European Agency for Safety and Health at Work

Occupational cancer risk factors in Europe – summary of the methodology of the Workers' Exposure Survey

European Agency for Safety and Health at Work

1 Introduction to the survey

1.1 Why EU-OSHA conducted this survey

The European Agency for Safety and Health at Work (EU-OSHA) has conducted a large worker survey, the *Workers' Exposure Survey on cancer risk factors in Europe (WES),* in six EU Member States: Germany, Ireland, Spain, France, Hungary and Finland.

This survey is the first of its kind in Europe, and it provides information on probable exposure of workers during the last working week to several known cancer risk factors, both chemical and physical. Detailed information on the specific circumstances of exposure across jobs and the preventive and protective measures applied at work (including personal protective equipment) was also collected. A selection of demographic data supports the identification of exposed worker groups.

The main goal of WES is to provide reliable and informative data on workers' exposure that is complementary to the existing data sources in the EU, such as workplace measurements or job-exposure matrices. WES results will provide additional valuable data in the context of future amendment proposals to the carcinogens, mutagens or reprotoxic substances at work directive (CMRD)[1] and thereby contribute to the fight against work-related cancer. Updated information on occupational exposures to selected cancer risk factors, comparable across countries, will also support one of the key objectives of the EU Strategic Framework on Health and Safety at Work 2021-2027 on improving the prevention of work-related diseases, in particular cancer, and will contribute to Europe's Beating Cancer Plan and the EU Roadmap on Carcinogens initiative.

WES is a cross-sectional survey providing a picture of the probability of workers' exposure to selected cancer risk factors at a given time point, and it should not be used to establish causal relations with current cancer outcomes. WES data should contribute to increasing awareness of cancer risks at the workplace and to a better understanding of where these exposures may occur, enhancing prevention and risk management across the EU.

1.2 Background of the survey

1.2.1 Australian Work Exposures Study

WES is based on the Australian Work Exposures Study (AWES), a telephone survey developed and conducted in Australia in 2011-2012 that explored the prevalence of occupational exposure to known or probable carcinogens and focused on those most relevant to Australian working conditions at that time.[2] More recently, a similar worker survey has been implemented in New Zealand.[3]

1.2.2 Specific sets of questions: job and task modules

The survey questionnaire is operationally divided into 50 job modules and 41 task modules, which include questions developed to assess potential exposure of workers to the selected cancer risk factors. Job modules contain questions about what the worker does in a particular job or occupation (e.g. driver, health professional). Task modules are sets of questions that relate to a specific work-related activity or process (e.g. welding or unloading vehicles), which might be carried out or applied in different jobs (for example, welding could be done by farmers, construction workers or foundry workers). Therefore, the same task module is often asked to workers in different occupations. The survey covers all types of occupations in Europe, and it includes questions on the tasks (or task modules) that are relevant for each job module.

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[1] Directive 2004/37/EC. See: https://eur-lex.europa.eu/eli/dir/2004/37

[2] Carey, R. N., Driscoll, T. R., Peters, S., Glass, D. C., Reid, A., Benke, G., & Fritschi, L. (2014). Estimated prevalence of exposure to occupational carcinogens in Australia (2011–2012). *Occupational and Environmental Medicine*, 71(1), 55-62. http://dx.doi.org/10.1136/oemed-2013-101651

[3] WorkSafe New Zealand (2023), New Zealand Carcinogens Survey 2021 – Overview. See: https://www.worksafe.govt.nz/research/new-zealand-carcinogens-survey-2021/

The total interview duration and the final set of questions differ for each worker, as they depend on the job and the specific tasks carried out in the last working week.

1.2.3 OccIDEAS and exposure assessment

WES uses an existing software developed by researchers in Australia, the Occupational Integrated Database Exposure Assessment System (OccIDEAS[4]), previously used in AWES and in the New Zealand Carcinogens Survey. OccIDEAS relies on the ability of workers to accurately describe what they do, and it estimates exposure by linking this factual information with the available evidence regarding exposures to cancer risk factors resulting from specific work tasks.

OccIDEAS has been customised for WES in terms of the questions posed to the workers and the rules underlying the assessment of the probability of exposure, to be relevant to the EU context.

Workers reply to detailed and targeted questions about their work, and the tool provides a personalised, automatic assessment of exposure to the risk factors considered in the survey, using rules that have been defined on the basis of the scientific evidence from the literature and expert assessment. A list of bibliographic references that supported the exposure assessment of WES and the definition of rules is published separately.

Estimation of exposure is provided in terms of probability of exposure to the cancer risk factors. Probable exposure in WES is further divided into three categories that are approximately related to EU occupational exposure limits (OELs) for the chemical risk factors considered, and are defined as:

- *Probable exposure at a high level* – exposure at or around the OEL;
- *Probable exposure at a medium level* – exposure between about 10% and 80% of the OEL; and
- *Probable exposure at a low level* – exposure that is higher than the general community, but less than about 10% of the OEL.

This working definition is based on the EU OELs set in the CMRD and its various amendments,[5] in the asbestos at work directive,[6] or in occupational dose limits set in other pertinent directives (e.g. ionising radiation directive[7]).

Exposure probability for a given worker is the result of combining information on all tasks performed at work during the last working week, and it can also consider the existence of ventilation, the use of respiratory protection, and other contextual information collected in the interview (distance from the source, indoor or outdoor location, etc.). When exposure to a risk factor occurs via different tasks for a given worker, the overall higher exposure level will be considered for this person.

Since levels of exposure estimated in the survey are not based on direct workplace measurements, the exposure assessment provided by WES should be regarded as indicative of exposure intensity.

2 How EU-OSHA conducted this survey: WES methodology

The work leading to the implementation of WES, coordinated by EU-OSHA, started in 2017 with a feasibility study,[8] and it has involved the contributions of different actors.

EU-OSHA has closely collaborated with the original developers of OccIDEAS and the survey concept (Data Scientists Ltd, from Australia). National teams of experts from the six countries were contracted to support with the content and language adaptation of the survey and to review exposure assessments in the EU context, as described in section 2.1.2. Ipsos (and sub-contractor cApStAn) worked on the

[4] See: https://www.occideas.org/
[5] Directive 2004/37/EC. See: https://eur-lex.europa.eu/eli/dir/2004/37
[6] Directive 2009/148/EC. See: https://eur-lex.europa.eu/eli/dir/2009/148
[7] Directive 2013/59/Euratom. See: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32013L0059
[8] EU-OSHA: Feasibility study on the development of a computer-assisted telephone survey to estimate workers' exposure to carcinogens in the European Union

adaptation and translation of the survey questionnaire into the six EU languages, as well as on all the steps leading to the effective survey implementation in the field.

EU-OSHA established and regularly consulted two advisory groups to provide technical and strategic input during the entire process: one with leading scientists in the areas of workplace exposure assessment, occupational hygiene or worker surveys (WES Expert Group[9]); and the other including representatives of workers, employers and government, and the European Commission (WES Advisory Group[10]).

2.1 Adaptation of the survey to the EU context

2.1.1 Cancer risk factors included in WES

WES includes exposure assessment for 24 cancer risk factors relevant in the EU context, including chemical and physical agents, that were selected based on several criteria, and in consultation with stakeholders and independent experts.

Table 1: List of cancer risk factors considered in WES

1,3-butadiene	Acrylamide	Arsenic	Asbestos	Benzene	Cadmium
Chromium VI	Cobalt	Diesel engine exhaust emissions	Diethyl/ dimethyl sulphate	Epichlorohydrin	Ethylene oxide
Formaldehyde	Lead and inorganic compounds	Leather dust	Mineral oils (as mists)	Nickel	Ortho-toluidine
Ionising radiation	Artificial ultraviolet radiation (including ocular UV)	Solar ultraviolet radiation (including ocular UV)	Respirable crystalline silica	Trichloroethylene	Wood dust

Briefly, inclusion of cancer risk factors in WES was based on the following criteria:

- The risk factor was already included in OccIDEAS; the tool had previously been used to assess exposure to that cancer risk factor.
- The risk factor was classified in group 1 or 2A (human carcinogens or probably carcinogens) by the International Agency for Research on Cancer Monographs.[11]
- For chemical substance/mixture, including if process-generated:
  - it meets the criteria for classification as a category 1A or 1B carcinogen set out in Annex I to the Classification, Labelling and Packaging (CLP) EU Regulation;[12] and
  - it is addressed in the CMRD or in one of the planned or adopted amendments.

Additional considerations in the process were:

- the risk factor causes relevant occupational exposures across occupations and sectors in the EU (for example, exposure to diesel engine exhaust emissions may occur in many jobs where vehicles are used); and
- the potential number of workers exposed, where such information was available.[13]

[9] The expert group includes Vida Beresneviciute (EU agency for Fundamental Rights), Agnès Parent-Thirion (Eurofound), Lesley Rushton (Imperial College London), Kurt Straif (IARC, ISGlobal), Jukka Takala (ICOH), the Head of department 'Working conditions and health' from the French Dares, and a statistician from the Education, health and social protection unit (Eurostat).

[10] For the composition of the group, see: https://osha.europa.eu/en/about-eu-osha/governance-eu-osha/composition-advisory-groups

[11] See: https://monographs.iarc.who.int/

[12] Regulation (EC) 1272/2008. See: https://eur-lex.europa.eu/eli/reg/2008/1272/2023-04-20

[13] Detailed information on all the cancer risk factors included in WES, providing details on their classification and legislation at the time of the survey development, will be published separately.

2.1.2 The national teams and their tasks

The adaptation process of the original Australian survey to the EU context has been a key step in the process of implementing WES. This work involved six teams of experts in occupational hygiene and cancer epidemiology, exposure assessment, and occupational safety and health legislation from the six EU countries where the survey was conducted[14] with a good knowledge of the exposure situation in their countries.

The adaptation with national experts was initiated in December 2020 and finalised end of 2021, and it was overseen at all stages by EU-OSHA. National experts were initially trained on the OccIDEAS tool and the questionnaire.

The expert teams were involved in:

- Developing a high-quality adaptation of the existing questionnaire. This included assessing and providing justified opinions, comments and suggestions for new or reworded questions in the existing job and task modules, including changes in exposure assessment rules and provision of supporting evidence (literature, results of measurements at national level, etc.).
- Proposing and developing new sets of questions or modules to ensure coverage of all relevant sectors and occupations where workers could be exposed in Europe, and defining the related exposure assessment rules.
- Providing expert feedback on the translation to their national languages of technical terms included in the survey (supported by an English glossary of terms), as well as on the language version of the job and task modules after translation.

2.1.3 Summary of main outcomes of the adaptation of the survey

Many of the questions and corresponding exposure assessment rules remained unchanged. However, the survey needed to be adapted to the European context to reflect exposures in sectors or activities that were not considered relevant in Australia. Questions that were deemed irrelevant to Europe were removed from the survey, for example those related to substances with legal restrictions or authorisations of use in the EU.

EU-OSHA and the experts fully revised exposure assessment rules for all the included cancer risk factors, also considering exposure in specific work settings like unventilated or confined spaces. As an example, the assessment rules were adapted for potential exposure to benzene occurring in different tasks, such as metal coating or plating, shoe or textile industry, cleaning tanks, working near generators and so on, to account for EU restrictions on benzene under REACH and its subsequent amendments.[15,16]

The job module on industrial manufacturing was adapted to include the production of medical devices or wooden products (wooden boards, furniture, paper pulp, etc.). New questions were included in relation to circumstances not considered in Australia but relevant in Europe, for example on the use of dosimetry badges for air transport or nuclear energy sector workers, or the mining of slate. The list of reflective surfaces that can enhance solar UV exposure was extended to include snow, and the potential for ocular exposure to UV radiation from reflection (by snow, water, sand) was re-evaluated. Exposure assessment to mineral oils was fully reviewed for the EU context across the entire questionnaire, considering that most uses in the EU are limited to highly refined mineral oils.

[14] EU-OSHA contracted the Irish Occupational Hygiene Consultants (IOHC) in Ireland, ISGlobal in Spain, ALCIMED in France, NKK in Hungary, and FIOH in Finland. EU-OSHA signed a collaboration agreement with the Federal Institute for Occupational Safety and Health (BAuA) in Germany.

[15] Regulation (EC) 1907/2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH). See: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32006R1907

[16] Annex XVII to REACH – Conditions of restriction (related to benzene). See: https://echa.europa.eu/documents/10162/7c8cf4ac-baf9-a05a-2cc7-c9bca4a9d5b7

The original task module on removal of asbestos and asbestos-containing products was adapted to reflect the asbestos removal work requirements and procedures in Europe, such as working in an enclosure under negative pressure, the presence of a decontamination unit on site and specific training for workers. Questions regarding occasional exposure to asbestos arising from non-intended removal of asbestos-containing material during repair or maintenance tasks were also added.

The national experts developed two entirely new modules for WES, covering important economic activities that were not relevant to the Australian context:

- a job module on manufacturing of chemical products (including fertilisers, pesticides, paints, adhesives, dyes and inks) and pharmaceutical products; and
- a task module on nuclear energy production and nuclear waste management, covering, for instance, the use of specific radio-protective garments and dosimetry badges.

Finally, the experts harmonised all the questions across the survey on the use of preventive measures following the hierarchy of control measures at the workplace (from working in closed systems to technical measures such as local exhaust ventilation and, lastly, the use of respiratory and other protective equipment), and they systematically included them across the job and task modules, where relevant.

2.2 Making the survey fit for purpose

2.2.1 Glossary of technical terms

The questionnaire contains technical terms and expressions as well as many abbreviations or acronyms. More than 900 technical terms were included in a technical glossary developed by EU-OSHA that provided an English definition of the term or expression as used in the specific work context. This glossary supported the correct translation of terms into the survey languages. The national experts reviewed the content of the glossary and provided advice regarding its translation, ensuring that the terms most familiar to workers in the specific job were used. This process improved the next steps of the development of the survey and consequently the quality and informative value of the interviews.

2.2.2 Translatability assessment and pretesting

Ipsos and cApStAn conducted a translatability assessment in the first half of 2021. They collected feedback from a pool of linguists, representing four different language groups (Germanic, Romance, Slavic and Uralic), who reviewed the draft version of the questionnaire, identified potential translation, adaptation or cultural issues, and provided recommendations for alternative wording and proposals for translations. Based on this feedback, EU-OSHA decided which of the suggestions or recommendations had to be incorporated into the English source questionnaire.

Ipsos conducted a cognitive pretest in two selected countries, Ireland and Hungary. A total of 20 in-depth interviews were conducted per country, targeting 14 job modules that had previously been identified as being particularly complex in terms of wording, or that were likely to identify high exposures. This pretesting aimed at assessing clarity and understandability of the questionnaire. Overall, only minor adjustments to the questionnaire were needed as most of the tested questions were clearly understood by respondents.

2.2.3 Translation to national languages

Ipsos and cApStAn applied the Translation, Review, Adjudication, Pretesting, and Documentation (TRAPD) approach for the translation of the survey questionnaire into the five national languages. For Ireland, the English version was slightly adapted to the national terminology.

TRAPD involves multiple stages of review and editing, including a review step by a third expert translator, to ensure a very high level of accuracy and quality of two independent translations. The entire translation process lasted six months, resulting in six comparable and harmonised language versions of the questionnaire that address national language peculiarities and differences in job-related terminology. All the language versions of the WES questionnaire will be made available by EU-OSHA.

2.2.4 Piloting the adapted WES

A pilot of WES was conducted between March and May 2022[17] to test exposure assessment and questionnaire performance (particularly of the newly developed modules), the technical set-up, interviewer performance, sampling and contacting procedures, data quality, the online mode of the survey, and the coding of occupation into ISCO-08[18] and activity sector into NACE.[19]

Trained interviewers conducted 213 telephone interviews on average in each country, in their national languages. In total, 49 job modules were tested. The interviews lasted on average 16 minutes, with screening time (obtention of consent, demographics, and correct job module allocation) taking three to four minutes. A generic job module (non-specific) was attributed to 9% of the respondents.

Based on the information obtained from the pilot, a few changes were implemented to shorten the interview length, increase the clarity of the questions, reduce free-text answers, improve the correct allocation of job modules (including minimising the use of the non-specific job module), and refine exposure assessment (i.e. reviewing some rules).

2.3 Implementing the survey

2.3.1 Survey population and sampling strategy

The survey population includes individuals working in all sectors of economic activity[20] during the week preceding the interview, aged 15 years or more, and whose usual place of residence and employment is in the territory of the country where the survey takes place.

Ipsos used a random digit dialling strategy targeting only mobile phones, which are shown to be used by 97-99% of the working population across the six countries included in the survey.[21] An EU-OSHA feasibility study signalled that using mobile phones can enhance the participation of young people and migrant workers – groups that tend to be underrepresented in telephone surveys.[22]

Ipsos designed a sampling strategy that over-sampled occupations with an expected higher risk of exposure to the selected cancer risk factors, and under-sampled the occupations with an expected lower risk (e.g. office workers). In other words, samples were drawn according to a disproportional sample design, which was later redressed by weighting. Ipsos aimed at obtaining robust survey estimates that allow for a more granular analysis of the results.

2.3.2 Fieldwork

The survey fieldwork lasted approximately 20 weeks from September 2022 to February 2023, through local fieldwork agencies, each involving a coordinator, experienced supervisors and a team of interviewers. In total, more than 390 interviewers were involved. Detailed fieldwork reports supported daily monitoring of the sample/interviewer performance for the six participating countries.

Both managers/supervisors and field interviewers were trained specifically to administer the survey. Online trainings included theoretical background on the survey, self-practice with a focus on job allocation using interactive self-assessment tools (e.g. role play, quizzes), and specific challenging examples; and sample interviews were provided and discussed. Additional training materials were developed in the six national languages, including a fieldwork manual. Interviewers were retrained again

[17] Vilahur, N., Cavet, M., Irastorza, X., & Schneider, E. (2023). O-77 Implementation of the workers' exposure survey to assess workplace exposures to cancer risk factors in Europe: Pilot study. *Occupational and Environmental Medicine*, 80 (Suppl. 1), A86-A87. https://oem.bmj.com/content/80/Suppl_1/A86.2

[18] See: International Standard Classification of Occupations: ISCO-08, 2012, International Labour Office, Geneva. https://www.ilo.org/global/publications/ilo-bookstore/order-online/books/WCMS_172572/lang--en/index.htm

[19] NACE Rev. 2 – Statistical classification of economic activities in the European Community, *Eurostat Methodologies and Working papers*, 2008, Office for Official Publications of the European Communities, Luxembourg. https://ec.europa.eu/eurostat/documents/3859598/5902521/KS-RA-07-015-EN.PDF

[20] Except in private households (NACE T), extraterritorial organisations (NACE U) and armed forces (ISCO sector 0).

[21] According to the Standard Eurobarometer 92 – Autumn 2019. See: https://europa.eu/eurobarometer/surveys/detail/2255

[22] See EU-OSHA: Feasibility study on the development of a computer-assisted telephone survey to estimate workers' exposure to carcinogens in the European Union

during the fieldwork period, to optimise and maintain the quality of the interviews, in particular the correct job module allocation.

In addition to sets of specific questions addressing daily tasks at work (job and task modules), the interviewers collected information on demographics and job characteristics of the respondents: gender, age, country of birth, occupation, type of contract, workplace size and sector of activity, professional status and weekly working hours.

Response rates ranged between 7% in Ireland and 22% in Finland. The main reason for non-response was refusal, with refusal rates ranging from 54% in Ireland to 34% in Spain and Finland. Regarding the online mode, fewer than 20 interviews were considered complete and valid.

2.3.3 Data quality control, data coding and weighting

The data collected for the survey were subject to several technical controls (e.g. accuracy of final scripts before the start of fieldwork), response quality and consistency checks. In most of the cases where an interview was flagged for further quality control, the allocation of the job module needed to be reviewed, since incorrectly assigned job modules lead to shorter interviews with a higher number of 'non-response' or 'don't know' answers.

After completion of fieldwork and data quality control, a total of 24,402 valid interviews were obtained.

During the interviews, respondents provided information regarding occupation and economic activity via open-ended questions. The recorded answer was manually coded into 3-digit ISCO-08 and 2-digit NACE classifications respectively. The team of coders were trained in March 2022 before the pilot of the survey, and they received an additional briefing in October 2022 before starting the coding of data from the main fieldwork. Additionally, a triple coding process was conducted for 10% of the sample (two independent coders, and a final review done by a third coder), with coding agreement reaching 90% or more of the cases.

As part of the weighting approach, Ipsos carried out the following additional steps to account for:

- Ownership of mobile phones: Most of the working population in the EU uses one mobile phone/SIM card. However, persons owning multiple phone numbers have potentially more chances of being contacted. Design weights were applied to create an unbiased sample in terms of probability of inclusion based on information about mobile ownership.
- Socio-demographic structure: In order to ensure that the sample accurately reflected the socio-demographic structure of the target population, a calibration weighting procedure using random iterative weighting was carried out on a country-by-country basis, by aligning the sample and population to a set of key variables for which population statistics are known (age by gender, ISCO and NACE and contract type within professional status) based on the EU Labour Force Survey 2021 annual population proportions.
- Cross-country analysis: As a final step, weights were created to facilitate cross-country analysis and to account for the total working population in each country covered by the survey.

The WES dataset, including the final assessment of exposure to the 24 cancer risk factors and demographic and job-related information for all respondents, will be made publicly available for research purposes in 2024.

Authors: Nadia Vilahur, Marine Cavet, Xabier Irastorza, Elke Schneider, European Agency for Safety and Health at Work (EU-OSHA)