was no difference by gender. We observed no association between CD62p or CD36 and PM<sub>2.5</sub>.

**Conclusion:** These data suggest an acute platelet response to increases in ambient PM<sub>2.5</sub> concentration. Further analyses will examine effect modification by specific genetic factors and specific periods of the day (e.g. rush hour), and examine whether PM<sub>2.5</sub> effects are more acute than 24 hours.

#### ISEE-0765

##### Health Status of 8–10 Year Old Children and the Arsenic Content of the Drinking Water

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**Introduction:** According to recently published data, respiratory morbidity of a population chronically exposed to arsenic was found to be significantly higher than that without arsenic exposure. In order to study this association in Hungary, we used reconstructed data on arsenic content of the drinking water in 4 counties of Hungary developed in the frame of the EU-funded arsenic epidemiological (ASHRAM) study and the data of the country-wide respiratory survey among 8–10 year old children (OGYELF).

**Methods:** Settlements supplied with drinking water with arsenic content over 30  $\mu\text{g}/\text{l}$  (exposed settlements) and below 3  $\mu\text{g}/\text{l}$  (control settlements) were selected from the ASHRAM database. Data on the health status of the children living in these settlements were taken from the OGYELF database based on parent-completed questionnaires on respiratory, allergic and psycho-somatic symptoms. Associations between these two groups of settlements were evaluated by chi-square and Mann-Whitney tests and logistic regression.

**Results:** The mean birth weight of the children living in the exposed settlements was found to be significantly lower than those in the control group. There was an increased prevalence of chronic bronchitic symptoms, ear ache, food allergy and attention deficit in the exposed settlements compared to the control ones.

**Conclusions:** Chronic arsenic exposure may be associated with several adverse health effects other than cancer but further studies are needed to understand the mechanism of their development.

#### ISEE-0766

##### Modelling Salmonella Numbers in Irish Raw Pork Sausages During Transport and Home Refrigeration

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**Background and Objective:** A consumer risk assessment model of *Salmonella* spp. associated with Irish raw pork sausages is under development. This preliminary work aimed to estimate the *Salmonella* levels in raw pork sausages after transport and home refrigeration.

**Methods:** The initial level of *Salmonella* in retail raw pork sausages for contaminated packs was modelled using Irish survey data (expected value 1.80 log CFU/g; 95% CI 1.17–2.30 log CFU/g). For the entire duration of transport, the temperature profile of the centre of a sausage pack against time was modelled using transient heat transfer equations. In parallel,

experiments were conducted to capture the natural temperature oscillations of the centre of a sausage pack stored up to 7 days in a number of domestic fridges. For the refrigeration module, a simulated temperature profile was obtained in two stages: a brief temperature adjustment stage modelled by heat transfer equations until approaching equilibrium, and a randomly-sampled temperature oscillation period from the experiment above until the completion of the total refrigeration time. The Baranyi's primary growth model was then applied in conjunction with a secondary square-root model to predict the *Salmonella* levels under the fluctuating temperatures during transport and refrigeration.

**Results and Conclusion:** The results of the simulation model (5000 iterations) showed that, while *Salmonella* levels of raw pork sausages do not increase significantly during transport and home storage (expected value 1.83 log CFU/g; 95% CI 1.23–2.71 log CFU/g), the probability of finding hazardous *Salmonella* levels above 5 log CFU/g from contaminated sausage packs is ~0.38%. Sensitivity analysis showed that, for the Irish conditions, the *Salmonella* levels in raw sausages are more affected by storage time ( $R = 0.43$ ) than by average temperature ( $R = 0.17$ ). Work is still underway for the cooking and dose-response stages of this risk assessment.

#### ISEE-0783

##### Cumulative Bone Lead Exposure, Length of Gestation, and Risk of Prematurity

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**Objectives:** Premature birth constitutes a significant public health issue worldwide and findings on the role of environmental toxicants, including lead exposure, in the complex etiology of this adverse birth outcome are inconsistent. It has been shown that lead can persist in bone for many years after exposure, serving as an endogenous source of exposure for the developing fetus. We assessed the effect of cumulative bone lead exposure on gestational age and risk of premature delivery.

**Methods:** Tibia and patella bone lead measurements were obtained 1 month post-partum by K-X-ray fluorescence from 1393 pregnant women recruited in Mexico City from three different birth cohorts between 1994–2001. Data were analyzed using linear and logistic regression adjusting for maternal age, maternal education, history of adverse birth outcome, maternal cigarette smoking during pregnancy, infant gender, birth cohort, and number of prior pregnancies, in order to examine the associations of tibia and patella bone lead exposure, gestational age (days) and risk of premature delivery (< 37 weeks gestation).

**Results:** Of the 1393 eligible participants, there were 93 (6.7%) preterm deliveries. An increase of 10  $\mu\text{g}/\text{g}$  in either tibia or patella bone lead did not result in a significant association with gestational age, after controlling for covariates of interest, decline in gestational age of  $-0.14$  days (95%CI  $-0.50, 0.70$ ), and  $-0.12$  days (95%CI  $-0.60, 0.40$ ), respectively. In adjusted logistic regression models, highest quartile of tibia and patella bone lead resulted in a 1.19 (95%CI 0.51, 2.75) and 1.23 (95%CI 0.62, 2.46) increased odds of delivering prematurely when compared to the lowest quartile of tibia and patella bone lead, respectively.

**Conclusion:** Results and limitations of our study will be discussed more in depth, but initial findings indicate that cumulative tibia and patella bone lead levels do not significantly impact length of gestation or risk of premature delivery.

## ISEE-0785

**Prevalence of Liver Diseases in the Estuary of Santos, Brazil**

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**Background and Objective:** Since 1950, tons of environmental contaminants like toxic metals, organochlorine compounds, dioxins and furans, among others substances have been released in the Estuary of Santos, in São Paulo State, a densely populated area. We estimated and compared the prevalence of liver diseases in exposed and non-exposed populations to environmental contaminants in the region of Santos Estuary.

**Methods:** We adopted a cross sectional study. Estimates of contamination in the Estuary region were provided by the São Paulo State Environmental Agency. A structured and pre-tested questionnaire was applied to 820 families in each one of the five studied areas: four of them in the Estuary region and one in a control area without evidences of environmental contamination but with the same socioeconomic profile of the contaminated ones. We estimated the proportion of liver diseases (ICD 10: B15-B19; C22-C24; K00-K93), in those areas and tested differences among them and between the whole contaminated area and the control area using the test for comparing two proportions and adopting a significance level of 5%. This study is part of a major study carried out to identify both exposure and effects indicators of diseases related to the contaminants observed in the Estuary Region.

**Results:** The prevalence of liver diseases was higher among residents of Estuary region (6.5%) when compared to the control area (4.9%) and the difference was statistically significant ( $P = 0.001$ ). When families with previous occupational exposure to any contaminant were excluded from the analysis the prevalence among Estuary inhabitants (6.8%) remained higher than among the controls (3.0%) ( $P = 0.000$ ). The highest prevalence was observed in the community living nearby the Pilões landfill, an irregular deposition site of industrial waste.

**Conclusion:** Living in an environmental contaminated area by industrial residuals increases the risk of liver diseases.

## ISEE-0786

**Leukemia and Proximity of Residence to Electric Power Lines in Sao Paulo City**

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**Background and Objective:** The association between extremely low-frequency electromagnetic fields and increased risk of childhood leukemia has been studied, although the findings were not consistent in establishing a relationship between cause and effect. The aim of this study was to investigate the relationship between reported cases of leukemia at the age from 0 to 19 years old and residence proximity to power lines in the city of Sao Paulo, between the years of 1997 and 2004.

**Methods:** For this purpose, the leukemia childhood cases registered in the Cancer Register Population Base of Sao Paulo City (RCBP-SP) were geocoded by residence address. Utilizing the 2000 Brazilian census demographic bases and the electric power lines geographical layers, it was possible to calculate leukemia incidence according to the distance to electric power lines. Geographical Information Systems (GIS—Maptitude 4.6) resources were used.

**Results:** The results demonstrated that childhood leukemia cases, registered in the RCBP-SP from 1997 to 2004 in Sao Paulo City, have geographical homogeneous distribution. However, the highest incidence value occurred inside 200 m. of distance from the electric power lines (22.46/100,000 inhab.), when compared with 400 m. (14.97/100,000 inhab.), 600 m. (16.08/100,000 inhab.), 800 m. (21.17/100,000 inhab.) and 1000 m. (20.07/100,000 inhab.), and also when compared to the media of the city (19.34/100,000 inhab.).

**Conclusions:** Although the present study is a descriptive analysis, the results suggest a relationship between the residence proximity to power lines and the incidence of childhood leukemia.

## ISEE-0790

**Associations Between Urban Sprawl and Body Mass Index in a Sample of Older Women in the United States**

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**Background and Objective:** There is increasing evidence that urban sprawl affects certain health outcomes and health related behaviors. More dense neighborhoods may be more walkable, leading to increased physical activity among residents and a reduced risk of overweight and obesity. We examined the relationship between urban sprawl and body mass index (BMI) in a cohort of older women.

**Methods:** We conducted a cross-sectional analysis using data from the Nurses' Health study, a prospective cohort study of nurses in the United States. Individuals' health information was obtained from questionnaires mailed in 2000. Sprawl was assessed using a county level sprawl index developed by Smart Growth America and linked to participants using their residential mailing address. Based on 2000 US Census data, this index incorporates several measures of population density and block size to indicate degree of sprawl. Data were obtained for 78,767 nurses (ages 53 to 81 years) living in 809 counties. To account for correlation between participants living in the same county, we examined the association between county level sprawl and BMI using multilevel modeling.

**Results:** Controlling for age, race, and smoking, a one-standard deviation decrease in sprawl was associated with an average decrease in BMI of 0.10 (95% CI  $-0.16$  to  $-0.04$ ). In a sub-sample of 66,253 nurses who filled out a food frequency questionnaire in 1998, we additionally adjusted for total caloric intake and found that a one-standard deviation decrease in sprawl was associated with an average decrease in BMI of 0.11 (95% CI  $-0.17$  to  $-0.05$ ).

**Conclusion:** These findings demonstrate that more compact urban form is associated with lower BMI in older women, even after adjustment for potential confounders including caloric intake. These findings suggest that land use policies may play an important role in population-based approaches to preventing and controlling obesity among older adults.

## ISEE-0793

**Effects of Industrial Emissions on Cardiovascular and Respiratory Markers of Asthmatic Children in Montreal, Canada**

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**Background and Objective:** Air pollution can cause exacerbations of asthma and adversely affect lung function, however, relatively little is known about the effects of specific pollutants and emission sources, including industrial point sources. We are carrying out a study in Montreal, Canada, to determine the effects of living close to an oil refinery and other industrial sources of pollutants on pulmonary and cardiovascular function of asthmatic children.

**Methods:** This panel study will enroll 120 asthmatic children living in close proximity to an oil refinery as well as other industrial sources of pollution. Over six separate 10-day periods, panels of up to 20 children will undergo daily tests of lung and cardiovascular markers: spirometry; exhaled nitric oxide (eNO); blood pressure and pulse oximetry. Exhaled breath condensate will also be measured using RTubeTM and analyzed for markers of inflammation and oxidative stress (specifically TBARS, 8-isoprostane, and interleukin-6). Exhaled nitric oxide will be measured by Portable NIOX MINO eNO analyzer from Aerocrine and spirometry will be measured by KoKo Spirometers. Daily concentrations of SO<sub>2</sub>, NO<sub>2</sub>, PM<sub>2.5</sub>, volatile organic compounds (VOC), polycyclic aromatic hydrocarbons (PAH), and ozone will be measured by means of outdoor monitoring at four locations surrounding the refinery. Participants will be asked to carry with them a small backpack that measures 24-hour integrated samples of SO<sub>2</sub>, NO<sub>2</sub>, PAH, and VOCs. Real-time PM<sub>2.5</sub> will also be measured, as well as vanadium and nickel as markers for emissions from the oil refinery. Proximity of home and school to point sources will also be evaluated.

**Results:** The effect of various air pollutants on lung and cardiovascular markers will be estimated using linear mixed-effects models, adjusted for salient risk factors.

**Conclusion:** This is the first study among asthmatic children to provide detailed longitudinal information on variations in health arising from personal exposures to emissions from oil refineries, other industrial sources, and traffic. Data collection begins in summer 2009.

## ISEE-0795

**Exposure Assessment to Cronobacter Sakazakii in Powder Infant Formula in Ireland**

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**Background and Objective:** *C. sakazakii* represents a significant risk to the health of neonates. Although, the organism natural habitat is currently unknown, powder infant formula (PIF) has been identified as a source and vehicle of neonatal infection. The objective of this study is to consider some statistical aspects, as the probability of accepting and rejecting a lot, considering two surveys carried out in Ireland to detect the contamination of *C. sakazakii* in PIF.

**Methods:** The assumptions and the method used to calculate the probability of accepting or rejecting a lot are the ones adopted by WHO risk assessment model for Enterobacter sakazakii in powder infant formula (<http://www.mramodels.org/esakmodel/ESAKRAModelWizard.aspx>).

Calculation of rejection rates requires the mean log concentration of *C. sakazakii* across all lots of PIF (cfu/g), which is estimated from  $C = \ln [1 - P > 0]/S$  where  $C$  is the concentration (per gram),  $P > 0$  is the prevalence, and  $s$  is the samples size (grams). True prevalence is estimated (2.7 and 0.07%) from apparent prevalence using the Bayesian approach based on beta (0.5, 0.5) and assuming the microbiological

analyses without error, thus considering sensitivity and specificity equal to 1.

In this study lots are simulated using the Monte Carlo software @Risk and tested against the microbiological criteria established in the EC 2073/2005 (absence in 10 g, 30 samples per unit).

**Results:** The outputs obtained are the probabilities of accepting/rejecting a lot (rejection rate of 56% and 2% for the first and second survey respectively) and graphically are presented several rejection rates calculated assuming different values for the within and between lot variability.

**Conclusion:** As Ireland supplies 15% of PIF in the world, monitoring the contamination of the product using an appropriate sampling plan and the application of microbiological criteria represents an important first step in reducing the risk of contaminating PIF product.

## ISEE-0798

**Atherosclerosis-Related Genes, Low-Level Lead Exposure and Age-Related Hearing Loss: The Normative Aging Study**

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**Background and Objective:** Although age-related hearing loss (ARHL) is one of the leading chronic health conditions experienced by the older adults, little is known about the impact of environmental toxicants and gene-environment interaction. Our recent study has shown associations between cumulative low-level lead exposures and ARHL in a community-based cohort. However, underlying biological mechanisms are still unknown. This study examined whether those associations were modified by genes related to atherosclerosis, including apolipoprotein-E (APOE: rs7412, rs429358, rs405509, rs440446, rs449647, rs769446), lipoprotein lipase (LPL: rs268, rs328, rs1801177), nitric oxide synthase-3 (NOS3: rs1799983, rs1800779), and vascular endothelial growth factor A (VEGFA: rs2010963), given that atherosclerosis which leads to cochlea ischemia and therefore elevate the risk of ARHL may be attributed by lead exposure.

**Methods:** Bone lead levels, markers of cumulative lead exposure, were measured using K-x-ray fluorescence in 563 middle-aged and elderly men in the Normative Aging Study. Pure-tone audiometric examinations were conducted to measure air and bone conduction hearing thresholds. We calculated a pure-tone average (PTA) of thresholds at 500, 1000, 2000, and 4000 Hz.

**Results:** After controlling for potential confounders, an interquartile range increase in tibia lead (14 mg/g) was associated with a 1.7 (95% confidence interval (CI), 0.44, 2.9) dB increase in the air conduction PTA among persons with at least one copy of the minor allele in APOE rs449647, whereas no association was found among persons with homozygous major alleles (−0.85 dB, 95% CI, −2.2, 0.54;  $P$ -interaction = 0.005). We also found significant effect modification by APOE rs769446. No effect modification by LPL, NOS3 and VEGFA genetic polymorphisms was found. The results with patella lead and those in the bone conduction PTA were similar but less significant.

**Conclusion:** This study suggests that some SNPs in the promoter region of the APOE gene modify the chronic effects of lead on ARHL.

## ISEE-0799

**Fine Particle Exposures During an Episode of Long-Range Transported Aerosols from Open Biomass Burning**

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**Background and Objective:** Particle emissions from open biomass burning can lead to deterioration of air quality hundreds of kilometers away from the source area. Our aim was to evaluate fine particle exposures during such an air pollution episode among persons susceptible to the health effects of air pollution.

**Material and Methods:** Mass concentrations of fine particles (PM<sub>2.5</sub>; diameter <2.5 µm) were determined from filter samples collected at a central outdoor measurement site daily for 6 months in Kotka, Finland. Concurrently with the outdoor measurements, elderly persons with coronary heart disease carried biweekly personal PM<sub>2.5</sub> monitors for one day. Information on factors potentially affecting exposure was collected with a questionnaire. Similar sampling equipments (portable pumps operating at 4 l/min, PM<sub>2.5</sub> cyclones) were used for outdoor and personal measurements. Ionic composition of PM<sub>2.5</sub> was determined from samples collected with collocated virtual impactors.

**Results:** During spring 2006 a fine particle episode lasting 11 days was linked to wildfires in Western Russia based on ionic composition of the samples (high levoglucosan, potassium, and oxalate concentrations), backward trajectories, and satellite maps on fire areas. For 41 study subjects, one measurement day coincided with the episode, 1–11 measurements being conducted during the rest of the study period. Average PM<sub>2.5</sub> exposure during the episode was 22.1 µg/m<sup>3</sup>, and during the rest of the study period 6.6 µg/m<sup>3</sup>. The respective outdoor concentrations were 25.3 and 4.9 µg/m<sup>3</sup>. During an episode day, 9 out of 10 study participants kept their windows open (on average 8 hrs per day), whereas during non-episode days 7 out of 10 participants did the same (4 hrs).

**Conclusions:** Fine particles exposures can be several times higher than normally during episodes of long-range transported particles from open biomass burning. Susceptible population groups should be better informed about ventilation and other factors affecting personal exposure.

#### ISEE-0800

##### Variations in Peak Expiratory Flow Measurements Associated to Air Pollution and Allergic Sensitization in Children in São Paulo, Brazil

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**Background and Objective:** The health effects of air pollution range from lung function decrements to mortality. In the last 20 years, there has been an increase in the incidence of allergic respiratory diseases worldwide. Even though genetic factors play an important role, air pollution has been discussed as one of the factors responsible for this increase. The objective of this study was to investigate the effects of air pollution on peak expiratory flow of children who were sensitized and children who were not.

**Methods:** Ninety-six children (9 to 11 years old) were followed from April to July, 2004 with daily measurements of peak expiratory flow. Blood samples were collected for IgE and total blood count. Skin prick test was done using common allergens: mites (*Dermatophagoides pteronyssinus*, *Dermatophagoides farinae* e *Blomia tropicalis*), dog (*Canis familiaris*), cat (*Felis domesticus*), cockroach (*Periplaneta americana*) and fungus (*Aspergillus fumigatus*, *Alternaria alternata*, *Cladosporium herbarium*, *Chaetomium globosum*, *Mucor mucedo*, *Pullularia pullulans*, *Penicillium notatum*). Daily hourly concentrations of all criteria pollutants, temperature and relative humidity were available for the entire period. Analysis was performed with the generalized estimated equations (GEE).

**Results:** A decrease in peak flow measurements was found to be associated mainly with PM<sub>10</sub>, NO<sub>2</sub> and O<sub>3</sub>, considering different time lags (hours, previous day, moving average). The effects of the pollutants were not different between children with or without allergic sensitization.

**Conclusion:** Even though air pollution had a small effect on peak flow measurements (less than 1% decrease), children are exposed to this air on a daily basis and this exposure can lead to a chronic inflammatory process that might impair their lung function in adulthood. This study does not support previous findings of a different effect of air pollution on respiratory function of children with allergic sensitization.

#### ISEE-0801

##### Occupational Noise Levels and Change in Blood Pressure Among BC Firefighters

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**Background and Objectives:** Firefighters are exposed to elevated noise levels during work; it has been suggested that these levels are highly variable and daily averages are often below occupational limits. However, firefighters experience excessive hearing loss indicating that they may be at risk of non-auditory effects of noise, such as increased blood pressure (BP) and heart rate (HR) that may contribute to their cardiovascular risk. The aim of this study was to determine occupational noise levels experienced by firefighters in British Columbia (BC), and to evaluate the effect on BP and HR.

**Methods:** Firefighters were recruited from three large municipal fire departments in BC using a stratified sampling scheme. BP and HR were ascertained on one non-work-day and during work shift(s) using a PhysioLogic® datalogging wrist oscillometric BP monitor. Measurements were taken multiple times throughout the day/shift. Full-shift personal noise samples were taken using datalogging Bruel & Kjaer 4436 dosimeters/SLMs.

**Results:** 109 full-shift noise measurements were collected from 40 firefighters; average age 40.2 years (25–56 years) and with 7.4 years (0.25–18 years) of experience. The mean noise levels were significantly different between day-shifts (85.2 dBA) and night-shifts (78.5 dBA),  $P < 0.0001$ . Peak noise levels exceeded allowable limits in 29% of samples, no differences between shifts were observed. Baseline pre-hypertension and hypertension was measured among 53% and 26% of subjects respectively. Increased BP during shifts were observed in 69% of subjects. Weak positive correlations were found between noise exposure and change in systolic BP ( $r^2 = 7.6\%$ ,  $P = 0.45$ ), diastolic BP ( $r^2 = 4.0\%$ ,  $P = 0.69$ ), and HR ( $r^2 = 17.7\%$ ,  $P = 0.07$ ).

**Conclusions:** Firefighters experienced noise exposures that exceeded occupational limits in our sample, without adjustment for shift length. Our preliminary results indicate that HR may be a better marker for physiological response to noise than BP. Future analysis will model the association to account for confounders and repeated measures.

#### ISEE-0802

##### By-Products Associated with Structural Rehabilitation for Water Distribution Systems

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**Background and Objectives:** The rehabilitation of water distribution systems can be effected using a membrane impregnated with a thermosetting polymer. The objective of this study was to assess whether this process releases by-products in drinking water, especially bisphenol A diglycidyl ether (BADGE) and triethylenetetramine (TETA).

**Methods:** Water samples were collected at two sites on the network. At each site, 2 samples were obtained before the rehabilitation work, and 8 additional samples were collected over a period of 48 hours after water circulation was restored. Samples were collected from the tap in glass bottles after a purge of 5 minutes. The samples were stored at  $-20^{\circ}\text{C}$  and analyzed using liquid chromatography/time-of-flight mass spectrometry.

**Results:** Concentrations of BADGE and TETA in samples collected before rehabilitation were all below the limit of detection (LOD: 0.05 and 2  $\mu\text{g/L}$  respectively). Samples collected after water circulation was restored contained concentrations of BADGE ranging from 0.36 to 1.3  $\mu\text{g/L}$ . Additional samples collected 1 year later still contained detectable concentrations (0.29 and 0.32  $\mu\text{g/L}$ ). Concentrations of TETA were below the LOD in all samples.

**Conclusion:** The rehabilitation of the drinking water network with polymers may lead to the release of by-products in trace concentrations over a long period of time. Further analyses are needed to better understand the factors affecting their presence in drinking water.

#### ISEE-0803

##### **Infiltration of $\text{PM}_{2.5}$ into Homes in Toronto, Canada: Can Commonly Available Housing Characteristics Be Used to Improve Exposure Estimates?**

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**Background and Objective:** Epidemiological studies of outdoor air pollution continue to be impacted by errors in estimating personal exposure. Differences in the infiltration of outdoor pollution between homes and over time contribute to exposure errors, but very few epidemiologic studies have considered infiltration because it is not feasible to measure in large numbers of homes and published literature on modeling is still scarce. This study sought to estimate infiltration efficiencies of  $\text{PM}_{2.5}$  in detached residential homes in Toronto and identify housing characteristics that could be used to predict infiltration efficiencies.

**Methods:** Fine particulate matter was measured continuously indoors and outdoors for 5-days at 60 detached homes in Toronto, Canada, July through November 2006 and July 2007 using a Dust-Trak. After censoring indoor sources, an average infiltration rate for each home was estimated using a recursive mass balance model with  $\text{PM}_{2.5}$  hourly averages. Participating households completed questionnaires on home characteristics and house assessment values were obtained from the Municipal Property Assessment Corporation of Ontario. These variables were offered into linear regression models as predictors of infiltration efficiency.

**Results:** After removal of incomplete and invalid data, 30 homes (50%) remained for inclusion in analyses. Average infiltration rate was 64% (standard dev = 22%); it was higher in the non-heating season ( $67\% \pm 23\%$ ,  $n = 21$ ) than in the heating season ( $56\% \pm 15\%$ ,  $n = 9$ ), though the difference was not significant. Predictors of higher infiltration were older homes ( $R^2 = 16\%$ ) and higher air exchange rate ( $R^2 = 17\%$ ) ( $P < 0.05$ ). In the non-heating season, central air conditioning use also predicted lower infiltration ( $R^2 = 10\%$ ,  $P < 0.05$ ). Other housing characteristics, including house assessment value, were not significantly associated with infiltration rates.

**Conclusion:** Although it remains challenging to predict infiltration rates for individual homes, some easily attainable housing characteristics may allow for the prediction of infiltration in future epidemiological studies of air pollution.

#### ISEE-0804

##### **Increase in the Death Risk for Respiratory Diseases in Elderly People Associated with Air Pollution in Volta Redonda City, Rio de Janeiro State, Brazil**

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**Background and Objective:** For many years we have observed that fast technological advancement has brought an increase in the quantity and variety of pollutants in the atmosphere, which are affecting the quality of life on our planet. By virtue of the many roles that it plays, the respiratory system is particularly exposed to aggressive environments and is often the organ most affected by exposure to air pollutants. This study aimed to evaluate the effects of  $\text{PM}_{10}$  and  $\text{SO}_2$  on deaths from respiratory diseases among the elderly, by gender, in Volta Redonda city, Rio de Janeiro State, Brazil.

**Methods:** This ecological time-series study used data on daily deaths from respiratory diseases (ICD-10, J00-J99) of people aged 65 years or more. These data were organized by gender, average concentrations of  $\text{PM}_{10}$  and  $\text{SO}_2$ , minimum temperature and relative humidity for the period from January, 2002 to December, 2006. The data were analysed using generalized additive Poisson regression, with constrained distributed lag models adjusted for long time trend, weekdays and holidays. The quality of fit for the final model was estimated using residual deviance analysis and the Akaike criteria.

**Results:** An increase of 10  $\mu\text{g}/\text{m}^3$  in  $\text{PM}_{10}$  and  $\text{SO}_2$  concentrations were associated with an increased risk of death from respiratory diseases in elderly women of 1.15 (95% CI: 1.04–1.26) and 1.26 (95% CI: 1.00–1.58), respectively. For elderly men, the increased risk of death was 1.09 (95% CI: 1.01–1.18) and 1.26 (95% CI: 1.01–1.57), respectively.

**Conclusion:** The results showed an association between ambient  $\text{PM}_{10}$  and  $\text{SO}_2$  concentrations and an increased risk of death among elderly people from respiratory diseases. Additionally, the greatest increased risk was in elderly women.

#### ISEE-0808

##### **Measurement and Determinants of Anogenital Distance in Healthy, Newborn Infants**

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**Background:** In toxicological animal studies, anogenital distance (AGD) is a sexually dimorphic trait that is a well established reproductive toxicity endpoint. AGD develops under the influence of dihydrotestosterone during fetal development, yielding a longer AGD in males when compared to females. A shortened AGD is associated with a variety of genital abnormalities in animal studies of male offspring, but little data exists on the determinants and normal variance of the measurement in humans.

**Methods:** We conducted a standardized training to learn AGD measurement methodologies in the University of Washington newborn nursery in 2008. Inter-rater and intra-rater reliability of measurements, was evaluated prior to the start of the study. We measured 173 (86 male, 87 female) newborn infants for AGD. Standard anthropometric data was collected (weight, length, and occipital head circumference) along with race and gestational complications. We examined AGD for sexual dimorphism and predictors of the measurement in infants using linear regression modeling.

**Results:** Within the standardized training, intra-rater reliability was 0.96 for females and 0.98 for males, and inter-rater reliability was 0.56 for females and 0.92 for males. Mean male AGD was 51.98 mm (SD  $\pm 5.53$ ) and mean female AGD was 37.19 mm (SD  $\pm 3.73$ ). Weight, length,

occipital head circumference, and gestational age were independent, significant predictors of AGD. Race was not a strong predictor of AGD.

**Conclusion:** We found that AGD is an easily learned and performed measurement in newborn infants. We demonstrated that AGD is a sexually dimorphic measurement in humans that is most strongly predicted by weight. The application of this measurement to clinically relevant outcomes related to in utero androgenization remains to be explored in further depth.

#### ISEE-0810

##### Neonatal Neurodevelopment and Prenatal p,p'-DDE Exposure: Evaluation by Three Different Tests

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**Background and Objectives:** Inconclusive results exist regarding the association between prenatal p,p'-DDE (DDE) exposure and neonatal neurodevelopment (NND) assessed by the Neonatal Behavioral Assessment Scale (NBAS). We used two additional tests to determine the consistency of this potential association.

**Methods:** A perinatal cohort study was assembled in January 2001, in an endemic malaria zone (Morelos, Mexico), where DDT was used until 1998. Participants were women of reproductive age who were interviewed before, during, and after pregnancy. Maternal serum samples during pregnancy were obtained and DDE maternal levels were determined by gas chromatography. Children (265) were assessed at on month of age ( $\pm 1$  week) with three different tests: reflex score of NBAS, Bayley Assessment Scale (Psychomotor (PDI) and Mental index (MDI)), and neurological soft signs of Graham-Rosenblith Newborn Behavioral examination. Information about delivery conditions, breastfeeding and birthweight was obtained by a structured questionnaire.

**Results:** The proportion of children with  $\geq 2$  abnormal reflex by NBAS was 16.6%; in contrast only 3.8% of children had  $\geq 2$  soft neurological signs. Means of PDI and MDI were 97.6 and 98.5, respectively. No significant association of prenatal DDE exposure was detected with each one of the tests used.

**Conclusions:** Our results suggest that NND is not associated with prenatal DDE exposure. However, the possibility that an undetectable subtle damage become further evident cannot be ruled out.

#### ISEE-0815

##### Trends of Mortality Rates for Respiratory Diseases in Brazil and Capital Cities, 1996 to 2005

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**Background and Objective:** Respiratory diseases represent one of the main causes of mortality in Brazil and in the world in the recent years. Compared to other cities, Brazilian State capitals concentrate more people, vehicles and industries that could create many serious health problems related to atmospheric pollution. This study was directed to evaluate mortality trends of respiratory diseases in Brazil.

**Methods:** To analyze mortality trends in the respiratory diseases (RD) in Brazil and in some Brazilian State capitals, some time series data during 1996 to 2005 were studied. In this study, mortality data for RD (ICD-10: J00-J99) was investigated from the Mortality Information System. For the modeling process, it became necessary to standardise data from mortality rates to RD as dependent variable (Y) and the years of the time series as

independent variable (X). Then, linear and exponential regression models were used to fit the data. The best model to represent mortality trends in each capital was chosen based on the significance levels ( $P < 0.05$ ).

**Results:** Trends of mortality rates decreased in Brazil and in most of the State capitals during the period observed. This reduction was most evident for the capitals situated in the regions Southeast, South and Central-West, like as Florianópolis and Porto Velho cities. Looking at a national overview, the standardized mortality rates (SMR) for RD in Brazil decreased 10.26%, mortality rates were 59.36 per hundred thousand in 1996 and 53.27 in 2005. Florianópolis city, in the South region, presented higher level reduction in the SMR with 48.31% and Porto Velho city, in the North region, showed higher increase at the same rates (157.89%).

**Conclusion:** This paper proposes a discussion about trends overview of mortality for RD in Brazil and in the important State capitals suggesting policy strategies and guidelines to reach the best quality on the national health system.

#### ISEE-0821

##### Particulate Matter and Malaria: A Case-Control Study

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**Background and Objective:** It has been hypothesized that smoke from the burning of biomass fuels could offer some protection against malaria, particularly in regions where the use of these fuels with traditional stoves is prevalent. Smoke may discourage mosquitoes from entering or resting in houses. The aim of this study was to investigate the effects of smoke in the sleeping rooms on the risk of clinical malaria in children in Nouna, Burkina Faso, a region with very high rates of biomass use.

**Methods:** This case-control study examined differences in sleeping room PM<sub>10</sub> concentrations and exposures in households of children  $\leq 9$  years old. Seventy-seven confirmed cases of malaria were matched to 141 community controls. Data collection involved interviews, visual inspections, measurements of area PM<sub>10</sub> concentrations and mosquito captures within sleeping rooms.

**Results:** Mean area sleeping room concentrations were 329  $\mu\text{g}/\text{m}^3$  for cases and 245  $\mu\text{g}/\text{m}^3$  for controls. Mean exposures were 2760  $\mu\text{g}/\text{m}^3$  hrs and 2680  $\mu\text{g}/\text{m}^3$  hrs for cases and controls, respectively. Univariate analyses indicated a significant difference between cases and controls, particularly with exposures of PM<sub>10</sub>  $\geq 1000$   $\mu\text{g}/\text{m}^3$  hrs (OR = 0.40, 95%CI: 0.20–0.81). Additional multivariate analyses adjusting for several sleeping area characteristics such as reported bed net use, door area and holes or spaces in the sleeping area did not result in any significant changes to this relationship. Analyses with sleeping area behaviours such as the number of persons in the same room as the case or control, waking time and bed time also did not show an effect. Surprisingly, counts of *Anopheles gambiae* were not found to be significantly correlated with either PM<sub>10</sub> concentrations or exposure.

**Conclusions:** These results could suggest that PM<sub>10</sub> may offer some protection against clinical malaria and that the relationship is not modified by sleeping room behaviours or characteristics. The lack of association with mosquito counts may need further investigation.

#### ISEE-0825

##### Influence of Folic Acid Supplementation on Genomic DNA Methylation: Findings from a Randomized, Placebo-Controlled Trial in Bangladeshi Adults

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**Background and Objective:** Arsenic (As) is a class I carcinogen to which 35 million people in Bangladesh are chronically exposed. Folate deficiency is common among Bangladeshi adults. Both As and DNA are methylated via one-carbon metabolism, a pathway dependent on adequate folate. Folate deficiency can induce genomic hypomethylation of DNA; animal studies suggest that As exposure can also result in genomic hypomethylation. Alterations in DNA methylation can influence genomic stability. We previously reported that folic acid (FA) supplementation to folate-deficient Bangladeshi adults chronically exposed to As in drinking water favorably influenced As methylation. Here we report the effect of FA supplementation on genomic methylation of peripheral blood leukocyte (PBL) DNA.

**Methods:** We conducted a randomized, placebo-controlled trial of FA supplementation among 194 folate-deficient (< 9 nmol/L) Bangladeshi adults. We measured genomic PBL DNA methylation (using a [<sup>3</sup>H]-methyl incorporation assay) at baseline and after 12 weeks of FA supplementation (400 µg). [<sup>3</sup>H]-methyl incorporation is inversely related to genomic methylation of PBL DNA. We calculated the change in [<sup>3</sup>H]-methyl incorporation between baseline and 12 weeks.

**Results:** Change in [<sup>3</sup>H]-methyl incorporation differed significantly by treatment group ( $P = 0.03$ ) (mean change-FA: -181 DPM/µg DNA; Placebo: 685 DPM/µg DNA) and the influence of treatment group depended on baseline [<sup>3</sup>H]-methyl incorporation level. For participants with [<sup>3</sup>H]-methyl incorporation levels below the median (42621 DPM/µg DNA) at baseline, the change in [<sup>3</sup>H]-methyl incorporation did not differ by treatment group ( $P = 0.76$ ). However, for participants with baseline [<sup>3</sup>H]-methyl incorporation levels above the median, the change in [<sup>3</sup>H]-methyl incorporation was significantly different by treatment group (mean change-FA: -1316 DPM/µg DNA; Placebo: 316 DPM/µg DNA,  $P = 0.003$ ).

**Conclusions:** FA supplementation to folate-deficient Bangladeshi adults appeared to prevent further declines in genomic methylation of PBL DNA and to increase methylation of genomic DNA among individuals with relatively higher genomic DNA hypomethylation at baseline.

#### ISEE-0828

##### The Impact of Maternal MTHFR677 Genotype and Lead Exposure on Infant Genomic DNA Methylation

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**Background and Objective:** Previous studies have indicated that genetic variations in methylenetetrahydrofolate reductase (MTHFR), a key regulatory enzyme of the one-carbon metabolic pathway, influence genomic DNA methylation levels. However, little is known about the transgenerational influence of the major variant of MTHFR, C677T, on genomic DNA methylation levels. Our objective was to evaluate the impact of maternal MTHFR C677T genotype on cord blood genomic DNA methylation levels and to determine if this association was influenced by maternal lead exposures.

**Methods:** Our subject population consisted of 97 maternal-infant pairs for which DNA methylation and MTHFR genotype data were available from

the Early Life Exposures in Mexico to Environmental Toxicants (ELEMENT) study. Genomic DNA methylation, prenatal lead exposure and MTHFR genotyping were assessed by LINE-1 Pyrosequencing, maternal patella bone lead levels using a spot source <sup>109</sup>Cd K-XRF instrument and TaqMan technology, respectively.

**Results:** Maternal MTHFR C677T genotype influenced infant LINE-1 DNA methylation levels (CC = 79.86% ± 0.5; CT = 79.83% ± 0.3; and TT = 78.90% ± 0.36;  $P$  for trend = 0.07). Furthermore, once stratified by median maternal patella lead exposure, the association between maternal MTHFR C677T genotype and infant LINE-1 DNA methylation was only apparent among mothers with high lead exposure (CC = 80.0% ± 0.93; CT = 79.32% ± 0.48; and TT = 78.35% ± 0.54;  $P$  for trend = 0.09); vs. mothers with low lead exposure (CC = 79.79 ± 0.60; CT = 80.39 ± 0.4; and TT = 79.45 ± 0.47;  $P$  for trend = 0.51). No significant associations were found among infants MTHFR C677T genotype and DNA methylation.

**Conclusion:** Data from this study suggest that genetic variants of MTHFR C677T among pregnant women are associated with a decrease in genomic DNA methylation in their offspring. Maternal genotype along with environmental exposures may play a large role in epigenetic programming.

#### ISEE-0830

##### Effects on Reproductive System of Mice Exposed to Environmental Contamination

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**Background and Objective:** This study investigated the effects on the reproductive system of balb-c mice exposed to water from a river which supplies the city of Cubatao, near to a deactivated industrial waste depositary.

**Methods:** Eighty male mice were separated in four groups exposed to water from different sources: Group A (mineral water); Group B (treated water); Group C (water from Cubatao city); Group D (water from the waste depositary region). The exposition occurred since they were weaned until sexual maturity. They coupled with females in reproductive age then were sacrificed. The evaluated parameters were testicle weight, sperm analysis, pregnancy rate, sex ratio of the offspring and Sertoli cell count. The tests of Levene and Kolmogorov-Smirnov was used to verify the homogeneity of the variances and the tack to the normal curve, respectively. The parametric tests used ANOVA and the non parametric tests used Kruskal-Wallis test and the test of multiple comparisons of Tukey (Kleibau).

**Results:** There is no presence of pollutants in the group "a" and group "c" water. Group "b" showed low levels of cadmium,  $3.58 \pm 0.50$  µg/L and  $2.92 \pm 0.10$  µg/L. Group "d" showed the presence of polycyclic aromatic hydrocarbons (PAH) and high levels of lead ( $113 \pm 11$  µg/L and  $221 \pm 16$  µg/L), cadmium ( $11.33 \pm 0.50$  µg/L and  $12.6 \pm 1.2$  µg/L) and mercury ( $4.58 \pm 0.92$  µg/L and  $5.3 \pm 1.1$  µg/L). There was no difference between groups in testicle weight, sperm analysis, pregnancy rate and Sertoli cell count. There was a significant reduction in sex-ratio (male X female) of the offspring in group b. This alteration cannot be explained only by the cadmium levels in group b water.

**Conclusion:** In the present work we cannot associate the exposition to water from the waste depositary and reproductive alterations.

#### ISEE-0831

##### Impacts on Health and Social Environment Among People Living near to a Solid Waste Disposal Site

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**Background:** Solid waste disposal causes negative impacts on the environment, health and wellbeing of population to living nearby. These impacts require objective and perceived evaluations to develop actions for mitigation and control.

**Objective:** To describe self-perceived impacts on health and social environment among people living near to a solid waste disposal site in Cali.

**Methods:** In addition to a cohort study, we carried out a qualitative research to explore experiences among 16 residents with leadership positions in their communities. Two neighborhoods were included and one small town, with different socioeconomic strata but all of them located less than two kilometers from Navarro landfill. Seven semi-structured interviews and one focus group were conducted. A thematic analysis was developed using thematic networks to identify recurrent patterns related to the experience of living in proximity to the solid waste disposal.

**Results:** Participants perceived respiratory health impacts that may be linked to disgusting odors of Navarro. In addition, there has been developed a bad reputation ("stigma") for the area because of the annoying odors, flies and close view of waste disposal. Particularly, in the small town called Navarro, the stigma is direct because the town has the same name of Navarro landfill and many people confuse Navarro town with Navarro landfill. In some areas people perceived of Navarro landfill have a negative impact on properties value.

Finally, our results show that regardless all participants occupied positions leadership; nobody reported social mobilisations initiatives in order to reduce Navarro negative effects.

**Conclusions:** Participants perceived negative health impacts and bad reputation in the neighbourhoods that have effects on social and physical environment among people living close to the solid waste disposal. Probably, in these communities people avoid to promote social mobilisation processes because they perceived threat on properties values or they do not have environmental concerns.

#### ISEE-0832

##### Stress, Traffic Related Air Pollution and Eczema and Wheeze in the First Year of Life: Project ACCESS

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**Background and Objective:** While both chronic stress and traffic related air pollution are associated with respiratory health and atopic outcomes in children, studies exploring the joint effect of these exposures are limited. We examined the relationship between violence, conceptualized as a chronic stressor, and black carbon from traffic sources on eczema and wheeze in infancy in the Asthma Coalition on Community, Environment, and Social Stress (ACCESS), an urban prospective birth cohort study in the US.

**Methods:** Mothers reported physician-diagnosed eczema or wheeze in their children during the first year of life and completed the My Exposure to Violence (ETV) scale. Black carbon (BC) exposure levels were estimated using a validated spatio-temporal land use regression model, based on mother's residence during pregnancy. Rasch modeling was used to create a summary measure of ETV. Associations between predicted BC, ETV and wheeze and eczema were examined adjusting for sociodemographics, birthweight for gestational age, season of birth, in-utero tobacco smoke and postnatal tobacco smoke exposure; infant outcomes were examined in separate regression models.

**Results:** In the sample of 403 children, 15% were diagnosed with eczema and 25% reported wheezing. The mean  $\pm$  SD predicted annual BC was  $0.42 \pm 0.2 \mu\text{g}/\text{m}^3$ . In adjusted analyses, ETV (OR 1.3, 95%CI 1.0, 1.7) and BC per interquartile range (OR 1.3, 95%CI 1.0, 1.8) were associated with wheeze; there was no significant interaction between ETV and BC. In stratified analysis, increased odds of wheeze was seen only among children with both above median ETV and above median BC exposure (OR 2.2, 95%CI 1.1, 4.1) albeit the test for an interaction was not significant.

**Conclusions:** Violence and traffic related BC are independently associated with wheeze in the first year of life but not eczema. These environmental exposures may be operating through pathways other than a predisposition to atopy.

#### ISEE-0834

##### Lead Exposure, Iron Metabolism Polymorphisms, and Psychiatric Symptoms in the Normative Aging Study

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**Objective:** In an aging population, the relationships between lead exposure and psychiatric symptoms are characterized with the interactions of several common iron dysregulation polymorphisms.

**Methods:** The Brief Symptom Inventory survey of 9 psychiatric symptoms and 3 global mood severity measures was administered to 888 participants in the longitudinal cohort Normative Aging Study with exposure measures of K-Shell X-Ray Fluorescence chronic bone lead and AAS-Furnace blood lead. Subjects were genotyped at two critical polymorphic sites in the iron metabolism hemochromatosis (HFE) gene, C282Y and H63D, as well as 1 site in the transferrin gene, P570S.

**Results:** In the eligible study population, 122 (13.66%) carried the HFE C282Y polymorphism, 205 (23.09%) carried the HFE H63D polymorphism, and 285 (32.06%) carried the transferrin polymorphism. Patella lead was a significant predictor of abnormal (mean+1SD) mood scores of hostility, phobia, somatization, anxiety, depression and all global scores. There were main effects of the HFE C282Y variant on hostility (OR = 7.28, 95% CI: 1.16–45.8), and the transferrin variant on the positive symptom total (OR = 2.62, 95% CI: 1.05–6.58) after adjusting for age, education, alcohol intake, smoking pack years, and time since bone lead measure. An IQR increase in tibia lead was associated with a 20.87% change (16.04, 25.89 95% CI) in odds of anxiety for carriers of the transferrin variant when compared to wild type (interaction term  $P = 0.0081$ ). Similar, less significant interactions were observed for transferrin variants with depression and phobia, and for C282Y and phobia.

**Conclusion:** Polymorphisms in two key iron metabolism genes are significant independent predictors of hostility and positive symptom total, while the same polymorphisms enhance the interactions between lead exposure and anxiety, depression, and phobia. A common oxidative stress mechanism of toxicity for iron overload and chronic lead exposure is supported in relation to several psychiatric symptoms in an aging population.

#### ISEE-0835

##### Health Endpoints Assessed During the Baseline Year of an Improved Cookstove Intervention Among Nicaraguan Women

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**Background and Objective:** Elevated indoor air pollution levels associated with the burning of biomass fuels in developing countries are well established. Several respiratory endpoints have been associated with these exposures, although little research has been performed on cardiovascular health.

**Methods:** We conducted the baseline assessment of an improved cookstove intervention among 126 nonsmoking primary household cooks in Granada (El Fortin neighborhood), Nicaragua. Traditional stoves were replaced with improved stoves with chimneys following the baseline measures. Baseline health endpoints were assessed after a 48-hour exposure assessment period

(summer 2008). Finger-stick dried blood spot samples were collected and stored for future analysis of inflammatory markers.

**Results:** The average age of the primary cooks was 35.6 years (standard deviation [SD], 16.1). The average body mass index was 28.1 kg/m<sup>2</sup> (SD, 6.7). On average, women cooked 19.2 meals per week and spent 4.4 hrs in the kitchen while the fire was burning. Thirty-two participants (25.6%) reported exposures to environmental tobacco smoke. Symptoms of cough, phlegm, wheeze, and headache during cooking were reported among 21.4%, 18.4%, 21.4%, and 61.1% of the women, respectively. Doctor diagnosed asthma, chronic bronchitis, and cardiovascular disease was reported among 12.4%, 9.1%, and 9.1%, respectively. Mean FEV<sub>1</sub> was 2.40 L (SD, 0.57); mean oxygen saturation was 97.6% (SD, 0.9); and mean systolic and diastolic blood pressure was 121.6 mmHg (SD, 22.0) and 76.5 mmHg (SD, 13.0), respectively. Baseline health endpoints will be examined in relation to baseline levels of pollution and in comparison to follow-up measures assessed during the summer of 2009 approximately 9 months after the introduction of the improved stoves.

**Conclusion:** Utilizing indicators of health that are relatively efficient, low cost, and noninvasive could prove useful for identifying the adverse health effects of elevated cookstove smoke exposures in developing country settings.

#### ISEE-0836

##### Importance of the Population Exposure Model in the Impact of PM and Daily Mortality

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**Background and Objectives:** A usual critique of ecological studies is the poor characterization of the population exposure to air pollution. In this work, the impact of population exposure modeling to particulate matter (PM<sub>10</sub> and PM<sub>2.5</sub>) on the risk estimates is analyzed for the inhabitants of Santiago (Chile), for the years 1997 to 2005.

**Methods:** All cause mortality risks were computed using a simple exposure model (average of several monitors) and a more detailed one, based on the results of an atmospheric photochemical model for four weeks, and extrapolated to the rest of the year.

**Results:** Significant contributions to the risk estimates were found when the detailed exposure model was considered. The elderly showed the biggest increase on risk due to PM<sub>2.5</sub> exposure, from 2.7% (CI 95%: 1.8–3.6) to 3% (1.9–4.1). For all ages, the increase was smaller, from 1% (0.4–1.7) to 1.2% (0.3–2.1). Even though the increases in risk were higher for the cold season, the incorporation of the proposed exposure wasn't statistically significant.

**Conclusion:** Health risks found were consistent with the evidence of previous national and international studies. The relative risks estimations using the proposed model were greater than using the average of the monitors, as usual in ecological studies. Even though the difference between the two models was not statistically significant, the RR increase is important for policy applications. The model based on photochemical estimations is a contribution in the exposure assessment, but its influence has to be explored with more detail.

#### ISEE-0837

##### Ares: A Library for Time Series Analysis in Air Pollution and Health Effects Studies Using R

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**Background and Objective:** Time series models have been extensively used in ecological studies using secondary data to estimate health effects of air pollution. Due to low cost of and easy availability of data, it is an initial analytical approach in the investigation of the effects of air pollution. The analysis of time series using generalised additive models

has become the standard methodology in many multicentric studies to evaluate health effects of atmospheric pollution. This work is being carried out as part of the ESCALA project, a multicentred project involving Brazilian, Mexican and Chilean cities.

**Methods:** This work presents a brief review of time series analysis methodology in epidemiological studies of health effects of air pollution and its implementation through a library for the R software, called ares.

**Results:** The use of the library is illustrated in detail through hospital admissions data for respiratory diseases in children in the city of Rio de Janeiro during the period September 2000 to August 2002.

**Conclusion:** The analysis of time series using generalised Poisson regression has become the standard methodology in various multicentred studies for the evaluation of health effects of atmospheric pollution. The ares library is an open source collection of computational routines that implement this methodology and is being used in the ESCALA study.

#### ISEE-0838

##### Sensitivity of Regional Health Effect Estimates to Different Approaches to Estimating Long-Term PM<sub>2.5</sub> Exposure

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**Background and Objective:** Estimation of long-term individual-level PM<sub>2.5</sub> exposure in health effects studies has made use of prediction approaches such as nearest monitor and kriging. A recent simulation study indicated that health effect estimates using these two approaches differed more in regions where pollutant concentrations were less spatially correlated. This simulation study extends this finding by examining whether nearest-monitor and kriged PM<sub>2.5</sub> exposure estimates produce different health effect estimates in 6 U.S. regions with different spatial correlation structures of PM<sub>2.5</sub>.

**Methods:** Six US study regions (Mid-Atlantic, Northeast, Southeast, Midwest, Northern and Southern California) were defined by overlapping 200 kilometer buffers from the centroids of 24 Women's Health Initiative Observational Study (WHI-OS) cities. Using year 2000 annual average PM<sub>2.5</sub> at EPA monitoring sites, we estimated geostatistical parameters and characterized the spatial correlation structure as the range divided by square root partial sill for each region. Then, we simulated PM<sub>2.5</sub> using estimated parameters and survival time to cardiovascular events based on previous findings from the WHI-OS (an incidence rate of 0.032 and relative risk (RR) of 1.24 per 10 µg/m<sup>3</sup> increase in PM<sub>2.5</sub>) in each region.

Given the simulated PM<sub>2.5</sub> concentration at monitoring locations, we predicted exposure to PM<sub>2.5</sub> at hypothesized subject locations using nearest-monitor and kriging approaches. RRs of cardiovascular events were estimated separately given the two prediction approaches in each region. Differences in RR from the two methods were then compared across regions.

**Result:** Long-term PM<sub>2.5</sub> spatial correlation was higher in the Midwest and lower in California. Differences in RRs for cardiovascular events from two predicted PM<sub>2.5</sub> were higher in the regions with lower PM<sub>2.5</sub> spatial correlation.

**Conclusion:** Health effect estimates of long-term PM<sub>2.5</sub> exposure are more sensitive to the approach to estimating individual exposure in regions where PM<sub>2.5</sub> is less spatially correlated.

#### ISEE-0840

##### Mortality Effects of PM<sub>10</sub> and O<sub>3</sub> in Chilean Cities: Results from the ESCALA Project

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**Background and Objectives:** ESCALA (Estudio de Salud y Contaminación del Aire en Latinoamérica) is a study that examines the



association between outdoor air pollution (PM<sub>10</sub> and O<sub>3</sub>) and health effects in Brazil, Mexico and Chile, in all causes, all ages mortality and in subgroups defined by cause, age and gender. We report the results for Santiago, a 5 M people city, Concepcion, a 600,000 people industrial city, and Temuco, a city of 360,000 people dominated by wood-burning pollution in winter.

**Methods:** Poisson regression was used to fit a model to the time-series data (1997–2005), adjusting for seasonality and meteorology. Distributed lag models were fitted considering a 2nd degree polynomial with exposure lagged up to 5 days.

**Results:** In Santiago, in most of the age groups and causes studied, PM<sub>10</sub> had a significant impact on daily mortality. The risk percentage change (RPC) for 10 µg/m<sup>3</sup> PM<sub>10</sub> ranged from 0.12% (cardiopulmonary, all ages) to 0.46% (respiratory, all ages). Ozone also had significant impacts for all causes, cardiopulmonary causes. The biggest effects were found for cerebrovascular/stroke (CEV) deaths (RPC 0.56 to 0.66 for all ages and elder).

The only significant effects in Concepcion were found for the elder population for respiratory causes (RPC 1.65%) and COPD (RPC 2.6 to 2.9%). In Temuco, COPD had the higher risk for the whole population (RPC 2.7 to 4%) and CEV also had a high risk (RPC 1.2 for all ages, 1.1 to 1.5 for elder).

**Conclusions:** These results provide further evidence of the adverse health effects of PM<sub>10</sub> and O<sub>3</sub> in cities of the developing world. The higher effects were found for two relatively small cities, with different mixtures of air pollution. Possible differential effects by socioeconomic characteristics of the exposed populations may explain much of the differences and are being currently investigated.

#### ISEE-0842

##### Indoor Air Pollution Concentrations Assessed During the Baseline Year of an Improved Cookstove Intervention in a Rural Nicaraguan Community

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**Background and Objective:** Cooking in many developing countries usually consists of burning solid fuels over open fires or in traditional stoves that emit high levels of air pollutants. Some previous studies have relied on crude proxies of exposure, such as stove type. However, large variations in air pollutant concentrations have been reported within stove types.

**Methods:** During the summer of 2008, we conducted the baseline assessment of an improved cookstove intervention among 119 households using traditional cookstoves in Granada (El Fortin neighborhood), Nicaragua. Indoor carbon monoxide (CO) and particulate matter (PM<sub>2.5</sub>) concentrations were assessed for approximately 48 hours in each home. Several pollutant metrics were calculated, including 48-hr average, 24-hr average (day 1 and day 2), and 1-hr maximum (day 1 and day 2).

**Results:** Mean 48-hr concentrations were 1478.3 µg/m<sup>3</sup> (standard deviation [SD], 2270.7) and 26.6 ppm (SD, 24.5) for PM<sub>2.5</sub> and CO, respectively. Mean 24-hr PM<sub>2.5</sub> concentrations for day 1 and day 2 were 1487.1 µg/m<sup>3</sup> and 1456.7 µg/m<sup>3</sup>, respectively; CO concentrations for day 1 and day 2 were 26.3 ppm and 26.7 ppm, respectively. The 1-hr maximum PM<sub>2.5</sub> levels for day 1 and day 2 were 8701.5 µg/m<sup>3</sup> and 8372.7 µg/m<sup>3</sup>, respectively; 1-hr maximum CO levels for day 1 and day 2 were 122.2 ppm and 129.8 ppm, respectively. Mean 24-hr PM<sub>2.5</sub> concentrations for day 1 and day 2 were moderately correlated (Spearman correlation coefficients [r] = 0.71); r = 0.87 for day 1 and day 2 mean 24-hr CO concentrations. PM<sub>2.5</sub> and CO were correlated with each other (48-hr mean, r = 0.77).

**Conclusion:** Elevated air pollution concentrations with large variations were demonstrated among households using traditional stoves. Baseline exposures will be examined in relation to follow-up concentrations assessed during the summer of 2009 approximately 9 months after the introduction of the improved stoves.

#### ISEE-0843

##### Can Living in the Surroundings of a Petrochemical Complex be a Risk Factor for Autoimmune Thyroid Disease?

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**Background and Objective:** A cross-sectional study was made with a comparison group to investigate a possible excess of Hashimoto's thyroiditis–HT and antibodies–ATA in the surroundings of a Petrochemical Complex.

**Methods:** People of both sexes aged over 20 years old were investigated in a random sample of residents in the area surrounding the Petrochemical Complex. Controls were investigated in an area with steel industries. In the areas searched, participants were chosen randomly and stratified a priori by sex and age group. As a result, 90.5% of the expected sample was obtained, totaling 1533 individuals. HT and ATA prevalences were compared by the chi-square test. Logistic regression was used to control the possible confounding factors for HT and ATA.

**Results:** Both TH (9.3%) and ATA (17.6%) prevalences were higher in the Petrochemical Complex area than in the control area (3.9% and 10.3%, respectively). After controlling the possible confounding factors, the OR for living in the surroundings of the Complex and presenting HT was 2.38 (CI95%: 1.41–4.02). According to the ATA criterion, the OR for living in the surroundings of the Complex was 1.78 (CI95%: 1.23–2.60).

**Conclusions:** The authors have found higher prevalence and risk of developing thyroiditis and anti-thyroid antibodies among residents of areas surrounding the Petrochemical Complex and think these findings need to be further studied in similar areas.

#### ISEE-0847

##### The Relationship Between the Length of Using Pacifier and Feeding Bottle and the Prevalence of Respiratory and Allergic Illnesses During Childhood

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**Abstract:** The exposure to plastics products, such as building materials, food package and toys, has been suggested to be a potential risk on the development of childhood respiratory and allergic disease/symptoms in recent studies. The current investigation therefore aimed to examine the association between the length of using pacifier and feeding bottle during babyhood and the prevalence of childhood respiratory and allergic disease/symptoms in a population of Taiwan, located in eastern Asia whose population has been less studied. Cross-sectional survey was

performed where questionnaires were completed by parents of 14,862 randomly selected kindergarteners (2–6 years), with 68% response rate. There was a significantly higher prevalence of wheezing (29.7 vs. 26.1%,  $P < 0.001$ ) and rhinitis (51.6 vs. 48.6%,  $P = 0.001$ ) reported during the last 12 months among children using pacifiers compared with those who never used pacifiers, and higher prevalence of reporting “cough at night” (11.4 vs. 6.8%,  $P = 0.03$ ) was also found in children who indicated using feeding bottles. After stratifying the data by the age of child when stopping using a pacifier or feeding bottle, the increasing prevalence was found for symptoms of wheezing during last 12 months, rhinitis at last 12 months, eczema at last 6 months (chi-square for trend  $< 0.05$ ); similarly, the significantly increasing trend by the age of stopping using a feeding bottle was also shown in doctor-diagnosed rhinitis or wheezing, reporting wheezing or rhinitis during last 12 months, coughing at night in last 12 months, and reporting eczema in last 6 months. Other meaningful confounders and co-variables are warranted to further characterize the preliminary evidence of current analyses supporting the adverse effect of using pacifiers and plastic feeding bottles on reporting childhood respiratory and allergic disease/symptoms.

#### ISEE-0850

##### Effects of the Humidity on Hospital Admissions by Respiratory Diseases in the Subequatorial Amazon

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**Background:** Models of climate change proposed by the IPCC forecast an important reduction of humidity in the Amazon region during 2020 to 2099.

**Objective:** To analyze the effect of variations in humidity on hospital admissions by respiratory diseases in children in the municipality of Alta Floresta, located at the subequatorial Brazilian Amazon.

**Method:** Ecological time series study considering daily levels of relative humidity as exposure, adjusting for temperature and air pollution depicted by the levels of  $PM_{2.5}$ , measured in  $\mu g/m^3$ . The outcome was the number of hospital admissions by respiratory diseases in children younger than 5 years of age.

**Results:** For a decrease of 10% in humidity the estimated relative risk percentage increase (RR%) in the outcome in children was 11.7% at the current day. Furthermore there were accumulated effects for 1 to 6 days ranging from 17.9 to 23.8%.

**Conclusion:** A decrease in humidity in the Amazon region should increase hospital admissions by respiratory diseases in children, after adjusting for temperature and air pollution.

#### ISEE-0854

##### Respiratory Outcomes, Work and Ambient Pollution

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**Background and Objective:** Adverse respiratory outcomes have been associated with workplace exposures in occupational and community based studies. This study described the differences of the association of work-related respiratory outcomes among adults from industrially polluted communities compared to less polluted communities in Durban.

**Methods:** Adults from households of schoolchildren participating in a study of childhood asthma and ambient pollution from communities in the industrially-polluted south and from less polluted north, with similar

socio-economic status, were interviewed using standardised questionnaires. Regression models analysed the association of work variables with respiratory outcomes, and determined differences between communities in the south and north.

**Results:** Of the 1585 adults, 47% were from the south, of whom 46.2% (south) and 46.9% (north) reported having a job in the last fortnight. Covariate adjusted predicted prevalences for asthma (7.6% vs 5.9%), chronic bronchitis (5.7% vs 3.2%) and emphysema (1.4% vs 0.3%) were higher in the industrially-polluted south compared to the north. Similarly, adjusted prevalences for respiratory symptoms of cough (5.5% vs 3.9%), phlegm (5.1% vs 4.1%) and wheezing (20.1% vs 15.6%) were higher in the south than north. Logistic regression, adjusting for history of hazardous occupation showed an increased risk for living in the south for asthma (OR = 1.2; CI:0.7–1.7), chronic bronchitis (OR = 1.7, CI: 1.0–3.0) and emphysema (OR = 4.2; CI:0.9–19.1), as well as cough (OR = 1.04; CI: 0.7–1.5) and shortness of breath (OR = 1.4; CI:1.0–1.9). There was no evidence that risks were modified by working in a hazardous job. Hazardous jobs were associated with an increased risk for asthma (OR: 1.3; CI:0.7–2.5).

**Discussion:** Adverse respiratory outcomes are associated with living in an industrially polluted community. Work association for such outcomes was not supported by our data, and there was suggestion that work modified the effect of geographical location. Controlling residential exposures are necessary to reduce the prevalence of adverse respiratory outcomes.

#### ISEE-0855

##### The Association of Rainfall and Drought Between Geographical Distribution and Infectious Diseases in Taiwan

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**Abstract:** In Taiwan, the increasing temperature was about twice of the average reported by IPCC over the past century. In addition, the intensity of rainfall also showed an increasing trend throughout Taiwan in the same period, yet much less studied for its potential impacts on distribution and epidemic of various infectious diseases. Data of Central Weather Bureau during 1994 to 2005 in Taiwan were acquired. We defined the mean daily rainfall is higher than 130 mm, 200 mm and 350 mm would be categorized as heavy rain, torrential rain and extreme torrential rain. When the mean daily rainfall was less than 0.6 mm, it would be defined as a drought day. Study tested significant clustering events for infectious diseases and mapped the distribution by Geographical information system (GIS). Regression analysis was to examine the correlation between mean rainfall and the cases of specific disease. Spatial regression model was applied to mapping and examining the relationship and distribution between rainfall and disease clustering. Regression analysis found significant relationship between mean daily rainfall and the daily cases of Dengue fever ( $P = 0.003$ ), Scrub Typhus ( $P < 0.001$ ) and Japanese encephalitis ( $P < 0.001$ ). The continuing drought days significantly affected the occurrence of Dengue fever ( $P < 0.001$ ), Scrub Typhus ( $P < 0.001$ ) and Shigellosis ( $P < 0.001$ ). Spatial analysis showed that the rainfall density of a-week-lag torrential event has significant effect on reporting shigellosis cases ( $P = 0.000$ ). There was a statistical relationship between the average precipitation of a longest-duration drought and number of dengue cases ( $P = 0.038$ ). Other significant variables included elevation, rainfall, urbanization and economic component. Difference level of rainfall appeared to affect geographical distribution of infectious diseases reported in Taiwan. However, difference in distributions of medical resources or sanitary condition would have to be taken into account in further analyses before the final conclusions between the climatic changes and infectious epidemics.

## ISEE-0857

**Uncertainties in Risk Estimations of Electromagnetic Fields of Overhead Power Lines**

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**Abstract:** A possible relationship between the exposure to electromagnetic fields (EMF) of high-voltage cables and a relative increase in child leukaemia has led to some social unrest in Holland. Epidemiological studies did not give a clear picture whether this relationship was valid or not, but the Health Council of the Netherlands concluded in 2000 on a reasonably consistent association between the occurrence of child leukaemia and proximity to overhead power lines. They concluded, however, that there was no evidence that the association was a causal relationship with exposure to EMF but such could not be excluded either.

Presuming causality, The National Institute for Public Health and the Environment (RIVM) estimated for the whole Dutch population roughly 1 new case of child leukaemia every two years due to high-voltage cables. In our study we systematically assessed uncertainties and assumptions in the existing quantitative risk analysis of EMF of high-voltage cables and child leukaemia.

We accomplished our research by adapting the uncertainty typology of Walker et al (2003) to the existing risk studies, and a pedigree matrix for the assessment of the potential value-ladenness of assumptions to the calculation of the RIVM. The assumptions were prioritised and characterised in an expert elicitation workshop.

Location, nature and level of uncertainties in the current risk studies were distinguished. Important assumptions identified were among others that the both distance and magnetic field strength in houses were taken as an indicator for exposure and no effect was assumed below 0.2 mT. All assumptions were prioritised and for some recommendations were made to examine them further. On the basis of the results an information leaflet is being developed which will be used in communicating uncertainties and risks concerning EMF of high-voltage cables on child leukaemia.

## ISEE-0858

**The Importance of Mercury Speciation in the Association of Mercury Exposure During Pregnancy with Elevated Maternal Blood Pressure**

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**Background and Objectives:** There is mixed evidence on the association between mercury exposure and blood pressure levels. Total mercury (THg), the most commonly measured mercury analyte, is a mixture of all mercury species. This study evaluates whether the relationship between mercury and blood pressure is species-dependent.

**Methods:** Speciated mercury was measured in 78 umbilical cord whole blood samples with THg  $\geq 2$   $\mu\text{g/L}$  among 300 samples collected during 2004–5. THg, methyl mercury (MeHg) and inorganic mercury (IHg) were analyzed using ICP-MS or HPLC-ICP-MS, with limits of detection at 0.33, 0.48, and 0.75  $\mu\text{g/L}$ , respectively. Maternal blood pressure was recorded at admission for labor and delivery using an automated sphygmomanometer. Linear regression models to predict maternal blood pressure used umbilical cord THg, or MeHg and IHg as independent variables, adjusting for maternal age, smoking and prepregnancy body mass index.

**Results:** Geometric means (95% confidence intervals) were 3.03 (2.78, 3.32)  $\mu\text{g/L}$  for THg; 2.68 (2.40, 2.98)  $\mu\text{g/L}$  for MeHg and 0.76 (0.70, 0.82)  $\mu\text{g/L}$  for IHg. THg was associated with a non-statistically significant decrease in blood pressure levels. An increase in 1  $\mu\text{g/L}$  MeHg was associated with

–1.33 (–3.07, 0.40) mmHg and –0.54 (–1.76, 0.68) mmHg change in systolic and diastolic blood pressure, respectively. An increase in 1  $\mu\text{g/L}$  IHg was associated with a 13.36 (0.25, 26.47) mmHg and 9.56 (0.39, 18.74) mmHg change in systolic and diastolic blood pressure.

**Conclusion:** In this exploratory analysis we found a strong association between IHg, but not MeHg, and higher blood pressure levels. This study demonstrates the importance of specific exposure characterization to evaluate exposure-effect relationships, in particular for mercury, which has different species with different toxicities.

## ISEE-0859

**Environmental Predictor of Allergen in Dust Samples and Its Relation to Total IgE Levels in Cord Blood in Cuernavaca, Morelos Mexico**

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**Background and Objective:** House dust mite exposure is an important risk factor for sensitization and subsequent development of allergic disease in genetically susceptible patients. Early infancy seem to be a critical period for primary sensitization. Our objectives were to identify predictors of indoor allergen exposure and to evaluate if indoor allergen exposure has a relationship with cord blood IgE levels.

**Methods:** In a cohort of 264 pregnant mothers, we evaluated prenatal environmental exposures by questionnaire. Allergen concentrations in dust samples ( $n = 264$ ) and total IgE levels in cord blood ( $n = 184$ ) were assessed. We used the lower limit of detection as a cutoff point to define increased allergen levels in dust samples and total IgE levels in cord blood as binary response (detectable vs. non detectable level (0.1 UI/ml)). We identified the main predictors of allergen levels in dust and used logistic regression models to predict total IgE levels in cord blood.

**Results:** 51.5% of homes had at least 4 detectable allergens. The main predictors of allergen levels in dust were size of housing, maid in the home, number of cars that pass by the house, pets at home, years of use of mattress, and insecticide use ( $P < 0.1$ ). Cord blood total IgE levels were significantly associated with Fel d 1 in dust (OR = 2.03, 95% CI 1.03 to 3.88) after adjustment for season.

**Conclusions:** Many environmental factors related to household hygiene can influence allergen levels in homes. An increase in cat allergen in the home is associated with high levels of total IgE in umbilical cord.

## ISEE-0863

**Schoolchildren Panel Study of Air Pollution from Biomass Burning in Amazon: Results by Gender and Age**

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**Background:** In the Amazon region several studies show that biomass burning plumes seem to have an important impact on human health.

**Objective:** To evaluate the effects of PM<sub>2.5</sub> from biomass burning on lung function in schoolchildren in the Brazilian Amazon region by gender and age.

**Methods:** A panel study with a sample of 309 schoolchildren from 6 to 15 years old. Daily measurements of PM<sub>2.5</sub>, temperature, humidity, respiratory symptoms and peak expiratory flow (PEF) were recorded during the dry season of 2006. Random effects models were used to



estimate the effects by gender and age groups. The exposure variable was the air pollution level on the current day.

**Results:** Children-specific temporal trends and exposures to temperature and humidity lagged by 2-days were regarded in the model. Moreover, height, weight, asthma diagnosis, gender, and age of the child were also adjusted for. The effect of air pollution on lung function was significant for boys from 12 to 15 years old. For every  $10 \mu\text{g}/\text{m}^3$  increase of  $\text{PM}_{2.5}$ , the PEF average decreased 0.62 l/min. For only asthmatic children, the effect was significant for girls aged 6 to 11 years. For every  $10 \mu\text{g}/\text{m}^3$  increase of  $\text{PM}_{2.5}$ , the PEF average increased 1.59 l/min. For only non-asthmatic children, the effect was significant for both boys and girls aged 12 to 15 years. For girls every  $10 \mu\text{g}/\text{m}^3$  increase of  $\text{PM}_{2.5}$ , the PEF average decreased 0.70 l/min whilst for boys every  $10 \mu\text{g}/\text{m}^3$  increase of  $\text{PM}_{2.5}$ , the PEF average decreased 0.73 l/min.

**Conclusion:** Exposure to fine particulate matter in the Brazilian Amazon region decreases the lung function of boys from 12 to 15 years old. However, for only non-asthmatic children exposure to air pollution decreases the lung function for boys and girls in the same age group.

#### ISEE-0864

##### The Correlation Between Indoor and Outdoor Bioaerosol at Homes of Different Height

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**Abstract:** Previous studies have suggested that reporting respiratory and allergic diseases is associated with exposure to indoor bioaerosols whose levels could be affected by outdoor source, and the respective environmental characteristics (temperature, relative humidity and wind speed etc.) at different height which might be linked to microbial growth. This study compared bioaerosol of indoor and outdoor by Burkard (Model PASA/B, Burkard Mfg Co., Richmansworth, UK) at 23 naturally-ventilated houses from five heights (3, 6, 9, 12 and 15 m). Duplicate samples, for average, were taken concurrently at inside the homes and outside at direction of prevailing wind. The sample size derived at a statistical power of >90%. There was no significant difference in temperature and relative humidity among sampling sites of five different heights with. The average bacterial concentrations being 7785 indoors and 1856 CFU/m<sup>3</sup> outdoors, and the fungal levels at 5400 and 7051 CFU/m<sup>3</sup>, respectively. The correlations were non-significant between temperature, relative humidity and level of airborne bacteria and fungi, neither were their levels with height of the sampling homes. The average I/O of the bacterial was 6.2 (0.7 ~ 22.8), while the fungi was 1.2 (0.3 ~ 2.9); yet, neither was found to be significantly linked with the heights of sampling homes. The current data do not seem to support a few previous investigations suggesting the role of height in affecting indoor microbial levels. Future work may aim to include sites of higher than 15 m before final conclusion.

#### ISEE-0867

##### Validity of 6-Minute Walk Test in Coal Workers' Pneumoconiosis Evaluations

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**Background and Objective:** Pneumoconiosis of coal workers is still one of the most essential occupational diseases occupied about 60–80% in Korea, so it is important to accurately estimate malfunction induced disorder. Diagnosis is generally based on history, examination, radiology and lung function test. However, those are not sufficient methods to confirm or refute a diagnosis of pneumoconiosis, so it is important to

develop complementary methods. Therefore the aim of this study investigated whether the 6-min walk test, which has been verified as practical in a broad type of respiratory impairments, is a reliable, valid, and sensitive test to assess the functional status of coal miners.

**Methods:** Data were collected from 86 ex-coal workers (80 men, 6 women) aged 54–82 years between April and June 2005. The data were collected during special health examinations at a specific hospital, and all participants submitted to a history, medical examination, pulmonary function tests, chest radiographs and 6-min walk test.

**Results:** The mean of the 6-min walk distance (6MWD) was 468.7 m. All variables were adjusted for the patient's age, gender, height and weight entering into all of the models. The 6MWD was significantly related to respiratory symptoms (cough and MRC dyspnea) and pulmonary function studies (FVC MVV Exercise Index). The 6MWD averaged 457.9 m for cough (yes,  $\geq 3$  months/y), 504.2 m (yes, <3 months/y) and 506.8 m (no) ( $P = 0.04$ ). The 6MWD averaged 533.7 m for MRC dyspnea (0), 497.7 m for (1), 467.7 m for (2) and 415.6 m for (3) ( $P = 0.04$ ). The 6MWD averaged 476.9 m for FVC ( $\geq 80\%$ ) and 423.7 m for (< 80%) ( $P = 0.03$ ). The 6MWD averaged 477.3 m for MVV (normal) and 395.6 m for (impaired) ( $P = 0.003$ ). The 6MWD averaged 490.5 m for Exercise Index (normal) and 466.8 m for (impaired) ( $P = 0.03$ ).

**Conclusion:** The 6-min walk test will be a complement to a diagnosis of coal workers pneumoconiosis.

#### ISEE-0868

##### Pests and Pesticides in the City: Washington, DC Survey

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**Background and Objective:** Pesticide studies tend to focus on agricultural workers and farms, but there is little known about city dwellers. Current urban integrated pest management (IPM) programs are severely hampered by not knowing what pests and pest control products low income are dealing with. Our study in Washington, DC is the largest examination of urban pests and pesticide uses.

**Methods:** After IRB approval, we surveyed 654 Washington, DC residents (> 18 years with valid identification) during summer 2008 seeking to understand what sorts of pests and pesticide products were used. Almost all respondents were interviewed at the city's libraries with a questionnaire that was either self-administered or led by trained interviewers.

**Results:** Residents reported many pests as problems in their residences, specifically ants, cockroaches, bedbugs, mice and rats, and many stated their dwellings were most commonly infested with mice/rats and cockroaches. Of those, the biggest problems appeared to be with mice and cockroaches. Residents favor using a variety of pest control approaches: spraying and applying poison for pests; having their landlords apply pesticides, as well as fixing screens to control pests. From these findings, it appears that D.C. consumers prefer pest control products that are safe for the environment, for pets, and for children, they need to be reasonably priced, and they need to be long-lasting.

**Conclusion:** Our findings suggest there is a strong need for community-based education programs that focus on preventing pests from entering residences as well as education related to safe uses. Specific information about stockpiles of products in the home is also necessary, particularly for households with children <6 years of age. Education is needed on the safe use, storage, and disposal of pesticides. Currently, this makes sustaining IPM programs very uncertain if their only target is to use products with low toxicity, without knowing the types of pests are common among city residents.

## ISEE-0869

**A Public Health Viewpoint on Climate Change Projections and Agricultural Sustainability in California: Heat Waves and Dairies as Case-in-Point**

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**Background/Objective:** Impacts of climate change on agricultural production is recognized as a critical public health issue for developing nations; and generally considered of less immediate concern to developed nations under the assumption of sufficient adaptive capacity to prevent significant adverse impacts on food availability and human health. California, USA, is developing climate change strategies for mitigation and adaptation. The public health sector has focused on food availability, quality, safety, and GHG reducing sustainable practices. The 2006 California heat wave, which was of unprecedented magnitude, highlighted the need to take a broader viewpoint on climate change effects on agriculture and potential human health impacts. California's Central Valley (CV) experienced a loss of ~1% of the state's dairy herd (25,000 cows), a 15% reduction in milk production, and a loss of 700,000 poultry—with an economic loss of about one billion US dollars.

**Objective:** Describe underappreciated interconnections between climate, agriculture, and human health, using example of heat waves and dairies, in light of California Climate Scenarios Project (CCSP) projections.

**Methods:** Semi-quantitative assessment based on review of literature, reports and discussions with State and local health and environmental officials, agricultural commissioners, and results from CCSP.

**Results:** Dairies were not prepared to handle the severity/duration of the event. Due to insufficient carcass processing capacity, under emergency guidelines most were buried, raising concerns for ground water quality/safety and air quality (including methane production). Psychosocial community stress was noted. Strategies to reduce heat stress risk in dairy cows rely heavily on water and power resources. CCSP projections indicate the CV will be prone to more intense day/nighttime and humid heat waves, and altered precipitation patterns, that will stress cows, energy and water resources, and community assets.

**Conclusion:** A more holistic assessment of the factors/risks connecting climate, agriculture, and human health is required, even in developed nations.

## ISEE-0870

**Climate Change in Mexico: Potential Zones of Epidemiological Impact of Dengue**

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**Background and Objective:** Evidences suggest that the climatic change influences the origin, intensification and redistribution of dengue. Based on the Maps prepared with the global distribution of dengue by means of developmental models that use climatic variables, we previously analyzed geographically small areas with weekly added information on temperature, precipitation and epidemiological variables. Generation of scenarios of climatic change in eco-regions of Mexico to evaluate the relation between the morbidity for dengue and the predominant climate, was our main objective.

**Methods and Model:** Projection of the morbidity for dengue due to climatic change in the different eco-regions in Mexico.

**Epidemiological Data:** The information of morbidity comes from the System of Informatics and Medical Geography of the National Institute of Public Health, Mexico.

**Climate Scenarios:** We used the exit of MGC (Model of Global Circulation), one of the most adequate for the Mexican territory: ECHAM5/MPI (version 5.3 of the software Magicc-Scengen).

**Results:** By the year 2030, approximately 7% of the excess cases of dengue will occur in the municipality of Rayon in the state of Chiapas. Similarly, approximately 5% will be in the Ixtlahuacan and Colima municipalities of the state of Colima. Possibly during June and September of the same year, the excess cases of dengue will happen in different municipalities in the states of Chiapas, Veracruz, Colima and Sonora. The excess cases in the above mentioned months coincide with the general pattern of precipitation and temperature.

**Conclusions:** It is necessary to include different indices of vulnerability of health, socio-economics and demographics with in the projection model. The target of this is to have a real approximation of a potential event and also modeling different climate scenarios.

## ISEE-0872

**Vitamin D and Asthma Symptoms in a Cohort of Inner-City Children in Baltimore, MD**

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**Background and Objectives:** Low vitamin D levels have been associated with a variety of health problems including increased risk for cancer, respiratory infections, atopy, and possibly asthma severity. The purpose of this paper is to examine the relationship between Serum vitamin D and symptoms in asthmatic children living in Baltimore, MD.

**Methods:** A cohort of 124 asthmatic children living in inner city Baltimore, MD had asthma symptoms and serum 25-hydroxyvitamin D assessed at baseline. Symptoms were also assessed at 3 months and 6 months. Longitudinal data analysis (GEE) was used to estimate the impact of vitamin D on asthma symptoms.

**Results:** Study participants were 2–6 years of age, predominantly African American (>90%) and from households of low economic status. Median serum vitamin D in this cohort was 29 ng/ml, with a range of 7 to 53 ng/ml. Fifty-five percent had serum levels less than normal (30 ng/ml), including a 23% with vitamin D deficiency (< 20 ng/ml).

Vitamin D levels were associated with symptoms of asthma, especially cough in the last two weeks. For every 1 ng/ml increase in vitamin D level there was a 2% reduction in the number of days of symptoms over the past 2 weeks ( $P < 0.05$ ). There was also a 1% increase in symptoms while running in the last two weeks for every 1 ng/ml increase in vitamin D that did not reach statistical significance ( $P < 0.17$ ).

**Conclusion:** Lower vitamin D levels are associated with increased cough among childhood asthmatics in a cohort of inner-city Baltimore pre-school aged children. Intervention studies are needed to determine if vitamin D supplementation can ameliorate symptoms of asthma in children.

## ISEE-0874

**Prenatal Exposure to Pyrethroid Insecticides and Infant Neurocognitive Development at 3 Years of Age**

Megan Williams,\* Dana Barr,† David Camann,‡ Andrew Rundle,\* Virginia Rauh,\* and Robin Whyatt,\* \*Columbia Center for Children's Environmental Health, New York, New York, United States; †Centers for Disease Control and Prevention, Atlanta, Georgia, United States; and ‡Southwest Research Institute, San Antonio, Texas, United States.

**Background and Objective:** We previously documented widespread use of spray insecticides among pregnant African American and Dominican women living in low-income, urban neighborhoods in New York City. Recently, we demonstrated a change in pesticide exposures as pyrethroids replace organophosphates following the 2000–2001 U.S. EPA pesticide

regulations. Pyrethroids are purportedly safer insecticides due to low volatility and rapid metabolism, yet experimental data suggest the potential for neurotoxicity following prenatal exposure. The objective of this study is to explore the association between prenatal exposure to permethrin, a common pyrethroid, and piperonyl butoxide (PBO), a pyrethroid synergist, and neurodevelopment among mother-infant pairs in our prospective cohort.

**Methods:** Neurodevelopment was assessed using the Bailey Scales of Infant Development (BSID-II) at 36-months of age. Exposure variables included permethrin and PBO in 3rd trimester personal air samples and permethrin in maternal and cord plasma collected at birth. We employed multiple logistic regression models treating PBO as a categorical variable (reference group = nondetectable, 1st-4th groups = quartiles of detectable levels) and permethrin as a dichotomous variable (nondetect vs. detect). All models adjusted for gender, ethnicity, prenatal ETS exposure, gestational age, maternal education, maternal IQ and quality of home environment.

**Results:** The odds of delayed mental development were 4.47 times as great (95% CI: 1.75–11.16;  $P = 0.002$ ) among children in the highest quartile of PBO exposure (median = 4.34 ng/m<sup>3</sup>) compared to children with lower prenatal piperonyl butoxide exposures ( $\leq 0.85$  ng/m<sup>3</sup>). There were no significant associations between cis- or trans-permethrin in either personal air or plasma and BSID-II scores at 36 months among children in this cohort.

**Conclusion:** Exploratory results show a significant association between PBO in personal air collected during pregnancy and delayed neurodevelopment at 36-months among children in this cohort.

#### ISEE-0877

##### Food Access Around the Home and Growth in the Body Mass Index of Children Aged 10–18 Years: A Longitudinal Cohort Study

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**Background:** Recent research on links between the built environment and overweight status has suggested that access to grocery stores or other markets selling fruits and vegetables may prevent unhealthy weight gain. Most of the published literature focuses on adults and uses cross-sectional data. The objective of this study is to examine access to food near homes in relation to the longitudinal growth in the Body Mass Index (BMI) of children.

**Methods:** Children aged 9–10 years ( $N = 2889$ ) were enrolled across multiple communities in Southern California in 1993 and 1996. Children were followed until age 18 or high school graduation to collect longitudinal information, including annual height and weight measurements. Multilevel growth curve models were used to assess the association between attained BMI levels at age 18 and food access around the home.

**Results:** Within a 500 m network buffer around the home, associations for attained BMI at age 18 were positive for all types food access, including grocery stores, restaurants and the combined sum of both types of food access. These results persisted even after controlling for numerous potential confounding variables at the individual, household, neighborhood, and town levels. Effects were generally larger in girls than in boys.

**Conclusions:** Previous findings from adult studies suggesting a protective effect of grocery stores may not extend to children and adolescents. The only protective effect in this cohort arose from not having any food stores within an easy walking distance of the home.

#### ISEE-0879

##### Daily Mortality and Air Pollution in Atlanta: August 1998–December 2006

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**Background and Objective:** Authors have previously published using two years of mortality data for the two largest counties in Atlanta, GA (Inhalation Toxicology 16, 2004). In response to questions regarding limiting the geographic area to only two counties, the authors investigate whether the estimated effects remain consistent in terms of magnitude and/or statistical significance with the addition of an extended mortality data series and/or larger geographic area of decedents.

**Methods:** The authors estimate the effects of pollution on human mortality for various AQI among decedents at least 65 years of age during 8/1/1998–12/31/2006. The authors also compare the effects for a four-county geographic area (Fulton, DeKalb, Gwinnett and Cobb counties) to the two-county area (Fulton and DeKalb counties) investigated previously.

**Results:** The estimated effects differ depending on the time series and geographic area. The estimated effect of PM<sub>2.5</sub> is lower in both magnitude and significance when estimated over the extended time series. Specifically, the published estimated effect for PM<sub>2.5</sub> was .0054 (2.96 t-value) for the period 8/1/1998–7/31/2000 compared to .0016 (1.83 t-value) for 8/1/1998–12/31/2006. The estimated effect declined further when estimated using mortality within the four-county geographic area. Results for other AQI are similar in that the estimated effects using the larger geographic area are generally lower, although t-values are higher in some instances.

**Conclusion:** Since it is difficult to define the “best” or most appropriate geographic area related to a specific measurement site, a comparison of various geographic definitions can illustrate the affect of different opinions on the estimated effects. The authors have shown the impact for a particular study location which should be replicated in other locations. It is likely, however, that no general pattern exists.

#### ISEE-0880

##### Potential Impact of Global Climate Change on Diarrhoeal Disease in Mexico

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**Background and Objective:** Diarrhoeal is one of the principal causes of childhood morbidity and mortality in developing countries. It causes 2 million deaths in children every year and is the major cause of childhood hospitalization. Increase of diarrhoeal diseases are linked to ambient temperature as well as contamination of groundwater-fed water supplies after rainfall events, therefore it is important to estimate whether future projections of climate change will induce the increase of cases of this disease.

The objective of this study is to project the future incidence of Diarrhoeal disease under a climate change scenario.

**Methods:** Climate change projections were generated by ECHAM general circulation climate model under A2 scenario assuming emissions in 550 ppm CO<sub>2</sub> by 2030. The excess of diarrhoeal diseases cases was estimated under this climate change scenario using (1) the average annual rate from 1998 to 2005; (2) literature base associating the increase of 5% of diarrhoeal cases with the increase of every °C of temperature and 10 mm of precipitation; and (3) the projected number of diarrhoeal cases per 100000 inhabitants to 2030.

**Results:** ECHAM A2 climate change scenario to 2030 is projected to increase the numbers of diarrhoeal cases by 5–12%. Most of the increase of cases is presented in the coastal areas during the months of June, July, August and September. July and September are projected to be the months with higher increase of precipitation, but not with higher increase of temperature.

**Conclusion:** Climate change is projected to increase the numbers of diarrhoeal cases and changes in precipitation are relevant to the results. Although some estimates of this disease have been calculated, these



estimates need to be adjusted by other factors that influences over the disease and using more climate change scenarios.

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**ISEE-0884****Database of Laboratories for Measurement of Exposure Biomarkers (MEB-Lab)**

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**Background and Objective:** Environmental epidemiology is a rapidly expanding field, fostered by the ever-increasing capacity to measure internal exposure to environmental chemicals. Researchers are often frustrated in their search for the best laboratory for their analyses of these chemicals in blood or urine. We have designed and developed a database of laboratories capable of measuring exposure biomarkers for research studies (MEB-Lab database).

**Methods:** The MEB-Lab searchable database contains detailed information about laboratories capable of measuring exposure biomarkers, offered as a resource to the community of environmental scientists. Data elements include the laboratory name, location, contact information, link to website, chemical biomarkers measured, analytic technique, limits of detection specific to the biologic media, and laboratory publications.

Users of the database are able to invoke simple standard queries to obtain information about laboratories that are capable of measuring a specified environmental biomarker or class of biomarkers, or to obtain information about the biomarkers measured by a specified laboratory. The design includes an online evaluation, triggered as the user exits the database.

**Results:** Currently this relational database includes information from 44 laboratories, gathered from their websites and other printed materials. Additional information has been received directly from 18 laboratories for this project provided by the National Institute of Environmental Health Sciences to the University of Cincinnati Center for Environmental Genetics (P30-ES06096), including the exact chemical and metal biomarkers measured and the laboratory limit of detection. Each laboratory is linked to information about 400 environmental biomarkers within 16 chemical classes. The database can be accessed through the University of Cincinnati Center for Environmental Health website [www.oh.ac.edu/ceg](http://www.oh.ac.edu/ceg), or at <http://cctst.uc.edu/meb/index.html>.

**Conclusions:** We continue to communicate with laboratories to acquire additional information to populate the database, and also modify the database based on evaluations from users.

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**ISEE-0887****Dietary Supplementation with Clean Food Improves Health Following Community Exposure to <sup>137</sup>Cs**

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**Introduction:** Little is known about the effectiveness of public health strategies to prevent adverse health outcomes following a community-wide radiological exposure event. Following the 1986 Chernobyl radiological disaster, government officials began a public health intervention to reduce children's radiological exposure. Every child in the agricultural Narodichesky Region was provided 3 complete meals of uncontaminated

food each day until the program funding was reduced in 1995 and only 1 meal was provided each day during the years since.

**Methods:** We examined the annual health screening data from 1993–1998 using a quasi-experimental interrupted time series design ( $n = 1,247$  children; 4,981 measurements). ARIMA models were used with the maximum likelihood estimation method to model adverse hematologic measures before and after 1995, controlling for child age, gender, soil <sup>137</sup>Cs level, born after the disaster, and an interaction of soil <sup>137</sup>Cs level with screening year.

**Results:** There were improving trends in hemoglobin concentration during both the intervention (years 1993–1995) and post-intervention period (years 1996–1998). However, the 1996–1998 post-intervention trend was significantly less than the intervention trend ( $P < 0.01$ ).

**Conclusion:** We found that the dietary intervention of clean food provision following community contamination with <sup>137</sup>Cs significantly reduced the burden of inhibited hemoglobin concentration.

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**ISEE-0890****Maternal Obesity and Dietary Intake of Polycyclic Aromatic Hydrocarbons During Pregnancy Jointly Affect Birth Weight**

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**Background:** To understand the sources of greater fetal vulnerability to the airborne polycyclic aromatic hydrocarbon (PAH) in the African-Americans, we examined the modification of the PAH effect by the maternal socioeconomic and lifestyle-related factors.

**Methods:** Nonsmoking, pregnant women with low risks of adverse birth outcome were monitored for their personal exposure to the airborne polycyclic aromatic hydrocarbons, and answered a questionnaire on health, lifestyle and exposure during third trimester. Birth outcomes were collected from the mother-newborn pair's medical records.

**Results:** After accounting for the independent risks of airborne PAHs, dietary intake of smoked, grilled or barbecued food items more than twice per week significantly reduced the birth weight by 312 g (95% CI, –528 to –97 g) among the African-Americans. Maternal obesity during the present pregnancy further exacerbated the airborne PAH risk by –88 g per one natural-log unit exposure (95% CI, –244 to 69 g) regardless of the ethnic background of the mothers. However, other factors, including being unmarried, secondhand smoke exposure, inability to pay for food, monthly rent, or clothing, respectively, were not associated with exacerbation of the airborne PAH risks.

**Conclusion:** High dietary intake of PAH sources appears to lower the birth weight for the African-American newborns. Furthermore, maternal obesity appears to exacerbate the airborne PAH risk.

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**ISEE-0891****Occupation and Brain Cancer: A Case Control in a Metropolitan Region of Rio de Janeiro, Brazil**

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**Background:** The increase of incidence and mortality rates of brain tumors in Brazil and overall the world has stimulated the inquiry of its etiological factors. Environmental exposure, mainly the occupational ones, has been extensively focused in the studies.

**Objective:** To identify associations between branches of economic activity and occupations related with brain tumors in adults, according to histological subtypes gliomas and meningiomas.

**Methods:** This case-control study of hospital base carried through in the metropolitan region of Rio de Janeiro, between 1999–2002. It was analyzed the occupational history of 239 cases and 267 controls, matched by frequency of sex and age, using the classifications for branches of economic activities and occupational groups.

**Results:** The risks had been esteemed by logistic regression with odds ratio (OR). In the analysis for activity branch, Agriculture presented OR: 2.52 (IC 95%: 1.15–5.53) for brain tumors with no histological stratification. Moreover, Social and Health, Public Administration and Education had presented Positive association without significance statistics. To meningiomas, its observed elevated risk in workers of the areas of Transport (OR: 3.14 IC 95%: 1.08–9.19) and Real Estate Activities (OR: 2.45, IC 95%: 1.17–5.15). In relation to the occupational groups, the agriculturists had presented significant risk: OR: 2.44 (IC 95%: 1.14–5.18). Direct association was evidenced in the groups of Transport/Production of Equipaments and Professional Armed Forces, whereas Technical Workers and Sell Workers had presented inverse association. The analysis for gliomas showed risk for Office Employees: OR: 2.33 (IC 95%: 1.02–5.29).

**Conclusion:** The findings suggest that agriculture workers, military and health professionals present risk for brain tumors, demanding new researches for identification of specific expositions.

#### ISEE-0892

##### Childhood Asthma Acute Primary Care Visits, Traffic, and Traffic-Related Pollutants

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**Background and Objective:** Prior research indicates that childhood asthma is associated with zinc and EC, which is suggestive of an association with roadway traffic. This study examines the relationship between traffic and asthma for exposures to indicators of tire wear particular matter as indicated by Zn, as well as diesel exhaust as indicated by PM<sub>2.5</sub> elemental carbon.

**Methods:** Members of the managed care organization who were aged 18 years and under and who had asthma were included in the study. Member home addresses were geocoded to latitude and longitude coordinates. A 300 m buffer for these coordinates was intersected with roadway traffic count data. For each subject, the sum of the length of roads in meters multiplied by the estimated average daily traffic was calculated. Zn and EC data were collected at a centrally-located monitor in the metropolitan area. Daily outpatient visit data were obtained from the electronic patient data warehouse. Poisson GLM determined associations between daily levels of acute visits for childhood asthma and Zn and EC for different levels of traffic measures over a 53-month study period.

**Results:** There were 13,664 unique addresses, and the mean monthly visits per member was  $0.0551 \pm 0.2590$ . Mean monthly traffic measures were significantly higher for members who had one visit in a given month compared to members who had zero visits in the month ( $P = .005$ ). Preliminary GLM results indicated the relationship between zinc and EC with asthma visits was statistically significant for members whose traffic measure was above the median as well as for those below the median.

**Conclusion:** Findings from this analysis are consistent with a hypothesis that children who are exposed to higher traffic levels have greater asthma attack rates. Further modeling will examine acute asthma visit associations with pollutants for children with the highest and lowest traffic measures.

#### ISEE-0893

##### The Impact of Agricultural Pesticide Use on the Prevalence of Adverse Perinatal Outcomes in Brazil

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**Background:** Epidemiological studies suggest that pesticide exposure may increase the risk of some adverse perinatal outcomes. In Brazil, where pesticide use is rising quickly, studies that evaluate the impact of pesticide exposure on perinatal outcomes prevalence are scarce.

**Objective:** To evaluate the degree of correlation between pesticide consumption in all Brazilian states in 2000 and perinatal outcomes the period between 2001 and 2005.

**Material and Methods:** Information about perinatal outcomes occurred in children born from 2001 to 2005 were collected from National Birth System. Spearman's correlation coefficients were obtained for pesticide consumption (per capita), total and types (herbicide, acaricide, fungicide, insecticide) and the following types of perinatal outcomes: low birth weight, preterm delivery, sex ratio and congenital abnormalities and twin births. In addition, states were divided into three groups according to their level of pesticide use (tertiles) and prevalence ratios were then calculated using first tertile as reference.

**Results:** Pesticide consumption showed moderate positive correlation with congenital abnormalities ( $r = 0.469$ ,  $P = 0.016$ ), low birth weight ( $r = 0.498$ ,  $P = 0.010$ ), preterm delivery ( $r = 0.419$ ,  $P = 0.033$ ), cryptorchidism ( $r = 0.452$ ,  $P = 0.020$ ), spontaneous abortion ( $r = 0.499$ ,  $P = 0.009$ ) and twin birth ( $r = 0.672$ ,  $P < 0.001$ ). We also observed a weak and non-significant negative correlation between pesticide consumption and sex ratio ( $r = -0.383$ ,  $P = 0.053$ ). For most perinatal outcomes, the perinatal outcomes' prevalence rates were higher in the states of moderate (2<sup>nd</sup> tertile) and high (3<sup>rd</sup> tertile) pesticide consumption.

**Conclusions:** Moderate-to-high correlation coefficients between pesticide consumption and some perinatal consumption were observed. The results suggest that population exposure to pesticides in 1999 in Brazilian states may have been associated with selected types of perinatal outcomes in the 2000s.

#### ISEE-0894

##### Sex Ratio and Organochlorine Pesticides: Time Series of 55 Years in an Exposed Population in Rio de Janeiro/Brazil

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**Background:** Cidade dos Meninos is a place in Duque de Caxias, Rio de Janeiro, Brazil where since the 1950s, people have been exposed to tons of abandoned organochlorine pesticides. These compounds are associated to some endocrine endpoints. One of them is to decrease sex ratio, even though evidence is not strong.

**Objectives:** To evaluate sex ratio at Cidade dos Meninos's population through 55 years.

**Material and Methods:** Sex ratio trends were investigated in Cidade dos Meninos from 1950 to 2005, according to births which parents were exposed to organochlorine (HCH, DDT, DDE, PCB and dioxins) spread all over since they were in utero. For the trend analysis, polynomial regression models were used. Four periods were designed to conduce trend analysis: before closing the factory (1), between the factory's closing and the time that the deposit was discovered (2), between the time that deposit was discovered and the Health Ministry intervention with calcium oxide (quicklime) (3), and after the Health Ministry intervention

with calcium oxide (quicklime) (4). Besides, chi-square statistic was obtained to evaluated significance.

**Results:** Sex ratio was clearly described as lower in periods (1) (ratio = 1.09) and especially in (4) (ratio = 0.93), in which the methodology used to neutralize organochlorine spread generated some other organochlorines as dioxins and furans. In the opposite way, the other periods (2) and (3) showed elevated sex ratio (respectively 1.35 and 1.53). Chi-square trend was statically significant ( $c_2 = 14.36$ ; 3df), and regression model obtained was strongly associated with the phenomenon ( $R^2 = 1$ ,  $P < 0.0001$ ).

**Conclusions:** These finds suggest that there is an association between organochlorine exposure and a male birth decrease.

#### ISEE-0895

##### Breast Cancer in Brazil: Time Trend and Correlation with Pesticide Consumption

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**Background:** Some pesticides are the focus of extensive studies as possibly responsible for some adverse reproductive and hormonal outcomes, such as adverse perinatal outcomes and some kinds of cancer, like breast cancer.

**Objective:** To analyze the time trend of breast cancer in Brazil between 1980 and 2005, and to estimate correlation between breast cancer mortality rates and pesticide consumption among Brazilian states.

**Material and Methods:** This is an ecological study conducted with secondary data obtained from the Mortality Information System (breast cancer mortality rates, standardized by age according to world population, between 1980 and 2005) and data from Agriculture Ministry (pesticide consumption from the 1997's), all of them among Brazilian states. It is considered that breast cancer mortality is a proxy for the total prevalence of breast cancer cases. Trend analysis of mortality rates were realized through polynomial regression model. Correlations between breast cancer mortality and pesticide consumption were estimated with Pearson coefficient.

**Results:** Breast cancer mortality rates trend showed a consistent regression linear model ( $y = 0.5427x + 8.5973$ ;  $R^2 = 0.8281$ ,  $P < 0.001$ ). Pearson coefficients were obtained to every type of pesticides: Total pesticide consumption ( $r = 0.618$ ,  $P = 0.001$ ), insecticide ( $r = 0.550$ ,  $P = 0.004$ ), herbicide ( $r = 0.652$ ,  $P < 0.001$ ), fungicide ( $r = 0.509$ ,  $P = 0.008$ ), acaricide ( $r = 0.411$ ,  $P = 0.037$ ).

**Conclusion:** Even though pesticide exposure and breast cancer is not clearly described as an associative relationship, this study corroborates some others, in other parts of the world to show this association.

#### ISEE-0896

##### Ozone, PM<sub>10</sub>, and Synoptic Circulation Patterns Associated with Asthma/Myocardial Infarction Hospital Admissions

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**Background and Objective:** Synoptic circulation patterns (large-scale tropospheric motion systems) are likely to affect air pollution and morbidity associations, in light of increased global warming and changing climatic patterns. We evaluated the effect of synoptic circulation patterns (air masses) on the association of air pollution (PM<sub>10</sub> and O<sub>3</sub>) and

asthma/myocardial infarction (MI) hospital admissions among adults in North Carolina.

**Methods:** Daily surface meteorology data (including precipitation, wind speed, dew point) for five selected cities in North Carolina were obtained from the Climate Data Center of the National Oceanic Atmospheric and Oceanic Administration. We used a spatial synoptic classification (SCC) system (Sheridan, 2002) to classify each day over the ten year period with one of eight different climatic patterns (dry polar, moist tropical, etc.). Daily 24 hour ambient concentrations of PM<sub>10</sub> and O<sub>3</sub>, were obtained from the U.S. EPA AQS (Air Quality System.) Asthma and MI hospital admissions data from a ten year period, 1996–2005, were obtained from the NC Department of Health and Human Services. Generalized linear models (GLMs) were used to assess the association of the hospitalizations with PM<sub>10</sub> and O<sub>3</sub> concentrations and specific air mass types with a zero to five day lag. We examined the effect across cities on days with same air mass type. In all models we adjusted for relative humidity, pressure, dew point, temperature, wind speed, and day-of-the-week effects.

**Results:** Ozone was associated with asthma and MI admissions under dry moderate air conditions (23% increase [95% CI 17, 30] and 17% increase [95%CI 10, 19], respectively.) PM<sub>10</sub> was associate with asthma hospitalizations (19% increase, 95%CI 6, 28], but not MI hospitalizations, under dry moderate conditions. A similar pattern was found for the moist tropical air mass.

**Conclusions:** Certain synoptic circulation patterns in conjunction with ambient air pollutant levels, were associated with increased asthma and MI hospitalizations.

#### ISEE-0897

##### Bounding Exposure Misclassification with Probability Bounds Analysis: Relaxing Assumptions of Independence in Food Frequency Questionnaire Responses and Behavior

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**Background and Objective:** Probability bounds analysis (PBA) was employed to examine exposure misclassification due to bias in dependencies between perception and behavior. This analytical approach to propagation of variability and uncertainty does not require assumptions about the distribution of uncertainty and facilitates consideration of all multimodal and multidirectional dependencies where specifics are unknown.

**Methods:** We evaluated a microexposure to contaminated drinking water. We determined the difference in daily consumption of 6-ounce equivalent glasses between hypothetical individuals reporting 8 and those reporting 4. We considered consumption as one estimate and the case where it is a composite of hot and cold water. The levels of variance employed are small compared to population levels observed in studies of nutrient intake by diet record and food frequency questionnaire. We assumed normal distributions and considered error in reported consumption using a standard deviation of 0.5 glasses and errors in volume at each consumption event using a standard deviation of 0.5 ounces. PBA was used to bound Monte Carlo Analysis (MCA) by considering dependencies in behavior and perception.

**Results:** The difference in consumption determined here is far from the expected value of 4 glasses, or that expected from a MCA of variability. Relaxing assumptions of independence between the quantity and volume of glasses results in a difference between 8 and 4 of -1 at the lower bound, to 9 glasses at the upper bound. When the total reported was compounded from hot and cold consumption, the difference ranged from -4 to 11.5 glasses. Allowing hot consumption to affect that of cold broadened bounds in the center of the distributions but not the tails.

**Conclusions:** Bias or unknown dependencies in narrow distributions can cause misclassification of exposure. PBA can be used to reveal the



importance of possible bias or unknown interactions in perception and behavior when evaluating or designing categorical exposure assignments.

#### ISEE-0898

##### The Public Perception of Electromagnetic Fields Risk in Taiwan

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**Background and Objective:** We investigated the public perception of risk, benefit and trust of various sources of electromagnetic fields (EMF, including base station, high-voltage transmission lines, transformer, mobile phone, microwave oven, and wireless internet) by a randomized telephone interview survey in Taiwan.

**Methods:** The telephone survey was conducted by the Center for Survey Research, Academia Sinica in October 2008. We collected 2,035 effective samples, with a response rate of 16.3% and a refusal rate of 38.2%. Since the sample was younger and with more female respondents as compared to the general population, we further adjusted the sample to the age and gender distribution of the 2007 nation-wide standard population.

**Results:** Taiwanese perceived high-voltage transmission lines, base station, and transformer as the most risky sources of EMF. Mobile phone and wireless internet were perceived as having higher benefits. As for the public trust in authority regulations, base station, microwave oven, and mobile phone received the lowest rating. Our study indicated that the perceived risk of EMF was negatively correlated with its benefit and trust, while benefit was correlated with its trust. Female, middle-aged, lower trust, lower benefit, and the belief that EMF may cause cancer were the major determinants of perceive risk in multivariate analysis.

**Conclusions:** Our study indicated that public trust in authority regulations of EMF played an important role in determining the public perceptions of EMF as well as age, gender, perceived benefit, and the belief that EMF may cause cancer.

#### ISEE-0902

##### The Risk Perception of Nanotechnology in Taiwanese General Population, Workers, and Experts

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**Background and Objectives:** We explored the risk perceptions of nanotechnology in Taiwanese general population, workers of nano-material plants, and nanotechnology experts.

**Methods:** We conducted a telephone survey (N = 2,035) in the general population, a questionnaire survey (N = 33) with workers, and a web-based survey (N = 52) with experts to collect the perceptions on nanotechnology in Taiwan. The respondents' perceptions of risks, benefits and trusts in the authorities associated with nanotechnology were further investigated.

**Results:** There were major differences in the perceptions of nanotechnology among the general population, workers, and experts. More than ninety percent of experts and more than eighty percent of the general population agreed that nanotechnology has potential benefits for the society. The percentage of experts that were "very worried" about the potential risks of inhalation exposures to nanoparticles was twice as high as that of the general population and the workers. More than eighty percent of workers worried about the adverse health effects of dermal exposures to nanoparticles. Trusts in authority regulations, nanotechnology industries, and mass media were generally low. Among the respondents ever heard of government regulations, the general population expressed more trust in the government while the experts' opinions were diverse.

The majority of respondents had not heard of the regulations regarding nanotechnology.

**Conclusions:** The perceptions of benefit, risk, and trust of nanotechnology among the general population, workers, and experts are significantly different. More risk perception and communication studies on different stakeholders are needed.

#### ISEE-0904

##### Paraoccupational and Environmental Mercury Exposure due to Small Scale Gold Mining in Central Nicaragua: A Cross-Sectional Assessment of Blood Mercury Levels in Children and Women

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**Objective:** To assess the local and regional impact of small-scale gold mining in Central Nicaragua on mercury exposure of the human population in these areas.

**Method:** We performed a cross-sectional assessment of mercury exposure in children and women living in gold-mining towns in central Nicaragua where the amalgamation process either was still used, or had been phased out, and to assess environmental mercury exposure in young women living in a downstream community located 100 km from mining area. Total mercury concentration in blood (B-Hg) was determined as a marker of exposure. Background information and potential determinants for mercury exposure were further investigated through using a semi-structured questionnaire. The fieldwork was carried out in 2006.

**Results:** Children and women from the general population in a small-scale artisanal gold mining town, where mercury was used for amalgamation, had elevated B-Hg levels compared to those living in a nearby mining town where mercury had not been used for 20 years. In miner's household members amalgam burning at home contributed to elevated B-Hg levels, especially if the burning took place indoors. In a community downstream from the mining area B-Hg levels were comparable with levels observed in miner's household members. In the downstream community, but not in the other areas studied, there was a clear correlation between fish consumption and B-Hg levels.

**Conclusion:** Our data suggests that the levels of mercury exposure for children and women can be reduced substantially by simple modifications of burning practices (e.g. amalgam burning in closed vessels at the local electrical mill plant, not at home). This study clearly identifies the downstream community being at a higher risk than the mining community proper. Clearly, there is a need for environmental monitoring of mercury concentrations in sediments and fish far downstream the gold mining areas in Nicaragua.

#### ISEE-0909

##### The Impact of Climate Change on the Future Incidence of Specified Foodborne Diseases in Ireland

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**Background and Objective:** Increases in mean temperatures may be expected in Ireland in coming decades as a result of climate change. The incidence of food-borne diseases may therefore be expected to rise. The purpose of this study is to quantify the future increases that may be expected in the incidence of salmonella, campylobacter, and Verocytogenic E. Coli.

**Methods:** Data on the incidence of salmonella, campylobacter, and Verocytogenic E. Coli were obtained from the HPSC, and meteorological data were obtained from Met Eireann, for the years 2004–2008. The present relationship of these diseases to mean temperatures was established.

Temperature outputs from the three global climate models were obtained and incorporated into the temperature-morbidity model established. To reduce systematic errors introduced by the modelling process, the output from the modelled baseline scenario was subtracted from the output of the future scenarios, and the differences in morbidity rates ascribed to the impacts of climate change. Morbidity outputs were established for three future time periods, 2010 to 2039, 2040 to 2069 and 2070 to 2099.

**Results:** Increases in the incidence of the three food-borne diseases were quantified. Increases in the region of 2% and 3% in the incidence of salmonella and campylobacter respectively may be expected. Most significantly, increases of approximately 10% in the incidence of the serious diseases, Verocytogenic E. Coli may occur in coming decades.

**Conclusions:** Food-borne disease is a significant cause of morbidity in Ireland; acute gastro-enteritis is one of the commonest reasons for visiting the family doctor in Ireland. In the absence of strict adherence to food hygiene practices, and as a result of temperature increases resulting from climate change, significant increases may be expected in the incidence of food-borne disease in Ireland.

#### ISEE-0910

##### Is ADHD a Risk Factor of Asthma?

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**Background and Objectives:** Both attention-deficit hyperactivity disorder (ADHD) and asthma are common childhood disorders and have increased rapidly in Korea over a couple of decades. Behavioral and emotional problems—such as ADHD—are known to be more common in children with asthma, but whether ADHD increases the risk of asthma is not clear yet. This study was conducted to evaluate the relationship between ADHD and asthma.

**Methods:** Children's Health and Environment Research (CHEER) survey is a prospective cohort study of children from 10 Korean cities. Between 2005 and 2006, we recruited 4,505 children who did not have asthma symptoms and history of asthma diagnosis and treatment in questionnaires of International Study of Asthma and Allergies in Children (ISAAC). Questionnaire survey on the general characteristics, developmental history, environmental exposure, and diet were done on the parents of the children. ADHD was evaluated with Conners and DuPaul Parent and Teacher Rating Scale. We derived adjusted odds ratio (aOR) and 95% confidence intervals (CIs) from logistic regression models controlling for potential confounders.

**Results:** Of 2,722 children who participated in the 2<sup>nd</sup> survey 2 years later, 163 children (6.0%) developed asthma symptoms. Mean age of the participants at the time of enrollment was 7.13 (SD 0.78) years and 51.4% were girls. Having ADHD symptoms was significantly associated with asthma symptom development 2 years later (aOR = 1.72; CI = 1.06–2.80). Maternal smoking (aOR = 2.58; CI = 1.24–5.34) was also associated with asthma symptom development.

**Conclusion:** Our results suggest ADHD may increase the risk of asthma development. Further analysis is needed to check the possibility of reverse causality.

#### ISEE-0911

##### Health Atlas Ireland – When Location Really Matters

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**Abstract:** Accessing large datasets, sophisticated analyses and quality mapping of health event and activity patterns have traditionally been time consuming and costly tasks that have often been outsourced on a once-off basis resulting in little institutional learning. Health Atlas Ireland was created by Health Intelligence, Health Service Executive (HSE) to resolve these challenges, achieve value for money, promote information governance, ensure in-house learning and enable internal and external collaboration across disciplines—planning, evaluation, epidemiology, research.

EU tendering processes was used to identify software developers (OpenApp). The Health Research Board and the HPSC provided seed funding. Subsequent resources were negotiated via CMOD. The system is web enabled using open source software with analysis systematised using R within an integrated and intuitive interface.

The following examples illustrate the depth of functionality:

- Identifying GP service black spots to 1 km<sup>2</sup> accuracy (spiderwebs, mesh maps).
- Hospital flows by patient source and discharge type/complexity (wagon-wheel mapping).
- Spatial representation of resource allocation inequalities (daisy wheel symbology).
- Supporting paediatric and cancer service reconfiguration to balance regional demand and skill mix.
- Spatial representation of hospital performance (indicator symbolisation).
- Address geocoding and location via imbedded GeoDirectory.
- Rapid census querying by service areas.
- Enabling “blue light” response in major emergencies—plume modeling, evacuation zones.
- Public interface allowing patients to find services and service providers to locate patients.

Health Atlas Ireland continues to meet the diverse and challenging intelligence needs of public health and informs service decision making at the highest level.

#### ISEE-0914

##### Association of Traffic-Related Air Pollution with Children's Neurobehavioral Functions in Quanzhou, China

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**Objectives:** The objective of this study was to explore the association between traffic-related air pollution exposure and its impacts of children's neurobehavioral functions.

**Methods:** A field study was conducted in Quanzhou, China where two primary schools were chosen based on traffic density and monitoring data of ambient air pollutants. School A was located in polluted area and School B in clear area. Nitrogen dioxide (NO<sub>2</sub>) and PM<sub>10</sub> at campus and classroom were monitored as the indicators for traffic-related air pollution. A battery of manual and computerized neurobehavioral testing was administered to evaluate children's neurobehavioral functions.

**Results:** Median concentrations of NO<sub>2</sub> in School A and School B campuses were 0.036 mg/m<sup>3</sup> and 0.007 mg/m<sup>3</sup>, respectively ( $P < 0.05$ ). The multivariate linear regression analyses showed that after controlling the potential confounding factors, children living in polluted area showed poorer performance on all tests, and the differences between 6 of 9 tests (66.7%) achieved statistical significance. They were Visual Simple Reaction Time with preferred hand and non-preferred hand, Continuous Performance, Digit Symbol, Aim Tracing and Sign Register, respectively.

**Conclusion:** Chronic low-level exposure to traffic-related air pollution may have a negative impact on children's neurobehavioral functions. More studies are needed to explore the potentially neurotoxic effects of traffic exhausts.

#### ISEE-0916

##### Blood Lead Levels of Rural Children and Its Trend in China

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**Objective:** To evaluate Chinese rural children's blood lead levels (BLLs) and identify its distribution features and to provide data for policy development to the prevention of rural environmental lead pollution.

**Methods:** Articles on rural children's BLLs published from 1994 to Oct, 2008, were collected using CNKI's (China National Knowledge Infrastructure) Chinese Journal Full-text Database and other ways. Articles are eligible for the following criteria were reviewed: (1) BLLs measured by Atomic Absorption Spectroscopy (graphite or others) or Inductively Coupled Plasma-mass Spectrometry; (2) strict quality control; (3) no local lead pollution sources in the areas where the screened subjects live; (4) children aged from 0 to 14 years old; (5) sample size bigger than 50.

**Results:** Analysis on the included 33 articles indicated that, the mean BLLs of Chinese rural children between 1994 and 2008 was 74.61 µg/L and 19.18% of the subjects have BLLs higher than 100 µg/L, which were both lower than the general children's BLLs between 1994 and 2008 that once reported as 83.82 µg/L and 26.38% respectively. Having the highest mean BLLs are children in Sichuan Province and Beijing City, with 145 µg/L and 100.40 µg/L respectively; while the lowest are children in Hebei Province and Jilin Province, with 54 µg/L and 41.14 µg/L respectively; children in Chinese southeastern coastal areas are in the middle level. The mean BLLs in rural areas and urban areas are 84.92 µg/L and 156.00 µg/L respectively, while the rate of children's BLLs higher than 100 µg/L are 21.59% and 39.51% respectively. The mean BLLs in rural areas and industrial areas are 70.77 µg/L and 146.92 µg/L respectively. The rural children's BLLs transferred from 87.53 µg/L to 71.90 µg/L after Chinese introduction of lead free gasoline in 2000.

**Conclusion:** The BLLs of rural children in China are lower than the general levels of children in China, the children's BLLs of rural areas were lower than that of urban areas as well as industrial areas.

#### ISEE-0918

##### A Case-Crossover Study Between Cold Wave and the Death of Many Kinds of Disease in Beijing

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**Objective:** Using case-crossover design to estimate the impact of cold wave to daily death counts in Beijing and evaluating the feasibility of case-crossover design in the study of relationship between weather and health.

**Method:** The data of death was from the Beijing Center for Disease Control and Prevention (CDC). The data of weather was provided from Institute of Urban Meteorology, CMA, Beijing. Case-crossover design was used to study the impact of cold wave from Jan. 1, 1998 to Jun. 30, 2000 to daily death of total death, non accidental death and different kinds of death; comparing the difference between one-direction retrospective and bi-directional control sampling approach.

**Result:** The statistics power of bi-directional control sampling approach is more powerful than one-directional retrospective. There are six cold waves, the first five ones lasting 2 days, the last one lasting 1 day. The temperatures decrease more than 8°, the biggest decreasing is more the 11°. The OR value always have a lag and the OR values are bigger than 1. The biggest OR values of each illness in bi-directional control sampling approach are: total death 1.367 (1.128~1.657), non-accidental death 1.355 (1.113~1.650), CVD 1.500 (1.032~2.181), CBD 1.681 (1.186~2.384), acute myocardial infarction 1.913 (1.066~3.432), respiratory diseases 3.091 (1.448~6.599), COPD 2.857 (1.088~7.506).

**Conclusion:** There are really effects between cold wave and daily death in Beijing; the use of case-crossover design to analyze the relationship between weather and health was feasible.

#### ISEE-0919

##### A Case-Crossover Study on the Heat Waves and Daily Death Counts

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**Objective:** To explore the effects of heat wave to daily death counts in Beijing.

**Methods:** The data of death was from the Beijing Center for Disease Control and Prevention (CDC). The data of weather was provided from Institute of Urban Meteorology, CMA, Beijing. Case-crossover design was used to study the impact of heat wave to death. All deaths in summer from Jan. 1, 1999 to Jun. 30, 2000 were cases. The controls were the 7th day before death to analyze the lag days, duration of the effects, and the hazard.

**Results:** There were five heat waves during the study period. The first heat wave sustained 9 days and the maximum temperature was 38.8°C with low humidity. The OR for the non-accidental death, cardiovascular disease and cerebrovascular disease were 1.442 ( $\chi^2 = 55.970$ ,  $P < 0.001$ ), 1.384 ( $\chi^2 = 9.499$ ,  $P = 0.002$ ) and 1.776 ( $\chi^2 = 32.438$ ,  $P < 0.001$ ), respectively. The second heat wave lasted 3 days, with the maximum temperature of 36.8°C and higher humidity than the first. The OR for the non-accidental death was 1.200 ( $\chi^2 = 2.730$ ,  $P = 0.098$ ). The third heat wave continued 7 days, with the maximum temperature of 41.5°C, and higher humidity than the first. The OR for all non-accident death, the daily death counts caused by cardiovascular disease, cerebrovascular diseases were 2.135 ( $\chi^2 = 215.082$ ,  $P < 0.001$ ), 2.613 ( $\chi^2 = 84.840$ ,  $P < 0.001$ ) and 2.317 ( $\chi^2 = 63.532$ ,  $P < 0.001$ ). The fourth last 3 days, with the maximum temperature of 39.6°C, low humidity. The OR for the non-accidental death and cerebrovascular diseases were 1.464 ( $\chi^2 = 4.529$ ,  $P = 0.033$ ) and 2.429 (Exact  $P < 0.064$ ). The fifth heat wave lasted for 4 days. The maximum temperature was 37.4°C, with low humidity during the period. The OR for daily death counts caused by all non-accidental and cardiovascular disease were 1.525 ( $\chi^2 = 6.040$ ,  $P = 0.014$ ) and 2.333 ( $\chi^2 = 5.625$ ,  $P = 0.018$ ), respectively.



**Conclusion:** There were significant increase for daily death counts in Beijing during the heat wave and there was lag days usually. The counts of non-accidental death was generally a time lag of 2~3 days. Cardiovascular disease and cerebrovascular disease deaths usually increase after 2~4 days. The increasing of air temperature was greater at the beginning of heat wave, the lag time was shorter. Fluctuations in daily maximum air temperature affected the death of cardiovascular disease death. The temperature rose higher after the beginning of the heat wave, the effects to cerebrovascular disease deaths was greater.

#### ISEE-0920

##### Interactive Effects of Particulate Matter and Temperature on Daily Non-Accidental Deaths in Beijing, China

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**Objective:** To analyze the interactions between particulate matter (TSP and PM<sub>10</sub>) and temperature on daily non-accidental deaths in Beijing, China.

**Methods:** The data of death was from the Beijing Center for Disease Control and Prevention (CDC). The data of weather was provided from Institute of Urban Meteorology, CMA, Beijing. The data of air quality was from the daily report of air quality in Beijing. Poisson semi-parametric generalized additive models (GAM) was used to examine whether there is interactive effects of particulate matter and temperature on daily non-accidental deaths for the period from Jan. 1, 1998 to Jun. 30, 2000 in Beijing, China. This was done through the use of joint particulate-temperature response curve and by stratifying the effect of particulate matter on daily non-accidental deaths by temperature.

**Results:** Result shows that temperature modifies the association between particulate matter and daily non-accidental death. A 10  $\mu\text{g}/\text{m}^3$  increase in TSP was associated with an increase of 0.177% (95% CI: 0.082%–0.272%), 0.052% (95% CI: 0.014%–0.071%) and 0.311% (95% CI: 0.438%–0.738%) in mortality at low moderate and high temperature which are stratified by the temperature of 5 percentile and 95 percentile; A 10  $\mu\text{g}/\text{m}^3$  increase in PM<sub>10</sub> was associated with an increase of 0.090% (95% CI: –0.026%, 0.288%), 0.185% (95% CI: 0.111%–0.225%) and 0.568% (95% CI: 0.517%–0.824%) in mortality at low, moderate and high temperature. Choosing different cut-points to investigate the sensitivity of the effect of particulate matter on daily non-accidental death finds that the increases in daily non-accidental deaths in high temperatures are larger than in moderate temperature per 10  $\mu\text{g}/\text{m}^3$  increase of TSP and PM<sub>10</sub>, and that most of the increases in mortality in low temperature are larger than in moderate temperature.

**Conclusion:** the result of this study suggests that it is important to evaluation the interactive effects of particulate and high temperature on daily non-accidental death.

#### ISEE-0934

##### Assessment of Health and Ecological Impact of Policy on a Legacy Contamination Case Study

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**Background and Objective:** To investigate the effect of policy decisions on the health and ecological impact of pollution in an industrial area.

**Methods:** A sustainability assessment methodology is applied to study the impacts of pollution in an industrial area of Bristol, UK. The effects of several regulatory/policy-related changes on a smelting facility sited in Avonmouth are investigated. Impacts considered in the investigation relate to levels of air pollution, human health effects and impacts on the local ecology. In this study the main driver or key question addressed is: what are the implications of various emission policies on ecological and health impacts? Several scenarios which represent a suite of regulatory changes imposed on the smelter over the operating period are considered. Firstly, a scenario models fate and transport of emissions with real site data. A second scenario considering constant emissions at 2002 levels investigates the impact of the smelter if a high level of intervention had been made from the start of the operations. A third scenario with constant emissions at peak levels allows consideration of the potential impacts if none of the interventions had been implemented.

**Results:** Actual Cd, PM<sub>10</sub>, As, Zn and Pb emissions data and associated information on the operating parameters and regulatory policies during each stage of the operating period are identified. Life cycle assessment modelling is carried out to examine the environmental burdens and associated life cycle impacts of the smelting operations on the local area and the wider environment. Air dispersion/deposition modelling is performed to identify the fate and transport of pollutants in the surrounding area. Results of this modelling work are then used in ecological impact assessment and human health impact analysis.

**Conclusion:** Analysis of the scenarios considered allows an assessment of the impact of the policy decisions on human and ecological health.

#### ISEE-0935

##### Development of a Software Based Decision Support Platform for Assessing the Impacts of Urban Pollutants

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**Background and Objective:** In order to fully assess the environmental, health and ecological impacts of changes in different products, processes and human activities occurring within an urban environment, a large number of research disciplines need to be considered. To address this a new software based decision support platform has been developed allowing sustainability assessment and comparison of various scenarios.

**Methods:** The decision-support framework is divided in three parts: problem structuring, problem analysis and problem resolution, the software platform follows the same approach. Following definition of sources of pollution, the software incorporates fate and transport models to map these pollutants as they progress through the urban environment. Tailored human health analysis and ecological impact modelling is then

used to assess the impacts, with uncertainty being considered. Additionally, the wider impacts of changes made within the urban environment, such as contribution to global warming or impacts of activities that feed into the urban environment are considered using Life Cycle Assessment and Substance Flow Analysis. Finally Multi-Criteria Decision Analysis tools are used to compare various scenarios in the context of various stakeholders viewpoints.

**Results:** The PURe Software Platform integrates these varied research disciplines into a cohesive package to aid planners, researchers and consultants in assessing the impacts of urban pollution. The integration is undertaken within the context of a Geographic Information System (GIS) allowing the clear visualisation of results at each stage of analysis. Throughout the development of the platform challenges have been faced in ensuring the correct integration of each model, thereby allowing the models to work alongside each other with minimal requirement for user intervention.

**Conclusion:** This paper outlines the development of this model and highlights some of the major challenges faced in combining discrete models and tools for performing fate and transport, impact modelling and life cycle assessment.

#### ISEE-0936

##### Acute Response to Exposure to Sarin in Veterans Tested at Porton Down

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**Background:** Porton Down is the UK's centre for research into chemical defence. Up to 30,000 servicemen have been involved in tests at Porton Down since WWI. Mortality and cancer incidence have been examined in over 18,000 Porton Down veterans who took part in tests between 1941 and 1989 (BMJ 2009). Here we draw on data from that cohort to describe exposures to the nerve agent sarin and measures of associated acute biological effect.

**Methods:** Data on chemical and non-chemical exposures were manually abstracted from the Porton Down historical archive. For every test, the name of the chemical(s) and date of test were abstracted. For nerve agents and vesicants, additional data were abstracted: exposure intensity, duration, route, presence of exposure modifiers. Maximum change in cholinesterase (ChE) was calculated. Data on pupil size change was also abstracted.

**Results:** Nerve agent tests took place between 1945 and 1987, when 3597 veterans were involved in 4299 tests. The most commonly tested nerve agent was sarin (2980 veterans; 3511 tests). Most sarin tests were by inhalation (85%) with 8% dermal and 3% ocular. Over half of sarin tests (53%) were unprotected.

Data on change in ChE were available for 712 inhalation and 273 dermal tests. For unprotected inhalation, median percentage RBC ChE activity decreased with increasing sarin exposure (Ct = concentration x time): for sarin Ct < 5 mg.min/m<sup>3</sup>, median ΔRBC ChE was -12%; for Ct > 10 mg.min/m<sup>3</sup>, median ΔRBC ChE was -45%). For tests with chemical protection median RBC ChE activity also decreased with increasing sarin exposure. Change in pupil size was available for 744 sarin tests.

**Conclusions:** Sarin was the nerve agent most frequently tested on veterans at Porton Down. Availability of data on exposure intensity and acute effect has allowed quantitative assessment of the effect on exposure of physical and chemical modifiers.

## SYMPOSIA PRESENTATIONS

#### ISEE-0015

##### The Value of Human Exposure Monitoring in the DEARS

Ron Williams,\* Alan Vette,\* Carry Croghan,\* Paul Jones,\* Carvin Stevens,\* Charles Rodes,† Jonathan Thornburg,† Phil Lawless,† and Hunter Daughtrey,‡ \*US Environmental Protection Agency, Research Triangle Park, United States; †RTI International, Research Triangle Park, United States; and ‡Alion Science and Technology, Research Triangle Park, United States.

**Abstract:** The US EPA recently completed the Detroit Exposure and Aerosol Research Study (DEARS). This three year field study (2004–2007) had a primary goal of understanding the agreement between community-based measurements of particulate matter (and its components) and select air toxics with those from matched daily personal and residential (indoor and outdoor) monitoring. A low-burden monitoring vest was used to station a compliment of both active and passive monitors on each participant. Nearly 36,000 pollutant measurements were obtained as well as almost 1200 participant monitoring days of survey information. Monitoring compliance (percentage of time a participant actually wore the vest each day) was determined to be an important factor in reducing surrogate uncertainty. Mean seasonal personal exposures to PM<sub>2.5</sub> of ambient origin (F<sub>pex</sub>) were determined to range from 0.56 to 0.80 once environmental tobacco smoke and personal monitoring compliance were factored. Ambient-based measures of volatile organic compounds (VOCs) were often less than acceptable surrogates of personal exposure. Ambient measures accounted for only 14 and 20% of the total personal exposure variability to benzene and 1,3 butadiene, respectively. Ambient-based measures of nitrogen dioxide were not significant predictors of human exposures (P = 0.17). DEARS data are providing the means to establish the uncertainty of ambient-based measures for epidemiological studies for a variety of pollutants. The value of which is the reduction in exposure misclassification in risk assessment or exposure modeling. Although this work was reviewed by EPA and approved for publication, it may not necessarily reflect official Agency policy.

#### ISEE-0064

##### Alignment of Personal and Planetary Health: Beyond Greenhouse Gases Alone

Gidon Eshel,\* and Pamela Martin,† \*Physics Dept., Bard College, Annandale-on-Hudson NY, United States; and †Geophysics Dept., Univ. of Chicago, Chicago IL, United States.

**Abstract:** The overarching theme of our talk will be the parallel nature of dietary choices' roles in individual, and planetary, health. The talk will start with a brief review of the impact of dietary choices on individual greenhouse gas footprint, and the alignment of nutritional and geophysical prudence. In the remainder, and bulk, of the talk, we will address two additional, and equally important, geophysical considerations of dietary choices, land use (spatial scope and intensity) and generation of biologically available Nitrogen-rich effluent. We will demonstrate that—just like in the case of greenhouse gas emissions, in which the clear fundamental choice is minimizing animal-based food in one's diet—vegetative diets also minimize the land used by one's diet, and the biologically available Nitrogen discharge it causes.

#### ISEE-0075

##### Algal Toxins in an Environmental Health Perspective

Ernesto Fattorusso, Patrizia Cimminiello, Carmela Dell'Aversano, and Martino Forino, University of Naples Federico II, Napoli, Italy.

**Abstract:** Marine toxins from harmful algae are listed among the most important causative agents of poisoning episodes involving seafood consumers. A wide diversity of algal toxins has been discovered so far; they rank among the most dangerous toxins. For some of them, doses of micrograms are lethal to humans. Well documented is the process through which shellfish accumulate toxins; other seafood, such as reef fish and crabs can also be affected by harmful algae. In addition to those toxins passed to consumers through the food chain, particular phytoplankton blooms can directly affect humans, which can get exposed to toxic algae through swimming or breathing aerosols. Some harmful algal proliferations can induce ecological disruption through killing of sea life.

The Mediterranean basin is home to a large variety of living species. Survival of this biodiversity depends on conservation of its necessary biotope. Unfortunately, many indicators have shown a declining quality of the Mediterranean seawater, as testified by the surge of harmful algal blooms in the last two decades. Although the causes for this expansion are still largely unknown, the growth of toxic plankton is sometimes intertwined with changes in weather conditions. Recently, a new threat has been impending over Mediterranean: the tropical alga *Ostreopsis ovata*. In summer 2005, the phenomenon broke out with alarming spread along the Italian coasts. Hundreds of people required medical attention after exposure to marine aerosol; the symptoms included fever associated with serious respiratory distress. We analyzed the toxic plankton through a new LC/MS method. The results allowed identifying the toxins: palytoxin, one the most potent toxins, and ovatoxin-a, a new molecule structurally related to palytoxin. Through the developed analytical method, a monitoring program along the coasts of Tyrrhenian southern Italy was developed in order to signal areas interested to toxic outbreaks and seafood contamination.

#### ISEE-0108

##### Residential Mobility, Cancer and Local Indicators of Geocoding Error

Geoffrey Jacquez,\*† and Robert Rommel,\* *\*BioMedware, Ann Arbor, MI, United States; and †The University of Michigan, Ann Arbor, MI, United States.*

**Background and Objective:** Although sources of error in geographic locations (e.g. geocoding error) used for describing and modeling spatial disease patterns are widely acknowledged, research on how such error impacts the results has been limited. In this paper we explore techniques for quantifying the perturbability of spatial weights to different specifications of geocoding error.

**Methods:** New measures for assessing impacts of geocoding error on spatial weights called leverage and perturbability are used to construct the LIGE (Local Indicators of Geocoding Error) scatterplot. We evaluate the approach in simulation studies, and then demonstrate it using a case-control study of bladder cancer in south-eastern Michigan.

**Results:** The LIGE scatterplot may be used to evaluate sensitivity of alternative spatial weight specifications to geocoding error both globally (when all locations are considered simultaneously) and locally (to identify those locations that would benefit most from increased geocoding accuracy).

**Conclusion:** Three results are significant. First, the shape of the geocoding error functions we explored (e.g. circular, elliptical, greek cross) is not important; what matters is the mean geocoding error and its variance. Second, our methodology allows researchers to evaluate the sensitivity of spatial statistics to geocoding error for specific geographies. This has substantial practical implications since it makes possible routine sensitivity analysis of spatial statistics to geocoding error. Third, those locations with high perturbability (most sensitive to geocoding error) and high leverage (that contribute the most to the spatial weight specification being considered) will benefit the most from increased geocoding accuracy, and are rapidly identified using the new visualization tool we call the LIGE scatterplot.

#### ISEE-0120

##### Ambient Air Pollution and Cardiac Malformations; A Register-Based Spatio-temporal Analysis

Payam Dadvand,\*† Judith Rankin,\* Stephen Rushton,\*† and Tanja Pless-Mulloli,\* *\*Institute of Health and Society, Newcastle University, Newcastle upon Tyne, United Kingdom; and †Institute for Research on Environment and Sustainability, Newcastle University, Newcastle upon Tyne, United Kingdom.*

**Objective:** To investigate the association between maternal exposure to ambient air pollution and the occurrence of congenital heart disease (CHD).

**Methods:** This case-control study used registry-based data on all CHD cases arising in the population of the Northeast England (1985–2003).

Exposure assessment and risk analysis were performed as two sub-studies. Sub-study I used exposure data on PM<sub>10</sub>, SO<sub>2</sub>, NO<sub>2</sub>, NO, CO, and ozone obtained from six automatic monitors for the period 1993–2003. Each study participant was assigned weekly average of pollutant levels measured by the closest operational monitor to the maternal residential postcode.

Sub-study II used data on black smoke (BS) and SO<sub>2</sub> obtained from 56 non-automatic monitors for the period 1985–1996. A two-stage spatiotemporal modeling approach was used to predict ambient pollutant levels at maternal residential postcodes for each week of their pregnancy.

Controls were matched to cases by year of birth with a control/case ratio of four to one. Single and multiple pollutant logistic regression models were used to quantify the adjusted odds ratios of exposure to air pollution and occurrence of each ICD-10 class of CHD and for the five most frequent individual CHD. Adjustment was performed for the year of birth, socioeconomic status, sex, season of conception, degree of urbanity. In sub-study II, a further analysis was carried out by using 1000 simulated exposure scenarios.

**Results:** In sub-study I, ventricular septal defect and congenital malformations of cardiac septa were found to be associated with exposure to CO and NO. Increased risk of congenital pulmonary stenosis and tetralogy of Fallot were detected due to exposure to CO and NO respectively. Sub-study II detected a weak association between maternal exposure to BS and congenital malformations of cardiac chambers and connections.

**Conclusion:** This study has demonstrated that maternal exposure to ambient air pollution increases the risk of specific CHD.

#### ISEE-0124

##### Improving Knowledge and Communication for Decision Making on Air Pollution and Health in Europe (Aphekom)

Hanns Moshammer,\* Bertil Forsberg,† Nino Künzli,‡ and Sylvia Medina,§,¶ *\*Medical University, Vienna, Austria; †Umea University, Umea, Sweden; ‡CREAL, Bracelona, Spain; §InVS, Paris, France; and ¶for the, Aphekom Team, Austria.*

**Abstract:** The health impact of current levels of air pollution (AP) is well established through epidemiological studies from all over the world and supported by mechanistic studies conducted in laboratories.

Short-term effects have been consistently shown in time-series and panel studies. Effect estimates are usually small but because exposure is widespread and concerned health endpoints are rather frequent, even these small effects pose a major threat to population's health. Long-term effects, studied mostly in cohort studies and underpinned by cross-sectional studies are stronger, although in Europe, robust studies are not numerous.

To encourage sound policy, reliable easy-to-understand information for decision makers, health professionals and the general public is vital, albeit not easy to achieve. Communication should neither evoke unreasonable fears nor should it neglect real risks, thus uncertainties on all levels should clearly be explained.



The EU-sponsored Aphekom project (Public Health Program EC Grant Agreement No.2007105) develops and delivers new information and tools so decision makers can set more effective local and European policies, health professionals can better advise vulnerable groups, and individuals can make better-informed decisions.

In specific, during the project's 2.5 years, Aphekom's more than 40 scientists in 25 European cities will develop health-impact indicators, and will report on health impacts and related costs. They will evaluate strategies designed to reduce AP. They will stimulate dialog between stakeholders. And they will provide guidance to health professionals on helping patients reduce their exposure to AP.

For Aphekom the ISEE conference is a welcomed opportunity to interact with the research community. This poster intends to stimulate this interaction through a short questionnaire asking the participants their opinion about AP, its relative importance for health, a rating of the most relevant pollution sources, and best approaches for community action. The questionnaire's answers will be collected during the conference and through the Aphekom Website.

#### ISEE-0127

##### Pesticide Exposures from Agricultural Applications in California and Gene-Environment Interactions in Parkinson's Disease

Beate Ritz, Angelika Manthripragada, Matthew Farrer, Myles Cockburn, Shannon Rhodes, and Jeff Bronstein, *UCLA, Los Angeles, United States.*

**Background and Objective:** Pesticide exposures are suspected to play a role in Parkinson's disease (PD), but well-designed studies that provide detailed information on specific exposure and genetic susceptibility to PD are rare.

**Methods:** We recruited 370 incident Parkinson's disease (PD) patients and 401 population controls into a case-control study in rural Central California and utilized the California pesticide use reporting system to create a GIS model for residential and occupational pesticide exposure. In addition, we analyzed DNA samples for polymorphisms in metabolic and PD pathway genes (DAT1 promoter clade diplotypes and 3'VNTR, PON1-55, VMAT2 promoter haplotypes).

**Results:** Among carriers of the variant MM PON1-55 genotype, organophosphate exposed but not unexposed individuals exhibited a greater than 2-fold increase in PD risk (e.g. for chlorpyrifos OR = 2.61 95% CI: 1.25, 5.44). Risk was also more pronounced in younger onset cases. Dopamine transporter gene (DAT1) susceptibility allele carriers (2+ alleles) with high exposure to paraquat and maneb exhibited a more than 4-fold risk increase (OR = 4.53; 95% CI 1.70, 12.1), and carriers of an over-expressor haplotype in the promoter region of the vesicular monoamine transporter gene (VMAT1) that sequesters dopamine and some neurotoxins into vesicles seemed to be less at risk of developing PD when pesticide exposed.

**Conclusion:** We show in our human data that exposure to specific pesticides may interact with genetic susceptibility factors for PD in biologic pathways as suggested by experimental data in animal and cell models.

#### ISEE-0148

##### Foodborne Viruses and Seafood Safety in an Environmental Health Perspective

Marion Koopmans,\*† *National institute of public health and the environment, Bilthoven, Netherlands; and* †*ErasmusMC, Rotterdam, Netherlands.*

**Abstract:** Aquaculture, including the production of shellfish, is one of the fastest growing food industries. With that, it is important to consider

microbiological contaminants that can be associated with this commodity. Bivalve filterfeeding shellfish are capable of filtering large quantities of water, thereby retaining viruses that may be present in the growing water. Contamination occurs when water is contaminated at source, e.g. by influx from sewage outlets or even overflow following heavy rainfall and flooding, which can be due to climate change. Market surveys performed all over the world have shown that virus contamination is common IN SEAFODD, and that noroviruses, enteroviruses and hepatitis A virus are commonly detected. This triggers the question how much disease can be attributed to shellfish consumption and the links to environmental contamination. Numerous outbreak reports can be found in the medical literature, but foodborne viral disease is poorly monitored and reported, and certainly not at a European level. Nevertheless, norovirus gastroenteritis and hepatitis A virus infection due to shellfish consumption are considered to be priority food-commodity/disease combinations for control of foodborne disease. This presentation will review the current knowledge as well as critical data gaps.

#### ISEE-0152

##### A Prospective Nested Case-Control Study of Serum Organochlorine Pesticides and Risk of Parkinson Disease

Marc Weisskopf,\*† Paul Knekt,‡ Eilis O'Reilly,\* Jukka Lyytinen,§ Antti Reunanen,‡ Francine Laden,\*† Larisa Altschul,\* and Alberto Ascherio,\*† *\*Harvard School of Public Health, Boston, MA, United States; †The Channing Laboratory, Department of Medicine, Harvard Medical School and Brigham and Women's Hospital, Boston, MA, United States; ‡National Institute for Health and Welfare, Helsinki, Finland, Finland; and §Department of Neurology, Helsinki University Central Hospital, Helsinki, Finland, Finland.*

**Background:** Pesticides have been implicated as a likely environmental risk factor for Parkinson's Disease (PD). No prior studies of pesticide exposures and PD, however, have examined biomarkers of exposure collected prior to the onset of PD. Our investigation sought to prospectively examine the association between serum biomarkers of exposure to organochlorine pesticides and incident PD.

**Methods:** We conducted a nested case-control study within the Finnish Mobile Clinic Health Examination Survey, with serum samples collected during 1968–1972, stored at –20° C, and analyzed in 2005–2007 for organochlorine pesticides using capillary gas chromatography. Incident PD cases were identified through the Social Insurance Institution's nationwide registry and confirmed by review of the medical records (n = 101). Controls (n = 349) were matched on age, sex, and municipality, and vital status. We used logistic regression to estimate adjusted odds ratios of PD.

**Results:** In analyses adjusted for age, sex, region, smoking, hypertension, triglycerides, cholesterol, and the other pesticides, a summary score of the serum concentrations of the five organochlorine pesticides found at high levels in this population was not related to PD risk. When each organochlorine compound was considered individually, only increasing dieldrin concentrations trended towards a higher risk of PD (odds ratio [OR] per interquartile range [iqr]: 1.27; 95% confidence interval [CI]: 0.96–1.67; *P* = 0.10). Because of possible strong confounding by cigarette smoking, we ran additional analyses restricted to never smokers (n = 68 cases, 183 controls). In these analyses, increasing dieldrin concentrations were associated with increased odds of PD (OR per iqr: 1.87; 95% CI: 1.20–2.91; *P* = 0.006). None of the other organochlorine pesticides were associated with PD in these analyses.

**Conclusions:** These results provide some support for an increased risk of PD with exposure to dieldrin, but chance or exposure correlation with other less persistent pesticides could contribute to our findings.

## ISEE-0157

**Ongoing Mobile Phone Research Studies and Latest Findings Where Available**

Aslak Harbo Poulsen, and Joachim Schüz, *Institute of Cancer Epidemiology, Danish Cancer Society, Copenhagen, Denmark.*

**Abstract:** There is some scientific and public concern that radiofrequency electromagnetic fields may increase risk of disease, especially in children, having thinner skulls, developing/immature brains and long lifespans. Many epidemiological studies have evaluated the relationship between mobile phones and health, particularly brain tumors. As pointed out by both WHO and EU, none of these studies have addressed the effects in children and most have been case-control studies which are by design limited to predefined outcomes and inherently prone to recall bias particularly with extended recall periods.

Several studies addressing these deficiencies are in progress. For adults **COSMOS**, a multinational cohort is being established in Denmark, Finland, Netherlands, Sweden and UK with a size (200,000+) and timeframe (25+ years) allowing detailed analyses even of rare outcomes and special user groups. Repeated questionnaires allow the study to reflect the evolving technology. The first population-based results have been provided by the less detailed cohort of adult **Danish subscription holders** (420,000) which has been analyzed for cancer and neurodegenerative diseases.

For children there now exist two cohort studies: **Danish National Birth Cohort**; mothers provided data on mobile phone exposure of their children (13,000), during pregnancy and childhood. The cohort has been analyzed for behavioral problems. **MORPhEUS**; an Australian study where 300 teenagers have repeatedly provided data on use of mobile phones and been tested for cognitive abilities. Furthermore two case-control studies of brain tumors in children are being setup: **CEFALO** is a collaboration between Denmark, Sweden, Switzerland, Norway, and the UK (start in 2005, age range: 6–19, expecting 550 cases in total). Exposure is assessed from structured interviews and operator provided records. **MobiKids**: Similar in design to CEFALO (age range: 10–24, expected cases: 1900, start in 2009, 12 countries).

## ISEE-0160

**Prenatal Exposure to the Major DDT Metabolite DDE and Longitudinal Measures of Body Mass Index in Boys from Southern Mexico**

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**Background and Objectives:** Recent data suggest that in utero exposure to DDE may reduce height and increase body mass index (BMI) in childhood, thus potentially raising the risk of adult health problems. The association between prenatal DDE exposure and growth was evaluated in 786 boys from Chiapas, a highly exposed area of Mexico. (Due to an initial study hypothesis regarding effects on other outcomes mediated by androgen-blocking, no girls were enrolled.) Median DDE levels in maternal serum at birth were 2.7  $\mu\text{g/g}$  lipids.

**Methods:** 2,629 measurements of recumbent length (cm) and weight (kg) were obtained in 2004–2005. Length and BMI ( $\text{kg/m}^2$ ) were age-standardized and reported as standard deviation scores (SDS). Multivariate random-effect models for longitudinal data with an unstructured covariance matrix were fitted. Models included child's age at measurement and interaction terms between age and each variable to estimate the association with rate of change (Singer & Willett, 2003. *Applied Longitudinal Data Analysis*, p.664).

**Results:** Median age during follow-up was 18 months (range: 5–38); median number of measurements per subject was 3, taken 3.2 months apart (median). After adjusting for child, maternal and socioeconomic

variables, and using  $\text{DDE} \leq 3 \mu\text{g/g}$  as the reference, those with  $>9 \mu\text{g/g}$  had an increase of 0.009 SDS (standard error,  $\text{SE} = 0.008$ ) in length per month (equivalent to 0.29 mm at 18 mo); the corresponding coefficient for BMI was  $-0.002$  ( $\text{SE} = 0.01$ ) ( $-0.003 \text{ kg/m}^2$  at 18 mo).

**Conclusion:** Our results do not support the prior findings of an association of childhood length or BMI with DDE exposure.

## ISEE-0164

**The Influence of Occupational and Residential Address Data and Additional Factors on Estimates of Historical Pesticide Exposure from a GIS Model**

Beate Ritz, Nicole Gatto, Anthony Wang, and Myles Cockburn, *UCLA, Los Angeles, United States.*

**Background and Objective:** Environmental and occupational life time pesticide exposures are suspected to play a role in chronic diseases such as cancer and Parkinson's disease (PD), but well-designed studies that provide detailed information on specific types of chemicals are rare.

**Methods:** We recruited 370 incident Parkinson's disease (PD) patients and 401 population controls into a case-control study in rural Central California and utilized the California pesticide use reporting system to create a GIS model for residential and occupational pesticide exposure based on subjects' address history between 1974 and 1999.

**Results:** We compared exposure measures for specific pesticides of interest relying on minimal residential address information only (such as current address) to those using long-term exposure measures based on both histories of residential and occupational addresses. We will show how these measures differ by age, sex and occupation and by geocoding accuracy. We will also provide some insights into models for different routes of pesticide exposure i.e. by air and soil vs. well water and occupational vs. environmental exposures only.

**Conclusions:** Our data allowed us to explore differences in long term pesticide exposure estimates depending on the type and accuracy of data employed in a geographic information system based model that relies on historical address data and pesticide application records.

## ISEE-0165

**Maternal Arsenic Exposure in Relation to Maternal and Child Adiposity and Risk Factors for Diabetes**

Adrienne Ettinger, *Harvard School of Public Health, Boston, MA, United States.*

**Introduction:** Accumulating evidence has shown an increased risk of Type 2 diabetes in general populations with arsenic exposure, but little is known about exposures during pregnancy and the association with gestational diabetes (GD). Infants born to mothers with GD are at increased risk of adverse birth outcomes, subsequent impaired glucose tolerance, and obesity.

**Methods:** Maternal arsenic exposure and risk of impaired glucose tolerance during pregnancy was examined in a population of pregnant women living in an area surrounding the Tar Creek Superfund site in Ottawa County, Oklahoma (USA). Infants born to these women were followed from birth to 24 months of age for growth and developmental outcomes.

**Results:** Maternal blood arsenic exposure ranged from 0.2 to 24.1  $\mu\text{g/L}$  (ppb)(mean  $1.7 \pm 1.5$ ). One-hour glucose levels ranged from 40–284 mg/dL (mean  $108.7 \pm 29.5$ ); impaired glucose tolerance was observed in 11.9% of women when using standard screening criterion ( $>140 \text{ mg/dL}$ ). Among this population of pregnant women, arsenic exposure was associated with increased risk of impaired GTT at 24–28 weeks gestation and, therefore, may be associated with increased risk of GD and subsequent adverse infant outcomes including development of childhood obesity. Neonatal glucose levels ranged from 25 to 130 mg/dL (mean  $69.6 \pm 17.3$ ); 6% of infants were born with hypoglycemia ( $<45 \text{ mg/dL}$ ). At

birth, almost 7% of infants were greater than 90<sup>th</sup> percentile for weight; however, this increased to 25% and 28%, respectively, at 12 and 24 months of age.

**Conclusion:** Understanding the effects of environmental exposures on glucose metabolism during pregnancy may have substantial public health importance beyond the direct effects on gestational diabetes. Better understanding of mechanisms responsible for development of obesity and modifiable risk factors such as environmental exposures, diet, and activity patterns, especially in children, may lead to efforts at primary prevention.

#### ISEE-0187

##### Blood Levels of Organochlorines Before, During and After Chemotherapy Among Non-Hodgkin Lymphoma (NHL) Patients

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**Background and Objective:** Associations between serum levels of organochlorines and risk of NHL have been examined in both population-based case-control and prospective cohort studies. The former have generally evaluated cases phlebotomized before treatment, to avoid potential treatment bias. Our previous report of 42 cases with low-grade follicular NHL treated with cyclophosphamide, doxorubicin, etoposide, and prednisone showed a significant decline in organochlorine serum levels following chemotherapy. The objective of the current study is to further explore this finding in additional cases.

**Methods:** We measured serum levels of PCBs and DDE (DDT metabolite) in samples collected before, during and after chemotherapy from 24 cases diagnosed with large B-cell lymphoma, and enrolled in an etoposide, vincristine, doxorubicin, cyclophosphamide, and prednisone clinical trial. Of 24 patients with a pre-treatment sample, 20, 18 and 15 patients gave a second, third and post-treatment sample, respectively. Changes in PCBs and DDE levels were examined over the course of chemotherapy.

**Results:** Lipid levels generally increased in most, but not all, cases during treatment, with levels returning to baseline in many, but not all, following chemotherapy. For the majority of patients, both lipid-corrected and -uncorrected PCB and DDE levels increased following the initiation of chemotherapy and declined through the follow-up visit, sometimes, but not always, falling below pre-treatment levels. The median % change between the lipid-corrected pre-treatment and post-treatment levels was -20.2% for PCBs and -17.3% for DDE.

**Conclusion:** Our results are consistent with the previous report suggesting that chemotherapy alters organochlorine serum levels. As certain organochlorines (e.g., dioxins) need to be measured in large amounts of serum that can be available in case-control studies but not usually in cohort studies, the case-control approach needs to continue to be utilized. It is critical however, that case-control studies examining this hypothesis use untreated cases to avoid misclassification of pre-diagnostic exposure.

#### ISEE-0191

##### Food Security, Nutrition and Health

Stuart Gillespie, International Food Policy Research Institute, Geneva, Switzerland.

**Abstract:** Agriculture, food security, nutrition and health are fundamentally linked, with the issues of food quantity and food quality being pivotal. While lack of energy is generally an issue only in highly food-insecure areas, micronutrient malnutrition is much more widespread and pervasive. As problems of insufficient and poor quality food persist, changes in the global environment are creating new emerging nutritional issues such as the “nutrition transition”—a process by which globalization,

urbanization and changes in lifestyle are linked to excess energy intake, poor quality diets, and low physical activity which lead to rapid rises in obesity and chronic diseases even among the poor in developing countries. Other major long-wave challenges currently pressuring agriculture-nutrition-health pathways include the AIDS epidemic in Africa, climate change and environmental degradation.

Yet despite these linkages and processes, agriculture and health policies and programmes tend to remain locked in sectoral silos, rarely integrated with each other. Agricultural policies address natural resource management, farmers' livelihoods, food security, and food safety—while public health policies revolve around the provision of prevention and curative care within clinic-based health systems. Agriculture is driven by an economic development rationale, while health aims to maximize human development. At the interface—and usually falling through the cracks—lies nutrition. Levels of chronic child malnutrition in Africa are disturbing, while in several south Asian countries which have seen high rates of economic growth, they are, to quote the Prime Minister of India, a source of “national shame”.

With partners from both health and agricultural organizations, the International Food Policy Research Institute (IFPRI) has recently developed the Agriculture and Health Research Platform (AHRP) to shed light on the links between agriculture, food security, nutrition and health, and to help break down the traditional barriers between the health and agricultural communities.

#### ISEE-0220

##### Similarities and Contrasts in the Social and Environmental Determinants of Weather-Related Mortality: Heat Versus Cold

Sari Kovats,\* and Tom Kosatsky,† \*London School of Hygiene and Tropical Medicine, London, United Kingdom; and †Environmental Health Services Division, BC Centre for Disease Control, British Columbia, Canada.

**Background:** Heat and cold are important determinants of daily mortality in Europe and North America.

**Methods:** Systematic review of the epidemiological literature on the environmental and social determinants of heat- and cold-related mortality.

**Results:** Overall, there has been a rapid increase in studies from Europe and North America on the determinants of heat mortality with less attention given to cold effects, although the latter are responsible for a greater burden of mortality. In most cities and regions in temperate climates, the annual function relating daily deaths to temperature is U-shaped, with the temperature-mortality nadir occurring at lower temperatures in cities with cooler mean temperature than in locations where average temperatures are higher. In general, the age incidence of heat-related mortality tends toward the elderly more than for cold. Studies have shown inconsistent results about differences in susceptibility to heat and cold by gender. Both hot and cold have appreciable effects on cardiovascular mortality, with stronger effects, but lower population burdens on respiratory mortality. Mortality displacement, while an important finding in heat-related mortality is less so for cold. The two have very different lag structures, 0–2 days in the case of heat and up to two weeks for cold. Marginalization, social isolation and lack of social contact is an important factor in heat wave-related mortality in the US, but not in Europe. Housing factors are more important than income as determinant of cold in England. Occupational exposures, homelessness and substance dependency are a determinant of both hyper- and hypothermia, although such deaths are few compared to the estimated burden of temperature-attributable mortality.

**Conclusions:** Knowing more about who is at risk and how is key to prevention planning and implementation.



**ISEE-0239****Ongoing RF Research Studies and Latest Findings Where Available, German Cross Sectional Studies, Bavarian Studies, Swiss Study, UK Base Station, etc.**

Katja Radon, Silke Thomas, Tobias Weinmann, Anja Kühnlein, and Sabine Heinrich, *Hospital of the LM University Munich, Munich, Germany*.

**Abstract:** Whether exposure to mobile telecommunication networks including base stations might negatively affect health and well-being is of public concern. While laboratory studies have illustrated that concern about the exposure may increase symptoms (nocebo effect), some epidemiologic studies using self-reported exposure as an exposure proxy showed an association between exposure to mobile phone base stations and self-reported well-being.

Facing these contradictory findings, mainly cross-sectional population-based studies were recently set-up in a variety of countries (e.g., Australia, France, Germany, the Netherlands, Switzerland, UK) using personal or stationary measurements or modified phones to assess exposure and self-reported symptoms as outcome. The objectives were (depending on the study) to identify 1) population exposure levels, 2) factors predicting individual exposure levels and 3) a potential association between exposure and well-being.

All studies indicated exposure levels well below the standard limits. Exposure levels were reproducible over one week. The major challenge was the limit of determination of the exposimeters as a large part of the measurements resulted in values below the limit. Individual exposure was determined by exposure to mobile phone base stations, use of cellular and wireless phones. While an association between self-reported exposure, concerns and well-being could sometimes be shown, no dose-response relationship between measured exposure and symptoms was found. However, two of the studies confirmed recent findings that exposure to mobile telecommunication networks might weakly be associated with behavioural problems in youngsters.

In conclusion, the nocebo effect described in laboratory studies could be reproduced in epidemiologic studies. Up to now, no consistent association between measured exposure and well-being could be shown across the age groups. Whether the association found between mobile telecommunication networks and behavioural problems might be due to the electromagnetic fields, the use of the mobile phones themselves or bias has to be shown in prospective studies.

**ISEE-0245****Association of Perfluorooctanoic Acid (PFOA) and Perfluorooctanesulfonate (PFOS) with Serum Lipids Among Adults Living Near a Chemical Plant**

Kyle Steenland, Sarah Tinker, Stephanie Frisbee, Alan Ducatman, and Viola Vaccarino, *Rollins Sch Pub Hlth, Emory U, Atlanta, Ga, United Kingdom*.

**Background:** Perfluorooctanoic acid (PFOA) and perfluorooctanesulfonate (PFOS) are compounds which do not occur in nature but have been widely used since World War II, and persist indefinitely in the environment. They are present in the serum of most Americans at about 4 ng/ml and 21 ng/ml, respectively. PFOA has been associated with cholesterol in a few studies of exposed workers.

**Methods:** We conducted a cross sectional study of lipids and PFOA and PFOS among 46,294 community residents age 18 and above, who drank water contaminated with PFOA from a chemical plant.

**Results:** The mean levels of serum PFOA and PFOS were 80 ng/ml (median 27) and 22 ng/ml (median 20) respectively. All lipid outcomes except HDL showed significant increasing trends by increasing decile of either compound. The predicted increase in cholesterol from lowest to highest decile of either PFOA or PFOS was 11–12 mg/dl. The odds ratios

for high cholesterol ( $\geq 240$  mg/dl) by increasing quartile of PFOA, were 1.00, 1.21 (1.12–1.31), 1.33 (1.23–1.43), and 1.40 (1.29–1.51), and were similar for quartiles of PFOS.

**Conclusions:** Due to the cross sectional nature of these data, causal inference is limited. Nonetheless, the associations between these compounds and lipids raise concerns, given their common presence in the general population.

**ISEE-0293****Investigation into Levels of Persistent Organic Pollutants in Fishery Produce Available on the Irish Market**

Rhodri Evans,\* Christina Tlustos,\* Iona Pratt,\* Brendan McHugh,† Linda Tyrrell,† and Evin McGovern,† *\*Food Safety Authority of Ireland, Dublin, Ireland; and †Marine Institute, Oranmore, Co. Galway, Ireland*.

**Background and Objective:** Persistent organic pollutants (POPs), including PCBs and dioxins which may be present in seafood have been suggested to present a risk to public health if these products are regularly consumed in moderate quantities. The results of a survey on levels of a range of persistent organic pollutants (POPs) in various fish species available on the Irish market are presented here. The POPs analysed as part of ongoing surveillance by FSAI over recent years include polybrominated diphenyl ethers (PBDEs), hexabromocyclododecane diastereomers (HBCD), polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs), and also dioxin-like and non dioxin-like polychlorinated biphenyls (DL- and NDL-PCBs).

**Methods:** Samples comprised farmed and wild Atlantic salmon, fresh herring, mackerel, tuna and shellfish, smoked farmed salmon and canned salmon, tuna, herring, sardines and mackerel. Muscle samples were homogenised and total lipid content was determined using the Smedes method[1]. Analysis of PCDD/Fs and PCBs was performed using HRGC/HRMS, whereas PBDEs were analysed using GC-MS and HBCD isomers were analysed using LC-MS/MS.

**Results and Conclusions:** In general the levels of all POPs examined in seafood available on the Irish market are low when compared to other European Member States, and well within the maximum permitted levels for these substances established in EC legislation. Exposure estimates indicate consumer intakes of these substances in Ireland are well below internationally established guideline values. The risks and benefits of consumption of seafood containing POPs will be explored in this talk, together with the trends towards decreasing levels as a result of regulatory controls on emissions of these environmental emissions and on levels in food and feed.

[1] Smedes, F. (1999). Determination of total lipid using non-chlorinated solvents. *Analyst*. Vol 124, 1711–1718.

**ISEE-0301****Results from Biomonitoring in 5 Repeated German HBM Surveys—The German Environmental Surveys (GerES)**

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**Background and Objectives:** The German Environmental Surveys (GerES) are large scale population studies, repeatedly been carried out since the mid-1980s. GerES I (1985/1986), GerES IIa/b (1990/92, West/East Germany), and GerES III (1998, reunified Germany) focussed mainly on adults, GerES IV (2003/06, incl. pilot study) exclusively on children. Objectives were to evaluate the body burden of pollutants in representative samples of the general population, to evaluate contributions of different pathways (air, water, food), and to link HBM, if possible, to toxicological or health data.

GerES is part of a health-related environmental surveillance system and was conducted in close co-operation with the National Health Interview and Examination Surveys of the Robert Koch Institute.

**Methods:** Participants were representatively chosen with regard to age, gender and community size. Main instruments used were human biomonitoring, ambient monitoring, and standardized interviews.

**Results:** HBM has been used and applied to health policy in Germany for several purposes. Examples are:

1. Identification of exposure pathways (phthalates, PAH, metals).
2. Development of strategies to prevent and reduce exposure (ban of PCP/other persistent biocides in wood preservatives or lead in fuel).
3. Evaluate success of regulation and policy-measures by time-trend analyses (metals, biocides, PBT/vPvB, adjustment of exposure after German reunification).
4. Support of environmental medicine by providing statistically derived reference values and epidemiologically/toxicologically founded HBM-values.
5. Recommend cautious use of amalgam fillings due to precautionary health reasons.
6. Improvement of the German Drinking Water Ordinance after GerES revealed exposure to metals via drinking water.

**Conclusions:** HBM serves as a scientific basis for the preparation of reasonable interventions to reduce exposure and to improve the quality of indoor air, drinking water and food.

**Acknowledgements:** We thank all GerES participants and their parents and gratefully acknowledge the financial support of the Federal Ministries for the Environment, Nature Conservation and Nuclear Safety and of Education and Research.

#### ISEE-0304

##### Traffic Noise and Physicians' Prescriptions of Drugs for Specific Diseases in the Urban Area of Rome

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**Background and Objective:** Road traffic is the main source of urban noise. In the context of the Rome Longitudinal Study (RoLS), we analyzed the association between residential road traffic noise and prescriptions for drugs reimbursed by the National Health Service for health problems potentially related to noise exposure, namely hypertension, stress related gastric problems and depression.

**Methods:** We selected 415,536 urban area residents, aged 46–71 years, who lived in the same place from 2001 to 2007. From the Regional Drug Dispense Registry, which comprises individual records for each medical prescription dispensed in public and private pharmacies, we selected drugs for hypertension (ATC codes: CO3, CO7, CO8, CO9), acid related disorders (AO2), and antidepressants (NO6A). On the basis of available traffic density data, Lday<sub>06.00–20.00</sub> and Night<sub>22.00–06.00</sub> sound levels from road traffic were estimated for each residence. The association between traffic noise (per 10 dB(A) increase of Lday and Night) and drug consumption (3+ prescriptions in a year for each ATC group) was analysed through logistic models.

**Results:** Average Lday was 63.6 (maximum 75.6) dB(A), and average Night was 53.3 (maximum 66.1) dB(A). The proportion exposed to Lday >70 dB(A) was 3.8% and Night >60 dB(A) was 3.7%. Adjusting for gender, age, education, socioeconomic level, and residential area, we found a statistically significant trend (per 10 dB(A)) for antihypertensive treatment (OR = 1.03; 95% CI 1.01–1.04) for both Lday and Night. The OR was 1.11 (95%CI 1.05–1.18) comparing the highest category of Lday 70+ versus <50 dB(A); for Night 60+ versus <40 dB(A) the OR was 1.05 (95%CI 1.02–1.09) No clear trend was observed for the other drugs.

**Conclusions:** Community traffic noise exposure is associated with an increased level of drug prescriptions for hypertension.

#### ISEE-0312

##### Aircraft Noise Exposure and Use of Medication

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**Abstract:** Long-term exposure to noise from aircraft and road traffic is associated with effects on well-being such as sleep disturbance and annoyance and with pathophysiological outcomes such as hypertension. Within the framework of the HYENA (Hypertension and Exposure to Noise near Airports) project, we investigated the effect of long-term exposure to aircraft and road noise on the usage of selected prescribed medication.

Use of prescribed medication for hypertension, stomach ulcer, cancer, sleep disorders, psychiatric disorders and respiratory diseases was measured by a cross-sectional survey of 4,861 persons 45–70 years of age, who had lived at least 5 years (3 years for Greece) near any of six major European airports. Exposure was assessed using detailed models with a resolution of 1dB (5dB for UK road traffic noise) and spatial resolution of 250×250 m<sup>2</sup> for aircraft noise and 10×10 m<sup>2</sup> for road traffic noise.

An increased risk of taking anti-hypertensive and anxiolytic medication was found for those exposed to aircraft noise at night, after adjustment for major confounders, but not for the other drugs under investigation. A 10dB increase in night-time aircraft noise exposure was associated with an odds ratio (OR) of 1.10 (95% CI, 1.02–1.20) in taking anti-hypertensives and OR of 1.29 (95% CI, 1.03–1.62) for taking anxiolytics. A higher risk of taking anxiolytics was observed for women vs men (OR = 2.52; 95%CI: 1.68–3.79) and differences were observed between countries.

Results indicate excess risks of using anti-hypertensive and anxiolytic medication related to long-term exposure to aircraft noise. The association found between aircraft noise and anxiolytic use is consistent with the hypothesis suggesting that health effects of noise are stress-mediated.

#### ISEE-0314

##### Enabling Comparison of Aflatoxin B1 Exposure in Different Study Populations Using Different Measurement Techniques

Leslie McCoy,\* Rosemary Schleicher,† and Carissa Powers,† \*CDC (Battelle), Atlanta, United States; and †Centers for Disease Control and Prevention, Atlanta, United States.

**Background and Objective:** Over the last several decades, biomarkers have been developed to assess human dietary exposure to aflatoxins essential to epidemiological studies. The most frequently used biomarker has been aflatoxin B albumin adduct(s), and several techniques have been developed to quantitate this biomarker(s) including high-performance liquid chromatography with fluorescent detection (HPLC-f), ELISA, RIA, and isotope dilution mass spectrometry (IDMS). Because these methods reflect different analytical approaches, the levels between methods are not equivalent and confound comparative interpretations. We present a comparative study using the different analytical methods with the same sample set and use the results to 'normalize' aflatoxin adduct levels for different studies.

**Methods:** Human serum samples ( $n = 102$ ) from the 2004 Kenya aflatoxicosis outbreak (Azziz-Baumgartner et al., 2005) and a USA blood bank ( $n = 28$ ) were analyzed by ELISA, HPLC-f, and IDMS in laboratories having appropriate analytical expertise (McCoy et al., 2008). The relationship between methods was evaluated by Deming or Pearson correlations. More recent studies conducted by IDMS at the CDC have examined aflatoxin levels in different African populations.

**Results:** The Deming slope for HPLC-f/IDMS was 0.71, ( $r^2 = 0.95$ ) and for ELISA/IDMS was 3.3 ( $r^2 = 0.96$ ). The estimated slope for RIA/IDMS  $\sim 50$  based upon estimates derived from Wang et al. (1996). Acute levels from the 2004 aflatoxin outbreak were up to 17.7 ng/mg albumin by IDMS; however, the same method did not detect levels above 1 pg/mg albumin in serum from USA subjects. Comparisons with more recent analysis and with historical analysis in parts of Africa indicate chronic aflatoxin levels higher in these groups than in the USA population, but much lower than in acute exposure.

**Conclusions:** The capability to compare aflatoxin adduct levels across methods and epidemiological studies should facilitate the interpretation of related study results.

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#### ISEE-0315

##### Aflatoxicosis and Food Contamination: Food Monitoring in High Risk Populations

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**Background and Objectives:** Aflatoxin, a potent fungal toxin, contaminates approximately 25% of crops worldwide. Since 2004, 477 aflatoxin poisonings have occurred in Eastern Kenya due to contaminated, homegrown maize (41% case-fatality rate). Because standard laboratory tests for aflatoxins in maize cannot be conducted in rural areas, local officials use visual inspection to screen for mold. To improve detection of aflatoxins in maize, an existing chromatographic rapid screening tool was modified for use in rural Kenya and its performance evaluated in 2006 and 2007.

**Methods:** A total of 421 households were randomly selected from affected districts. Maize was collected from each household and screened using visual inspection and the rapid screening tool. The sensitivity, specificity, and predictive value positive (PVP) of visual inspection and the rapid screening tool to detect aflatoxins above the regulatory limit (20ppb) were determined by comparing screening results to results from VICAM<sup>TM</sup> immunoaffinity fluorometric methods, representing the gold standard.

**Results:** In 2006, maize from 85 (52%) of 165 households had aflatoxin levels  $>20$ ppb compared to 40 (16%) of 256 in 2007. Modified rapid screening sensitivity was 90% and specificity was 96%. The PVP decreased from 97% to 78% between 2006 and 2007 due to decreased prevalence of contamination. Visual inspection sensitivity and specificity were 29% and 81%; PVP was 65% in 2006 and 17% in 2007. At very high levels ( $>200$ ppb), rapid screening sensitivity was 100%, while visual screening sensitivity was 32%.

**Conclusion:** The rapid screening tool performed better than visual screening, particularly at the highest levels of contamination. Findings suggest that rapid screening may improve early detection and control of aflatoxin contamination in Kenya and provide a useful tool for preventing aflatoxin poisoning worldwide.

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#### ISEE-0319

##### An Estimate of the Burden of Disease from Methylmercury in Various Global Regions

Herman Gibb,\* and Jessie Buckley,† *\*Tetra Tech Sciences, Arlington, VA, United States; and †University of North Carolina, Chapel Hill, NC, United States.*

**Background and Objective:** The contamination of fish and shellfish by methylmercury in Minamata Bay, Japan dramatically demonstrated methylmercury's neurotoxic effects, which were particularly severe among infants exposed during the prenatal period. In recent years, concern has centered on exposure to methylmercury among subsistence fishers, sport fishers, persons eating particular types of fish, and indigenous communities near industrial and mining activities where mercury is emitted (e.g., gold mining). This presentation estimates the burden of disease from prenatal methylmercury exposure in several high-risk groups.

**Methods:** A dose-response relationship between mercury in maternal hair and IQ has previously been published. The current analysis identified data on the distribution of hair mercury concentrations in women of child-bearing age in populations throughout the world. Based on these distributions, IQ deficits in infants were estimated and an incidence rate of methylmercury-induced mild mental retardation (MMR) was estimated. The resulting disease burden measured in Disability Adjusted Life Years (DALY) was then calculated.

**Results:** The incidence rate for MMR is estimated to be as high as 17.37 per 1000 infants born among a subsistence fishing population in the Amazon, resulting in a loss of 202.8 DALYs per 1000 infants. Other populations in which a disease burden was estimated include subsistence and sport fishers in Canada, Japanese fish consumers in Akita prefecture, and Chinese fish consumers.

**Conclusion:** Quantification of the disease burden provides an important basis for targeting populations at risk for health deficits important to public health. The challenge for risk communication is how to balance the message of risk with the benefits of fish and shellfish consumption. Ideally, the burden of disease from methylmercury should be primarily focused on lowering the amount of mercury in the environment rather than by managing fish consumption.

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#### ISEE-0335

##### Potential Contributions of Food Consumption Patterns to Climate Change

Annika Carlsson-Kanyama, and Alejandro Gonzales,\**FOI, Stockholm, Sweden; and †Research institute of bioiversity and the environment, Bariloche, Argentina.*

**Abstract:** Anthropogenic warming is mainly caused by emissions of greenhouse gases such as carbon dioxide ( $\text{CO}_2$ ), methane ( $\text{CH}_4$ ) and nitrous oxide ( $\text{N}_2\text{O}$ ) with agriculture as a main contributor for the latter two gases. Other parts of the food system contribute  $\text{CO}_2$  emissions that emanate from the use of fossil fuels in transportation, processing, retailing, storage and preparation. Food items differ substantially when greenhouse gas emissions are calculated from farm to table. A recent study of about 20 items sold in Sweden showed a span from 0.4 kg  $\text{CO}_2$  equivalents per kg edible product to 30 kg  $\text{CO}_2$  equivalents. For protein rich food such as legumes, meat, fish, cheese and eggs the difference is a factor 30 with the lowest emissions per kg for legumes, poultry and eggs and the highest for beef, cheese and pork. Large emissions for ruminants are mainly explained by  $\text{CH}_4$  emissions coming from enteric fermentation. For vegetables and fruits, emissions are usually not more than 2.5 kg  $\text{CO}_2$  equivalents per kg product, even if there is a high degree of processing and substantial transportation. Products transported by plane are an exception as emissions may be as large as for certain meats. Emission from foods rich in carbohydrates such as potatoes, pasta and wheat are less than 1.1 kg per kg edible food.

**Conclusion:** We suggest that changes in the diet, towards more plant-based foods, towards meat from animals with little enteric fermentation and towards foods processed in an energy efficient manner present an interesting and little explored area for mitigating climate change.



## ISEE-0341

**Socio-Demographic, Health and Clinical Predictors of High Aflatoxin Levels in HIV Positive Ghanaians**

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**Background and Objective:** Few studies have investigated the effect of aflatoxin on the health/clinical status in humans. We measured aflatoxin B<sub>1</sub> albumin adduct (AF-ALB) levels in plasma of HIV positive and negative Ghanaians, and examined the relationship between AF-ALB levels and demographic, health and clinical characteristics in the HIV positive group.

**Methods:** We conducted a cross-sectional study in the Ashanti Region of Ghana using a convenience sample of 156 HIV positive and 158 HIV negative individuals. Participants completed an interviewer-administered demographic and health survey and donated blood to assess AF-ALB levels, liver function, hepatitis B virus infection, malaria antigen, CD4 count and HIV viral load.

**Results:** Almost all (99.68%) participants had AF-ALB in their plasma. The mean AF-ALB was significantly higher for the HIV positive group (mean  $\pm$  SD = 1.064  $\pm$  0.598 pmol/mg) than for the HIV negative group (mean  $\pm$  SD = 0.908  $\pm$  0.463 pmol/mg;  $P$  = 0.011). HIV positive participants were divided into high and low AF-ALB groups based on their median AF-ALB level (0.929 pmol/mg) for analysis. Higher proportions of HIV positive participants with high AF-ALB reported symptoms similar to those seen in acute aflatoxicosis—yellow eyes (19.2% vs 9.1%,  $P$  = 0.07); pale stool (12.8% vs 3.9%,  $P$  = 0.05); and vomiting (20.5% vs 10.4%,  $P$  = 0.08). A higher proportion of HIV positive participants with high AF-ALB levels had high (>1.0 mg/dL) total bilirubin (12% vs 4%,  $P$  = 0.07) and high (>0.3 mg/dL) direct bilirubin levels (10% vs. 1%,  $P$  = 0.02). By multivariate analysis, there were statistically significant associations (all  $P$  < 0.05) between employment status, yellow eyes, CD4 count, and direct bilirubin levels with AF-ALB levels.

**Conclusion:** These findings suggest that among people exposed to dietary aflatoxin those who are HIV positive may accumulate higher levels of AF-ALB in their blood. Certain health/clinical factors have been identified as predictors of high AF-ALB levels.

## ISEE-0359

**Serum PFOA and PFOS and Pregnancy Outcome**

David Savitz, Cheryl Stein, and Marcelle Dougan, Mount Sinai School of Medicine, New York, New York, United States.

**Background and Objective:** Experimental studies have suggested PFOA may be associated with reproductive toxicity, and there is some epidemiologic support for a small effect on infant size. However, none of the previous studies have been able to address clinically significant endpoints of preterm birth or low birth weight, nor have any considered miscarriage or birth defects.

**Methods:** Using data from the C8 Health Project, the authors examined the relation between serum perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) and self-reported pregnancy outcome from a cross-sectional study of highly exposed residents of the Mid-Ohio Valley (2000–2006). Data on 1,845 pregnancies to 1,505 white

women who were pregnant within the 5 years preceding PFOA and PFOS measurement were analyzed. Generalized estimating equations were used to calculate adjusted odds ratios (OR) and 95% confidence intervals (CI).

**Results:** Neither PFOA nor PFOS showed any association with miscarriage or preterm birth. Preeclampsia was weakly associated with PFOA (OR = 1.3, 95% CI = 0.9, 1.9) and PFOS (OR = 1.4, 95% CI = 1.0, 2.0) for exposures above the median. PFOA was not associated with an increase in low birth weight, but PFOS showed an increased risk above the median (OR = 1.6, 95% CI = 1.0, 2.6) although not a dose-response gradient. Birth defects were weakly associated with exposures above the 90<sup>th</sup> percentile for PFOA (OR = 1.7, 95% CI = 0.8, 3.6) and above the 75<sup>th</sup> percentile for PFOS.

**Conclusion:** With the possible exception of preeclampsia and birth defects, which have not been previously considered, this study provides evidence against reproductive toxicity of PFOA and PFOS although conclusions are limited by imprecision and the quality of self-reported data.

## ISEE-0369

**Residential Mobility During Pregnancy in the North of England**

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**Background:** Many epidemiological studies assign exposure to an individual's residence at a single time point, such as birth or death. This approach makes no allowance for migration and may result in exposure error, reduced study power and biased risk estimates. Pregnancy outcomes, with short exposure windows and lag periods, are less susceptible to this bias; however pregnant women are a highly mobile group. Our objective was to explore the determinants and influence of mobility on characteristics of maternal environment.

**Methods:** We assessed mobility between booking appointment (~13 weeks gestation) and delivery in northern England using data from the Northern Congenital Abnormality Survey (NorCAS) (1985–2003). Cases with a gestational age at delivery of  $\geq 24$  weeks and with known addresses at both booking and delivery were eligible.

**Results:** Out of 7,919 eligible cases, 705 (8.9% (95% CI 8.3–9.5)) moved between booking and delivery. Movers were younger (25.4 versus 27.3 years,  $P$  < 0.01) and from more deprived areas (index of multiple deprivation (IMD) score 38.3 versus 33.7,  $P$  < 0.01) than non-movers. In movers, aspects of the maternal environment did change following the move, including IMD score (37.4 at delivery versus 38.8 at booking,  $P$  < 0.05) and Townsend deprivation score (3.7 at delivery versus 4.0 at booking,  $P$  < 0.05).

**Conclusion:** Mobility in the north of England (9%) is considerably lower than that reported in North America (20–30%) and the only other study from the UK (23%). Consistent with other studies, mobility was related to maternal age and socio-economic status, and most moves were made locally. While these data support anecdotal evidence that this population is comparatively stable, the mobility we have observed can significantly influence 'exposure' to various aspects of the maternal environment. Migration should therefore be considered a potential source of bias in studies reliant on postcode at delivery to assign prenatal exposures.

## ISEE-0378

**The Impact of Residential Mobility on Birth Outcomes in Washington State**

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**Background and Objectives:** Studies of possible associations between environmental exposures and term low birth weight (LBW), spontaneous preterm delivery (PTD) and small for gestational age (SGA) frequently use residential address at birth for assessing exposures, even though as many as 1/3 of mothers move during pregnancy. The direction and magnitude of the association of exposures with these outcomes often are subject to exposure misclassification if a mother moved during pregnancy, although this is rarely taken into account.

**Methods:** To examine this effect, we utilized routinely collected Washington State birth certificates (1992–2004) that include a field enabling us to identify movers. We compared movers to non-movers with respect to (1) socio-demographic characteristics, (2) prevalence of LBW, PTD and SGA, and (3) the association between LBW, PTD and SGA and traffic exposure.

**Results:** Approximately 32% of Washington State mothers moved during pregnancy. Compared to non-movers, movers were more likely to be: ages 15–19, African American, unmarried, Medicaid recipients, report occupation as unemployed or housewives, and have no formal education beyond high school. Movers had a greater prevalence of LBW, PTD and SGA births compared to non-movers (differences of 4%–8%). The adjusted odds ratios (ORs) for LBW and SGA births among those who moved during pregnancy were elevated overall and for each trimester (1.0–1.2), although strongest for the third trimester. For PTD, the ORs were slightly elevated in the third trimester only (1.0–1.1). There were some differences in risk by parity. Finally, we found associations of traffic exposure (proximity and traffic intensity) with LBW, PTD and SGA, and generally these were more pronounced among non-movers.

**Conclusion:** The observed differences in outcomes by mobility status are consistent with our hypothesis that mobility may result in exposure misclassification and should be considered in similar studies of environmental exposures.

## ISEE-0401

**A Critical Evaluation of Exposure Surrogates in RF-EMF Research: Recommendations for Improving Exposure Assessment**

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**Background:** So far, radiofrequency electromagnetic field (RF-EMF) health research has focused on the head's exposure originating mainly from the use of mobile phones. For some health outcomes, however, whole body radiation absorption may be more crucial. Recently developed personal RF-EMF meters (exposimeters) are suitable to estimate RF-EMF exposure of the whole body. However their application is limited in large study collectives and for long term exposure measurements, thus reliable exposure surrogates are needed. The aim of this analysis is to compare different exposure surrogates with personal exposure measurements.

**Methods:** Personal RF-EMF exposure measurements of 12 frequency bands ranging from FM radio (88 MHz) to W-LAN (2.5 GHz) were collected from 166 individuals who carried an exposimeter (EME SPY 120) during one week. In addition, five exposure surrogates were derived: i) distance between place of residency and closest mobile phone base station, ii) self estimated exposure, iii) spot measurement in the bedroom, iv) geospatial modelling of RF-EMF from fixed site transmitters at place of residency, and v) exposure

predictions combining geospatial modelling with data about exposure relevant behaviour. Spearman's rank correlations between these surrogates and personal exposure measurements were calculated.

**Results:** In the study collective, mean personal RF-EMF exposure during one week was 0.22 V/m (range: 0.08–0.58 V/m). Compared to personal exposure Spearman's rank correlation for distance to the closest base station was  $-0.03$  ( $P = 0.75$ ); for self-estimated exposure  $0.07$  ( $P = 0.31$ ), for spot measurement  $0.44$  ( $P < 0.01$ ); for geospatial modelling  $0.28$  ( $P < 0.01$ ), and for predictions combining geospatial modelling with exposure relevant behaviour  $0.49$  ( $P < 0.01$ ).

**Conclusions:** Simple exposure proxies such as distance to base station are inappropriate for epidemiological research. More sophisticated approaches considerably improve exposure assessment. Nevertheless, still little data about RF-EMF exposure of the population are available and substantial uncertainty about the relevant predictors for exposure in different countries exists.

## ISEE-0403

**Developing Methods for Estimating the Impacts of Climate Change on Malnutrition**

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**Background:** Climate change is likely to influence future crop productivity globally, with greatest vulnerability in developing nations. To date, assessments of the climate-change attributable impacts on "health" have focused on food availability and access to estimate 'millions at risk of hunger' and have neglected malnutrition as an outcome. We developed a new model for estimating climate change-attributable burdens of malnutrition for the QUEST-GSI project (global-scale impacts of climate change: an integrated multi-sectoral assessment), part of the NERC-funded QUEST research programme on global change.

**Methods:** GLAM global crop model (Walker Institute) estimates of future cereals yields were used to drive a food availability model (Southampton University) to provide estimates of future undernourishment at the country level. As malnutrition has multiple causes, stunting in children aged under 5 was estimated as a function of undernourishment (food-causes) and a GDP-derived development indicator (non-food causes) of stunting. A Bayesian approach for estimating the parameters of the health impact model was used by combining prior expert knowledge of the parameter values with current health outcome data observations.

**Results:** The model outcome measures are proportion of population with stunting for five world regions (Sub-Saharan Africa and South Asia) under 4 SRES emissions scenarios. The proportion stunted was converted to DALYs following methods developed for the WHO global burden of disease assessment. Malnutrition burdens were estimated under three scenarios of improvements in agricultural technology. The main sources of uncertainty were described and quantified, where possible.

**Conclusion:** Although the models indicate the burden of malnutrition is likely to increase under climate change, such estimates are very sensitive to model assumptions, and incorporate a large range of uncertainty from both the climate and socio-economic inputs and assumptions.

## ISEE-0409

**Recent Developments in the Science-Policy Interface in Environment and Health in Europe**

Marco Martuzzi, *World Health Organization, Rome, Italy.*

**Background:** The "modern" model of science-policy interface, based on mutual legitimization of science and political power, is under strain for

several reasons, including increasing complexity and uncertainty, requiring alternative models of risk governance. Considerable progress has taken place with approaches that address such limitations.

**Methods:** Several European projects and initiatives are underway that explore, develop, refine, test and apply approaches for supporting a better use of scientific evidence on environmental health determinants towards policy. Comparing and contrasting the achievements of some of these efforts, and assessing them against the priorities set by countries of the pan-European region of WHO, provides several useful insights.

**Results:** There are a number of points in the modern model that can be modified in order to make it more realistic, more relevant and informative to policy questions, e.g.:

- multiple distribution mixing can be modeled;
- uncertainty can be characterized more appropriately;
- formal processing of expert opinion can be added;
- common metrics such as burden of disease or monetary value can be used;
- competing ethical frameworks can be adopted.

Some approaches such as Health Impact Assessment depart even more from the modern model by involving stakeholders in the capacity of peers and questioning the super partes status of experts.

**Conclusion:** These methods can and sometimes do support policy development, but their use in Europe is somewhat patchy. Efforts are underway by WHO and other agencies to promote a more systematic approach.

#### ISEE-0411

##### Mobile Phone Use and Brain Tumors—A Review of the Epidemiological Evidence

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**Abstract:** In the last few years a large number of epidemiological studies on mobile phone use and risk of brain tumors in adults have been published. The International Commission for Non-Ionizing Radiation Protection (ICNIRP) Standing Committee on Epidemiology has reviewed and interpreted evidence in the light of potential methodological problems inherent in the available studies. These are particularly selection bias introduced by selective non-response and inaccuracy and bias in recall of phone use. Studies of glioma mostly show small increased or decreased risks among mobile phone users, but a subset of studies show appreciably elevated risks. No plausible explanation for the deviant results has been identified. Overall the studies published to date do not demonstrate a raised risk for any tumor of the brain within approximately 10 years since first use; pooling the results across studies show an overall risk estimate for glioma of 1.0 (95% CI 0.9–1.1) for up to 5 years since first use, and 1.0 (95% CI 0.8–1.1) for approximately 5–10 years. Also for longer latencies, the available data do not suggest an association between mobile phone use and fast-growing tumors such as glioma; the overall pooled estimate for long-term use is 1.1 (95% CI 0.8–1.4). Analyses taking laterality of mobile phone use and tumor location into consideration suggest that recall bias when reporting side of phone use may have influenced the results: risk estimates are consistently increased for mobile phone use on the same side as the tumor, whereas contralateral use is associated with reduced risks, regardless of time since first use. Data for longer-term use are still limited in volume, and for latencies longer than 12–15 years there are currently no data available, as use of handheld

mobile phones is still a relatively recent phenomenon. Currently there are no data available on tumor risk in children.

#### ISEE-0414

##### Deriving and Communicating Risks: Strengths, Needs, Opportunities

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**Abstract:** The use of information from toxicology and epidemiology to estimate the total public health risk of environmental hazards has a long tradition in many areas, including air pollution research and the related policy making. Such health impact assessments are particularly useful to translate current knowledge of the association between air pollution and health into an estimate of the health burden attributable to pollution and of the possible future benefits of clean air regulations. The wide use of these tools on the local, regional, national, multi-national and the global scale strongly enhanced fruitful debates and communication between researchers, policy makers, interest groups, and the public.

The progress made in the assessment of acute and in particular of long-term effects of air pollution on morbidity and mortality, and the identification of traffic corridors as a particularly polluted space raised new methodological issues and limitations with unsettled implications on risk assessment procedures and communications. The conceptual and quantitative implications of pollution affecting chronic pathologies as well as morbidities that develop on the grounds of these pathologies will be discussed. The challenges in risk assessment in dealing with proximity to traffic corridors will be highlighted. Similarities, discrepancies, strengths and limitations of 'attributable deaths' and 'attributable years of life lost' (or gained) will be addressed. The presentation provides inputs into the discussion on how to move forward.

#### ISEE-0417

##### Oxidative Potential: Moving Towards a Toxicity Based Measure of PM Exposure

Cathryn Tonne,\*† Sean Beevers,\* Paul Wilkinson,† and Frank Kelly,\* *\*King's College London, London, United Kingdom; and †London School of Hygiene and Tropical Medicine, London, United Kingdom.*

**Background and Objectives:** To date, the majority of evidence about the health effects of particulate air pollution from epidemiology and controlled exposure studies is based on particle mass concentration as the exposure metric. Yet, particulate matter (PM) is a complex mixture, and particles of different size and composition are likely to have different toxic effects. One of the properties of particles likely to reflect toxicity is their oxidative potential (OP).

**Methods:** The capacity of inhaled particles to induce oxidative stress was measured by their depletion of antioxidants in an acellular model of lung lining fluid. A total of 1055 TEOM filters were collected at 40 monitoring sites in Greater London between 1999 and 2006. The oxidative potential of PM collected on each TEOM filter was determined by its ability to deplete ascorbate (AA) and glutathione (GSH). These OP data were expressed per mass of PM and per m<sup>3</sup> of air. We analysed the extent of temporal and spatial variation in OP and investigated whether predictors of PM<sub>10</sub> concentration were also predictors of OP using regression modelling.

**Results:** The coefficient of variation for GSH/μg was 51% compared to 31% for PM<sub>10</sub> concentration. Long-term temporal trends for the GSH and AA OP measures were distinct from those of PM<sub>10</sub> concentration. OP was either weakly or uncorrelated with PM<sub>10</sub> concentration: the correlation between GSH/μg and PM<sub>10</sub> concentration was  $r = 0.26$ ,  $P < 0.0001$  and that for AA/μg was  $r = -0.03$ ,  $P = 0.26$ . Significant predictors of PM<sub>10</sub> concentration were not strong predictors of OP.



**Conclusion:** There was considerable variability in OP measurements across London. Mass based measures of OP were only weakly correlated with PM<sub>10</sub> mass concentration, indicating that OP captures attributes of particles not reflected by mass concentration. Predictors of spatial variation appear to differ substantially between PM<sub>10</sub> concentration and OP.

#### ISEE-0433

##### Current Relevance of New Biomarkers for Inclusion into HBM Surveillance Studies

Jürgen Angerer,\* Holger Koch,\* Ulrich Ewers,† Jürgen Hölzer,‡ Thomas Brüning,\* and Michael Wilhelm,‡ *\*BGFA Research Institute of Occupational Medicine, Bochum, Germany; †Institute of Hygiene of the Ruhr-District, Gelsenkirchen, Germany; and ‡Department of Hygiene, Social and Environmental Medicine, Ruhr-University Bochum, Bochum, Germany.*

**Background:** Phthalates, acrylamide, aromatic amines and perfluorinated compounds (PFCs) belong to those environmental pollutants, which currently attract most attention. Phthalates are ubiquitously occurring plasticizers modulating the endocrine system. Acrylamide is an unavoidable constituent of the diet and is “probably carcinogenic to humans” (IARC). This also applies to aromatic amines. Recent studies have demonstrated that the population is exposed to a broad spectrum of aromatic amines. PFCs are accumulating in the human body and may reduce fecundity as well as fetal growth even at environmental background levels.

**Methods:** For human biomonitoring (HBM) purposes reliable analytical methods have been developed. Those parameters in blood or urine were chosen, which specifically and sensitively reflect internal exposure. The results of several HBM population studies are summarized in order to draw first conclusions on exposure and possible health risks.

**Results:** HBM population studies showed that:

1. Phthalates
  - a) internal exposure of the population is very high
  - b) the general population is exposed to a set of phthalates simultaneously
  - c) certain population groups are exposed far beyond ADI
  - d) the main metabolites are the secondary metabolites.
2. Acrylamide
  - a) uptake of acrylamide in non-smokers occurs almost exclusively via diet
  - b) uptake of acrylamide by the general population has to be reduced.
3. Aromatic amines
  - a) aromatic amines are taken up from multiple sources like diet, pesticides residues etc
  - b) the role of tobacco smoking for the exposure to aromatic amines has been overestimated in the past.
4. PFCs
  - a) some PFCs have extraordinarily long half lives even under conditions of environmental exposure.

The German HBM commission is deriving limit values for these substances.

**Conclusions:** HBM provides a very powerful tool to estimate internal exposure. Methods and parameters are readily available even for newly emerging substances. HBM can be used to study human metabolism under environmental conditions.

#### ISEE-0443

##### Approaches for Reconstructing Exposures Accounting for Human Mobility and Space-Time Variability in Environmental Contaminants

Jaymie Meliker, *Stony Brook University, Stony Brook, NY, United States.*

**Background and Objective:** Recent advances in space-time technology are beginning to allow environmental epidemiologists and exposure scientists to better incorporate space-time variability in individual-level epidemiologic studies. This presentation will review sources of mobility data, methods for creating historical datasets of environmental contaminants, and strategies for linking these datasets to generate spatially and temporally resolved exposure estimates in epidemiologic studies.

**Data Sources:** Sources of mobility data include self-reported residential/occupational mobility histories or daily mobility patterns, centralized population registries which include residential histories, residential histories from credit reports, and location-enabled devices (e.g., global positioning system (GPS)). Sources of space-time data on environmental contaminants include monitoring networks, space-time models of monitored data, and remotely sensed data from satellite imagery and airborne platforms. Temporal gaps have been a stumbling block in the use of remotely sensed imagery for exposure assessment; however, new approaches in space-time interpolation may prove helpful in addressing this challenge.

**Data Linking:** Another difficulty in space-time exposure reconstruction has been our computationally limited ability to link information across space-time datasets; until recently researchers have been forced to simplify the dynamic nature of their datasets by reducing or eliminating the spatial or temporal dimension. Advances in geographic technology now enable researchers to join datasets based on space-time characteristics allowing for spatially and temporally resolved exposure reconstruction at the individual-level. Applications will be demonstrated using arsenic in drinking water in a bladder cancer case-control study, and particulate matter air pollution in a cohort study.

**Conclusion:** Applications of space-time technology for exposure assessment in environmental epidemiology are in their infancy. Additional applications are needed, as well as validation studies that demonstrate the benefits of incorporating both spatial and temporal variability in exposure assessment in comparison with spatial-only or temporal-only approaches.

#### ISEE-0444

##### Long-Term Health Effects of the Prestige Oil Spill (Galicia, Spain)

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**Background and Objective:** The wreckage of the oil tanker Prestige in November 2002 heavily contaminated the coast of Galicia, north-western Spain. Our aim was to evaluate long-term respiratory effects and chromosomal aberrations in relation to clean-up operations in local fishermen.

**Methods:** In stage 1 (January–September 2004), a questionnaire survey was done among 6,780 fishermen (76% response) from 38 cooperatives. In stage 2 (September 2004–February 2005) a detailed health examination was done in selected subgroups of 501 highly exposed fishermen and 177 without exposure to clean-up work. Respiratory outcomes included forced spirometry and methacholine challenge testing and a variety of biological markers in exhaled breath condensate (EBC). Chromosomal lesions and structural alterations were determined in peripheral lymphocytes. In stage 3 (June–July 2008) data on respiratory symptoms was obtained in 623 telephone interviews (92% response) and participants were invited to participate in stage 4 (functional tests and biological markers; November 2008–April 2009).

**Results:** Stage 1 showed a dose-dependent association between participation in clean-up work and the prevalence of lower respiratory tract symptoms. Stage 2 showed that among lifetime non-smokers, exposed fishermen significantly had more often bronchial hyperresponsiveness (15% vs. 9%) and increased levels of 8-isoprostane

(48% vs. 20%) and of Vascular Endothelial Growth Factor (59% vs. 14%) in EBC. Structural chromosomal alterations were more common in exposed (23%) than in non-exposed (4%). Stage 3 showed that the prevalence of respiratory symptoms had slightly declined over time but was still higher (35% vs. 28%) in exposed fishermen.

**Conclusion:** Fishermen who participated in the clean-up of the Prestige oil spill showed respiratory effects including bronchial reactivity and oxidative stress in combination with symptoms, as well as indications of chromosomal abnormalities. This suggests both a persistent inflammatory reaction in the airways and a systemic genotoxic effect.

#### ISEE-0450

##### Pre-Diagnostic Serum Concentrations of Organochlorine Compounds and Risk of Testicular Germ Cell Tumors

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**Background and Objective:** Recent findings suggest that exposure to organochlorine (OC) compounds, chlordanes and p,p'-dichlorodiphenyl-dichloroethylene (p,p'-DDE) in particular, may increase the risk of developing testicular germ cell tumors (TGCT). To further investigate this question, we conducted a nested case-control study of TGCT within the Norwegian Janus serum bank cohort.

**Methods:** The study was conducted among individuals with serum collected between 1972 and 1978. TGCT cases diagnosed through 1999 (N = 49) were identified through linkage to the Norwegian Cancer Registry. Controls (N = 51) were matched to cases on region, blood draw year and age at blood draw. Measurements of 11 OC insecticide compounds and 34 polychlorinated biphenyl (PCB) congeners were performed using gas chromatography/high-resolution mass spectrometry. Case-control comparisons of lipid-adjusted analyte concentrations were performed using the Wilcoxon signed-rank test. Odds ratios (OR) and 95% confidence intervals (CI) for tertiles of analyte concentration were calculated using conditional logistic regression.

**Results:** TGCT cases had elevated concentrations of p,p'-DDE (tertile 3 vs. tertile 1 OR (OR<sub>T3</sub>) 2.2, 95% CI 0.7–6.5; P<sub>Wilcoxon</sub> = 0.07), oxychlordane (OR<sub>T3</sub> 3.2, 95% CI 0.6–16.8; P<sub>Wilcoxon</sub> = 0.06), trans-nonachlor (OR<sub>T3</sub> 2.6, 95% CI 0.7–8.9; P<sub>Wilcoxon</sub> = 0.07) and total chlordanes (OR<sub>T3</sub> 2.3, 95% CI 0.6–8.6; P<sub>Wilcoxon</sub> = 0.046) compared to controls, although no ORs were statistically significant. Seminoma cases had significantly lower concentrations of PCB congeners #44, #49 and #52 and significantly higher concentrations of congeners #99, #138, #153, #167, #183 and #195.

**Conclusion:** Our study provides additional evidence supporting an association between exposures to p,p'-DDE and chlordane compounds, and possibly some PCB congeners, and TGCT risk.

#### ISEE-0455

##### A National Human Biomonitoring Program on POPs and Heavy Metals in Spain

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**Abstract:** In 2007 Ministry of Environment established a contract with the Institute of Health Carlos III to start the first National Human Biomonitoring program with focus on persistent organic pollutants (POPs) and Heavy Metals. The study started in 2009 and was established in collaboration to medical examination centers across the Spanish peninsula. Study participants were selected through a stratified cluster sampling. Strata were defined according to 11 geographical areas: Northwest 1 (Galicia), Northwest 2 (Asturias, Cantabria), Northeast 1 (Basque Country), Northeast 2 (Navarre, La Rioja, Aragon), Central 1 (Castile and Leon), Central 2 (Madrid), Central 3 (Castile-La Mancha, Extremadura), East 1 (Catalonia), East 2 (Valencian Community), South 1 (Andalusia), and South 2 (Murcia). A total of 36 physical examination centers were selected across these strata following a compromise allocation: a minimum of 2 examination centers within each geographical area, with the remaining 14 centers being distributed proportionally to the working population in each area according to the Spanish Active Population Survey 2007. Also, to ensure a proper seasonal distribution the 36 selected centers were assigned to 4 recruitment periods: January–March, April–June, July–September, and October–December 2009.

Firstly, the corresponding centers within each geographical area were randomly selected with probability proportional to its size (annual number of physical examinations).

At a second stage, 25 workers of service sector (10 men and 15 women) and 25 workers of other economic sectors - agriculture, industry, or construction - (15 men and 10 women) were sampled within each selected examination center. Participants were consecutively selected within the recruitment period randomly assigned to each center.

The overall sample comprised 1800 participants. Small geographical areas, non-service economic sectors, and women were over-sampled in order to improve precision in these subgroups. The presentation will give an overview of the aims, plans and advances achieved under this program.

#### ISEE-0465

##### In Utero Organochlorine Exposure and Obesity in Children of Farmworkers

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**Background and Objective:** In utero exposure to endocrine disrupting compounds, such as DDT and DDE, has been hypothesized to increase risk of obesity later in life. The Center for the Health Assessment of Mothers and Children of Salinas (CHAMACOS) study is a longitudinal birth cohort study of low-income Latinas living in an agricultural community in California. We examined the relation of in utero DDT and DDE exposure with obesity at 5 and 7 years.

**Methods:** We include 265 CHAMACOS children who had maternal serum DDT levels and follow-up at 5 and 7 years. In utero exposure to DDT and DDE was measured in maternal serum during pregnancy and reported as lipid-adjusted values (ng/g). At 5- and 7-years, standing height (cm) and weight (g) were measured. Body mass index (BMI) was calculated as weight (kg) / height (m)<sup>2</sup>. Obesity was defined as ≥95<sup>th</sup> percentile of the sex-specific BMI-for-age calculated using 2000 Centers for Disease Control and Prevention growth charts.

**Results:** At 5 years, 87 (33%) of 265 children were obese. The prevalence of obesity increased with exposure to DDT (I: 1.5–7.3 ng/g (29.9%); II: 7.4–11.6 ng/g (33.3%); III: 11.7–41.6 ng/g (34.8%); IV: 41.7–33,174.0 ng/g (33.3%)) and DDE (I: 48.7–597.4 ng/g (26.9%); II: 597.5–1,067.6 ng/g (36.4%); III: 1,067.7–2,679.7 ng/g (28.8%); IV: 2,679.8–159,303.3 ng/g (39.4%)). Compared with children in the lowest quartile of exposure, the odds of obesity was increased in the highest quartile of exposure for DDE (IV: OR = 1.77, 95% CI 0.85, 3.68,

$P = 0.13$ ), but not for DDT (IV: OR = 1.18, 95% CI 0.56, 2.44,  $P = 0.67$ ).

**Conclusion:** At 5 years, the prevalence of obesity in the CHAMCOS cohort is high. We found some evidence that in utero DDE but not DDT exposure may increase the likelihood of becoming obese with age. We will present the 7 year data.

#### ISEE-0473

##### Pesticide Exposure and Parkinson's Disease (PD) in the Agricultural Health Study (AHS)

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**Background and Objective:** Pesticide exposure may increase PD risk, but detailed data are lacking. Using data from the AHS, an ~89,000 member cohort of licensed pesticide applicators and their spouses enrolled in Iowa and North Carolina in 1993–1997, we found that self-reported PD was associated with cumulative lifetime use of pesticides and with factors affecting pesticide exposure, including high-intensity exposures and inadequate use of personal protective equipment. Because this study was limited by reliance on self-reported PD, we conducted a further study based on confirmed diagnoses.

**Methods:** The Farming and Movement Evaluation (FAME) study is a case-control study of PD nested within the AHS. PD diagnoses were confirmed by movement disorder specialists. We enrolled 115 confirmed PD cases and 383 age-, sex-, and state-matched controls. Using structured interviews, we collected information on lifetime use of pesticides implicated in PD by prior human studies or by experimental models or mechanistic hypotheses. We collected additional information on other factors affecting exposure, including application methods and use of personal protective equipment. Data were analyzed by unconditional logistic regression with adjustment for age, sex, state, and cigarette smoking.

**Results:** We found that PD risk was associated with exposure to specific pesticides and confirmed and extended our earlier work on factors affecting exposure.

**Conclusions:** These results add to evidence supporting an association between pesticide exposure and PD risk. They recapitulate experimental models and may shed light on mechanisms involved in PD pathophysiology.

#### ISEE-0479

##### International Assessment of Agricultural Science and Technology for Development (IAASTD)

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**Background:** The IAASTD was an intergovernmental process that focused on the role of agricultural knowledge, science and technology (AKST) in reducing hunger and poverty, improving rural livelihoods and human health, and facilitating environmentally, socially and economically sustainable development. The assessment was published in early 2009.

**Methods:** The IAASTD included a global and five sub-global assessments of the generation, access, dissemination and use of public and private sector AKST, using local, traditional and formal knowledge; existing and emerging technologies, practices, policies and institutions; information needed by decision makers in different civil society, private and public organizations on options for improving policies, practices, institutional and

organizational arrangements; and options for future public and private investments in AKST. It brought together a range of stakeholders to share their experiences, views, understanding and vision for the future.

**Results:** Key findings include that AKST has contributed to substantial increases in agricultural production; people benefited unevenly from these yield increases across regions; emphasis on increasing yields and productivity has in some cases had negative consequences on environmental sustainability; global demographic changes and changing patterns of income distribution over the next 50 years are projected to lead to different patterns of food consumption and increased demand for food; a systematic redirection of AKST towards agroecological strategies is needed to address environmental issues; the generation and delivery of AKST needs to be redirected to address a range of persistent socioeconomic inequities; more determined involvement of women's knowledge, skills and experience is required to advance progress towards sustainability and development goals; many of the challenges facing agriculture over the next 50 years will require more integrated applications of existing science and technology; and some challenges may be resolved only by development and application of new and emerging AKST.

**Conclusion:** More information and issue briefs are available at <http://www.agassessment.org/>.

#### ISEE-0490

##### Residential Exposure to Polychlorinated Biphenyls and Organochlorine Pesticides and Risk of Childhood Leukemia

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**Background:** The etiologic role of persistent organochlorine chemicals in childhood cancer risk has not been evaluated in population-based studies. House dust is a reservoir for chemicals used in the home and nearby environment. Ingestion of house dust is an important route of chemical exposure for young children. We estimated the risk of childhood leukemia associated with persistent organochlorine chemicals using carpet dust as an exposure indicator.

**Methods:** We studied 184 acute lymphocytic leukemia (ALL) cases 0–7 years of age and 212 birth certificate controls from the Northern California Childhood Leukemia Study (2000–2006). Using a high volume surface sampler (HVS3) vacuum, we sampled carpets that were present in the home before the diagnosis/reference date. We measured concentrations (ng/g) of six polychlorinated biphenyl (PCB) congeners (105, 118, 138, 153, 170, 180) and the organochlorine pesticides chlordane, p,p'-DDT and its metabolite p,p'-DDE, methoxychlor, and pentachlorophenol. Odds ratios were calculated using unconditional logistic regression analysis adjusting for demographics, age of the home, sampling season (for organochlorine pesticides), and breastfeeding (PCBs).

**Results:** Detection of any PCB congener in the dust conferred a two-fold increased risk of ALL (OR = 1.97, 95% Confidence Interval [CI] 1.22–3.17). Compared to those in the lowest quartile of total PCBs, the highest quartile was associated with about a three-fold risk (OR = 2.78, 95% CI 1.41–5.48;  $p$  trend = 0.02). We observed significant positive trends in risk associated with concentrations of the PCB congeners 118, 138, and 153 ( $P$  for trend = 0.02, 0.03, 0.02, respectively). The associations with PCBs were stronger among non-Hispanic Whites, despite a similar distribution of exposure among all ethnic/racial groups. We observed no significant association with concentrations of chlordane, p,p'-DDT, p,p'-DDE, methoxychlor, or pentachlorophenol.



**Conclusion:** Our findings suggest that PCBs, which are considered probable human carcinogens and cause perturbations of the immune system, may be a risk factor for childhood leukemia.

#### ISEE-0500

##### STEMS-Air: A GIS-Based Dispersion Model for City-Wide Exposure Assessment

John Gulliver,\* and David Briggs,† \*University of the West of Scotland, Paisley, United Kingdom; and †Imperial College London, London, United Kingdom.

**Background and Objective:** Exposure misclassification continues to be a major source of uncertainty in air pollution epidemiology. Improved methods are therefore needed that allow estimation of short-term (e.g. daily) exposures at individual level, over large (e.g. city-wide) study populations. Dispersion models offer one means of achieving this, but are limited by their hungry data demands and processing requirements. To overcome these constraints, we have developed a source-receptor model (STEMS-Air), adapted to run in a Geographical Information System (GIS) for rapid assessment of space-time variations in air pollution exposures. This paper outlines the methodology and presents results of field validation studies.

**Methods:** STEMS-Air implements a simple Gaussian plume model of dispersion via grid-based, FOCAL functions in ArcGIS. It includes an emissions pre-processor to convert information on source activity (e.g. traffic flows and speeds) into emission rates over a fine, regular grid, for a range of pollutants. A meteorological pre-processor is included to determine atmospheric stability, based on wind speed, wind direction, cloud amount, time of year and day. STEMS-Air operates by generating a window around each site, aligned to reflect the prevailing wind direction, and then computes the distance- and direction-weighted sum of contributions from all emission sources within the window. Initial validation of the model has been done for daily concentrations of PM<sub>10</sub> and NO<sub>x</sub>, for five monitoring locations in London.

**Results & Conclusion:** Comparisons between model predictions and measured concentrations at the five monitoring sites gave  $r^2 = 0.6-0.7$ , comparable to that achieved by other, more complex methods. Intercomparison with the proprietary ADMS-Urban dispersion model gave  $r^2 = 0.89$ . Given the simpler data demands and ease of use of STEMS-Air, the results thus suggest that it provides a valid and valuable methodology for air pollution modelling and exposure assessment in epidemiological studies.

#### ISEE-0516

##### The Multiple Challenges of Meeting Future Global Food Security

Colin Butler, National Centre for Epidemiology and Population Health, Canberra, ACT, Australia.

**Background and Objective:** The number of people with frank undernourishment (of energy and/or protein) has recently increased, and now approaches a billion. The number with micronutrient deficiency is much higher. Human undernourishment thus is intractable, although this is belied by the Millennium Development Goal and earlier food summits which periodically release misleadingly ambitious targets for solving world hunger. This paper will introduce this seminar by exploring some of the interacting forces which operate to obstruct and even steepen this challenge.

**Methods:** Secondary analysis of international literature.

**Results:** Dynamically interacting social and physical factors appear to reduce the likelihood of future food security for all. The social factors are often summarized as a lack of political will, but can be separated into three: 1. People who are well and over-fed rarely conceive alleviation of hunger of people personally unknown as something they can or even should assist with; 2. Extremely under-fed people lack sufficient organizational capacity,

economic power and personal resources to nutritionally rescue themselves; and 3. Large scale collective social forces operate and flow, like a current through the sea of humanity, to thwart solutions.

Physical factors which cause anxiety about future food supply include climate change, biofuels, human disease, and scarcer water, energy and phosphorus. Other speakers in this symposium will discuss some of these aspects; collectively they make the outlook for hunger appear even more formidable, were it not for one thing—the simultaneous existence of a billion over-fed people, whose excessive caloric intake provides a literal and metaphoric life-preserver to reduce future global food insecurity.

**Conclusion:** It is possible to conceive how a sustainable civilization can emerge, in which partial convergence of nutritional status evolves, with co-benefits for the fat, the thin and the environment. This seems utopian; it may be necessary.

#### ISEE-0522

##### Plasma Organochlorine Levels and Risk of Non-Hodgkin Lymphoma in the Physicians' Health Study

Kimberly Bertrand,\* Donna Spiegelman,\* Jon Aster,‡ Larisa Altshul,\* Susan Korrick,† Scott Rodig,‡ Shumin Zhang,§ Tobias Kurth,\*§ and Francine Laden,\*† \*Harvard School of Public Health, Boston, MA, United States; †Channing Laboratory, Brigham and Women's Hospital and Harvard Medical School, Boston, MA, United States; ‡Dept. of Pathology, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, United States; and §Division of Preventive Medicine, Brigham and Women's Hospital and Harvard Medical School, Boston, MA, United States.

**Background and Objective:** Non-occupational exposure to polychlorinated biphenyls (PCBs) and p,p'-dichlorodiphenyldichloroethylene (p,p'-DDE) may increase the risk of non-Hodgkin lymphoma (NHL).

**Methods:** We conducted a case-control study nested within the Physicians' Health Study, a prospective cohort established in 1982. We measured concentrations of PCBs and p,p'-DDE in baseline blood samples from 205 men diagnosed with NHL and 409 age- and race-matched controls. Lipid-adjusted organochlorine concentrations were categorized into quintiles based on the distribution among controls. We used conditional logistic regression to estimate the rate ratios (RRs) and 95% confidence intervals (CIs) for each quintile relative to the lowest quintile. We also evaluated these associations for major histologic subtypes of NHL.

**Results:** We found significant positive associations for the sum of 51 PCB congeners assayed ( $\Sigma$ PCB), the group of immunotoxic congeners, the individual congeners 118, 138, 153, and 180, and the sum of these four congeners with risk of NHL. The simple RR for the highest quintile of lipid-adjusted  $\Sigma$ PCB versus the lowest was 1.9 (95% CI: 1.1–3.2;  $P$ -trend = 0.001), with similar trends for individual congeners and groups defined as above. Adjustment for height, body mass index, alcohol intake, smoking, and fish intake did not substantially change the effect estimates. No association was observed for p,p'-DDE. There was no evidence of statistical heterogeneity in effects by histologic subtype.

**Conclusions:** These results support the hypothesis of a positive association between PCB exposure and development of NHL in men.

#### ISEE-0535

##### Food Insecurity, Social and Health Inequities

Sharon Friel,\*† \*National Centre of Epidemiology and Population Health, ANU, Canberra, Australia; and †Department of Epidemiology and Public Health, UCL, London, United Kingdom.

**Background and Objective:** While health has improved for many, the extent of health inequities between and within countries is growing. Meanwhile, humankind is disrupting the global climate and other life-

supporting environmental systems, thereby posing fundamental risks to health and well-being, especially in vulnerable populations but ultimately for all. Food, nutrition and hunger constitute a key link between the global health and climate change agendas.

This paper will explore how inequities in the food system, combined with underlying inequities in daily living conditions leads to food insecurity (defined here as the inability to enjoy an adequate and nutritious diet). This then impacts on the health and well-being of individuals and households and on the social behaviour of food-poor households and their members. The paper also investigates how climate change interacts with the food and social systems to produce inequities in health.

**Methods:** Secondary analysis of global data sets and international literature.

**Results:** An estimated 963 million people worldwide live in hunger. Simultaneously, many are becoming fatter as a “nutrition transition” towards energy-dense, nutrient-poor diets accelerates particularly among many socially disadvantaged groups in all but the poorest countries.

The nature of the food system—from trade, agricultural production through retailing and consumption—contributes to food insecurity and inequities in diet-related health. The food system is also a major contributor to climate change, and is increasingly affected by it, resulting in reduced quantity, quality and affordability of food in many countries. This contribution is predicted to increase, and to cause disproportionate harm to vulnerable populations.

**Conclusion:** The underlying determinants of health inequity and of environmental change overlap substantially. Inequities in the food system, combined with the unequal distribution of material, social and cultural resources is driving food insecurity, the related health inequities and climate change.

#### ISEE-0549

##### On Changes in Susceptibility to Ambient Temperature, Long-Term Mortality Displacement and Age at Death

Joachim Rocklöv, and Bertil Forsberg, *Occupational and Environmental Medicine, Umeå University, Umeå, Sweden.*

**Background:** Extreme temperature has a large impact on mortality, but little is known about variations of the effect of temperature between years or with time. We aimed to study the relation between winter mortality and effect of temperature the next summer, as well as time trends in the effect of temperature in cause specific groups, hypothesizing a decreasing or enlarging pool of fragile individuals may influence such patterns. Additionally we assess the daily mean age at death with respect to high and low temperature, cause specific and separately for men and women.

**Methods:** We established regression models for daily mortality (Poisson distributed) and daily mean age at death (normally distributed) as outcomes with weather variables and confounders as explanatory variables.

**Results:** There were apparent time trends in the effect of temperature on mortality. Moreover, the mean age at death was significantly affected by weather and also here there were time trends. Generally, in Sweden, the daily mean age at death increased during extreme cold or hot conditions, strikingly similar to the risk of death during these conditions. The effect of heat during summer is modified by winter mortality. Mean age at death during warm days increased after winters with higher mortality when the effect of temperature was lower in general.

**Conclusion:** Population dynamics, as the size of the fragile pool of individuals, affect the effect of temperature on mortality outcomes and may induce trends. Further on, both cold and warm temperatures tend to increase the daily mean age at death, indicating the susceptible population is generally the very old in both mortality groups. These findings are important in the context of adaptation and efficacy of interventions.

**Reference:** Rocklöv J, Forsberg B, Meister K. Winter mortality modifies the heat-mortality association the following summer. *Eur Respir J* 2009; 33: 245–251.

#### ISEE-0576

##### International Collaboration on Air Pollution and Pregnancy Outcomes (ICAPPO): Pilot Study Analytic Plan for Data Re-Analysis

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**Background and Objective:** ICAPPO's goal is to examine whether differences in analytic methods have contributed to observed differences in air pollution/fetal associations among published studies. Accordingly, the first step was to initiate a pilot study to: 1) foster collaboration among investigators and assess the ability of the collaborators to work according to an agreed analytic plan; and 2) with a well-defined analytic plan, quickly apply a basic statistical plan to participant's existing datasets, and present results from all the studies/investigators together (pooled or just presented together). This presentation describes the analytic approach used for the pilot study.

**Methods:** A small group was formed to develop the protocol for the pilot study. Specification of study population, birth outcomes, pollution variables, covariates, and analytic approach was developed. Discussions among the collaboration participants at a 2008 ISEE pre-conference workshop in Pasadena informed the process.

**Results:** The pilot study, focusing on particulate matter (PM<sub>10</sub>) and fetal growth, was developed and disseminated to participants in January 2009. Briefly, each participant will use his or her dataset, limiting records to live-born, singleton, term (37+ weeks' gestation) infants with known values for birthweight, gestational age, maternal education (or another index of socioeconomic status), dates of birth and last menstrual period, and ambient PM<sub>10</sub> concentration. The primary outcome variable is low birth weight. The primary exposure variable is PM<sub>10</sub> averaged over the entire pregnancy using the geographic scale of the original dataset. If PM<sub>10</sub> or maternal education is unavailable, use of alternative measures is recommended. Other covariates are optional and will vary among studies. Logistic regression will be used for the primary analysis. Sensitivity analysis is encouraged but not required.

**Conclusion:** Investigators from approximately 25 locations are collaborating in the pilot study. Results from this effort, both procedural and analytic, will be compiled during the summer 2009.

#### ISEE-0583

##### Philosophy and Epidemiology—Current Trends

Jutta Lindert, *Protestant University of Ludwigsburg, Ludwigsburg, Germany.*

**Round:** In research, for centuries theory and philosophy had priority over observation. Some aspects of philosophy have been pervasive for epidemiology from its beginning, like causal inference. Causality is a fundamental concept both in philosophy and in epidemiology. Causal explanations may be based on an (attempted) understanding of underlying mechanisms, or they may be based on a observation without deeper understanding of the underlying mechanisms. The concept of causality has shifted its paradigms over the centuries. At the moment, statistical associations are fundamental in epidemiology at the moment. The degree of associations can be given mathematical value. In an editorial in the year 2000, the New England Journal of Medicine, presented the application of statistics to medicine as one of the eleven most important developments in medicine in the last

thousand years. But, the validity of causality in epidemiology based on the statistical paradigm varies a lot.

**Aims:** to describe contemporary philosophical approaches to knowledge and causality (e.g. causal diagrams (DAGs), critical hermetics).

**Results:** Knowledge and causal modelling in science and in epidemiology is connected to paradigms and to underlying world views. Hence, in spite of all progress in epidemiology, the concept of causality is still full of uncertainties. Construction of causality needs to be linked to the social subject who does the epidemiological research. To the extent that causal modelling in epidemiology is a constitutive process, it necessarily includes the self-reflection of the epidemiologist as a methodological self-understanding. This philosophical aspects need to be considered in further development of epidemiological causal thinking.

**Conclusion:** While the reality is always more complex, contradictory and elusive than our limited philosophical theories and epidemiological methods can possibly encompass, some things remain incontestably 'factual'. Philosophy and epidemiology can help each other to understand more of the "factual reality".

#### ISEE-0609

##### Embedding Nutrition in Agriculture and Health: Addressing Critical Challenges

*Stuart Gillespie, International Food Policy Research Institute, Geneva, Switzerland.*

**Abstract:** Agriculture is the primary source of livelihood for the majority of the world's poor who in turn are most vulnerable to ill-health. Agricultural policy and practice affect human health and health in turn affects agricultural productivity and output. Agriculture supports health by providing food, fibre, medicinal plants, and materials for shelter for the world's population; among rural communities, it contributes to livelihoods and food security, and provides income which can be spent on health care and prevention. Successful health policies in turn benefit agriculture by protecting the labour force from days (and income) lost to illness, chronic disabilities or mortality. Good health and productive agriculture are both essential for poverty reduction, and key instruments to achieving most of the Millennium Development Goals.

As a pivotal interface between agriculture, health and social development sectors, nutrition is critically important for success in each sector - yet it routinely "falls between the cracks". Nutrition is inherently multifaceted in nature, and a multisectoral approach is needed to make sustainable progress in reducing or preventing malnutrition. But promoting cooperation in research and policy between different sectors is challenging—sectoral barriers that provide disincentives to collaboration need to be overcome, and challenges in transdisciplinary analyses and communications confronted.

New approaches are needed—ranging from acquiring new knowledge about the interactions between agriculture, nutrition, water and health, to developing joint thinking and efforts to disseminate and apply this knowledge more widely and effectively.

After briefly describing the major current and emerging challenges, this paper moves on to discuss approaches to generating truly intersectoral, transdisciplinary approaches to effectively embedding nutritional considerations into agriculture and health policies and programmes.

#### ISEE-0612

##### Arsenic Metabolism and Toxicity in Early Life—Interactions with Nutrition

*Marie Vahter,\* Barbro Nermell,\* Jena Hamadani,† and Rubhana Raqib,†*  
*\*Karolinska Institutet, Stockholm, Sweden; and †International Centre for Diarrhoeal Disease Research, Dhaka, Bangladesh.*

**Abstract:** Inorganic arsenic appears frequently in drinking water, giving rise to life-long exposure. Arsenic is a documented carcinogen and toxicant, but data on developmental effects in humans is limited. Our ongoing research, involving a large mother-child cohort with a wide range of arsenic exposure via drinking-water in Bangladesh, aims at evaluating critical windows of arsenic exposure and the role of metabolism and nutrition. Arsenic is methylated via one-carbon metabolism, and thus influenced by folate and homocysteine metabolism. Methylarsonic acid (MMA) and dimethylarsinic acid (DMA) are main metabolites excreted in urine. A high urinary fraction of DMA generally implies efficient detoxification, while increasing fraction of MMA is associated with increasing risk of health effects. However, little is known about the situation early in life. Both inorganic arsenic and its methylated metabolites readily pass the placenta, while excretion in breast-milk is low and essentially limited to inorganic arsenic. Prenatal arsenic exposure is associated with increased risk of fetal loss and infant mortality and morbidity, without major influence of maternal malnutrition. At least some of the effects seem to be related to immunosuppression, measured as reduced thymus size and breast milk trophic factors and inflammatory changes in placenta. We find essentially no arsenic-related effects on cognitive and motor development, when tested in 2,000 children before two years of age. However, affected functions may show-up later in childhood. In conclusion, although prenatal arsenic is associated with increased risk of toxic effects in early life, the efficient maternal metabolism in second and third trimester and the low excretion in breast milk seem to imply certain protection. After weaning, when arsenic metabolism becomes less efficient, susceptibility to toxic effects and interactions with nutritional factors may increase.

#### ISEE-0613

##### Use of Epidemiologic Methods to Assess Effects of Climate Change on Health: Methodological and Philosophical Challenges

*Jouni J.K. Jaakkola, Institute of Health Sciences, University of Oulu, Oulu, Finland.*

**Background and Objective:** A broadly used definition of epidemiology is "the study of the distribution and determinants of health-related states and events in specified populations, and the application of this study to control of health problems" (IEA 2001). Epidemiologic methods have evolved from the 17<sup>th</sup> century to comprise a set of methods related to study design and concepts including measures of disease occurrence, confounding, effect modification and bias. Further, approaches to causal inference have constituted a central area of the discipline. Concerns of the effects of climate variability and change stimulate an increasing body of research applying epidemiologic methods. This presentation elaborates the suitability of contemporary epidemiologic methods in addressing the hypothesised direct and indirect effects of climate change on health-related-states and events.

**Methods:** Systematic literature search (PubMed, Medline 1966–2008) was used to identify the studies which have addressed direct and indirect effects of climate variability and climate change on health-related states and events using epidemiologic methods. Relevant articles were reviewed for study design, concepts and causal inference applied and evaluated in the context of contemporary epidemiologic methods.

**Results:** Direct or indirect determinants of health, related to climate variability and climate change, include temperature extremes, floods, aero-allergen production, food-poisoning, water-borne infection, regional crop yields, fisheries and sea-level rise. Depending on climatic area and time perspective these changes may have both adverse and beneficial effects. The studied adverse health effects include mortality and morbidity from respiratory and cardiovascular diseases, allergic diseases, diarrhoeal diseases, water and vector-borne infections, mental health disorders and injuries. Many of the studies incorporate exposure-response relations from epidemiologic studies to complex models and scenarios.



**Conclusions:** Epidemiology can provide useful empirical exposure-response functions for different climate change scenarios, but the type of problems addressed in assessing effects of climate change will stimulate evolution of new methods and philosophical ideas.

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**ISEE-0615****Professional Exposure to Pesticides and Parkinson's Disease (PD) among French Agricultural Workers**

Alexis Elbaz,\*† and Frédéric Moisan,\* \*Inserm, U708 (Neuroepidemiology), Paris, France; †Département Santé-Travail, Institut de Veille Sanitaire, Saint-Maurice, France.

**Background:** We studied the relation between PD, professional pesticide exposure, and agricultural patterns among affiliates of the Mutualité Sociale Agricole, the French social security for farm owners/helpers and other workers in the agricultural area. Our objective was to investigate the role of specific pesticides, dose-effect relations, and gene-environment interactions.

**Methods:** In the TERRE case-control study (1998–1999), 247 cases from 62 French districts with recently diagnosed PD were compared to 676 matched controls. Detailed pesticide data were collected by occupational physicians; questionnaires were reviewed by experts. DNA was collected. We conducted a prevalence study (PARTAGE, 2007) in 5 districts by identifying all patients taking levodopa or who made PD health claims. Data from the agricultural census were used to characterize agricultural patterns of counties. Logistic models were used to study the relation between PD prevalence in counties and types of crops.

**Results:** In TERRE, PD was associated with professional pesticide exposure (OR adjusted for age, gender, district, smoking = 1.8). Men used pesticides considerably more frequently than women; among men, the association was stronger for insecticides (OR = 2.2), than for fungicides (OR = 1.5) and herbicides (OR = 1.4). Organochlorine insecticides (OR = 1.9) were more strongly associated than other insecticides. Organochlorines interact with the P-glycoprotein encoded by the MDR1 gene. Overall and in men, there was no association between PD and two SNPs (e21/2677[G/T/A], e26/3435[C/T]) associated with differences in MDR1 expression/function; however, the OR for organochlorines exposure was three times higher among men carrying the e21 TT genotype (interaction,  $P$ -value = 0.10). In PARTAGE, PD prevalence in counties increased with the density of specific crops (fruit trees) (trend,  $P < 0.05$ ).

**Conclusion:** We confirm the association between PD and professional pesticide exposure and show that some pesticides (organochlorine insecticides) and crops (fruit trees) are more likely to be associated than others. In addition, our results suggest a MDR1 by organochlorines interaction among men.

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**ISEE-0617****The Exxon Valdez Oil Spill and Its Impact on Community and Ecology**

Riki Ott, Earth Island Institute, San Francisco, CA, United States.

**Background and Objectives:** On March 24, 1989, the Exxon Valdez grounded in Prince William Sound (PWS), spilling between 11 to 38 million gallons of crude oil. Comprehensive ecosystem studies were funded through a 1991 civil settlement for natural resource damages under the Clean Water Act. Toxic tort lawsuits filed by former cleanup workers triggered a citizen-driven investigation into health effects. Further, sociologists made the fishing and Native community of Cordova, Alaska, a case study on disaster trauma from the spill and litigation, which is now the longest running such study in the world. Cordova residents also became proactive in rebuilding their community. The goal was to synthesize information to effect positive social change.

**Methods:**

1. Synthesis of available documents, including scientific papers, medical records, court records, congressional hearings, and state and federal reports.
2. Interviews with principle investigators, medical doctors, lawyers, and affected citizens (cleanup workers, fishermen, Natives, and others).
3. Strategic use of university environmental law clinics and civil action to leverage political action.
4. Development of models (exercises) to mitigate trauma and empower citizens.

**Results:** A fishermen's blockade of oil tanker traffic after delayed collapse of fish populations in PWS (August 1993) triggered comprehensive ecosystem studies. A popular book, *Sound Truth* and Corporate Myth\$, summarized the paradigm shift in oil ecotoxicology (human and wildlife) and helped trigger, along with law clinic reviews and other civil action, the reopener clause in the civil settlement for additional funds to mitigate unanticipated ecological harm. A second popular book, *Not One Drop*, and documentary film, *Black Wave*, on psychosocial trauma and healing, are helping initiate a popular movement to restrict corporate power.

**Conclusion:** Citizens are using the EVOS legacy of lingering social, economic, and environmental harm to advocate for social change ([www.ultimatecivics.com](http://www.ultimatecivics.com)).

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**ISEE-0643****The Importance of Arsenic from Diet Sources to Studies of Arsenic Exposure at Low-to-Moderate Levels**

Ana Navas-Acien, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, United States.

**Background and Objectives:** Total urine arsenic integrates multiple exposure sources as a marker of overall inorganic (arsenite, arsenate) and organic (arsenobetaine, arsenosugars) arsenic. Urine speciation can evaluate arsenic metabolism and differentiate inorganic from organic exposure. Organic arsenicals, mostly from seafood, have little toxicity compared to inorganic arsenic. While arsenobetaine is excreted unchanged in urine, arsenosugars are metabolized to several species including dimethylarsinate (DMA). Our objective was to evaluate the impact of organic arsenic exposure to total arsenic and DMA concentrations in spot urine samples from US adults.

**Methods:** Cross-sectional study in 998 adults  $\geq 20$  y who participated in the 2003–2004 National Health and Nutrition Examination Survey (NHANES). Total urine arsenic, DMA and arsenobetaine were measured using inductively coupled plasma dynamic reaction cell mass spectrometry.

**Results:** Median levels of total arsenic, DMA and arsenobetaine were 8.3, 4.0, and 1.1  $\mu\text{g/L}$ , respectively. 139 (weighted prevalence 13%) participants self-reported seafood intake in the past 24-h. After adjustment for age, sex and urine creatinine, total arsenic, DMA and arsenobetaine were higher in participants who self-reported seafood intake. Arsenobetaine levels were similar across participants self-reporting fish, shellfish, mollusks or sushi/seaweed intake. DMA concentrations, however, were statistically higher among participants self-reporting mollusks (median 12.0  $\mu\text{g/L}$ ) or sushi/seaweed (median 9.5  $\mu\text{g/L}$ ) compared to those reporting only fish (median 6.2  $\mu\text{g/L}$ ). Among participants reporting no seafood intake in the past 24-h, the correlation of arsenobetaine with total urine arsenic was 0.76 and with DMA it was 0.43.

**Conclusions:** Organic arsenicals are major contributors to total urine arsenic and DMA in the general US population, including participants reporting no seafood intake in the past 24-hours. Arsenobetaine, as a marker of organic arsenicals, can be useful to control for organic arsenic

in epidemiologic studies investigating the health effects of inorganic arsenic exposure.

#### ISEE-0652

##### Population Attributable Risk of Low Birth Weight Related to PM<sub>10</sub> Pollution in 7 Korean Cities\*

Ju-Hee Seo,\* Jong-Han Leem,† Eun-Hee Ha,\* Ok-Jin Kim,\* Byung-Mi Kim,\* Ji-Young Lee,‡ HyeSook Park,\* Yun-Chul Hong,§ and Young-Ju Kim,¶ \*Dept. of Preventive Medicine, School of Medicine, Ewha Womans University, Seoul, Korea, Republic of; †Dept. of Occupational & Environmental Medicine, College of Medicine, Inha University, Incheon, Korea, Republic of; ‡Dept. of Social and Preventive Medicine, College of Medicine, Inha University, Incheon, Korea, Republic of; §Dept. of Preventive Medicine, College of Medicine, Seoul National University, Seoul, Korea, Republic of; and ¶Dept. of Obstetrics and Gynecology, College of Medicine, Ewha Womans University, Seoul, Korea, Republic of.

**Background and Objective:** Population-attributable risk (PAR) is a very important concept in guiding policy decisions regarding the preventive approaches to many diseases. However, little research has been conducted examining the PAR for air pollution and LBW. Thus, we investigated the association between maternal exposure to air pollution during pregnancy and low birth weight, and calculated the PAR for air pollution and LBW in 7 Korean cities.

**Methods:** We collected birth records from the Korean National Birth Registry to obtain information about birth outcomes in 7 Korean cities during 2004. The birth data we used were the 37–44 weeks gestations period of singleton. A geographic information system and kriging methods were used to construct exposure models. We included 177,660 full-term singleton babies in our analysis. Associations between air pollution and LBW were evaluated using univariate and multivariate logistic regression, and the PAR for LBW due to air pollution was calculated.

**Results:** When only spatial variation of air pollution was considered in each city, the adjusted odds ratios unit of particulate matter <10 µm in diameter (PM<sub>10</sub>) for LBW were 1.08 (95% CI = 0.99–1.18) in Seoul, 1.24 (95% CI = 1.02–1.52) in Pusan, 1.19 (95% CI = 1.04–1.37) in Daegu, 1.12 (95% CI = 0.98–1.28) in Incheon, 1.22 (95% CI = 0.98–1.52) in Kwangju, 1.05 (95% CI = 1.00–1.11) in Daejeon, and 1.19 (95% CI = 1.03–1.38) in Ulsan. The PAR for maternal PM<sub>10</sub> exposure during pregnancy was 7% for LBW babies in Seoul, 19% in Pusan, 16% in Daegu, 11% in Incheon, 18% in Kwangju, 5% in Daejeon, and 16% in Ulsan.

**Conclusion:** Our study showed that the PAR for LBW due to maternal exposure to PM<sub>10</sub> during pregnancy is substantial. Air pollution is an important risk factor for LBW because every pregnant woman is exposed to air pollution.

\*This study was supported by the Eco-technopia 21 project (2005, 091-052-036) from Ministry of Environment, Korea.

#### ISEE-0653

##### Scientific Basis for the Contingency Planning Against Coastal Oil Spill

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**Background and Objectives:** In order to minimize the effect of environmental disasters on human health, the national contingency plan

should include a plan devoted to environmental health management. This study presents a scientific basis for the establishment of an environmental health contingency plan for dealing with accidental coastal oil spills and suggests some strategies for use in an environmental health emergency.

**Methods:** The existing literature about environmental health systems and emergency planning, particularly with respect to vulnerable populations, and various fundamental factors involved in response strategies for oil spill were analyzed. The analysis was based on the data derived from Hebei Spirit oil spill and the authors used air dispersion modeling.

**Results:** Spill amounts of more than 1,000 kilolitres can affect the health of residents along the coast, especially those who belong to vulnerable groups. Almost 30% of South Korean population (13,725,628 persons) lives in the vicinity of the coast. The area that is at the highest risk for a spill was defined. The most prevalent types of oil spilt in Korean waters have been crude oil and bunker-C oil, both of which have relatively high specific gravity and contain volatile organic compounds, polycyclic aromatic hydrocarbons, and heavy metals. In the case of a spill of more than 1,000 kilolitres, depending on the distances involved, the coastal characteristics, and the type of oil, it may be necessary to evacuate vulnerable and sensitive groups.

**Conclusions:** To prepare for future oil spills, Korea should establish environmental health planning that considers the spill amount, the types of oil, and the distance between the spot of the accident and the coast. To make it possible to make rapid decisions and so minimize the health impact of an oil spill, a response team that includes environmental health specialists should be assembled in advance.

#### ISEE-0655

##### Transport Noise and Incidence of Cardiovascular Disease

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**Background and Objective:** Large parts of the population in urban areas are exposed to transport noise and levels are increasing. Evidence is accumulating that exposure to community noise is associated increased risks of cardiovascular disease, however, most studies have been of cross-sectional design. The objective of this review is to summarize recent Swedish studies on community noise exposure and incidence of cardiovascular disease.

**Methods:** One study included 1571 cases of myocardial infarction occurring 1992–1994 in Stockholm county and 2095 population controls. Residential exposure to noise and air pollution from road traffic was estimated based on residential history from 1970 combined with information on traffic intensity and distance to nearby roads. Another study included 4721 subjects followed for 8–10 years with regard to incidence of hypertension. This study focused on exposure to air craft noise which was estimated based on residential history.

**Results:** An increased risk of myocardial infarction related to long term noise exposure from road traffic at 50 dB(A) or higher was observed in subjects without hearing loss or exposure to noise from other sources (RR 1.38, 95% CI 1.11–1.71), with a positive exposure-response trend. No strong effect modification was indicated by sex or other cardiovascular risk factors, including air pollution. Furthermore, an excess risk of hypertension per 5 dB(A) exposure to air craft noise, among those not using tobacco, was observed for men (RR 1.21, 95% CI 1.05–1.39) but not in women (RR 0.97, 95% CI 0.83–1.13). In both sexes combined, an increased risk of hypertension related to air craft noise exposure was indicated among those reporting annoyance to air craft noise.

**Conclusion:** Exposure to community noise appears to increase the incidence of cardiovascular disease.

## ISEE-0656

**Acute Effect of Black Carbon and Particle Pollution in the Air on Exhaled Nitric Oxide of Elementary School Children Before and During 2008 Beijing Olympic**

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**Background:** Before and during 2008 Beijing Olympics, extensive control measures were taken to drastically improve the air quality during the Olympics. This provided an excellent opportunity for studies on health effects of air pollution.

**Methods:** A panel of 37 9–12 year old school children in Beijing was studied to evaluate the associations between the exposure of black carbon and particulate matter with exhaled nitric oxide (eNO). The concentrations of PM<sub>2.5</sub>, black carbon in PM<sub>2.5</sub> (BC) and in total suspended particle (TBC), as well as gaseous pollutants were measured on a daily basis. We analyzed the correlation between eNO and ambient pollutants with generalized estimating equations (GEE) and polynomial distributed lag models (PDL), controlling for weight, asthma state, ambient temperature and relative humidity.

**Preliminary Results:** Significant associations were found between eNO increase and exposures to ambient pollution. The strongest positive associations were found between eNO and 48-hr average pollutant concentrations. In response to a 1 µg/m<sup>3</sup> increase of BC for 24hr (lag0), 25hr–48hr (lag1) and 48hr, eNO increased 3.9% (95% CI, 3.3–4.5%), 2.2% (95% CI, 1.6–2.9%), and 4.6% (95% CI, 3.9–5.4%) respectively. For TBC, the eNO increased 2.4% (95% CI, 2.1–2.8%), 1.5% (95% CI, 1.1–1.9%) and 2.9% (95% CI, 2.4–3.3%), respectively. For PM<sub>2.5</sub>, the eNO increased 2.9% (95% CI, 2.4–3.5%) 0.8% (95% CI, 0.2–1.3%) and 3.2% (95% CI, 2.5–3.9%), respectively. We found that eNO was associated with hourly averages of BC and TBC up to 10–14 hr after exposure. The sum for the lag coefficients covering 48 hours was 4.10% eNO per 1 µg/m<sup>3</sup> increase in BC.

**Conclusions:** This study provides evidence of the health benefits of air pollution control measures for the Beijing Olympics, as well as new evidence on the health effects of black carbon on inflammation biomarkers, and the lag effect structure between black carbon exposure and respiratory health parameters.

## ISEE-0657

**Air Pollution Characteristics Before, During, and After the Beijing Olympics**

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**Background:** The air quality in Beijing has been improved significantly in the last decade. Yet this improvement was undermined by rapid increases in vehicles numbers and energy consumption in Beijing. For the 2008 Beijing Olympics, air pollution was a serious concern. In order to formulate air pollution control strategies for the 2008 Olympics and to evaluate the controlling effects, an international collaborative project, CAREBEIJING (Campaigns of Air Quality Research in Beijing and Surrounding Regions) led by Peking University was conducted in the summers of 2006, 2007, and 2008. In the meantime, a health study (CAREBEIJING-H) with two panels assessing cardiovascular and respiratory responses of susceptible populations was also conducted.

**Methods:** With the efforts of more than 100 scientists and students from 20 research institutes in different countries, ground, aircraft, and satellite

observations were carried out to measure gaseous and particulate pollutants and to study the transfer and transport of air pollutants.

**Results:** The extensive data on gaseous and particulate pollutants collected were used to guide the government's air pollution control policies for the Beijing Olympics and to assess the effectiveness of these policies. The main findings are: 1) PM and O<sub>3</sub> were the two most important pollutants to control during the Beijing Olympics; 2) SO<sub>2</sub> and VOCs were the major precursors of PM and ozone, therefore, the controlling measures should focus on them; 3) regional controlling efforts were needed. During the Olympics, significant reductions of NO<sub>x</sub>, SO<sub>2</sub>, CO, BC, PM<sub>2.5</sub>, and O<sub>3</sub> were observed. The level of reduction ranged from 10% to 60%, depending on which period to compare with.

**Conclusions:** The air pollution control during the Beijing 2008 Olympic game is one of the largest air quality experiments and a unique public health intervention experiment. Its success provides a great lesson for megacity air pollution control.

## ISEE-0661

**Acute Health Effects of Hebei Spirit Oil Spill**

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**Background and Objective:** On December 7th, 2007, the Hong Kong tanker Hebei Spirit was crushed by a crane ship towed by the Samsung tugboat, at northwest of Taeann beach, Korea. More than 12,547 kl of oil spilt into the sea, hitting the western coastline about 1,052 km. To examine the acute health effects of the oil spill, metabolites assay and questionnaire survey was performed in the area.

**Methods:** Two polycyclic aromatic hydrocarbon (PAH) and four volatile organic compounds (VOCs) metabolites, and 6 heavy metals were analyzed in urines of 154 residents involved with the clean-up work, 98 children, and 30 pregnant women residing in the contaminated area, and controls residing far from the accident sites. The 113 volunteers' urine pairs collected the day before and after their clean-up work were analyzed. A questionnaire survey was taken to examine physical symptoms in 282 residents, 570 volunteers, 1,356 children, and 80 pregnant women. Mental health was also checked.

**Results:** The levels of VOC and PAH metabolites were not significantly different between the exposed and controls, while heavy metals were significantly different between them. The metabolite levels after clean-up were higher than before clean-up in volunteers. The risk of physical symptoms increased according to increasing duration of clean-up work. The prevalence of depression and psychosocial stress among residents was much higher than the general Korean population. The risk of physical symptoms and the prevalence of depression and anxiety among children increased as their house or school located closer to the contaminated coastline. The pregnant women resided nearer the accident site compared to those residing farther away reported a higher prevalence of physical symptoms, psychosocial stress and depression.



**Conclusion:** Study for long term health effects of the oil spill should be planned by constructing exposed cohorts and monitoring the residual exposure via multiple-media.

#### ISEE-0667

##### Longitudinal Cohort Study of Prenatal Exposure to Mercury in the Mediterranean Region

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**Background/Objectives:** Neurotoxicity from prenatal exposure to methylmercury has been studied but no firm conclusions have been reached on the dose-response relationship, especially at levels of exposure less than 10 ppm. This study has enrolled a total of 1700 pregnant women and their children in Slovenia, Croatia, Italy and Greece to assess the impact of mercury exposure through fish consumption during pregnancy on child neurodevelopment. We present here results at baseline on levels of total mercury (THg) and methylmercury (MeHg) in maternal hair in relation to fish consumption patterns during pregnancy and estimate correlations between THg and MeHg concentrations in maternal hair and between maternal and cord blood.

**Methods:** Maternal hair, blood, and cord blood samples are collected at different times during pregnancy and after delivery. THg in hair is analysed by CV-AAS and, in subjects whose hair THg exceeds 1 ppm, MeHg in hair and blood samples is determined by gas chromatography. We assessed fish consumption through food frequency questionnaires administered during pregnancy and 1–3 months after delivery, respectively.

**Results:** Mean THg in hair is 0.94 ppm, with 69% <1 ppm and 10% >2 ppm. Less than one serving/week of fresh fish is consumed by 45% of mothers and >3 servings/week by 8%, with a correlation between hair THg and fresh fish consumption ( $r_s = 0.45$ ,  $P < .0001$ ) during pregnancy. In paired samples, THg in maternal hair and maternal blood are highly correlated ( $r = 0.88$ ,  $P < .0001$ ) as well as MeHg in maternal blood and THg in maternal hair ( $r = 0.78$ ,  $P < .0001$ ). There is a moderate correlation between THg in maternal hair and MeHg in cord blood ( $r = 0.57$ ,  $P < .0001$ ). In maternal hair samples with THg >1ppm, 98% of total mercury is methylmercury.

**Conclusion:** Current mercury levels in hair are low, but there is a correlation between consumption of fresh fish and hair THg levels.

#### ISEE-0672

##### Immune Markers in a Community Exposed to PFOA: Findings from the C8 Science Panel Study

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**Background and Objective:** Perfluorooctanoic acid (PFOA, also known as C8) is widespread and has been shown to be immunotoxic in rodents. A survey in a group of residents from the Ohio and West Virginia communities with PFOA water contamination was conducted in 2005–2006. The current study, part of the C8 Science Panel Community Study, is an analysis of immune markers in the blood from adults

included in that survey, to assess if there is relationship between PFOA and these markers.

**Methods:** 56,315 participants 18 years and older had consumed drinking water for at least one year from sources with PFOA contamination, providing demographic information by questionnaire. Serum was analysed for PFOA, PFOS and the following immune markers: immunoglobulins IgG, IgM, IgA, and IgE, total antinuclear antibodies (ANA) and C reactive protein (CRP). Regression analyses of PFOA and these immune markers (after log transformation) included adjustment for age, smoking behaviour, alcohol use, body mass index and ethnic group. Males and females were assessed separately.

**Results:** Immune markers were largely within normal reference ranges. Several statistically significant trends were found: IgA fell with increasing PFOA in both sexes, and a similar pattern for CRP. For IgE a weaker relationship was only evident in females. For IgG and IgM there was no evidence of a consistent trend. ANA shows a significant positive relationship with increasing PFOA. The changes between the 25<sup>th</sup> and 75<sup>th</sup> centile of PFOA were modest: 3–4% for IgA, 5–7% for CRP and ANA.

**Conclusion:** The associations found between this immune biomarkers and PFOA do not necessarily indicate that PFOA is the cause of changes observed, as these are cross sectional data. Nonetheless the patterns suggest that there may be a relation between immune function and PFOA exposure in exposed persons, and this is being investigated further.

#### ISEE-0676

##### Providing Simulations of Food Crop Production for Health Impacts

Gillian Rose,\* Tim Wheeler,\* and Sari Kovats,† \*Walker Institute, University of Reading, Reading, United Kingdom; and †London School of Hygiene and Tropical Medicine, London, United Kingdom.

**Abstract:** Crop production is central to maintaining health. Lack of locally produced food, particularly in developing countries, is a major contributor to malnutrition. However, changes in climate and climate variability are likely to have a profound effect on the geographical areas suitable for crop production, as well as the range of crops that can be grown there. This paper will review how advances in the simulation of food crop production under climate change could be used in studies of health impacts in a future climate.

**Materials and Methods:** The Global Large Area Model (GLAM) is a crop simulation model specifically designed to use outputs at the scale of climate models and so provide simulations of changes in food production at scales of countries and regions. We used GLAM to project suitable production areas for a range of important crops under a number of climate change scenarios.

**Results:** Changes in climate (in particular temperature and rainfall) and increased climate variability will impact the productivity of crops, affecting the total calories available from food grown locally and the constituents of diets. Developing countries will be most severely affected due to the financial cost of adapting, including fertiliser application, irrigation and new cultivars. Under future climate scenarios, it may be unproductive to grow the crops that currently contribute to local diets. However, by identifying regions of future food concern it may be possible to identify other varieties or crop species that will be better suited to the local climate.

**Conclusions:** Climate change is likely to exacerbate malnutrition and under-nourishment in some parts of the world through a change in the productivity of local crops. Better links between studies of changes in food crop production and health impacts are needed to inform the adaptation of these communities to climate change.

## ISEE-0679

**Mother and Child Contaminants and Dietary Impacts on the Body Burden of Contaminants: Contribution of North-South Research Collaboration to Maternal and Child Global Health**

Jon Oyvind Odland, University of Tromsø, Tromsø, Norway.

**Abstract:** The levels of environmental contaminants in maternal blood during pregnancy and in cord blood at delivery give an indication of the potential risk to the developing fetus and child. In the light of the paucity of data from the Southern Hemisphere, the Arctic Monitoring and Assessment Programme (AMAP) initiated collaborative research programmes in developing countries in the Southern Hemisphere. Up to 2009 several publications have presented new and unique data on biological contaminant levels and pregnancy outcome in the Arctic and selected countries in the south. The Arctic indigenous populations are at special risk, suffering from both global contamination and local point sources of pollution, influencing their daily diet. A new and unpredictable dimension is the climate change, leading to possible release of toxic substances in the environment also in the Southern Hemisphere. In Southern Africa the reintroduction of DDT in the fight against malaria is an important health issue for the populations at risk. The symposium will report on the findings and progress of studies performed both in the Arctic, with emphasis on Norway and Russia, and the Southern (South Africa, Vietnam and Brazil) Hemisphere. The protocols are developed through the AMAP network, including the QA/QC of the laboratory performance in all study bases. This cooperation allows a direct comparison of results and assessments.

## ISEE-0682

**Influenza Epidemics, Seasonality, and the Effects of Cold Weather on Cardiovascular Mortality**

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**Abstract:** Epidemiological studies have shown that extremes in ambient temperature are associated with short term increases in mortality. To control for seasonality, most previous time series studies used non-parametric functions of time. We conducted a US multi-city study evaluating whether adjustment for influenza epidemics changes the exposure-response function of temperature, and whether controlling for the remaining seasonal pattern could be modeled more simply.

Counts of daily cardiovascular deaths and of emergency hospital admissions of the elderly for pneumonia during 1992–2000 were obtained for 48 cities. Applying city-specific Quasi-Poisson regression models we estimated the association between daily cardiovascular mortality and temperature. Models included day-of-the-week indicators and regression splines of temperature, relative humidity, barometric pressure. In the base model a regression spline of date with five degrees of freedom (df) per year captured trend and seasonality. In the alternative model a regression spline of pneumonia admissions, a sinusoidal function of time, and a regression spline of date with ten df were included instead.

Temperatures were lower in the north-east compared to the south-west and the range differed greatly. The alternative model fit the data better than the base model based on GSV-scores, capturing well the regular seasonal pattern as well as the irregular pattern of the outcome. The temperature-response function was mostly U- or J-shaped and not greatly affected by adjusting for influenza. The pooled estimated increase in risk for a temperature decrease from 0 to  $-5^{\circ}\text{C}$  was 1.6% (95% confidence interval (CI) 0.9–2.4%) in the base and 1.9% (95% CI 1.2–2.6%) in the alternative model.

This study on the effect of temperature on mortality shows that including epidemic data explained most of the irregular seasonal pattern, allowing more parsimonious models than when adjusting for seasonality only with smooth functions of time. The effect of cold temperature is not confounded by epidemics.

## ISEE-0684

**Contaminant Studies of the Delivering Population in Murmansk Region, Russia.**

Erik Eik Anda, Jon Oyvind Odland, and Anton Kovalenko, University of Tromsø, Tromsø, Norway.

**Abstract:** Ambient air pollution and other environmental hazards such as persistent organic pollutants are thought to have adverse effects on reproductive health and birth outcomes. At the root of investigations describing such causal relationships, there should be a well functioning medical birth registry. The Murmansk County Birth Registry was established in 2005 and is annually cataloguing over 8500 deliveries. Murmansk County has a population of 857 000 all of which reside above the Arctic Circle. The fact that this is an arctic population is interesting in itself, especially in relation to global environmental changes, but the region also exhibits a unique industrial and residence setting. Individual communities are built around polluting industries such as nickel plants, aluminium plants, nuclear plants and such famous naval bases as Severomorsk. This presents a unique opportunity to describe the burden of pollution for the people living in these individual communities and in turn the effect of pollution and other environmental contaminants on delivering women and their children. Phase one will commence in the fall of 2009. This will be an intercommunity comparison of mothers' plasma contaminants to establish whether the contaminant levels are community-specific. If they are, it should be possible to look at adverse pregnancy outcomes based on specific communities. Phase two in 2010 and 2011. Evidently, phase one can only be used to point out possible correlations and not causal relationships. Phase two will be to conduct case-control studies within the cohorts or "nested" case-control studies. Compared to cohort studies these are cost-effective and with nearly the same levels of precision. The presentation will further elaborate on the ability of such a "nested" case-control study to reveal causal relationships between contaminants and adverse pregnancy outcomes.

## ISEE-0685

**Global Environmental Change and Human Health: An Earth System Science Partnership Response**

Mark Rosenberg,<sup>†</sup> and Martin Rice,<sup>\*</sup> <sup>\*</sup>Earth System Science Partnership, Paris, France; and <sup>†</sup>Queen's University, Ontario, Canada.

**Background and Objective:** The purpose of this paper is to introduce the new Earth System Science Partnership (ESSP) Project on Global Environmental Change and Human Health (GECHH) launched by the four global environmental change research programmes: an international programme on biodiversity science (DIVERSITAS), the International Geosphere-Biosphere Programme (IGBP), the International Human Dimensions Programme on Global Environmental Change (IHDP) and the World Climate Research Programme (WCRP).

**Methods:** The evolving Science Plan explores priorities and settings for the future coordinated international study of the relationships between GEC and human health, taking into account the complexities of concurrently acting environmental changes and the importance of socioeconomic and cultural contexts as modifiers of community vulnerability.

**Results:** The added value of this Project is clear in that it seeks to identify and quantify current health impacts of GEC and to forecast the future health impacts. These scenarios of future health impacts will form a

new, dynamic and integrative node in the developing domain of Earth System Science. They will help focus on policy options that ensure a healthier and more sustainable future. The Project will also make connections with other international organizations concerned with health and the environment and argue that there is a natural synergy to be pursued between the GEC and human health community and the ISSE community.

**Conclusion:** Many of the researchers in the environmental epidemiology community are already carrying out research that overlaps with the ESSP GECHH agenda and, therefore, we seek to encourage even greater participation of the ISSE community in the future activities of the ESSP Global Environmental Change and Human Health Project.

#### ISEE-0689

##### On Science-Policy Interface—Results from Synthetic Analysis of Five EC-Funded Projects, Part I: “Assessment” Issues

Rainer Fehr,\* and Helmut Brand,† *\*LIGA.NRW, Bielefeld, Germany; and †U Maastricht, Maastricht, Netherlands.*

**Background and Objective:** The WHO Collaborating Center (CC) on “Regional Health Policy and Public Health” at LIGA.NRW is committed to assist in all phases of the public health policy cycle. One of CC’s approaches refers to integrating experiences and recommendations across existing projects on evidence-based policy-making. This poster focusses on “assessment”.

**Methods:** A set of five related, EC-funded projects concerning the science-policy interface was chosen: Benchmarking Regional Health Management II (BEN II, 2004–2007), European Environment and Health Information (ENHIS II, 2005–2007), European Policy Health Impact Assessment (EPHIA, 2002–2004), Evaluation of cross-border activities (EUREGIO, 2004–2007), and Policy Impact Assessment of Public Health Reporting (PIA PHR, 2005–2008). This set includes both “general” public health and environment-focussed projects. The projects underwent synoptic, largely qualitative analysis.

**Results:** As for “analysis”, this set of projects covers a range of specific approaches which can be broadly classified into (i) status quo analysis of health and health determinants incl. health systems, and (ii) prospective, concurrent, or retrospective impact analysis, highlighting the change in burden of disease resulting from policies or other arrangements. Key concepts for both arenas, as gathered from the projects, include (indicator-based) comparative analysis; establishing, piloting, and evaluating generic methodologies; and “good practice” approaches. Specific concepts include “organigraphs” for charting how organisations work; dedicated policy-supporting information and analysis systems; “reference frameworks” to judge what interventions and policies contribute to good practice; step-wise procedure models, e.g. on health impact assessment; and cluster analysis of regions. The combined results of the projects are referenced and mapped out for easier access.

**Conclusion:** Taken together, the five EC-funded health policy projects offer a basis for improved “analysis” activities in the policy cycle. After this “proof of concept”, the approach should be field-tested.

#### ISEE-0691

##### The Russian Arctic Mother-Child Cohort—The First Results of a Follow Up Study of Persistent Toxic Substances (PTS) Blood Levels

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**Background and Objective:** Certain indigenous communities in the Russian Arctic are at a high risk of exposure to contaminants. Concentrations of PCBs, mercury and lead in some blood samples from

the women of reproductive age exceeded the internationally recommended levels of concern and, in some cases, action levels. Significant associations between the maternal serum concentration of some PTS and a number of adverse reproductive effects have been shown. The objective of the follow up study was evaluation of the effects of PTS maternal and cord blood levels 5 years after the first examination, which could be used as a basis for body burden prediction and assessment of the potential risk to the developing foetus and child.

**Materials and Methods:** Results of chemical analyses of PTS in blood samples from 17 mothers and their babies born in Chukotka coastal area in 2001–2002 were compared with PTS levels from the same women and their children in 2007. Data on maternal and child health were collected from the mothers’ medical files, newborns’ delivery records and questionnaires of the mothers.

**Results:** Maternal blood serum levels of POPs generally decreased significantly in 2007 compared with corresponding levels in 2001–2002 (for different organochlorines from 19% to 72%). Maternal blood levels of lead decreased 21% while the average mercury level was the same. Children’s blood serum levels of POPs generally increased significantly in 2007 in comparison with corresponding cord blood serum levels in 2001–2002 (for different organochlorines from 14% to 132%), except oxychlordane and DDT which dropped by about 30% each. The children’s blood levels of lead did not change, while the average mercury level decreased by 31.4%.

**Conclusions:** For the first time in the Russian Arctic a trend study has been performed among an Arctic mother-child cohort that could be used as a model in future investigations connected with PTS, reproductive health and child development.

#### ISEE-0692

##### On Science-Policy Interface—Results from Synthetic Analysis of Five EC-Funded Projects, Part II: “Policy Development” and “Assurance” Issues

Rainer Fehr,\* and Helmut Brand,† *\*LIGA.NRW, Bielefeld, Germany; and †U Maastricht, Maastricht, Netherlands.*

**Background and Objective:** The WHO Collaborating Center (CC) on “Regional Health Policy and Public Health” at LIGA.NRW is committed to assist in all phases of the public health policy cycle. One of CC’s approaches refers to integrating experiences and recommendations across existing projects on evidence-based policy-making. This poster focusses on “Policy development” and “assurance”.

**Methods:** A set of five related, EC-funded projects concerning the science-policy interface was chosen: Benchmarking Regional Health Management II (BEN II, 2004–2007), European Environment and Health Information (ENHIS II, 2005–2007), European Policy Health Impact Assessment (EPHIA, 2002–2004), Evaluation of cross-border activities (EUREGIO, 2004–2007), and Policy Impact Assessment of Public Health Reporting (PIA PHR, 2005–2008). The projects underwent synoptic, largely qualitative analysis.

**Results:** Similar to “assessment”, this set of projects covers a range of specific approaches to “policy development”. They refer to both the actors involved and the activities undertaken. In policy-making, different actors, e.g. decision-makers, citizens, and professionals, need to be accommodated. Overviews of existing policies, e.g. inventory of national policies on selected issues in 18 European countries as produced by one project, may provide examples which can be adapted to specific new situations. Taken together, the projects reflect policy-making at European, national, and regional (subnational) levels, including priority-setting as well as other methodological and organizational aspects. Promoting and hindering factors for cooperation with diverse sectors and actors, as identified, e.g., in analysing cross-border projects, can be of general interest. Just as for the “analysis” poster, the combined results of the 5 projects are referenced together and mapped out for easier access.



**Conclusion:** The five EC-funded health policy projects also offer a basis for improved “policy development” activities in the policy cycle. After this “proof of concept”, the approach should be field-tested.

#### ISEE-0695

##### The Contribution of Large European Research Consortia

Fintan Hurley,\* David Briggs,† and George Morris,‡ \**Institute of Occupational Medicine, Edinburgh, United Kingdom; †Imperial College, London, United Kingdom; and ‡NHS Health Scotland, Edinburgh, United Kingdom.*

**Background and Objective:** In Europe the EC and others support several large-scale projects developing methods and tools to inform policy development by using scientific evidence, and modelling, to predict those public health effects (of planned policies and measures) that are mediated via the environment. This paper indicates progress on methods, and describes different experiences of the engagement of researchers and policy makers.

**Methods:** The paper considers three projects. INTARESE and HEIMTSA are two large, multi-centre Integrated Projects of the EC 6<sup>th</sup> Framework Research Programme. These have evolved in partnership using a methodology of Integrated Environmental Health Impact Assessment. A third collaborative project, EDPHiS, was designed to inform the Scottish Government's environment and health strategy, Good Places, Better Health (GPBH).

**Results:** The EC projects have developed complementary case studies or modules based on sectors (INTARESE), or on pollutants linked with scenario development (HEIMTSA), as steps towards predicting the intended and unintended health effects of policies. They will now collaborate in analyzing the EU-wide health effects of climate change mitigation and adaptation policies. It has however been difficult to engage policy makers, and others, until recently when results became available. EDPHiS, contrastingly, was designed from the outset to link with policy makers, and is now embedded within ScotEnvH, a wider environment and health “intelligence network” that is one cornerstone of the whole GPBH implementation structure.

**Conclusion:** Having policy makers at arms length initially (HEIMTSA, INTARESE) has allowed co-ordinated development of methods, but some uncertainties about their suitability (which are now being addressed). Close involvement with policy makers (EDPHiS) raises the stakes in terms of visibility and delivery, but gives built-in relevance and opportunity to ‘plug in’ to wider processes. Researchers in all three projects find that actual or potential policy relevance is motivating and satisfying.

#### ISEE-0697

##### Air Pollution Exposure in Europe—Assessment in the ESCAPE study

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**Background and Objective:** The ESCAPE study is a large EU-funded study on long-term health effects of outdoor air pollution. The study adds air pollution exposure assessment to health data already available from European cohort studies. It is conducted by 24 institutes covering Europe. As long-term exposure to air pollution has been associated with a range of adverse health effects, we have chosen for a broad representation of health effects including a) adverse pregnancy outcome studies, and birth cohort studies of children for outcomes such as asthma and allergy; b) cohort studies of respiratory

biomarker and morbidity endpoints; c) cohort studies of cardiovascular biomarker and morbidity endpoints; and d) cohort studies of non-accidental and cause specific mortality, and cancer incidence.

**Methods:** Exposure assessment includes development of land use regression models to estimate individual exposure of study participants to ambient air pollution. Specifically, we will perform spatially resolved measurements of PM<sub>10</sub>, PM<sub>2.5</sub>, the soot content of PM<sub>2.5</sub> and NO<sub>x</sub> in 21 study areas and NO<sub>x</sub> only in an additional 18 study areas. In each study area, 40 sites will be monitored for NO<sub>x</sub>; PM will be monitored at 20 sites per study area. At each site, three 2-week average samples will be taken in different seasons. Standardized sampling and analysis methods will be employed. The measurements will be used to develop stochastic models, using predictor variables (e.g. traffic, population, topography, land use) using Geographic Information Systems.

**Results:** Methodological challenges include integration of dispersion models for some areas; modeling of variations in space and time for birth cohort studies that need shorter-term exposure metrics; assessment of historical exposures for cohort studies that already collected health data; separation of effects of traffic noise and air pollution.

**Conclusion:** In 2008, monitoring has started in half of the study areas. First results will be presented.

#### ISEE-0700

##### Global Aspects and Health Effects of Oil Tanker Accidents

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**Background and Objective:** Over the last decades, numerous accidents involving large oil tankers have occurred close to the coasts of several countries. The residents and the people involved in clean-up operations were exposed to toxic substances potentially leading to adverse health effects. Several epidemiological studies have investigated the impact of exposures from oil spills on the health of the affected population. This study aimed to review the scientific information concerning the wreckage of oil tankers and human health.

**Methods:** A systematic review about the human health effects related to oil spill accidents including the Exxon Valdez (1989), Braer (1993), Sea Empress (1996), Nakhodka (1997), Erika (1999), Prestige (2002) and Tasman Spirit (2003) was carried out.

**Results:** Included were 18 studies, predominantly epidemiological studies with a cross-sectional design. Exposure was typically assessed using a questionnaire and in a few studied additionally using environmental and/or personal monitoring. The identified studies basically focussed on short-term effects of acute exposures to fuel oil, and most reference was made to neurological symptoms, irritation of the skin and mucous membranes, and respiratory problems. Some of the studies included biological monitoring. However, this was heterogeneous between studies and between study groups and results should therefore be interpreted with caution. The most noteworthy findings were an increase number of DNA damages and immunological alterations. The significance of these findings is not clear yet, and should ideally be evaluated prospectively.

**Conclusions:** The investigation of health effects of exposure to oil spills has focussed on short-term effects of acute exposures and information obtained from the determination of biological markers is scarce.

#### ISEE-0702

##### Concentrations of Toxic Metals in Blood and Cord Blood of Delivering Women from Three Indian Ocean Coastal Communities, South Africa. North-South Research Collaboration

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**Background and Objectives:** To explore levels of persistent toxic substances (PTS) in pregnant and delivering women as an indication of the potential risk to the developing foetus and child. The objective of this study was to assess prenatal exposure to toxic metals in three locations along Indian Ocean in South Africa.

**Methods:** A cross-sectional study was conducted among 350 women giving birth who presented for delivery in three public hospitals. Whole blood was collected from randomly selected mothers and newborns and analyzed for the concentrations of cadmium, mercury, lead, manganese, cobalt, arsenic, chromium and selenium using ICP-MS technique. A socioeconomic questionnaire was applied and post-partum delivery records were collected. All statistical analyses were conducted using the STATA package, version 10.

**Results:** The study found statistical differences between locations (rural, industrial and control) in levels of some metals in delivering women. The median concentration in maternal blood of mercury (0.9 µg/L), lead (25 µg/L) and chromium (6.2 µg/L) were highest in the rural location; cobalt (0.15 µg/L) in the industrial location; selenium (543 µg/L) and cadmium (0.54 µg/L) in the control location. Regression analyses show that the correlation between paired maternal and umbilical cord blood for mercury, cobalt and arsenic was highly significant. The study confirms that the toxic metals have an ability to cross placental barrier by different mechanisms. Analysis of the socio-economic and birth outcome data identified a number of confounders that are specific to developing countries.

**Conclusion:** Findings of this investigation re-confirmed that anthropogenic contaminants are present in the coastal Indian Ocean region of South Africa and may pose greater health risks to the populations highly compromised by poverty and poor health status when compared with the populations of developed nations in the Northern Hemisphere.

#### ISEE-0709

##### Residents' PFOA Serum Concentrations Before and After Granular Activated Carbon Filtration at Public Water Systems in Little Hocking, Ohio and Lubeck, West Virginia

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**Background:** We are measuring PFOA serum concentrations over time, including immediately before and after water filtration, for 200 residents served by two water districts with PFOA contamination in order to estimate its serum half-life. Lubeck Public Service District began filtering public water in June 2007, and Little Hocking Water Association followed in November 2007.

**Methods:** By design we selected most participants based on self-reported primary use of Lubeck public water for drinking at home (66%). We also included some participants consuming Little Hocking public water (20%), and some participants reporting primary use of bottled water for drinking at home in either water district (14%). 197 participants remained enrolled throughout the first year of the study, each donating 6 blood samples between May 2007 and June 2008. Linear mixed effects models were used to estimate subject-specific rates of decrease in log PFOA serum concentrations and corresponding subject-specific half-lives.

**Results:** The average decrease in PFOA serum concentrations in Lubeck during the year after filtration was 32 ng/mL (26%) for public water consumers and 16 ng/mL (28%) for bottled water consumers. For Little Hocking customers, the average decrease in PFOA serum concentrations during the six months after filtration was 39 ng/mL (11%) for public water consumers (n = 39) and 28 ng/mL (20%) for bottled water consumers. The estimated average rate of decrease in serum PFOA

concentration for all four groups is 26% per year, corresponding to an average PFOA serum half-life of 2.3 years (95% CI: 2.1 to 2.4 years). Subject-specific half-lives varied widely in our study; most were between 1.5 and 4.6 years.

**Conclusion:** Although our estimate of the average half-life is shorter than other published values, long half-lives cannot always be accurately calculated from shorter studies. We expect to report more precise half-life estimates when this study is completed in 2012.

#### ISEE-0710

##### Regional Differences in Levels of Persistent Organic Pollutants in Plasma of South African Delivering Women: Impact of the Reintroduction of DDT Use in Malaria Areas

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**Background and Objectives:** Exposure to persistent organic pollutants (POPs) in the living environment may cause detrimental health effects in population with the developing foetus and infants being at highest risk. The aim of this study was to measure selected POPs in women giving birth in different geographical regions of South Africa and to identify areas of concern, with special emphasis on malaria areas. To date, no study has been performed that measures concurrently PCBs, DDTs and other organic pollutants in the most susceptible population group, namely delivering mothers in South Africa.

**Methods:** A total number of 96 delivering women donated blood for POPs analyses. Each sample was analysed for 15 polychlorinated biphenyls (PCBs) congeners; six DDTs metabolites (dichlorodiphenyltrichloroethane p,p'-DDT and o,p'-DDT; diphenyldichloroethylene p,p'-DDE and o,p'-DDE; dichlorophenylethane p,p'-DDD and o,p'-DDD) and other pesticides such as hexachlorocyclohexanes (α-HCH, β-HCH, γ-HCH), hexachlorobenzene (HCB), heptachlor, chlordanes (t-CD and c-CD), nanochlor (t-NC and c-NC) and mirex in maternal plasma. Statistical analyses were conducted using the STATA package, version 10 (StataCorp, 2007).

**Results:** The levels of PCB congeners were found to be low in all samples and across all sites. DDTs metabolites were detected in most participants of this study with large regional differences. In two malaria endemic sites where indoor residual spraying (IRS) with DDT takes place to control malaria vector, the highest levels of DDTs metabolites were measured. In coastal malaria site, the geometric mean levels of 5177 ng/g lipids and 1797 ng/g lipids for p,p'-DDE and p,p'-DDT, and in inland malaria levels of 1966 ng/g lipids and 726 ng/g lipids for p,p'-DDE and p,p'-DDT respectively. Similarly, the γ-HCH was found to be elevated overall with the highest levels measured in both malaria sites.

**Conclusion:** This investigation has identified malaria areas as regions of concern in South Africa where the main study is currently in progress.

#### ISEE-0712

##### The North Norwegian/Vietnamese Mother and Child Contaminant Study

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**Background and Objectives:** In 2005, a cross-sectional study among delivering women (n = 189) took place in two communities in south-central Vietnam with the aim to establish local analytical capacity for OCs analysis; to determine levels of contaminants; and to identify risk factors. The North Norwegian mother and child contaminant cohort study is ongoing from 2007 until 2009, and are recruiting around 500 pregnant

women. The main objective is to analyse levels of contaminants; to investigate health risks; and to create data for dietary advises.

**Methods:** Both studies included a questionnaire on diet and life style, medical records, pregnancy outcomes, and details about the neonates at different stages, and analyzing of OCs in maternal blood. Predictors of exposure to OCs were recognized by univariate analysis and multivariate linear regression model. The Norwegian cohort is following up the women during pregnancy and delivery. Blood levels of contaminants at each stage are being analyzed, a focus not discussed in the literature so far. The focus will be on the dietary source.

**Results:** The main findings from Vietnam in maternal plasma were relatively high concentrations of p,p'-DDE (11.8 µg/l) and p,p'-DDT (1.2 µg/l) with no significant community differences. The ratio of p,p'-DDE / p,p'-DDT (12.2) suggests, as in other Vietnamese OCs studies, a relatively recent use of this pesticides. Concentrations of PCB 153 (0.12 µg/l) and other congeners were low in both communities. The dependence on residence location of plasma PCB 153 concentrations likely reflects differences in the dietary patterns. The results from the Norwegian study are pending.

**Conclusion:** Relatively high levels of DDE and DDT are reported for the Vietnamese communities and give reason for concern like the long-term effect on children's health. Further, rather low levels of PCBs with small but significant community differences were observed. Conclusion from the Norway study will be presented.

#### ISEE-0728

##### AIDS, Agriculture and Climate Change in Southern Africa

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**Background and Objective:** In southern Africa where AIDS is "hyper-endemic", AIDS-related morbidity and mortality undermines livelihoods with negative outcomes for food and nutrition security. In turn, food insecurity places individuals at greater risk of being exposed to HIV, exacerbates the socio-economic impacts of AIDS, and worsens HIV-related illnesses.

These serious interactions do not exist in isolation. Multiple shocks and stresses—social, economic, political, environmental, and health-related—continue to threaten the agricultural livelihood base of southern Africa. Compounding this, climate change will likely play a major role in the deep-rooted livelihoods crisis in a region reliant on rain-fed agriculture with limited capacity to adapt to climate stress.

This paper will explore these interacting forces as a major area for future policy research.

**Methods:** Secondary analysis of international literature, with particular reference to case study material on livelihood security, climate and HIV and AIDS in southern Africa.

**Results:** It is likely that Southern Africa will experience the worst effects of climate change. Marginalised groups, including those impacted by AIDS, will suffer more from these impacts. Worsening interactions will continue to undermine coping strategies with possible negative outcomes in terms of food intake and disease burden. Clearly, the interactions between agriculture, as a major livelihood source, and climate change and HIV and AIDS are shaping the development pathways of this region.

**Conclusion:** HIV and AIDS in southern Africa, through impacts on livelihoods, is making people more vulnerable to the impacts of climate change, while the exposure to the impacts of climate change is making people vulnerable to the impacts of AIDS epidemic. Despite the apparent relationship, their linkage and interrelations has been near absent in both climate change and HIV and AIDS literature, which requires attention for future policy and programming.

#### ISEE-0735

##### Neurobehavioral Effects of Manganese Exposure Through Inhalation and Dietary Intake in Italian Adolescents

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**Background and Objective:** Increased parkinsonism was observed in Valcamonica, a valley in the province of Brescia, Italy. Prevalence data were higher in the vicinities of ferroalloy plants and associated to the concentration of manganese in deposited dust. The aim of the present study was to assess motor, cognitive and neurosensory functions in adolescents in the exposed area and in a reference area. Methods: Metals were measured in airborne particles collected with 24-hours personal samplers, and in salad sampled in local gardens. Samples were analyzed with Total Reflection X-Ray Fluorescence. Soil was analyzed at surface and 10 cm depth. Adolescents were recruited through the local school system for neurobehavioral examination and assessment of dietary intake of metals. Blood and urine samples were collected for metal analysis.

**Results:** A total of 303 children residing in an exposed area and a reference area participated in the study. Airborne manganese was  $84.38 \pm 89.65$  ng/m<sup>3</sup> in the exposed area and  $22.79 \pm 23.82$  ng/m<sup>3</sup> in the reference area. Lead, iron, zinc and chromium also showed significantly higher levels. Manganese results were significantly higher also at the surface and at 10 cm depth of soil and in salad. Exposure biomarkers were not significantly different between the two areas. Children in the exposed area showed impairment of motor coordination and odour identification associated with airborne manganese at multivariate analysis. Blood lead was inversely associated with IQ.

**Conclusion:** Environmental exposure to manganese in adolescents is related to deficit in motor and olfactory functions whereas concomitant lead exposure is related to decrease of IQ.

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#### ISEE-0736

##### Foetal Exposure to Lead and Related Effects on Newborns in Two Portuguese Regions

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**Background and Objective:** Subtoxic blood lead levels (BLL) during pregnancy can be responsible for intrauterine delays in foetal development and thus increased risk of morbi-mortality of newborns. Since there is no protective transplacental barrier to lead, foetal exposure is due to maternal environmental exposure together with either increased absorption or bone



demineralization with consequent release of lead, or both, that may occur during pregnancy. In non-occupationally exposed women, lead exposure may be increased due to residing near lead sources, consumption of polluted food products, and habits such as alcohol consumption and tobacco smoking. The main purpose of this study was to provide Portuguese data on the extent and pattern of foetal exposure to lead as determined through lead biomonitoring in the blood of pregnant women. Investigation on maternal BLL determinants and potential effects of subtoxic BLL on premature delivery and on newborn's characteristics was also objective of this study.

**Materials and Methods:** BLL was determined before delivery, in a total of 791 pregnant women, primiparae or with last child  $\geq 3$  years, residing in two different Portuguese regions.

**Results:** On average, BLL were not high (GM = 2.3  $\mu\text{g/dl}$ ), although 4.8% were  $\mu\text{g/dl}$ . BLL were significantly associated with residence region, smoking (before and/or during pregnancy), risky occupation, and being primiparous. Despite that smokers mean BLL (3.9  $\mu\text{g/dl}$ ) was significantly higher ( $P < 0.001$ ) than that of non-smokers (2.5  $\mu\text{g/dl}$ ), smoking lost statistical significance in a multivariate linear regression analysis. However, results from multiple regression approaches for BLL and the above mentioned covariates on outcomes such as prematurity and each of the newborn's characteristics suggest that cigarette smoking before or during pregnancy makes significant and independent contribution to lower birth-weight.

**Conclusion:** These findings support the public health recommendation that women in fertile age should not smoke.

#### ISEE-0737

##### The Beijing HEART Study: Study Hypotheses and Preliminary Results

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**Background:** Taking advantage of drastic reductions in air pollution levels during the Beijing Olympics, we designed the Beijing Health Effects of Air Pollution Reduction Trial (HEART) Study to test the following hypotheses concerning biological mechanism of air pollution health effects: (1) Biomarkers of lung and systemic inflammation, vascular endothelial dysfunction, blood coagulation, autonomic dysfunction, and oxidative stress measured in local residents will change significantly in response to this substantial air pollution reduction. Further, these biomarkers will return to pre-Olympic levels following relaxation of air pollution controls when the Olympics are over. (2)  $\text{PM}_{2.5}$ , ultrafine particles, and certain PM constituents will each be associated with specific biomarkers across the whole study period.

**Methods:** We recruited 131 non-smoking medical residents. Ambient air pollution was measured on the same campus where the participants were measured for the biomarkers during their scheduled six clinical visits, two visits within each of the three time periods: pre-, during-, and post-Olympics.

**Preliminary Results:** Mean concentrations of  $\text{PM}_{2.5}$ ,  $\text{NO}_2$ ,  $\text{NO}_x$ ,  $\text{SO}_2$ , and CO during the Olympics were approximately 39% to 57% of their pre-Olympic levels. Compared to their during-Olympic mean levels, post-Olympic concentrations of PM, CO and  $\text{SO}_2$  increased slightly, post-Olympic concentrations of  $\text{NO}_2$ , NO, and  $\text{NO}_x$  increased substantially to have exceeded their pre-Olympic levels. Biomarker analyses have just begun and the data are still undergoing the quality check process at the time of writing this abstract. Crude analyses show changes in concentrations of several biomarkers in the hypothesized directions.

**Conclusions:** This real-world study is a comprehensive investigation of several prominently hypothesized mechanisms of particulate air pollution

effects. Preliminary data analyses show improvements in several respiratory and cardiovascular endpoints during the Olympic period. This will provide objective evidence for the improvement of public health resulting from an air pollution intervention that clearly demonstrated air quality improvement.

#### ISEE-0755

##### The Influence of Selenium on Genomic Methylation of Leukocyte DNA, Blood and Urinary Arsenic Concentrations and Arsenic Metabolites in Bangladeshi Adults

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**Background:** The metabolism and toxicity of arsenic may be influenced by selenium due to their mutual biochemical antagonism—they form a ternary complex with glutathione which is excreted in bile. They also share similar biotransformation pathways—both are methylated by S-adenosylmethionine to metabolites with shorter circulating half-lives. There is also some evidence that Se can modify epigenetic processes.

**Methods:** To examine the relationships between Se, As, and DNA methylation, we assessed plasma Se concentrations, As methylation profiles in blood and urine, and genomic methylation of leukocyte DNA in a cross-sectional study 300 Bangladeshi adults.

**Results:** Se was negatively associated with As concentrations in both blood and urine ( $r = -0.14$ ,  $P = 0.03$  and  $-0.19$ ,  $P = 0.0009$  respectively); these correlations persisted with further control for covariates. While Se was not associated with the relative distribution of As metabolites in urine, it was negatively associated with monomethylarsonic acid (%MMA) ( $P = 0.005$ ) and positively associated with dimethylarsinic acid (%DMA) ( $P = 0.034$ ) in blood. Se was negatively associated with methylation of leukocyte DNA ( $P = 0.014$ ). Unexpectedly, we found an inverse association between plasma Se and plasma folate ( $r = -0.24$ ,  $P < 0.0001$ ).

**Conclusions:** Evidence of the biological antagonism between As and Se was observed in this study of adults chronically exposed to As in drinking water. The association between Se and As metabolites may be related to the influence of Se on the selenoprotein, thioredoxin reductase, which can facilitate the reduction of MMAIII to MMAV, a prerequisite to methylation of MMAV to DMA. The inverse association between Se and plasma folate—like arsenic—may be related to the role of folate in Se methylation. The underlying mechanisms and implications of the negative association between Se and DNA methylation are unclear and warrant further investigation.

#### ISEE-0759

##### Environmental Change, Food Security and Human Health

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**Background and Objective:** Food security is a fundamental to human health. Multiple interactions exist between environmental change, food security and human health. The direct impact of a changing environment for food production is perhaps the most obvious, and certainly the most researched. But there are other interactions that are also important for human health considerations. These can best be identified by considering the full food system rather than just the agricultural (ie food production) aspects. The Global Environmental Change and Food Systems (GECAFS) international research project of the Earth System Science Partnership has brought together the food chain and food security literatures to develop the food system conceptual framework for such research (Ericksen 2008; Ingram 2009). The objective of this element of GECAFS' research was to

I develop a method for a systematic approach to considering food security vis a vis food production.

**Methods:** Application of the Global Environmental Change and Food Systems “food systems” concept to identify key linkages between environmental change, food security and human health; Secondary analysis of international literature.

**Results:** The GECAFS Food Systems conceptual framework identifies a number of interactions that are not immediately apparent if taking a more classic “impacts” approach including, for instance, the importance of income/livelihood strategies on access to food, or the role of food in mental/social wellbeing as well as physical nutrition. It also identifies the direct and indirect feedbacks from food system activities to health; e.g. water & air pollution from food processing and distribution; impacts of land cover change driven by agriculture intensification on vector borne disease, pesticides/toxins exposure for agriculture workers, etc.

**Conclusion:** The GECAFS food systems approach helps identify interactions among human health, GEC and food security. It demonstrates how options for adapting food systems may give rise to unforeseen human health consequences.

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#### ISEE-0768

##### Ethical Dimension of Global Change

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**Abstract:** There are essential ethical dimensions of global change and globalization that need to be addressed. Globalization is based on market forces and therefore should be guided by an ethical framework. Ethical issues related to the production trade and marketing of agriculture products such as food, alcohol and tobacco need to be addressed and Codes of Ethics for international trade of agriculture should be developed and or revised.

Global Climate and Environmental Change is slowing the pace of sustainable development, either directly through increased exposure to adverse impact or indirectly through erosion of the capacity to adapt. The most vulnerable people will suffer earliest and most, so global change should be addressed in a way that is fair and adherent to the human rights principles of non-discrimination and equality. Producing food crops for use as bioenergy, to replace fossil fuels, remains controversial from an ethical point of view. Conversion of land from food to fuel production has contributed to increasing food prices and will reduce availability of food crops. This has had a negative impact on human nutrition at a time when the world's population continues to grow.

Meeting the Millennium Development Goals for poverty elimination and sustainable development while reducing risk and maintaining diversity is an overriding priority. The ethics related to the increasing competition between food and non-food uses of agricultural resources in the light of the expanding demand for bio-fuels needs and food crisis need to be addressed from a human rights perspective. This approach includes the promotion of pro-poor policies, fair trade, sustainable food production for poverty reduction, bio-diversity protection, access to safe food for all, prevention of infectious diseases, direct food aid and development of anti-hunger alliances within a human rights framework.

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#### ISEE-0771

##### The Global Context of Food Safety

*Frans Brom, and Jan Staman, Ratheneu Institute, Den Haag, Netherlands.*

**Abstract:** The complexity of the food chain has diminished its transparency. A widening physical and mental gap between production

and consumption has lead to a situation in which many people have no idea about the production reality of products they purchase. For food, this is more problematic than in other areas. Food is something special. Food gets very close to people and it deeply touches them. Not only is it vital for the sustenance of our life, it also has a symbolic function: food is an important factor in the construction of our individual and social identity. That is why the right to adequate food not only states that food should be safe “free from adverse substances” but also that it should be acceptable within a given cultural context.

For food risk assessment this leads to challenges in all steps of the risk analysis (assessment, management and communication). Risk Communication is the exchange of information and opinions concerning risk among risk assessors, risk managers, consumers and other interested parties. Its goal is to foster public trust and confidence in the safety of the food supply and exchange information, attitudes, values, practices and perceptions of interested parties concerning risks associated with food. In risk analysis this includes issues like the choices in the identification of adverse effects and hazards or the choices in estimating exposure in real life. In risk management it includes issues like the impact of risk lowering measures on food quality, the role of precaution and the impact of food safety regulations on international trade. In order to facilitate value communication and common standards setting against the background of existing value pluralism explicating and accepting these value judgments and differences is a first step.

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#### ISEE-0774

##### Prenatal Exposures to Phthalates and Polycyclic Aromatic Hydrocarbons and Body Size at Age Five

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**Background and Objective:** There is growing concern that prenatal and early life exposures to endocrine disrupting chemicals promote weight gain and childhood obesity.

**Methods:** Data on height and weight at age 5 years were analyzed from a birth cohort of children in Northern Manhattan and the Bronx. BMI Z-score at age 5 was calculated using the C.D.C. growth curves SAS Macro. Phthalate metabolites were measured in maternal urine samples collected during the third trimester. Prenatal exposure to polycyclic aromatic hydrocarbons (PAH) in ambient air was assessed by two day personal air monitoring conducted during the third trimester. PAH exposure was measured as the sum of benzo[a]anthracene, chrysene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, indeno-[1,2,3-cd]pyrene, disbenz[a,h]anthracene, and benzo[g,h,i]perylene concentrations. Linear regression analyses were used to determine whether prenatal exposures were associated with BMI Z-score.

**Results:** Data on maternal urinary phthalate metabolites and BMI Z-score at age 5 were available from 113 children. In univariate and in multivariate analyses controlling for potential confounding variables, the concentrations of metabolites of Di (2-ethylhexyl) phthalate (MEHP, MEHHP, MEOHP and MECPP) were not associated with BMI Z-score at age 5. Data on ambient air PAH concentrations and BMI Z-score were available from 289 children. After control for the gestational age, birth weight, race/ethnicity, mother's pre-pregnancy weight, compared to children in the first tertile of PAH exposure, children in the second tertile had 0.17 higher mean z-score ( $P = 0.38$ ), and those in the third tertile had 0.44 higher mean z-score ( $P = 0.02$ ). There was a significant p for trend for increasing BMI Z-score across tertiles of PAH exposure ( $P = 0.01$ ).

**Conclusion:** Childhood body size is not associated with prenatal exposure to phthalates, but is significantly, positively associated with prenatal inhalation exposures to PAH in this cohort.

#### ISEE-0778

##### Uncertainty and Precaution in Food, Health and Environment: European Agenda

Marco Martuzzi,\* and Cristina Tirado-von der Pahlen,† *\*WHO Europe, Rome, Italy; †School of Public Health, University of California Los Angeles, Los Angeles, United States.*

**Abstract:** The WHO is committed to developing strategies and tools for supporting the development and adoption of health-friendly policies in environment and health. Many challenges exist, especially in contemporary society, where fast technological development and increasing complexity in societal organisation create an endless variety of circumstances that have the potential to have far-reaching health implications, as in the case of global change and food security.

In a response to this concern, the WHO and other health agencies have expanded the scope of their work in environment and health, to include not only risk factors, but also “upstream” health determinants, such as development plans and policies. The notion of “environment” tends thus to be broadened: the series of Ministerial Conference on Environment and Health in Europe, for example, includes in its scope the social, familiar and political context of children’s life, as well as the exposures to physical agents.

When uncertainty is large, no doubt a “better safe than sorry” attitude is warranted. However, in many circumstances the concrete choice of the appropriate course of action is controversial: decisions, typically, have to find the difficult balance on (i) costs and benefits, in terms of health but also in terms of profit and economic return; (ii) using the available, often thin or worse contradictory, evidence; (iii) winners and losers; (iv) immediate returns and long-term, perhaps hidden costs.

The precautionary principle embodies these difficulties. It is not the only tool to support decision making in environment and health under scientific uncertainty, but the debate around the precautionary principle has provided extremely useful insights into this matter. The WHO has been long engaged in clarifying relevance and value of the precautionary principle as a tool for protecting health, the environment and the future generations’ health and welfare.

#### ISEE-0782

##### Risk Benefit Analysis of Food Consumption and Production on Health and on the Environment

Cristina Tirado-von der Pahlen, *School of Public Health, University of California Los Angeles, CA, United States.*

**Abstract:** The analysis of risks and benefits of food consumption and production for health and/or the environment have not been addressed in an integrated way. This assessment is necessary when risks and benefits coexist, for example in foods (food nutrients vs contaminants), or as a result from food technologies (e.g. biotechnology, nanotechnology), or food production and farming systems (e.g. intensive versus extensive farming systems etc.).

The assessment of risk to human health of food substances or nutrients is usually conducted independently of possible health benefits. Both health risks and benefits need to be balanced. At the same time, the risk and benefits of food technologies and food production systems in the environment and/or health should be also considered and integrated into the whole assessment.

This session will provide an overview on the need for an analysis of the risks and benefits of food consumption and production on health

and/or the environment as a tool for risk managers for decision and policy making and for regulatory purposes. The need for the development of a science based, methodology for risk-benefit assessment will be discussed.

#### ISEE-0784

##### An Overview of Recent Publications and Current Issues on Air Pollution and Pregnancy Outcomes

Rémy Slama,\* Tracey Woodruff,† Johanna Lepeule,\* and Jennifer D. Parker,‡ *\*INSERM, Le Kremlin-Bicetre, France; †University of California, San Francisco, San Francisco, United States; and ‡National Center for Health Statistics, CDC, Hyattsville, MD, United States.*

**Background and Objective:** Research about air pollution effects on reproduction is a rapidly expanding field. The objective of this presentation is to review publications from the last year and consider how international collaborative projects can address research gaps.

**Methods:** Published manuscripts were identified in the fields of perinatal and paediatric epidemiology, environmental health, and toxicology.

**Results:** New publications from multiple research groups address a wide range of new approaches in terms of studied outcomes, methods of exposure assessment, and study design. New toxicological studies contribute to our understanding of effect mechanisms.

**Conclusions:** The wide range of studies provides critical information regarding some of the uncertainties about the role of air pollution in perinatal outcomes. International collaborative projects may be able to build on these diverse research perspectives to fill research gaps.

#### ISEE-0796

##### The Impact of Residential Mobility on Exposure Assessment in Cancer Epidemiology

John Nuckols,‡\* Matthew Airola,† Joanne Colt,‡ Ali Johnson,¶ Molly Schwenn,\*\* Richard Waddell,§ Margaret Karagas,§ Debra Silverman,‡ and Mary H. Ward,‡ *\*Colorado State University, Fort Collins, CO, United States; †Westat, INC, Rockville, MD, United States; ‡National Cancer Institute, Rockville, MD, United States; §Dartmouth College, Hanover, NH, United States; ¶Vermont Dept of Health, Burlington, VT, United States; and \*\*Maine Dept of Health & Human Services, Augusta, ME, United States.*

**Background and Objective:** Epidemiologists at the U.S. National Cancer Institute (NCI) conducted two large scale studies that include location of residential histories over participant lifetimes. We discuss the degree of mobility of these participants and its impact on conducting exposure assessment of environmental contaminants.

**Methods:** We received addresses from 2,611 participants in a New England Health and Environment Study (NEHES) concerning arsenic and disinfection byproducts (DBP) in water supply, and from 2,378 in a SEER-NHL Study (NCINHL) concerning proximity to dioxin-emitting facilities. We geocoded locations for both studies using address-matching software followed up by interactive manual geocoding of inexact matches. We used a GIS to analyze the degree of mobility in each study population and its impact on exposure metrics used in each epidemiological study.

**Results:** We found 69% of the study population in NEHES (55% in NCINHL) moved at least 7 times over an average residential history of 69 and 57 years, respectively. The average number of residences per participant was 10 and 7. In NEHES residential relocations for 88% of participants resulted in a change in water supply source, an important variable in estimating arsenic and DBP exposure. In NCINHL 366 participants resided within 2 km of a dioxin-emitting facility between 1987 and their reference year (1998–2000). 25% of these participants had more than one residence during this exposure period, resulting in a change in proximity to type, distance, and/or number of dioxin emitting facilities.



**Conclusions:** Results from the analysis of residential mobility in two large scale cancer epidemiological studies of environmental contaminants indicate it could have significant impact on exposure assessment in terms of changes in contaminant source at different residence locations. The degree of impact will be a function of the change in concentration of the contaminant due to relocation.

#### ISEE-0806

##### Development of an Approach for the Risk-Benefit Analysis of Foods and Food Components by the Scientific Committee of the European Food Safety Authority

Bernard Bottex, *European Food Safety Authority, Parma, Italy.*

**Abstract:** In order to allow the risk manager to weigh the risk against the benefit a qualitative or quantitative risk-benefit analysis is required. There is however no such internationally agreed scientific approach for health benefit assessments of foods, food ingredients and nutrients. The European Food Safety Authority (EFSA) self-tasked its Scientific Committee to develop a guidance document for performing risk-benefit assessments of food related to human health risks and human health benefits.

A Working Group (WG) of experts addressed the situations for which a risk-benefit assessment (RBA) would be appropriate and the importance of the problem formulation between the risk manager and the risk assessor. A stepwise approach was developed to perform a RBA. Going further in the tiered approach implies going towards quantitative comparison; it requires the use of a common currency to compare risks and benefits, and ultimately the use of probabilistic modelling.

**Results:** The WG discussed specific aspects of RBA such as the importance of the selected endpoint and the part of the population considered for the outcome of the assessment, the usefulness of human data, or how animal data can be extrapolated to the human situation in order to facilitate the risk-benefit comparison. A number of uncertainties are affecting the risk-benefit assessment: in the hazard / positive health effect characterisation, in the exposure assessment, and in the risk-benefit comparison. These uncertainties need to be characterised and communicated to enable the risk manager to take enlightened decisions.

This presentation will present the status of EFSA's work to develop a methodology for its Scientific Panels to perform human health RBA. A number of examples will be presented to illustrate how this scientific framework could be applied in practice.

#### ISEE-0811

##### Associations Between Children's Blood Lead Level and Their Health Status

Peter Rudnai,\* Mihály János Varró,\* Tamás Rudnai,\* Miklós Náray,† Bernadette Schoket,\* Livia Anna,\* Erika Györfy,\* Katalin Kovács,\* Jozsef Uromi,‡ Tamás Herczegh,§ and Judit Bodnár,¶ *\*National Institute of Environmental Health, Budapest, Hungary; †National Institute of Occupational Health, Budapest, Hungary; ‡Public Health Institute of the 22nd District of Budapest, Budapest, Hungary; §Out-patient Clinic of the 22nd District of Budapest, Budapest, Hungary; and ¶Northern-Hungarian Regional Public Health Institute, Eger, Hungary.*

**Objectives:** To assess the blood lead level of children living in areas which used to be affected by environmental lead pollution and were since remediated, to study the associations between the blood lead level and the children's health and to identify environmental and genetic risk factors of lead-related health effects.

**Methods:** 253 children aged between 4–15 years living in 5 towns earlier affected by environmental lead pollution were included in the study. The lead level of venous blood was measured by ICP-MS. Polymorphisms of

ALAD, VDR FokI and VDR BsmI and in 102 children, the basic haematological parameters were also determined. The children's health status and the possible sources of environmental lead exposure were assessed by a questionnaire completed by the parents. Linear and logistic regression analysis as well as Mann-Whitney test were performed using STATA 9.2 software.

**Results:** 4.5% of children were found to have blood lead levels above 10 µg/dL. The geometric mean level was 3.0 µg/dL. Age, gender, lead water pipes, car and motor repair in the neighbourhood, parents' smoking and various markers of poor socio-economic status (lack of running water, heating with plastics and tires, and living close to a waste dump site) were found to be significant determinants of lead exposure. Blood lead level was significantly associated with a decrease of red blood cell's volume and haemoglobin content (only in children with homozygote ALAD), the reported prevalence of fatigue, sleeping disturbance, daydreaming, concentration problems and poor school achievements.

**Conclusions:** In spite of phasing out of lead additives in fuels 10 years ago, there are still local sources of environmental lead exposure which should be identified and eliminated.

**Acknowledgement:** The study was supported by the National Research and Development Fund (NKFP-1/B-047/2004).

#### ISEE-0814

##### Retrospective Exposure Estimation for Perfluorooctanoic Acid in Eastern Ohio and Western West Virginia

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**Background and Objectives:** The source of PFOA in the environment of eastern Ohio and western West Virginia is believed to be the Washington Works plant. PFOA was released into the air resulting in PFOA particulate deposits on surfaces through wet and dry deposition and directly into the Ohio River. Penetration through soil and pumping by industrial and municipal wells near the Ohio River can result in groundwater contamination and associated exposure via inhalation, ingestion, and dermal contact. Our objective is to determine exposures experienced by participants in the epidemiological studies, and since data on environmental concentrations are limited for the exposure period, we explore methods based on environmental modeling.

**Methods:** We used the EPA Regulatory Model AERMOD to model atmospheric dispersion of PFOA and the EPA Pesticide Root Zone Model Version3 to model PFOA transport through soil. The USGS model MODFLOW was used model groundwater flow. To obtain historical estimates of total exposure, these results were combined with residential and working histories as well as the source of water use. These results will be coupled with a pharmacokinetic model to estimate serum PFOA concentrations.

**Results:** The inhalation pathway dominated exposure in the early years; however, ingestion of contaminated groundwater, now supplying most of the drinking water for nearby residents, is now the main route of exposure. Contamination of public water systems occurred both via the river through groundwater communication and leaching through the soil. Residents nearest the plant were most affected. Although plant emissions peaked in the 1990s, and are now diminished, contamination of groundwater will continue for some time via soil leaching.

**Conclusions:** The development of this modeling framework allows a more complete picture of exposures and affords a better picture of the components of exposure, their relative importance, and potential control strategies.

#### ISEE-0820

##### Health Risk and Benefit Assessment: Needs at the International Level

Jorgen Schlundt, WHO, Geneva, Switzerland.

**Abstract:** Whereas risk assessments of foodborne hazards have been ongoing at the international level for a long time, for chemicals as well as more recently also for microorganisms, the benefits related to the consumption of specific foods have until now not been quantifiable in the same way. Measurable benefits of the consumption of specific foods or a specific diet often relate to the prevention of disease (including non-communicable diseases—"life-style" diseases). WHO develops—typically in collaboration with FAO—internationally agreed methodology for risk assessment. Such methodology is available for chemical and microbiological hazards, but has not yet been developed for benefit assessment. Although a quantitative risk-benefit approach may be possible in principle in the future, present uncertainties relative to the underlying factors to be considered within a benefit assessment suggest that significant standardization work is needed to move this important new area of food safety and nutrition scientific advice forward.

#### ISEE-0824

##### Hearing and Posture of Primary School Children from Industrial Area of Upper Silesia, Poland

Krystyna Pawlas, Natalia Pawlas, Dorota Kus, Agata Kowalska, and Elzbieta Olewinska, *Institute of Occupational Medicine and Environmental Health, Sosnowiec, Poland.*

**Introduction:** Children are recognized as very susceptible to lead. Some papers showed effects of environmental lead exposure on hearing and posture. Both require an interaction of peripheral and central nervous system. The aim of the study was to assess the effect of lead on children's posture stability and hearing.

**Material and Methods:** The study group consisted of 327 children 4–13 years old, living in the vicinities of lead plants. After health history questionnaire, posturography was performed. Sway of the body was recorded under four conditions, standing on the platform with eyes opened, eyes closed, eyes opened and foam pad under feet, eyes closed and foam pad under feet. Hearing was examined by tone audiometry and acoustic otoemissions. Lead in blood samples (BPb) were measured. The examination was performed on the blind basis.

**Results:** Average BPb was  $63.9 \pm 41.5$   $\mu\text{g/L}$ , and ranged 22–230  $\mu\text{g/L}$ . The sway variables were increasing with BPb. Sway parameters reached the highest values in subjects tested with eyes closed and during standing on foam pad, especially in children with BPb  $>100$   $\mu\text{g/L}$ . Hearing thresholds and acoustic emissions were affected as well at selected frequencies.

**Conclusions:** Lead showed ototoxic properties, both hearing and body posture were affected by lead. Otoacoustic emissions decreased, hearing threshold as well as body sway increased with elevation of BPb, even at low concentration in blood. Posturography seems to be a useful tool for the assessment of low level lead exposure effects on the nervous system at low blood lead levels.

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#### ISEE-0827

##### Health Impact Assessment of Energy Efficiency Improvements in the Built Environment in Pursuit of Climate Change Objectives

Paul Wilkinson, *London School of Hygiene & Tropical Medicine, London, United Kingdom.*

**Background and Objective:** To assess the advantages and disadvantages for health of interventions aimed at energy efficiency improvements in the home and in the built environment more generally in the context of policy imperatives to meet climate change abatement targets.

**Methods:** Building physics modelling of the indoor environment and integrated assessment of the associated health effects under a range of assumptions about changes to domestic energy efficiency using the UK as an example.

**Results:** Not all important health effects of energy efficiency are directly quantifiable or beneficial. The range of effects include reduction in necessary expenditure on fuel, with the opportunities this may bring for deployment of limited disposable income on the essentials for healthy living; improvement to indoor temperatures during winter cold and/or summer heat with consequent effects on cardio-respiratory health and psycho-social well-being; and reduction in mould growth. Against these are possible adverse effects on indoor air quality (relating to combustion pollutants, radon, volatile organic compounds from furniture and other materials, indoor tobacco smoke and exacerbation of mould growth) if energy efficiency is in part achieved through critical reduction in air exchange; and the potential for higher unit fuel prices if there is a switch to energy supply by low-carbon generation. The net effect of these changes is complex and dependent on the degree to which improved efficiency is achieved by switching of energy carriers, by improvements to appliance efficiency, or by changes to the thermal properties of the building fabric and ventilation.

**Conclusion:** The built environment provides multiple options for mitigation of greenhouse pollutants. The net effect of improved efficiency is likely to be beneficial for health in the majority of circumstances, but there is need for caution in relation to ventilation and the costs of fuel switching.

#### ISEE-0833

##### Recent Steps to a Harmonised Approach to HBM Across Europe

Ludwine Casteleyn,\* Birgit Van Tongelen,§ Reinhard Joas,† Alexandra Polcher,‡ Pierre Biot,‡ and Anne Catherine Viso,¶ \*University of Leuven, Leuven, Belgium; †BiPRO, Munchen, Germany; ‡FPS Health, Food Chain Safety and Environment, Brussels, Belgium; §DG Environment EU Commission, Brussels, Belgium; and ¶INVS Sante, Paris, France.

**Background:** Human biomarkers are increasingly used in environmental health to assess exposure to environmental pollutants and related potential health effects. Well-designed biomonitoring programmes can provide the evidence base to drive policy relevant recommendations. By getting pollution more personal they also have great impact in raising awareness for needs and possibilities of prevention.

**Methods:** The European Environment and Health Strategy (2003, European Commission) paid particular attention to this potential. Activities within the TWG Biomonitoring demonstrated the need for more harmonisation of activities in Europe. The Commission's Communication on the Environment and Health Action Plan 2004–2010 recognised the value of HBM and the importance of coordination. Action 3 announced the development of a coherent approach to HBM in Europe in close cooperation with the Member States.

**Results:** Since 2004 strong political commitments were expressed at several levels. Recently Council Conclusions (20 12 2007) and an EU Parliament Resolution (04 09 2008) related to the mid-term review of the

Action Plan addressed the need for an adequate funding for a European Human Biomonitoring pilot project.

Incorporating Human biomonitoring (HBM) as a scientific and policy tool at a European level requires availability of European-wide structures for gathering, storing and analysing biomarker- and other data. However, Member States are very different with respect to environmental exposures, health concerns, analytical capacities, political and health priorities, cultural background, and perception of ethics. Collaboration between several disciplines and fields is required and adds to the complexity. Also, HBM is not yet at its full potential: much research work is needed on e.g. validation of biomarkers, integration with other data, development of guidance values, etc.

**Conclusions:** Harmonisation efforts are a challenge at scientific, political, social, legal and ethical level. Most recent steps in this process will be highlighted at the conference.

**Acknowledgements:** ESBIO, ECNIS, NewGeneris.

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#### ISEE-0853

##### **Evidence for the Assessment of Long-Term Environment & Health Policies**

Paul Wilkinson, *London School of Hygiene & Tropical Medicine, London, United Kingdom.*

**Background and Objective:** Concern about climate change and other global, emerging and long-term environmental threats has increased attention on the evidence needed to inform broad strategic policy directions as opposed to more immediate and specific forms of option appraisal. Methodological questions relating to the development of such evidence is assessed in the context of recent modelling studies.

**Methods:** Overview of the methods and lessons learned from scenario-based studies relating to health effects of energy-related policies.

**Results:** Modelling the health effects of long-term policy choices entails many uncertainties. Strategic choices typically have bearing on health through a complex array of pathways only some of which are amenable to quantification; multiple uncertainties arise in relation to human behaviours and in the necessary assumptions about long-term trajectories in technological, social and economic development, population health and environmental exposures; model results are sensitive to assumptions about discount rates and other parameters; the costs of policy alternatives are generally difficult to quantify because of the unpredictability of future technological innovation, volume-related efficiency savings and the need for infra-structure development; and the specification of 'counter-factual' alternatives typically entails a range of scenarios that reflect a very simplified view of reality. As a result, most quantitative models can be interpreted only within a limited context, and are informative mainly as 'experimental' tests of the broad balance of risks and benefits rather than as accurate and detailed representations of the future under alternative strategies.

**Conclusion:** Comparative models relevant to strategic policy choices are most securely interpreted only as broad and theoretical guides to changes in population health rather than as approximations to real life. They may none-the-less offer important insights to support aspirational strategic choices without accurate quantification of health costs and benefits.

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#### ISEE-0878

##### **Diet and Climate Change: Does It Matter?**

Sam Soret, and Joan Sabate, *Loma Linda University School of Public Health, Loma Linda/California, United States.*

**Background:** Substantial evidence exists linking food production and environmental degradation. Climate change may alter agricultural productivity across wide areas, decreasing food security. Often overlooked is the interconnection between food consumption patterns and climate

change. We compared the carbon emissions of agricultural inputs required to produce vegetarian and nonvegetarian diets.

**Methods:** Food consumption patterns of vegetarians were compared with nonvegetarians, by using data from the Adventist Health Study, a cohort of 34,000 California Adventists, of which 45% were vegetarians. Consumption of 10 foods, of a 50 food-item questionnaire, was significantly different by vegetarians (beef, chicken, eggs, beans, and six fruits). California agricultural practices and commodity production data were collected for three carbon-intensive operations: fertilizer and pesticide application, and primary energy. The three inputs were converted into carbon equivalent (CE) emissions per amount of commodity produced using published emission factors, and subsequently multiplied by the differential consumption of the 10 food items.

**Results:** Consumption of a vegetarian diet resulted in 2.4 times less CE emissions compared to a nonvegetarian diet in this population. Producing the commodities for the vegetarian diet required fertilizer, pesticide, and primary energy inputs, which resulted in 4.0, 2.5, and 1.05 less CE emissions, respectively. The emissions associated with the production of a vegetarian diet are annually 7.1 kg CE per capita less than those of a nonvegetarian diet.

**Conclusion:** Producing a vegetarian diet results in substantially less GHG emissions than a nonvegetarian diet. These findings support the hypothesis that plant-based diets have a lower global warming potential than meat-based diets, although exceptions may occur in relation to some agricultural practices, transportation and processing. Daily food choices of large segments of the population may ultimately result in major impacts on the environment and have public health consequences. Diet matters for mitigating climate change.

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#### ISEE-0922

##### **Estimating Future Heat Related Mortality as a Function of Climate Change**

M. Baccini,\*† and A. Biggeri,\*† *\*University of Florence, Florence, Italy; and †ISPO, Florence, Italy.*

**Objectives:** High ambient summer temperatures have been shown to influence daily mortality in cities across Europe. Quantification of the population mortality burden attributable to heat is crucial to the development of adaptive approaches. We quantified the impact of summer heat on mortality in 15 European cities during the 1990s. Projections of future impact of heat on mortality are also derived, on the basis of the climate changes scenarios reported in the Intergovernmental Panel on Climate Change Special Report on Emission Scenarios (IPCC, 2007). Three warming scenarios have been defined at 2030 on the basis of different hypothesis on future levels of greenhouse gas emission.

**Materials and Methods:** We used a Monte Carlo approach to estimate the number of deaths attributable to heat for each city. These estimates rely on the results of a Bayesian random effects meta-analysis which combines city-specific heat-mortality functions as described by an exposure threshold corresponding to the minimum risk of death and a slope above the threshold.

**Results:** The number of heat-attributable deaths per summer ranged from 0 in Dublin to 423 in Paris. The mean attributable fraction of deaths over the 15 cities was around 2%. The highest observed impact was in three Mediterranean cities (Barcelona, Rome and Valencia) and in two continental cities (Paris and Budapest). The largest impact was on persons over 75 years, but in some cities important proportions of heat-attributable deaths were also found for younger adults. Increases larger than 10% in the number of heat-attributable deaths at 2030 were found for most cities under the three IPCC scenarios.

**Conclusion:** Heat has an important impact on population mortality. Under warming hypotheses, this phenomenon is expected to increase. Attention should be given to the excess of deaths in younger cohorts, because it translates into larger numbers of potential years of life lost.



**ISEE-0923****Rural Livelihoods, Living Standards and Health***Martin Prowse, Overseas Development Institute, London, United Kingdom.*

**Abstract:** Recent reports by the World Bank, OECD-DAC, FAO and IFPRI place agriculture back at the heart of the development endeavour. And rightly so. Despite rapid urbanization, absolute poverty will continue to be a mainly rural phenomenon for decades. In addition, within rural spheres agriculture often forms the bedrock of off-farm livelihood strategies (particularly important for the poor) and non-farm diversification. There is clearly a pressing need to increase the five percent of official development assistance currently directed at the sector.

But this is not to say that stimulating agricultural productivity only has positive well-being and health effects. To illustrate this point, we discuss the commercialisation of agriculture in Malawi through the rapid expansion of smallholder burley tobacco production 1994–2004. We focus on the relationship between burley production and smallholder food security. The dominant narrative during the reform process asserted how growers would improve food security through both improved access to food (via increased incomes) and increased production of food crops (mainly maize) on the farm. We detail findings from spatial analysis and intensive livelihoods research in the central region of Malawi during 2002–2004 which suggests that agricultural commercialisation contributed to food insecurity amongst the poorest.

**ISEE-0924****Health Co-Benefits from Green Transportation: The Triple-Win Biking Project***Maggie L. Grabow, Scott Spak, Jeff Sledge, Steve Ventura, and Jonathan A. Patz, Nelson Institute, Center for Sustainability and the Global Environment (SAGE), University of Wisconsin, Wisconsin, United States.*

**Abstract:** With the recognition that global climate change is real and likely will cause many societal, health and environmental risks, sustainable energy, agriculture and transportation options have rapidly risen in priority. Yet, how well do we understand the trade-offs (both negative and positive) of such sweeping measures? For example, urban sprawl contributes to health risks of both obesity and air pollution, particularly regarding modes of transportation. Within the United States, nearly 100 cities exceed the U.S. Environmental Protection Agency National Ambient Air Quality Standard for ozone pollution. Though fuel efficiency standards have improved, the average number of miles driven has increased dramatically. Forty percent of automobile trips in the United States are shorter than two miles and over twenty-five percent are less than one mile - easily walkable or bikeable. We researched what the benefit of replacing shorter car trips with bicycle trips would be to: (1) global climate change mitigation from reduced greenhouse gas emissions, (2) improvement in local air quality and human health, and (3) caloric expenditure and subsequent improvement to personal fitness. Urban design can influence societal activity patterns as well as environmental impacts such as air pollution. We are examining the eleven largest cities in the Midwest, US and developing a city-specific health index based on the ability to replace car travel with bicycling. By utilizing regional air pollution models and exposure-response respiratory disease models, we quantify the triple benefits on health via personal fitness, air pollution reductions, and mitigation of greenhouse gas emissions.

**ISEE-0925****Building a Framework to Identify Global Health Impacts of Power Generation Systems***Julia M. Gohlke,\* Simon Hales,† Christopher J. Portier,\* Alistair Woodward,‡ Diarmid Campbell-Lendrum,† and**Annette Prüss-Üstün,† \*Laboratory of Molecular Toxicology, National Institute of Environmental Health Sciences, Research Triangle Park, North Carolina, United States; †Department of Public Health and Environment, World Health Organization, Geneva, Switzerland; ‡School of Population Health, University of Auckland, Auckland, New Zealand.*

**Abstract:** Development of energy policies that improve global health requires understanding the complex interplay between systems for energy delivery and a sustainable, healthy environment. The growing health risks associated with greenhouse gas emissions has resulted in a global call for development of new energy policies emphasizing efficiency and low-carbon energy cycles; yet increased access to affordable and stable energy are important considerations for improving health in developing nations. Development of a comprehensive framework for assessing the global health implications of energy systems will allow policymakers to compare health impacts across proposed energy policies. Using a life cycle approach, a framework is developed that examines potential routes to health impacts from each stage of the energy production process. Taking coal-fired power generation as an example, the health impacts that are of particular concern are occupational hazards in the coal mining industry (including accidents, pneumoconiosis, COPD, and noise induced hearing loss), and public health impacts attributable to emissions of nitrous oxides, sulfur oxides, particulate matter, heavy metals, and greenhouse gases. Dioxin and radionuclide emissions may be of concern as well. Each of these categories are considered in detail, focusing on comparative risk assessment approaches developed by the World Health Organization to estimate the global disease burden associated with individual risk factors. This project can serve as a framework to develop similar assessments for alternative energy systems, thereby allowing global health impact comparisons across power generation technologies.

**ISEE-0926****Values, Ethics and Sustainability from an Environmental Justice Perspective***Colin L. Soskolne, School of Public Health, University of Alberta, Edmonton, Canada.*

**Abstract:** The problem of failing to ask “in whose best interests” we are working results in an accumulation of harms that add to environmental deficits. These deficits serve to extend the gap between the rich and the poor and thus work against attainment of the Millennium Development Goals (MDGs). At the 2005 ISEE conference in Johannesburg, South Africa, the theme of that meeting was on reducing the gap by bridging the interests of the “north” and the “south” under the theme “Sustaining World Health Through Environmental Epidemiology: setting a new global research agenda”. It resulted in a paper published in 2007 in the *Epidemiology and Society* section of *EPIDEMIOLOGY* entitled “Toward a global agenda for research in environmental epidemiology” (Vol. 18(1):162–166). This presentation focuses on the recommendations contained in that paper as they relate to environmental justice issues around biofuels and food security, specifically in terms of new transportation and energy policies. Our role in researching related questions is shown to influence the evidence base for maintaining the *status quo* or for embracing a new green agenda.

**ISEE-0928****Effect of High Temperature and Heat Waves in European Cities***P. Michelozzi,\* D. D'Ippoliti,\* C. Marino,\* F. de' Donato,\* K. Katsouyanni,† A. Analitis,† A. Biggeri,‡ M. Baccini,‡ C.A. Perucci,\* and B. Menne,§ \*Department of Epidemiology, Local health Authority Rome E, Rome, Italy; †Department of Hygiene, Epidemiology and Medical Statistics, Medical School, Athens University, Athens, Greece; ‡Department of Statistics G. Parenti, University of Florence, Florence,*

Italy; and §Global Change and Health, WHO Regional Office for Europe, Rome, Italy.

**Background and Objective:** Two multi-city projects funded by the European Union provided estimates of the impact of high temperature and heat waves on mortality and hospital admissions using an integrated and standardized approach: the PHEWE project (Assessment and Prevention of Acute Health Effects of Weather Conditions in Europe) and the EuroHEAT project (Improving Public Health Responses to extreme weather/heat-waves).

**Methods:** The PHEWE study estimated the impact of high temperature on mortality and hospital admissions, in 15 cities (Athens, Barcelona, Budapest, Dublin, Helsinki, Ljubljana, London, Milan, Paris, Prague, Rome, Stockholm, Turin, Valencia, and Zurich). The EuroHEAT study, built upon the results and databases of the PHEWE project, was focused on the assessment of the effect of heat wave episodes on mortality in 9 cities (Athens, Barcelona, Budapest, London, Milan, Munich, Paris, Rome and Valencia). The two projects cover different periods (1990–2000 and 1990–2004, respectively).

In both studies, GEE models were used to estimate the impact of high temperature and heat wave episodes. Evaluation of the effect by sex and age group, and for specific causes of deaths/hospital admissions were performed. Results were pooled into two groups, Mediterranean and Northern-Continental cities.

**Results:** The two studies showed great heterogeneity in the thresholds level, in the impact of high temperature, and in the effect of heat waves episodes among the cities. The meta-analytic value of the threshold was 29.4°C for Mediterranean cities and about 6°C lower for North-continental cities. The increase in daily mortality for 1°C increase in temperature was greater in Mediterranean cities (+3.1%) than in Northern-Continental cities (+1.8%). The increment in daily mortality during heat waves was also greater in the Mediterranean cities (+21.8%) than in the North Continental cities (+12.4%). In most cities the risk of mortality was up to 3 times greater for heat waves of long duration and high intensity.

The greatest impact on mortality was observed during the 2003 heat wave, and the estimated effect ranged from (+105%) in Paris to +5.9% in Munich. In both studies the largest effect was observed for respiratory mortality suggesting a specific effect of high temperature on the respiratory system. Results confirmed an increasing effect by age, and in most of cities a greater susceptibility of females was observed.

**Conclusion:** Results from these studies suggest that the effect of heat is heterogeneous among cities and it may be explained by the levels of exposure and by the different susceptibility of the resident population.

Public health interventions need to address these aspects in order to prevent a possible additional burden of disease during the summer season.

#### ISEE-0929

##### Investigating the Synergistic Effects Between Meteorological Variables and Air Pollutants: Results from the European PHEWE, EUROHEAT and CIRCE Projects

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**Background and Objectives:** In the past 20 years, extensive scientific evidence demonstrated and quantified the short-term effects of air pollution and weather extremes on health. However, the studies formally addressing synergy between pollutants and meteorological variables are relatively few. Within the multi-centre European projects PHEWE, EUROHEAT and CIRCE we have investigated the interaction between the effects of air pollutants and meteorological variables on mortality.

**Methods:** We used data from 22 cities in Europe and around the Mediterranean, including daily values for total and cause-specific mortality, air pollutants concentrations (PM<sub>10</sub>, NO<sub>2</sub>, O<sub>3</sub>, SO<sub>2</sub>, CO) and meteorological variables (apparent temperature, wind speed and direction,

“heat-waves”). A GEE modeling approach was applied assuming a Poisson distribution on the outcome variable.

**Results:** We found evidence for an interaction between high temperatures and high ozone and PM<sub>10</sub> concentrations. This was particularly evident for “heat-wave” days. For the age group 75–84 years, the estimated heat wave effect is 54% larger on high ozone days. During high PM<sub>10</sub> days the heat-wave effects on mortality, for both the 75–84 and the 85+ years age groups, are significantly larger. Differences between cities in Northern Europe, Southern Europe and non-European cities around the Mediterranean were also investigated. It was noted that failure to adjust for air pollution when estimating the temperature effects on mortality may lead to overestimation of the heat and heat-wave effects by up to 30%.

**Conclusions:** The effects of heat-wave days on mortality are larger during high ozone and PM<sub>10</sub> days. For ozone this is more evident for those aged 75–84 years compared to those older than 85. In contrast, the interaction with PM<sub>10</sub> appears to affect the elderly to a larger extent, probably due to the high penetration of PM indoors. There was no evidence for interaction between heat-wave days and the concentrations of NO<sub>2</sub>, SO<sub>2</sub> and CO.

#### ISEE-0931

##### Exposure and Toxic Effects of Elemental Mercury in Gold Mining Activities

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**Background:** Elemental mercury (Hg<sub>0</sub>) is widely used in gold-mining activities in South America, Africa and Asia. Miners use Hg<sub>0</sub> to extract gold, and are exposed by inhalation when burning the gold amalgam to get rid of the Hg<sub>0</sub>. Burning is usually performed only once per 1–3 weeks. Gold buyers again burn the gold to be sure that they only buy gold.

Hg<sub>0</sub> affects the central nervous system (CNS), but the exposure-response relationship for discrete but important effects is not well known. As indicators of exposure, Hg levels in blood, plasma and urine are useful. It is usually assumed that there is a simple relationship between exposure and these biomarkers. However, recent data indicate that genetic traits may modify the retention of Hg. Also, there is a possibility that such factors may influence the exposure-response curves.

**Objectives:** To define the exposure patterns in gold miners and buyers. To establish any modification of the Hg retention and CNS effects, on the one hand, and biomarkers of retention, on the other, by genetic polymorphisms.

**Subjects and Methods:** In Ecuador, male gold miners (N = 289), gold buyers (N = 65) and population referents (N = 72) were examined. Life style and occupational and medical histories were recorded, and a neurological examination was made.

A neurophysiological examination was performed (reaction time, tremor, diadochokinesis, posture).

Total Hg was determined in blood (B-Hg), plasma (P-Hg) and urine (U-Hg) by atomic fluorescence spectrometry. The urinary values were adjusted for creatinine.

Polymorphisms in glutathione (GSH)-synthesizing (glutamyl-cystein ligase) and -conjugating (GSH-S-transferases) genes were determined by Taqman allelic discrimination assay.

**Results:** In the miners, Hg levels decreased with time after burning of gold amalgam.

**TABLE 2.** Hg Levels (Medians)

	B-Hg	P-Hg	U-Hg
	( $\mu\text{g/L}$ )	( $\mu\text{g/L}$ )	( $\mu\text{g/g crea}$ )
Group N			
Miners 72	5.3	1.9	5.0
Buyers 37	30	20	36
Referents	5.0	1.4	1.6

**Conclusions:** Gold buyers had higher Hg retention than gold miners, who were higher than controls. Data on neurological examinations and gene-environment interactions will be presented.

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#### ISEE-0932

##### **INTARESE: Integrated Assessment Framework for Estimating the Health Effects of Climate Change**

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**Background:** The INTARESE project aims to develop a framework for integrated environmental assessment, that is focused on policies, is systemic, and is based on a 'full-chain' analysis. This paper reports the results of the "Climate" workpackage that developed a method to quantify the impact on health due to global climate change.

**Methods:** Published exposure-response functions (pooled temperature-mortality relationships) were used to estimate current and future age-specific heat-related mortality. The future impacts of climate change were estimated for a range of climate scenarios (high to low emissions) compared to impacts under the current climate. Future population estimates were derived from national estimates scaled to age specific projections for the study area. It was assumed that some acclimatization would occur, but no changes in age-specific deaths rates.

**Results:** In London, annual heat-related mortality in 2030 was estimated to range from 29 (95%CI 2, 58) deaths (low emissions scenario) to 49 (2, 58) (high emissions) compared to 5 (0, 10) deaths under the current climate, assuming no acclimatization or additional policy measures. By 2050, heat mortality is projected to increase to 307 (27, 592) deaths per year under the high emissions scenario. Uncertainty around future population growth accounted for less than 5% of the total burden.

**Conclusions:** The estimation of future burdens of heat and cold needs to include robust assumptions about changes in population growth and aging, acclimatization and adaptation. Estimates of the impacts of climate change on health require new approaches to uncertainty assessment. Current scientific evidence for policies to prevent heat-related mortality are insufficiently robust to estimate their current or future benefit at the population level.