Annals of Work Exposures and Health, 2022, Vol. 66, No. 5, 671–686
https://doi.org/10.1093/annweh/wxab110
Advance Access publication 22 December 2021
Short Communication

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Occupational Exposure Assessment Tools in Europe: A Comprehensive Inventory Overview

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Submitted 17 September 2021; revised 4 November 2021; editorial decision 4 November 2021; revised version accepted 15 November 2021.

Abstract

Objectives: The Network on the Coordination and Harmonisation of European Occupational Cohorts (OMEGA-NET) was set up to enable optimization of the use of industrial and general population cohorts across Europe to advance aetiological research. High-quality harmonized exposure assessment is crucial to derive comparable results and to enable pooled analyses. To facilitate a harmonized research strategy, a concerted effort is needed to catalogue available occupational exposure information. We here aim to provide a first comprehensive overview of exposure assessment tools that could be used for occupational epidemiological studies.

Methods: An online inventory was set up to collect meta-data on exposure assessment tools. Occupational health researchers were invited via newsletters, editorials, and individual e-mails to provide details of job-exposure matrices (JEMs), exposure databases, and occupational coding systems and their associated crosswalks to translate codes between different systems, with a focus on Europe.

Results: Meta-data on 36 general population JEMs, 11 exposure databases, and 29 occupational coding systems from more than 10 countries have been collected up to August 2021. A wide variety of exposures were covered in the JEMs on which data were entered, with dusts and fibres (in 14 JEMs) being the most common types. Fewer JEMs covered organization of work (5) and biological factors (4). Dusts and fibres were also the most common exposures included in the databases (7 out of 11), followed by solvents and pesticides (both in 6 databases).

What's Important About This Paper?

OMEGA-NET was set up to enable optimization of the use of industrial and general population cohorts across Europe to advance aetiological research. This inventory forms the basis for a searchable web-based database of meta-data on existing occupational exposure information, to support researchers in finding the available tools for assessing occupational exposures in their cohorts.

Conclusions: This inventory forms the basis for a searchable web-based database of meta-data on existing occupational exposure information, to support researchers in finding the available tools for assessing occupational exposures in their cohorts, and future efforts for harmonization of exposure assessment. This inventory remains open for further additions, to enlarge its coverage and include newly developed tools.

Keywords: epidemiology; exposure assessment; exposure databases; harmonization; job-exposure matrix

Introduction

Prospective cohort studies are considered the strongest design in occupational epidemiology, as it often allows for obtaining information directly from individuals and updating information over time (Blair *et al.*, 2015). Although many large cohorts with occupational information exist in Europe (Kogevinas *et al.*, 2020), these are not yet used to their full potential in the study of occupational risks. Pooling these data would increase statistical power, offering opportunities such as looking at rare outcomes and interactions between risk factors, as well as enabling the exploration of between-countries differences (Turner and Mehlum, 2018). A major limiting factor is the lack of large-scale systematic and harmonized exposure assessment that is required for coordinated occupational health research (Peters *et al.*, 2020). Good quality exposure assessment is essential to detect and characterize relevant exposure–disease associations.

The first step in the exposure assessment process often involves translating narrative descriptions of occupational histories into occupational codes, either manually or by using (semi-)automated systems to code such free text. These codes then offer the opportunity to link a study to a job-exposure matrix (JEM), i.e. a cross-tabulation between occupational title and workplace hazards.

JEMs are an important tool in large-scale and systematic exposure assessment (Kromhout and Vermeulen, 2001; Peters, 2020). JEMs are often based on expert judgement, but exposure (measurement) data can also be used to develop a JEM (Ge *et al.*, 2018). Numerous JEMs have been developed and described over the years, all with their own coding systems and definitions of exposure. However, many different coding systems exist, and vary between countries and over time. Due to these differences in coding systems, a preliminary step using crosswalks that represent correspondence between systems may be required to link a study to a specific JEM ('t Mannetje and Kromhout, 2003).

Occupational exposure measurements of a wide range of occupations have been collected in several national exposure databases during recent decades (Peters *et al.*, 2012). Based on these data, exposure levels for all types of jobs and time periods could potentially be estimated by statistical modelling. Although several large occupational exposure databases exist, their use in population-based research has been limited due to a lack of FAIR (findable, accessible, interoperable, and re-useable) principles.

Although comparisons between individual JEMs have been published (e.g. Offermans *et al.*, 2012), JEMs have not been systematically compiled and compared. Additionally, a clear overview of all available JEMs, exposure databases, job coding systems, and crosswalks has been lacking, and knowledge about these tools is not easily available. More accessible information on job coding systems and crosswalks between different systems will also support harmonization of exposure data and tools across countries.

Our aim was to collate regional (i.e. continental) and country-specific exposure assessment tools, with an initial focus on Europe, that can be applied to large general population cohorts to allow for risk analyses and to facilitate health impact analyses.

Methods

OMEGA-NET (the Network on the Coordination and Harmonisation of European Occupational Cohorts, http://omeganetcohorts.eu/) is an EU COST Action that started in 2017 and will continue into 2022 (Turner and Mehlum, 2018). OMEGA-NET includes members from over 40 countries, including European and neighbouring countries (Belarus, Morocco, Palestinian Authority, Russian Federation) as well as international partner countries Australia, the United States, and the United Arab Emirates. The project was set up to enable optimization of the use of industrial and general population cohorts across Europe to advance aetiological research (Turner and Mehlum, 2018).

Within the scope of OMEGA-NET, an online inventory was created to collect meta-data on various exposure assessment tools (https://occupationalexposuretools.net). Occupational health researchers were invited to provide details on JEMs, exposure databases, occupational coding systems, and the associated crosswalks, with a focus on Europe. The inventory was promoted, and contributions were sought, by mailings within consortia with a focus on occupational health research [OMEGA-NET, and the EU-H2020 Exposome Project for Health and Occupational Research (EPHOR) (Pronk *et al.*, unpublished data) including representatives from 12 European countries], the newsletter of the International Commission on Occupational Health, an editorial in this journal (Peters *et al.*, 2020), conference presentations, and by directly approaching individual researchers that were identified via searches in PubMed and Google.

Combining all meta-data, an open resource for occupational exposure assessment tools has been built. Data entries were checked for inconsistencies and clarifications were sought where necessary. Here, we describe the characteristics of the meta-data available as of August 2021. As we focus on tools that can be used in general population cohorts, we have excluded data that were provided on industry-specific JEMs (n = 3) for current descriptive analysis.

Results

Meta-data on 36 general population JEMs, 11 exposure databases, and 29 occupational coding systems have been collected from individual researchers up to August 2021.

A wide variety of exposures were covered, with dusts and fibres (in 14 JEMs) being the most common types (Table 1). Among dusts and fibres, asbestos was the most assessed exposure, with presence in 10 JEMs, followed by quartz and wood dust (both in 7 JEMs). Fewer JEMs covered organization of work including working time (5) or biological factors (4). Other exposures that were relatively often covered included benzene, chromium, nickel, and physical workload (each in seven JEMs). Many JEMs were originally developed for the Nordic countries, with FINJEM being the earliest JEM in our inventory (Kauppinen *et al.*, 1998). There was also overlap in development of JEMs: FINJEM formed the basis for three later JEMs (i.e. NOCCA, INTEROCC, and MatEmEsp), whereas SYN-JEM used DOM-JEM as input. Furthermore, 27 JEMs were based on expert assessment, 17 included direct measurements, and 13 relied on self-reported data, with many reporting a combination of these sources. Five JEMs had an industry axis, 13 were time varying, and 7 were sex specific.

Meta-data were provided for exposure databases covering the Netherlands (n = 3), France (n = 3), UK (n = 2), Norway (n = 1), and multinational (n = 2) (Supplementary Table 1, available at *Annals of Work Exposures and Health* online). The earliest data are included in ExpoSYN (1951–2009). For six databases (Colchic, EV@LUTIL, EXPO, HSE-BMDB, NECID, and SCOLA), data collection is still ongoing. Dusts and fibres were also the most common exposures in the databases (7 out of 11), followed by solvents and pesticides (both included in 6 databases).

Information on the occupational coding systems included international (i.e. ISCO), as well as national coding systems from more than 10 countries. Their relation to other coding systems and the availability of crosswalks and/or automated coding systems is shown in Table 2.

Discussion

Existing occupational exposure assessment tools, including JEMs, exposure databases, coding systems, and crosswalks have been collated in an inventory. Although many different types of exposures have been covered by the 36 JEMs, the most common exposure group was dusts and fibres, while biological factors and employment conditions were much less frequent. This distribution may partly represent the major research focus in occupational epidemiology over the last decades. On the other hand, not all exposure types are equally appropriate for assessment by JEMs (Peters, 2020), which may also be reflected by our inventory. The availability of multiple JEMs on the same exposure allows for studying method uncertainty and to study if associations are method dependent (e.g. Offermans *et al.*, 2012). The geographical coverage showed that most JEMs were developed in Western and Northern Europe. Based on the current inventory, it would appear that JEMs developed for Eastern and Southern Europe, in particular, could be a major improvement on the current toolbox for occupational exposure assessment in large cohorts.

While the OMEGA-NET team actively made contacts and sought contributions from researchers, our

Table 1. Overview of the 36 JEMs entered in the OMEGA-NET inventory of exposure assessment tools by August 2021.

JEM name	Job coding	Exposure metrics
ALOHA + JEM (Skorge *et al.*, 2009)	ISCO 1988	*Intensity*: semi-quantitative
Asbestos JEM[a,b] (Swuste *et al.*, 2008)	ISCO 1968	*Intensity*: semi-quantitative; *probability*
AsbJEM[a,b] (van Oyen *et al.*, 2015)	N/A	*Intensity*: quantitative
BEN-JEM[b] (Spycher *et al.*, 2017)	ISCO 1998	*Intensity*: quantitative; *probability*
CANJEM[a,b] (Sauvé *et al.*, 2018)	ISCO 1968 SOC 2010 CITP 1968 NOC 2011 CCDO1971	*Intensity*: semi-quantitative; *probability*; *frequency*
Constances JEM (Yung *et al.*, 2020)	PCS	*Intensity*
COVID-19-JEM (Oude Hengel *et al.*, 2021)	ISCO 2008	*Probability*
dBAR-JEM[b,c] (Stokholm *et al.*, 2020)	ISCO 1988	*Intensity*: quantitative
DEE-JEM (Ge *et al.*, 2020)	ISCO 1968	*Intensity*: quantitative; *probability*
DOM-JEM (Peters *et al*, 2011)	ISCO 1968	*Intensity*: semi-quantitative

Time period covered (time intervals)	Exposures	Data source(s)	Region for which the JEM was originally developed
n.s.	*Dusts and fibres*: mineral dust; organic dust *Solvents*: chlorinated solvents; aromatic solvents; other solvents *Metals*: metals (n.s.) *Pesticides*: fungicides; herbicides; insecticides *Other chemicals*: gas and fumes (n.s.)	Expert assessment	Europe, North America
1945–1994 (5-year intervals)	Asbestos	Expert assessment Direct measurements	The Netherlands
1943–present (1943–1966, 1967–1986, 1987–2003, 2004+)	Asbestos	Expert assessment Direct measurements	Australia
1945–2009 (1945–1959, 1960–1984, 1985–1994, 1 995–1997, 1998–2000, 2001–2003, 2004–2006, 2007–2009)	Benzene	Expert assessment Direct measurements	Europe, North America
1930–2000 (varying intervals)	CANJEM included 258 agents from the selected categories (*not further specified in online inventory*)	Expert assessment	North America
n.s.	Awkward work postures; physical work load; repetitive work movements; sedentary work; standing work; work with video display units (VDU)	Expert assessment Self-reported data	France
2020	*Biological factors*: infection risk (number of contacts; type of contacts; indirect contact; location; social distancing; face covering) *Organization of work*: job insecurity; migrants	Expert assessment	Denmark, The Netherlands, UK
n.s.	Noise	Expert assessment Direct measurements	Denmark
n.s.	Diesel engine exhaust	Expert assessment Direct measurements	Europe, North America
n.s.	*Dusts and fibres*: asbestos; biological dust; quartz *Metals*: chromium; nickel *Other chemicals*: diesel engine exhaust; PAHs (n.s.) *Biological factors*: animal contact; endotoxins	Expert assessment	Europe

Table 1. Continued

JEM name	Job coding	Exposure metrics
FINJEM[b] (Kauppinen *et al.*, 1998)	ISCO 1958	*Intensity*: quantitative; *probability*
INTEROCC Chemical-JEM (van Tongeren *et al.*, 2013)	ISCO 1968 ISCO 1988	*Intensity*: quantitative; *probability*
INTEROCC ELF-JEM (Turner *et al.*, 2014)	ISCO 1968 ISCO 1988	*Intensity*: quantitative
Lower Body JEM (Rubak *et al.*, 2014)	ISCO 1988	*Intensity*: quantitative; *probability*; *duration*; *frequency*
LUXAR-JEM[a] (Vested *et al.*, 2019)	ISCO 1988	*Intensity*: quantitative (lux), *peaks*

Time period covered (time intervals)	Exposures	Data source(s)	Region for which the JEM was originally developed
1945–1997 (1945–1959, 1960–1984, 1985–1994, 1995–1997)	*Dusts and fibres*: asbestos; man-made mineral fibres; inorganic dust (n.s.); quartz; animal dust; flour dust; plant dust; pulp or paper dust; synthetic polymer dust; textile dust; wood dust (hardwood); wood dust (softwood); wood dust (n.s.); leather dust *Solvents*: aliphatic and alicyclic hydrocarbon solvents (n.s.); benzene; styrene and styrene oxide; toluene; xylene; aromatic solvents (n.s.); methylene chloride; perchloroethylene; trichloroethanes; trichloroethylene; chlorinated hydrocarbon solvents (n.s.); formaldehyde; organic solvents (n.s.) *Pesticides*: fungicides; herbicides; insecticides *Metals*: arsenic; cadmium; chromium; iron; lead; nickel *Other chemicals*: carbon monoxide; diesel engine exhaust; gasoline engine exhaust; isocyanates; benzo(a)pyrene; bitumen fumes; oil mist; PAHs (n.s.); environmental tobacco smoke; sulphur dioxide and trioxide; welding fumes (n.s.) *Biological factors*: Gram-negative bacteria of human origin; moulds *Physical agents*: cold; hand-arm vibration; heat; noise; ionizing radiation; non-ionizing radiation; solar and ultraviolet radiation; ultrasound; noise; impulsiveness; hand vibration *Ergonomics, physical workload, and injury related*: accident risk *Psychosocial domains*: psychological job demands; social support at work from supervisors *Organization of work*: night (permanent or rotating)	Expert assessment Self-reported data Direct measurements	Finland
n.s.	*Dusts and fibres*: asbestos; quartz; animal dust; wood dust (n.s.) *Solvents*: gasoline; benzene; toluene; methylene chloride; perchloroethylene; trichloroethanes; trichloroethylene *Metals*: cadmium; chromium; iron; lead; nickel *Other chemicals*: diesel engine exhaust; benzo(a)pyrene; bitumen fumes; sulphur dioxide and compounds; welding fumes	Expert assessment FINJEM	International
n.s.	Non-ionizing radiation	Expert assessment Direct measurements	Europe, North America
n.s.	Awkward work postures; physical work load; standing work; whole-body vibration	Expert assessment	Denmark
n.s.	Light at day	Expert assessment Direct measurements	Southern Scandinavia

Table 1. Continued

JEM name	Job coding	Exposure metrics
MatEmESp[b] (García *et al.*, 2013)	CNO-94	*Intensity*: qualitative, quantitative; *probability*; *frequency*; *peaks*
Matgéné[a,b] (Marant Micallef *et al.*, 2021)	ISCO 1968 PCS 1994	*Intensity*: semi-quantitative; *probability*

Time period covered (time intervals)	Exposures	Data source(s)	Region for which the JEM was originally developed
1996–2005	*Dusts and fibres*: asbestos; man-made mineral fibres; quartz; animal dust; flour dust; wood dust (n.s.) *Solvents*: gasoline; aliphatic and alicyclic hydrocarbon solvents (n.s.); benzene; aromatic hydrocarbon solvents (n.s.); methylene chloride; perchloroethylene; trichloroethanes; trichloroethylene; chlorinated hydrocarbon solvents (n.s.); formaldehyde; organic solvents (n.s.) *Pesticides*: thiram; captam; 2,4-D or 2,4,5-T; atrazine; diquat; diuron; chlorpyriphos; endosulfan; methomyl; pyrethrins *Metals*: arsenic; cadmium; chromium; iron; lead; nickel *Other chemicals*: benzo(a)pyrene; bituminous fumes; PAHs (n.s.); oil mist; sulphur dioxide; isocyanates; welding fumes (n.s.) *Physical agents*: heat; noise *Ergonomics, physical workload, and injury related*: awkward work postures; physical work load; repetitive work movements; sedentary work; standing work; work with video display units (VDU); vibrations; safety hazards *Psychosocial domains*: violence; job control, autonomy; psychological job demands; role conflict/ambiguity/clarity; social support at work from supervisors; skill use opportunities; work engagement; job insecurity; esteem; sociodemographic characteristics of working force *Organization of work*: contract duration; job insecurity; low pay; work contract type; night (permanent or rotating); duration; regular/variable working hours; shift work; working weekends; employment situation	Expert assessment Self-reported data FINJEM	Spain
1950–2010 (varying intervals)	*Dusts and fibres*: asbestos; ceramic fibres; mineral wools; cement; quartz; flour dust; leather dust *Solvents*: aliphatic and alicyclic hydrocarbon solvents (n.s.); aromatic solvents (n.s.); benzene; gasoline; methylene chloride; perchloroethylene; trichloroethylene; carbon tetrachloride; chloroform; formaldehyde; ketones; ethers; alcohols; ethylene and propylene glycols *Other chemicals*: PAHs	Expert assessment	France

Table 1. Continued

JEM name	Job coding	Exposure metrics
NOCCA-JEM[b] (Kauppinen *et al.*, 2009)	NYK	*Intensity*: semi-quantity; *probability*
NORJEM—mechanical[c] (Hanvold *et al.*, 2019)	ISCO 1988 STYRK-98	*Intensity*: qualitative
NORJEM—psychosocial[c] (Hanvold *et al.*, 2019)	ISCO 1988 STYRK-98	*Intensity*
OAsJEM (Le Moual *et al.*, 2018)	ISCO 1988	*Intensity*: semi-quantitative
Physical workload factors JEM[c] (Solovieva *et al.*, 2012)	ISCO 1988	*Probability*, *duration*, *frequency*
POLLEK (Szemik *et al.*, 2020)	N/A	*Intensity*, *probability*, *duration*, *frequency*
Psychosocial JEM[c] (Solovieva *et al.*, 2012)	ISCO 1988	*Intensity*: quantitative
RF-JEM (Migault *et al.*, 2019)	ISCO 1988	*Intensity*: quantitative, *probability*
Shiftwork JEM (Fernandez *et al.*, 2014)	ISCO 1968	*Probability*
SHOCK-JEM (Huss *et al.*, 2013)	ISCO 1988	*Intensity*
Shoulder JEM (Dalbøge *et al.*, 2016)	ISCO 1988	*Intensity, duration, frequency*

Time period covered (time intervals)	Exposures	Data source(s)	Region for which the JEM was originally developed
1945–1994 (1945–1959, 1960–1974, 1975–1984, 1985–1994)	*Dusts and fibres*: asbestos; quartz; animal dust; wood dust (n.s.) *Solvents*: gasoline; benzene; toluene; chloroform; methylene chloride; perchloroethylene; trichloroethanes; trichloroethylene; formaldehyde *Metals*: chromium; iron; lead; nickel *Other chemicals*: diesel engine exhaust; gasoline engine exhaust; benzo(a)pyrene; bitumen fumes; sulphur dioxide and compounds; welding fumes *Physical agents*: light at night; ionizing radiation; solar and UV radiation *Ergonomics, physical workload, and injury related*: physical work load *Organization of work*: night (permanent or rotating)	Expert assessment Direct measurements FINJEM	Nordic countries
n.s.	Awkward work postures; physical work load; standing work; hands above shoulder height; standing/walking	Self-reported data	Norway
n.s.	Job control, autonomy; psychosocial job demands; social support at work from supervisors; skill use opportunities; monotonous work; job strain	Self-reported data	Norway
n.s.	*Dusts and fibres*: animal dust; flour dust; plant dust; textile dust; wood dust (n.s.) *Solvents*: organic solvents *Pesticides*: fungicides; herbicides Metals: metal (n.s.) *Other chemicals*: detergents and cleaning products; isocyanates	Expert assessment Literature data	France
n.s.	Awkward work postures; physical work load; repetitive work movements; standing work	Self-reported data	Finland
n.s.	Career advancements opportunities; psychological job demands; work–family interface	Self-reported data Direct measurements	Poland
n.s.	Job control, autonomy; psychosocial job demands; social support at work from supervisors; skill use opportunities	Self-reported data	Finland
n.s.	Non-ionizing radiation	Expert assessment Self-reported data Direct measurements Literature data	Europe, North America, Oceania
n.s.	Exposure to light at night; phase shift; sleep disruption; poor diet; lack of physical activity; lack of vitamin D; graveyard shifts; early morning shifts	Expert assessment Self-reported data	Australia
n.s.	Electric shock	Expert assessment Direct measurements	Europe, North America
n.s.	Awkward work postures; physical work load; repetitive work movements; hand-arm vibration; computer work	Expert assessment Direct measurements	Denmark

Table 1. Continued

JEM name	Job coding	Exposure metrics
SIOPS-JEM (Behrens *et al.*, 2016)	ISCO 1968 ISCO 1988	*Intensity*: quantitative
Swedish noise JEM[b] (Sjöström *et al.*, 2013)	ISCO 1958 ISCO 1988 ISCO 2008 NYK SSYK 96	*Intensity*
Swedish physical workload JEM[b,c,d]	ISCO 1988 SSYK 96	*Duration*
Swedish psychosocial JEM[b,c,d]	ISCO 1988 SSYK 96	*Duration*
SWEJEM Chemicals and Particles[d]	FOB 80 SSYK 96	*Intensity*: quantitative (mg/m^3); *probability*
SYN-JEM[b] (Peters *et al.*, 2016)	ISCO 1968	*Intensity*: quantitative
US Pesticide JEM (Liew *et al.*, 2014)	IPUM-USA 2000	*Intensity*: semi-quantitative
Wood dust JEM[b] (Basinas *et al.*, 2016)	ISCO 1988	*Intensity*: quantitative

ns, not specified; PAH, polycyclic aromatic hydrocarbons.
[a]Industry axis.
[b]Time varying.
[c]Sex specific.
[d]No scientific publications identified.

Time period covered (time intervals)	Exposures	Data source(s)	Region for which the JEM was originally developed
n.s.	Social prestige	Expert assessment	Europe, North America
1970–2004 (5-year intervals)	Noise	Expert assessment Direct measurements	Sweden
1989–2013 (1989–1997, 1997–2013)	Heavy lifting (at least 15 kg); physically strenuous work; fast breathing; forward bent position; twisted position; hands above shoulder level; repetitive work; frequent bending or twisting; physical load index	Self-reported data	Sweden
1989–2013 (1989–1997, 1997–2013)	Job control, autonomy; psychosocial job demands; social support at work from supervisors; skill use opportunities; job strain	Self-reported data	Sweden
n.s.	*Dusts and fibres*: asbestos; man-made mineral fibres; quartz; stone and concrete; animal dust; flour dust; plant dust; pulp or paper dust; synthetic polymer dust; textile dust; wood dust (hardwood); wood dust (softwood); wood dust (n.s.); leather dust *Solvents*: gasoline; aliphatic and alicyclic hydrocarbon solvents (n.s.); benzene; styrene and styrene oxide; toluene; aromatic solvents (n.s.); methylene chloride; perchloroethylene; trichloroethylene; chlorinated hydrocarbon solvents (n.s.); formaldehyde *Pesticides*: fungicides; herbicides; insecticides *Metals*: arsenic; cadmium; chromium; iron; lead; nickel *Other chemicals*: carbon monoxide; detergents; diesel engine exhaust; gasoline engine exhaust; isocyanates; synthetic metal processing or drilling oils or fluids; benzo(a)pyrene; bitumen fumes; PAHs (n.s.); sulphur dioxide and trioxide; welding fumes (n.s.)	Expert assessment Direct measurements FIN-JEM	Sweden
1960–2010 (1-year intervals)	*Dusts and fibres*: asbestos; quartz *Metals*: chromium VI; nickel *Other chemicals*: benzo(a)pyrene	Direct measurements DOM-JEM	Europe, Canada
n.s.	Pesticides (n.s.)	Self-reported data	North America
1978–2004 (1-year intervals)	Wood dust (n.s.)	Expert assessment Direct measurements	Europe

Table 2. Meta-data on the 29 occupational coding systems in OMEGA-NET inventory by August 2021.

System name	Version year	Country/region	Related coding system	Crosswalk available to related system/version	Semi-automated coding
CH-ISCO-19	2019	Switzerland	SSCO 2000	No	
CITP-08	2008	France	ISCO-08	Yes	
CNO-94	1994	Spain	ISCO-88	Yes	
CNO-11	2011	Spain	ISCO-08	Yes	
DISCO-88	1996	Denmark	ISCO-88	Yes	
DISCO-08	2010	Denmark	ISCO-08	Yes	
FOB 80	1980	Sweden	ISCO-58	Yes	
ISCO-58	1958	International		Yes	
ISCO-68	1968	International		Yes	CAPS
ISCO-88	1988	International		Yes	CAPS
ISCO-08	2008	International		Yes	CAPS
NOC 2006	2006	Canada		Yes	
NOC 2011	2011	Canada		Yes	CAPS
NOC 2016	2016	Canada		Yes	
NUP06	2006	Italy	ISCO-88	Yes	
NYK83	1983	Sweden	FOB80	Yes	
PCS	2003	France		No	SICORE
SBC 1992	1992	Netherlands	ISCO-88	Yes	
SSCO 2000	2000	Switzerland	CH-ISCO-19	No	
SSYK 1996	1996	Sweden	ISCO-88	Yes	
SSYK 2012	2014	Sweden		Yes	
STYRK-08	2011	Norway	ISCO-08	Yes	
UK SOC 1990	1990	United Kingdom		Yes	CASCOT
UK SOC 2000	2000	United Kingdom		Yes	OSCAR
UK SOC 2010	2010	United Kingdom		Yes	CASCOT
UK SOC 2020	2020	United Kingdom		Yes	CASCOT
US SOC 2000	2000	United States		Yes	
US SOC 2010	2010	United States		Yes	SOCcer
US SOC 2018	2018	United States		Yes	O*Net

CAPS: https://ssl3.isped.u-bordeaux2.fr/CAPS-CA/Langue.aspx; CASCOT: https://warwick.ac.uk/fac/soc/ier/software/cascot/; O*Net: https://www.onetonline.org/; OSCAR: https://pubmed.ncbi.nlm.nih.gov/27973677/; SICORE: https://www.census.gov/prod/2/gen/96arc/ixbschuh.pdf; SOCcer: https://doi.org/10.1136/oemed-2015-103152.

inventory was largely dependent on the person(s) responsible for each tool to enter meta-data in the online system. This approach ensured the relevant information was collected as accurately as possible. Particularly for older exposure assessment tools, institutional knowledge may be lost if the responsible persons are no longer active in the research area. We, therefore, focussed on more recent and currently cited exposure tools, which we also considered to be most relevant. The downside of this dependency on individual researchers was that not all identified exposure tools have been included. For example, meta-data on a major national exposure database [i.e. MEGA from Germany (Gabriel *et al.*, 2010)] were not entered by August 2021.

We further focussed our efforts on collecting information on JEMs and databases that are active and could potentially be used in the exposure assessment of general population cohorts. Hence, tools that were highly specific for one type of occupation or one study population were not our main priority. For example, although we know there are many exposure measurements collected in specific industries (Peters *et al.*, 2012), we did not actively approach their database custodians, as many such databases are not available for use outside their intended scope [e.g. the Dust Monitoring Program of the European Industrial Minerals Association (Zilaout *et al.*, 2017)]. There were also JEMs developed for one specific population, e.g. the Matex-JEM that was specifically developed for one company, using its internal job classification, and as such is not applicable to other settings (Imbernon *et al.*, 1991).

Furthermore, we initially focussed on European tools, fitting with the initial objectives of OMEGA-NET. However, the inventory and its website remain open for new entries and a more global coverage would certainly be preferable to support the broader objectives to promote collaborative and harmonized research in the area of occupational epidemiology.

To have an easy entry point into finding these important exposure tools was one of the goals of OMEGA-NET. Therefore, all collected meta-data on exposure assessment tools have been made publicly available via a searchable web-based database (https://occupationalexposuretools.net/inventory/). With this effort we have brought together a wealth of information on available exposure assessment tools, that will aid the exposure assessment process in many occupational cohorts.

Supplementary Data

Supplementary data are available at *Annals of Work Exposures and Health* online.

Funding

This publication is based upon work from COST Action CA16216 (OMEGA-NET), supported by COST (European Cooperation in Science and Technology). MCT is funded by a Ramón y Cajal fellowship (RYC-2017-01892) from the Spanish Ministry of Science, Innovation and Universities and co-funded by the European Social Fund. ISGlobal acknowledges support from the Spanish Ministry of Science and Innovation through the 'Centro de Excelencia Severo Ochoa 2019-2023' Program (CEX2018-000806-S), and support from the Generalitat de Catalunya through the CERCA Program.

Acknowledgements

We are grateful to all researchers who provided data on exposure assessment tools for the online inventory, in particular Irina Guseva Canu (Institute for Work and Health, Lausanne, Switzerland), Svetlana Solovieva (Finnish Institute of Occupational Health, Helsinki, Finland), and Seckin Boz (Swiss Tropical and Public Health Institute, Basel, Switzerland), and the OMEGA-NET Working Group 2.1 members: Balázs Ádám, Inge Brosbøl Iversen, Alex Burdorf, Annett Dalbøge, Deborah Glass, Lode Godderis, Marcel Goldberg, Signe Hjuler Boudigaard, Sibel Kiran, Damien McElvenny, Marilia Silva Paulo, Milena Petrović, Milena Popovic Samardzic, Nurka Pranjic, Vivi Schlünssen, Henk van der Molen, and Susana Viegas. All authors contributed substantially to the work and approved the final version of the manuscript. They also agree to take responsibility for the work.

Conflict of interest

None declared.

Data availability

The data were derived from sources in the public domain: https://occupationalexposuretools.net/inventory/.

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