ERS International Congress 2023: highlights from the Epidemiology and Environment Assembly

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Abstract

In this article, early career members of the Epidemiology and Environment Assembly of the European Respiratory Society (ERS) summarise a selection of four poster and oral sessions from the ERS 2023 Congress. The topics covered the following areas: micro- and macro-environments and respiratory health, occupational upper and lower airway diseases, selected tobacco and nicotine research, and multimorbidity in people with lung diseases. The topics and studies covered in this review illustrate the broad range of the multifaceted research taking place within Assembly 6, from the identification of indoor and outdoor environmental risk factors for the development and worsening of respiratory diseases to the concerningly increasing use of nicotine products and their health consequences beyond respiratory health and comorbidity in respiratory diseases.

Introduction

In this review, early career members of the Epidemiology and Environment Assembly of the European Respiratory Society (ERS) summarise a selection of research projects presented during the ERS 2023 International Congress. Four sessions (two thematic poster and two oral sessions) focusing on areas underlining the vast variety of research activities taking place in Assembly 6, the impact of indoor and outdoor environmental factors, including specific pollutants related to occupation. One session shed further light on the effects of newer nicotine products on (respiratory) health, with e-cigarettes being a hot topic this year. The results reported a need for increased knowledge of e-cigarettes and that there are diverging attitudes toward e-cigarettes among general practitioners.

Micro- and macro-environments and respiratory health

In this series of oral presentations, 10 studies explored the multifaceted relationship between environmental factors and respiratory health. The session commenced with a study examining the internal lung environment's influence on COPD, followed by an exploration of the effects of the external outdoor and indoor environments. It concluded with a presentation on the impact of respiratory inhalers on the environment and economy.

BACKMAN *et al.* [1] presented a study which assessed biomarkers such as hs-CRP (high-sensitivity C-reactive protein), MMP-9 (matrix metalloproteinase-9), and TIMP-1 (tissue inhibitor of metalloproteinase-1) in three groups with varying lung function decline trajectories. Significant differences in hs-CRP and MMP-9 levels were observed among these groups, with better prognosis associated with lower hs-CRP and MMP-9 levels. Those with rapid and severe lung function decline showed an imbalance between TIMP-1 and MMP-9 levels. These findings suggest the potential for personalised COPD treatment strategies based on distinct biomarker profiles.

The session featured several presentations examining the outdoor environment's impact on respiratory health. Three studies focused on the consequences of chemical or particulate matter (PM) pollution. YU *et al.* [2] investigated the association between long-term exposure to urban air pollution and long COVID in young Swedish adults. Employing dispersion models for PM with aerodynamic diameter <2.5 µm ($PM_{2.5}$), PM_{10}, black carbon (BC) and nitrogen oxides (NO_x) at residential addresses, the study identified a significant positive association between $PM_{2.5}$ exposure in 2019 and the incidence of long COVID. SO *et al.* [3] presented research which investigated the links between long-term air pollution exposure and asthma, COPD and medication usage for obstructive airway diseases among 3 million Danish adults in an administrative cohort. They revealed positive associations between all three pollutants (modelled $PM_{2.5}$, nitrogen dioxide (NO_2), and BC) and these health outcomes, with the strongest associations for asthma. ZHAO *et al.* [4] examined long-term exposure to ambient ozone and its association with lung function decline among 3014 European adults in the European Community Respiratory Health Survey. Their findings suggested a significant association between ozone and declining lung function (forced expiratory volume in 1 s and forced vital capacity), even after accounting for simultaneous exposures to $PM_{2.5}$, NO_2 and greenness. Three presentations revolved around farming and green space and their implications on respiratory health. In one study, CORNU HEWITT *et al.* [5] investigated residential exposure to microbial air pollution from livestock farms and antimicrobial resistance in the upper respiratory tracts of individuals with and without COPD. This unique focus on microbial pollutants, which is a category frequently overlooked, revealed that this exposure resulted in an uneven distribution of resistance genes among highly exposed individuals. Specific antimicrobial resistance genes gaining dominance could be related to the increased risk of symptoms and infections observed in COPD patients living near livestock farms [6]. The influence of green environments on lung function was investigated by VALENCIA-HERNANDEZ *et al.* [7] in European birth cohorts. Their meta-analysis results indicated that greenness did not consistently correlate with improved lung function, potentially due to disparities among cohorts. The authors are currently exploring additional factors, including the potential modifying effects of pollution, as well as the role of green spaces in influencing asthma and physical activity. Simultaneously, PACIÊNCIA *et al.* [8] examined how air pollution modifies the relationship between green space exposure and allergic rhinitis development, utilising data from the Finnish Espoo cohort. Their results demonstrated that children exposed to elevated air pollution experienced a reduced risk of allergic rhinitis with greater green space exposure during the summer, compared with individuals with lower green space exposure. Conversely, in regions with cleaner air, greater exposure to green spaces during the spring increased the risk of allergic rhinitis. These findings suggest that the impact of green space on allergic rhinitis can be enhanced in areas with elevated air pollution levels.

Two presentations shifted the focus of the session to the indoor environment. AMIN *et al.* [9] investigated the impact of indoor bacteria on lung function and inflammation in 1038 adults residing in Northern Europe. Using 16S rRNA amplicon sequencing, they found that greater bacterial diversity and richness improved lung function in men but exacerbated inflammation in women, with specific bacterial types like *Actinobacteria* associated with enhanced lung function and others like *Bacteroidia* linked to reduced lung function. The second presentation, given by KOTHE *et al.* [10], assessed the effects of modern cookstoves on lung heath and indoor air pollution in rural Rwandan communities. This randomised controlled trial involved 907 women primarily engaged in farming who used wood for cooking. The outcomes demonstrated significant reductions in respiratory symptoms and improved lung function (forced vital capacity) in households using the new cookstoves *versus* traditional ones. Concentrations of indoor air pollutants also notably decreased (up to 60%), particularly in homes with indoor kitchens, highlighting the health benefits and improved air quality associated with adopting more efficient cooking methods in communities facing high levels of indoor air pollution.

The concluding presentation shifted from the environment's impact on respiratory health to the reciprocal influence of treating respiratory conditions on the environment and economy, particularly concerning inhaler usage as presented by SORIANO *et al.* [11]. In Spain, changing inhalers for non-clinical reasons among patients with COPD and asthma carries substantial economic and environmental repercussions. Annual care costs exceed EUR 3.7 billion, with EUR 328 million attributed to inhaler misuse and device changes, contributing to over 396 000 metric tonnes of carbon dioxide (CO_2) equivalent emission. Implementing

retraining programmes for patients, physicians, and nurses offers a sustainable solution, projected to cost of EUR 36 million and 2600 metric tonnes of CO_2 equivalent. This study emphasised the importance of addressing device management in healthcare policies to promote global health and sustainability.

In summary, these diverse topics collectively shed light on the complex interplay between environmental factors, respiratory health and broader societal and economic implications.

Occupational upper and lower airway diseases

The posters in the "Occupational upper and lower airway diseases" session addressed the mortality and morbidity related to respiratory diseases due to occupational exposure as well as occupational or household asthma risk factors, and also included studies aiming to characterise the respiratory health of specific populations of workers.

Three studies presented the impact of occupational exposures on respiratory mortality and morbidity. FARAH et al. [12] showed that between 700 and 800 million deaths worldwide due to malignant and chronic respiratory diseases were attributable to occupational exposure from 1990 to 2019. This study also evidenced a decline in the worldwide mortality and disability-adjusted life years rates for chronic respiratory diseases attributable to occupational exposures, but a concerning increase in the mortality rates for malignant ones. In the population-based FinEsS-study, JALASTO et al. [13] observed an increased mortality related to respiratory diseases due to occupational exposure to dusts, gases and fumes. QUINTERO SANTOFIMIO et al. [14] found consistent results as they also observed an increased mortality risk due to low or moderate lifetime occupational exposures to vapours, gases, dusts and fumes (VGDF) in participants with small airway obstruction (airway <2 mm) from the UK Biobank. The authors concluded that lifetime exposure to VGDF may increase the risk of premature death among people with small airways obstruction [14], common in chronic respiratory diseases such as asthma and COPD [15].

Among studies performed on specific populations of workers, two aimed at estimating COPD prevalence according to exposures and specific jobs. MINOV et al. [16] showed that the occupational exposure to VGDF increased the COPD prevalence, with the highest COPD prevalence observed in construction workers, professional drivers and textile workers. Among the cases identified from the UK Health and Occupation Research (THOR) network, COPD was more frequent in manufacturing, construction, mining and quarrying workers [17]. The most commonly identified COPD causative agents were coal, dust, tobacco smoke, asbestos, silica, welding fumes, and cement, plaster and masonry [17]. These two studies emphasised the importance of improving the definition of occupational COPD and developing preventive measures in order to reduce the burden of COPD [16, 17].

Four posters aimed to study the associations between occupational exposures and asthma outcomes. HENNEBERGER et al. [18] observed that using cleaning, disinfecting and medical products, as well as completing tasks for cleaning fixed surfaces and administering aerosolised medicines, was associated with current asthma with and without exacerbation in a sample of US healthcare workers. SIT et al. [19] found consistent results as they observed associations of lifetime occupational exposures to irritants, including disinfectants, cleaning products and solvents, with current asthma and asthma symptoms among French adults from the population-based CONSTANCES cohort. JAAKKOLA et al. [20] showed that occupational exposures to moulds, construction dusts and fumes (scents, chemicals, cleaning agents and air pollutants) were associated with a significantly reduced asthma control among men and/or women in Northern Finland. In contrast, WALTERS et al. [21] did not evidence a significant association of the inhaled occupational exposure to asthmagens, including respiratory sensitisers, irritants, cleaning agents and detergents, with asthma control in English patients with severe asthma. Overall, these four emphasised the importance of considering these occupational exposures for better asthma management [18–21].

In addition to presentations mainly focused on occupational exposure, two studies investigated the impact of the use at home of cleaning products on asthma. A first study performed on French adults from the NutriNet-Santé cohort showed that the weekly household use of several cleaning products, including newly studied ones such as green products and those used in wipe form, was associated with poor asthma control, with strong associations for an almost daily use of these products [22]. Mechanisms by which cleaning products might affect asthma remain poorly understood; most cleaning products are considered as irritants and might induce asthma through non-allergic mechanisms while sprayed products might be sensitisers due to the perfumes they contain [23]. A second study by PACHECO DA SILVA et al. [24] from a case–control asthma cohort (EGEA) found that a high weekly use of sprays and an almost daily use of irritants at home was associated with one or two distinct asthma endotypes, suggesting an overlap of allergic/non-allergic mechanisms for both irritants and sprays.

In conclusion, this session provided new knowledge on the occupational exposures at risk for respiratory diseases, in particular for asthma and COPD. These studies highlighted targeted exposures such as cleaning agents (asthma) and specific agents contributing to VGDF (COPD) on which to act and develop preventive measures in order to reduce the respiratory disease-related morbidity worldwide.

Selected tobacco and nicotine research

Tobacco and nicotine products continue to be a major public health concern. While tobacco smoking is still one of the most preventable and destructive epidemics in the world [25], the increase in the use and popularity of e-cigarettes may be a cause for concern and remains an active interest in the respiratory medical field. Studies on the health effects of tobacco smoking in pregnancy and early airway changes, e-cigarettes and tobacco industry tactics were presented in this session.

Alpha-1 antitrypsin (AAT) is a protease inhibitor that protects lung structure against the degradation of the proteolytic enzyme elastase [26]. KORSBÆK et al. [27] highlighted their Danish national population study that evaluated the effect of AAT deficiency (AATD) on cancer risk. According to the matched control group (n=26 750), the AATD group (n=2702) had an increased risk of skin cancer (hazard ratio (HR) 2.18, 95% CI 1.81–2.63), leukaemia (HR 1.76, 95% CI 1.12–2.79), liver cancer (HR 3.91, 95% CI 2.23–6.85), and all cancers (HR 1.25, 95% CI 1.13–1.38). Lifestyle factors such as smoking cause telomere reduction; senescence of somatic cells, apoptosis or oncogenic transformation may occur [28].

The previously reported association between smoking/smoke exposure and leukocyte telomere length (LTL; a biomarker of biological ageing) [29] was further investigated by CHEN and DAI [30], who used the UK Biobank and found that current smokers may have shorter LTL (β=−0.29, 95% CI −0.42 to −0.16), and ever smokers may face the risk of shorter LTL. Additionally, LTL showed a negative relationship with pack-years and second-hand smoke exposure.

E-cigarettes and other nicotine products might be the cradle of a new epidemic, in particular among the young population [31], and were a hot topic within this session, with four talks focused on health effects of their usage and general practitioners' attitudes regarding e-cigarettes. TO et al. [32] presented data from a cross-sectional survey study conducted in Canada. 905 participants aged 15–30 years responded, with one in eight participants reporting e-cigarettes use. E-cigarette users demonstrated more than twice as much life stress than non-users (AOR 2.10, 95% CI 1.36–3.24). SELAMOGLU et al. [33] presented data from an online survey administered to general practitioners in Istanbul. Out of 243 general practitioners, more than half agreed that e-cigarettes have adverse health effects, can be addictive, and may act as a gateway to smoking. However, general practitioners disagreed that e-cigarettes were a smoking cessation aid and are safer than traditional cigarettes. More than half felt confident in their knowledge of traditional cessation medications and felt insecure about their level of knowledge and answering questions about e-cigarettes. BRYNEDAL et al. [34] studied the vascular effects of acute use of e-cigarettes with and without nicotine. Using a double-blind crossover design, participants underwent forearm venous occlusion plethysmography 2 h post e-cigarette vaping. Intra-arterial administration of acetylcholine (ACH) and sodium nitroprusside increased the forearm blood flow (FBF), and ACH-induced FBF was significantly higher after nicotine e-cigarette exposure compared to non-nicotine e-cigarette exposure. Finally, LOVE et al. [35] presented data on the tetrahydrocannabinol Δ8-THC, which is included in vape juice and oils sold in the USA, and how it may alter the respiratory epithelium. Using liquid chromatography mass spectrometry (LC-MS), vaped condensates were created from both Δ8-THC oil and juice. Vaporisation of the Δ8-THC oil produced high levels of both Δ8-THC quinone (Δ8-THCQ) and cannabidiol quinone (CBDQ). RNA sequencing demonstrated that, at 12 h, 414 and 209 genes were altered, and at 24 h, 2360 and 108 genes were altered by Δ8-THCQ and CBDQ, respectively. Further pathway analysis suggested that both quinones may cause inflammation and dysfunction to the cilia.

The next speaker, Elif Dağlı, examined tobacco industry economic incentives administered by the Ministry of Industry and Technology of Turkey (January 2019–August 2022). VAT exemption was applied to all companies. Tax deduction, investment contribution, employer share of insurance premium, and customs duty exemption, interest support, income tax withholding and insurance premium support for 10 years were applied to companies [36]. This constitutes a clear violation of World Health Organization Article 5.3 [25].

BASINA et al. [37] assessed smoking status in 83 women with normal and complicated pregnancies in Ukraine. The women were split into three groups: 1) healthy pregnancies (n=14), 2) presence of extragenital disease (n=36), and 3) obstetric complications (n=32). Smoking whilst pregnant was low across all groups; however, it was highest among group 1 (2%) and group 3 (2%). 25% of the study population stated they quit smoking because of their pregnancy. Worryingly, over half of the study population (54%),

both never-smokers and ex-smokers, stated they were still exposed to passive smoking. The researchers found no significant difference in smoking behaviour/exposure domains across the three groups.

Finally, VALACH et al. [38] presented data on the use of oscillometry in assessing early smoking-induced airway changes. The researchers used data from the large observational Austrian LEAD study and performed Z measurements on 7560 healthy participants. Resistance (R), reactance (X) at 5 Hz, area under X (AX) and frequency dependence of R (R5–R19) were analysed. They discovered that smokers with >10 pack-years had significantly higher R5 value (88% of predicted) compared to never-smokers (84%) and ex-smokers with <10 pack-years (74%), demonstrating that smokers with >10 pack-years may have increased obstruction in the central airway. Oscillometry is a feasible approach to detect these Z changes early.

Multimorbidity in people with lung diseases

In this poster session, studies covered a broad range of health conditions co-occurring in people with lung diseases such as asthma, COPD and tuberculosis (TB).

Three posters focused on Swedish cohorts. The first one, by SMEW et al. [39], explored the association between parental asthma and the risk of type 1 diabetes in offspring, and found that, while maternal asthma during pregnancy did not increase the risk of type 1 diabetes (HR 0.90, 95% CI 0.75–1.08), pre-existing maternal and paternal asthma were associated with a higher diabetes risk (1.18, 1.08–1.29 and 1.21, 1.10–1.34, respectively). Second, ALMQVIST et al. [40] investigated the persistence of asthma from 8 to 28 years. Out of the 170 asthmatics at 8 years who participated in the follow-up survey at 28 years, 61.8% had current asthma. The authors found that severe respiratory infections before the age of 8 years (OR 2.9, 95% CI 1.2–7.0), allergic sensitisation at 8 years (2.6, 1.1–6.6), and bronchial hyperreactivity at 17 years of age (9.0, 1.7–47.0) were associated with asthma at 28 years. Third, WANG et al. [41] looked at the association between depression and respiratory health outcomes in young adults (n=2994) and found that 13.5% of them had been diagnosed with depression, and this was associated with a higher risk of chronic bronchitis (OR 1.58, 95% CI 1.21–2.06) and respiratory symptoms (1.41, 1.11–1.80) in early adulthood, independent of smoking. The study also suggested a link between depression and metabolic and inflammatory dysregulation.

Several posters in this session explored conditions associated with asthma. VIINANEN et al. [42] studied the prevalence of adult asthma in Finland and found a 6% prevalence (n=278 172). The authors found that half of asthmatics had been diagnosed in secondary care, 9% of them with severe asthma. Moreover, among individuals with available blood eosinophil count, 54% could be classified as eosinophilic severe asthma. MAUCLIN et al. [43] studied the association between cumulative rhinovirus-specific IgG responses and severe asthma and lung function in children and adults, and found that increased levels of cumulative rhinovirus-specific IgG responses were associated with a higher risk of asthma in children (with stronger associations in more severe cases), but a lower risk in adults. Additionally, SHIGDEL et al. [44] studied the prevalence of sleep-related symptoms among asthmatics and found that people with asthma had higher odds of sleeping ⩽6 h (OR 1.61, 95% CI 1.20–2.17), reporting difficulty initiating sleep (1.92, 1.65–2.23), maintaining sleep (1.79, 1.56–2.07) and early morning awakening (2.36, 1.96–2.84) compared to non-asthmatics.

Other posters investigated different conditions. LIN et al. [45] explored sarcopenia in a group of older adults living in retirement homes (n=305, mean age 82 years, 43% male), and found that sarcopenia was more common among individuals with COPD, compared to those without the disease (OR 2.79, 95% CI 1.37–5.69). BAYLIS et al. [46] examined 407 patients diagnosed with eosinophilic granulomatosis with polyangiitis, and observed that individuals in the vasculitic phase of the disease (31%) had more clinical manifestations, comorbidities and worse health outcomes, compared to those in the eosinophilic phase (54%). NOWINSKI et al. [47] studied TB between 2020 and 2022 in Poland, and found an increase in the number of TB and multidrug-resistant TB (MDR-TB) cases notified in 2022, compared to previous years. Their results seem to be related to the war in Ukraine, given that 75% of MDR-TB cases reported in 2022 were Ukrainians. Finally, PERA et al. [48] investigated the trends of azithromycin prescription in the general adult population, as well as in individuals diagnosed with asthma, COPD or asthma–COPD overlap in the Netherlands, and showed that azithromycin prescription was higher in people with lung diseases compared to the general population, with the highest incidence rates in asthma–COPD overlap.

In summary, posters presented in the session provided relevant knowledge on the prevalence and risk associated with diverse health conditions co-existing with lung diseases.

Conclusions

The ERS 2023 Congress brought a spectrum of interesting research in respiratory and environmental epidemiology to light. This review emphasises the discoveries from various sessions, reflecting a rich array of research areas within Assembly 6. COPD and asthma remain the most common respiratory diseases, with a high burden on both individual and societal levels. In order to change the increasing prevalence, the importance of research into modifiable risk factors becomes increasingly paramount. Collectively, the results from a session focusing on the role of indoor and outdoor environmental factors underlined the negative impact of air pollution in a broad sense, but also highlighted the potential for initiatives to reduce the risk and worsening of respiratory diseases at both an individual as well as governmental level.

Studies from another session focusing on the mortality and morbidity related to respiratory diseases due to occupational or household exposure provided new knowledge on specific risk factors for the worsening of asthma and COPD. The identification of specific hazardous occupations for people with pre-existing respiratory diseases can be used for guidance of the individual.

In the session regarding nicotine and tobacco, the results showed that the use of e-cigarettes is increasing and popular, which is concerning as they have been promoted as a "healthier" alternative to traditional cigarettes. There is an urgent need to inform both patients and primary healthcare professionals on the acute and long-term negative impact of e-cigarettes on health, which includes effects from cellular and pathophysiological changes in the respiratory system. The identification of novel and modifiable risk factors for the onset and prognosis of respiratory diseases may have the potential to counteract the burden of disease in terms of functional impairment, quality of life, and also the risk of comorbidity.

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