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SCIENTIFIC REPORT

Occupational exposures of women to chemical substances: Improvement of an existing job exposure matrix to provide sex-specific estimations of exposure

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R-1190-en

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Bibliothèque et Archives nationales du Québec, 2024
ISBN 978-2-89797-285-1 (PDF)

IRSST – Communications Department
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ACKNOWLEDGEMENTS

Exposure assessment was conducted by Robert Bourbonnais and Mounia Rhazi, under the supervision of Vikki Ho and Jérôme Lavoué, after initial planification meetings with the entire research team. Dora Rodriguez was responsible for job coding and along with Louise Nadon provided advice and aid. Daniel Margulius assisted in the creation of a tool to compare occupational exposures among women and men holding the same jobs. Romain Pasquet, Patrick Belisle, and Chelsea Almadin participated in the analysis of the data.

We are grateful to two leading researchers who allowed us to use data from their case-control studies: Mark S. Goldberg, affiliated with the Department of Medicine at McGill University and France Labrèche, affiliated with the École de santé publique at the Université de Montréal and with the Institut de recherche Robert-Sauvé en santé et en sécurité du travail (IRSST) du Québec.

This study was funded by the Institut de recherche Robert-Sauvé en santé et en sécurité du travail (IRSST).

Vikki Ho holds a Sex and Gender Science Chair in Cancer Research from the Canadian Institutes for Health Research. During the conduct of this work, she was supported by the Cancer Research Society, the Fonds de recherche du Québec — Santé and the ministère de l'Économie, de la Science et de l'Innovation du Québec. Currently, Vikki Ho is the recipient of a Research Scholar J2 Award from the Fonds de recherche du Québec – Santé.

SUMMARY

It has been recognized that women and men have different occupational profiles which may, therefore, translate into different occupational disease risks. Yet, most of our current understanding of occupational diseases stems from evidence accumulated from studies conducted in men. Meanwhile, women currently represent 48% of the labour force in Québec. Women's health in the workplace continues to be an under-studied area and we are hindered particularly by the lack of understanding of how gender impacts workplace exposures. There is evidence that task assignments and working conditions may differ even when women and men have the same occupations. These different task assignments may translate into different exposures to toxic chemicals, ergonomic demands, risk of accidents, and psychosocial stressors. Whereas biological differences between women and men may be an underlying causal factor in the etiology of diseases, the consideration of gender differences in exposure assessment remains a challenge in occupational health research given the lack of existing tools that capture gender differences.

In the context of exposures occurring in the past or over a long period of time, expert assessment is superior to self-reported exposures since experts can account for the time period of exposure, local peculiarities of production processes or materials used, as well as particular tasks performed by the subject. Nevertheless, expert assessment remains costly in terms of resource time and thus, several prominent researchers have advocated for the use of job exposure matrices (JEMs). In particular, JEMs built from data derived from expert assessments have been proposed as a cost-efficient alternative to expert assessment. Such a database, known as the Canadian Job Exposure Matrix (CANJEM) was constructed by Drs. Jérôme Lavoué and Jack Siemiatycki from the exposure information obtained within four case-control studies conducted in Montréal between 1979 and 2004, that included over 12,000 subjects (over 30,000 jobs) wherein the majority of study subjects were men.

The improvement of CANJEM estimations of chemical and physical exposures of women in the workplace was one important objective of this project. To this end, expert assessment of the occupational histories of women in the Montréal Breast Cancer Case-Control Study from 2008 to 2011, directed by Mark S. Goldberg and France Labrèche, was employed. A team of trained chemists and industrial hygienists reviewed occupational histories to assign standardized occupation and industry codes, and exposures for each occupation held. Adding this enhanced data to CANJEM, our study aimed to discern whether occupational exposures differ between women and men holding the same jobs. In order to evaluate possible differences in exposure, sex-specific JEMs were developed to compare the frequency of occupations and the prevalence of agents between sexes. Then, the agreement of exposure metrics of the probability, frequency, intensity, and frequency-weighted intensity of exposure between each JEM was calculated. Hierarchical

Bayesian models were then created to estimate notable differences between corresponding female- and male-specific JEMs based on the probability of exposure. Lastly, from the enhanced information in CANJEM, we derived estimates of the prevalence of exposure to 258 workplace agents among Montréal women.

Experts conducted assessments of 4,362 job descriptions from lifetime occupational histories provided by women in the Montréal Breast Cancer Case-Control Study. Upon comparison of sex-specific JEMs, the frequency of occupations differed between sexes regardlesss of whether all occupations in each separate JEM or occupations common to both JEMs were examined. Furthermore, the prevalence of agents in each JEM differed, with few overlapping across the most prevalent agents. It was observed that occupations common to both women and men revealed moderate agreement in the probability, frequency, intensity, and frequency-weighted intensity of exposure to CANJEM agents. Occupations held by women were frequently exposed to organic solvents, cleaning agents, and aliphatic aldehydes while occupations held by men were frequently exposed to PAHs (from any source and from petroleum specifically), organic solvents, and carbon monoxide.

From Hierarchical Bayesian analyses, we observed that agent-occupation combinations (using a 5-digit ISCO-68 job code resolution) among men had higher probabilities of exposure to CANJEM agents relative to women in one time period (1933-2011). Among commonly held occupations, different agents in which either women or men had higher probabilities of exposure were observed. Women working in farming had higher probabilities of exposure to a greater number of agents than men. Female *Farm Workers (General)* had notably higher probabilities of exposure to six agents while male *Farm Workers (General)* had two agents for which their probabilities of exposure were higher than females. In comparison, men had higher probabilities of exposure to agents in occupations such as labourers and salespersons. Men holding the occupational title of *Manager, Retail Trade* had significantly higher probabilities of exposure across 16 agents relative to three that were higher in women. In general, notable difference analyses illustrated that women in the workforce had more significantly higher probabilities of exposure to cleaning agents, fabric dust, and ozone while men had more significantly higher probabilities of exposure to PAHs (from any source or from petroleum), carbon monoxide, and lead.

One of the key gaps limiting further understanding of gender differences in occupational exposure is the paucity of reliable information about exposures incurred by women. From the enhancement of CANJEM with the addition of more occupations held by females, occupational titles frequently held by Montréal women and the prevalent exposures incurred in the workplace from 1933 to 2011 were identified. The most frequently held jobs among women tended to be in the textile and production, health care, and service industries. Meanwhile, organic solvents, cleaning agents, and ozone were the most prevalent agents that working women were exposed to. Interestingly, Montréal women were exposed only to 196 CANJEM agents out of 258 and thus, 62 CANJEM agents were not listed in any occupations held by women.

Our findings will assist in the improvement of the ability of CANJEM to evaluate workplace exposures in women. Given the limited data that exists on the relationship between sex and/or gender and exposure, the validity of applying exposure assessment tools developed from information collected from men (or primarily from men) to studies in women is unknown. Our results add to previous findings of industry segregation between women and men in that it is observed that exposure profiles may also differ within the same occupational group due to differences in assigned tasks. Upon observing such exposure differences between women and men across agent-occupation combinations, it is evident that further efforts must be made to incorporate exposure information of female workers into JEMs and that a female JEM may be needed to accurately estimate exposures for certain workplaces. Ultimately, it is clear that we must develop tools whereby we can equitably monitor and inform the safety and health of female workers.

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LIST OF ACRONYMS AND ABBREVIATIONS

BCS1:	Breast Cancer Study 1
BCS2:	Breast Cancer Study 2
BNCS:	Brain Cancer Study
CANJEM:	Canadian Job Exposure Matrix
CCDO:	Canadian Classification and Dictionary of Occupations
CrI:	Credible interval
ECDF:	Empirical cumulative distribution frequency
FINJEM:	Finnish Job Exposure Matrix
FWI:	Frequency-weighted intensity
ICC:	Intraclass correlation coefficient
ISCO-68:	1968 International Standard Classification of Occupations
ISIC:	International Standard Industrial Classification of all Economic Activities
JEM:	Job Exposure Matrix
LCS:	Lung Cancer Study
LCL:	Lower credible limit
MAH:	Monocyclic aromatic hydrocarbon
MCS:	Multisite Cancer Study
NAICS2012:	2012 North American Industry Classification System
NOC2011:	2011 National Occupation Classification
PAH:	Polycyclic aromatic hydrocarbon
SIC80:	1980 Standard Industrial Classification System
SOC2010:	2010 Standard Occupational Classification System
UCL:	Upper credible limit

INTRODUCTION

The occupational health and safety issue

It has increasingly been recognized that women and men have different occupational profiles which may, therefore, translate into different occupational disease risks. However, although women currently represent 48% of the labour force in Québec, most of our current understanding of occupational diseases stems from evidence accumulated from studies conducted in men (Messing et al., 2003). Women's health in the workplace continues to be an under-studied area, though initiatives set by Canadian granting agencies, such as the consideration of sex and/or gender differences in all research proposals submitted to the Canadian Institutes of Health Research, are slowly bridging the gap in knowledge.

In occupational health, we are hindered particularly by the lack of understanding of how sex and gender impacts workplace exposures. Biological (i.e., sex) differences may account, in part, for varying rates of occupational disease in women versus men given the same exposure (Messing et al., 2003). While gender differences in occupational diseases and injuries could be attributable to the different occupations held by women and men (Messing et al., 2003). There is also evidence that task assignments and working conditions may differ even when women and men hold jobs with the same occupation titles (Messing et al., 2003). These different task assignments may translate into different exposures to toxic chemicals, ergonomic demands, risk of accidents, and psychosocial stressors (Messing et al., 2003). Whereas biological differences between women and men may be an underlying causal factor in the etiology of diseases, gender differences in exposure are an important element that may challenge the validity of occupational exposure assessment methods used commonly in occupational health research and surveillance.

Gender differences in workplace hazards

Sex and gender differences are two interrelated concepts. Sex refers to a set of biological attributes whereas gender is comprised of the social, environmental, cultural, and behavioural factors and choices that influence a person's self-identity (Canadian Institute of Health Research [CIHR], 2019; Clayton & Tannenbaum, 2016). In this project, sex (e.g. female, male) was used to distinguish women from men as our database collected only information on sex in relation to job title. However, as tasks assigned in occupations, relationships, behaviour, power, and other social differences are often gendered and this will affect the exposures incurred, our interpretation of sex differences, in the introduction and discussion, introduces the notion of gender. The predisposition to develop a health problem and the occurrence of occupational injuries varies by sex (Barmby et al., 2002; Buchanan et al., 2010; Taiwo et al., 2009). These trends are observed in Québec, in

Canada, and elsewhere. In Québec, women generally receive higher average durations of compensation due to a higher frequency/severity rate of occupational injuries relative to men in the same occupational category, thus a preponderance of various occupational injuries continues to disproportionately affect women (Duguay et al., 2012).

If occupational risks differ by sex, the reasons for the difference are rarely investigated. One literature review that explored biases in exposure assessment reported that differences in work and task assignments occurred even when women and men have the same occupational titles (Kennedy & Koehoorn, 2003). Cherry et al. (2018) supported these findings and reported that such differences between women and men occurred across and within jobs - particularly in construction trades. Furthermore, differences in body size, proportion, and muscle mass have been shown to affect the fit of personal protective equipment (PPE) and PPE is often designed for an average male (Curtis et al., 2018). Studies of occupational injury have also found that incidence is affected by tool design, working surface height, and equipment dimensions as these factors may create very different demands on the body depending on the anthropometric measurements of the worker, which is determined to a large extent through sex (Berecki-Gisolf et al., 2015; Chiou & Keane, 2017; Locke et al., 2014; Messing et al., 2003).

Sex-based differences in occupational chemical exposures have received even less attention. In the U.S., a cross-sectional study compared exposure to occupational and social hazards between 456 women and 791 men from 14 workplaces. Data were collected from a self-administered questionnaire, an in-person interview, and a workplace fact-finding visit by an industrial hygienist. Overall, no differences were found in this study between women and men in the proportion reporting high exposure to chemicals or dust in the previous year (Quinn et al., 2007; Sembajwe et al., 2010). In contrast, in a New Zealand survey in the general population inquiring about a list of possible workplace exposures, men generally reported being exposed two to four times more frequently than women to several kinds of dust or chemicals, with the exception of disinfectants, hair dyes, and textile fibers to which women were 30% more exposed than men (Eng et al., 2011). Limiting their analyses to women and men with the same occupational title did not change the results (Eng et al., 2011). Overall, it can be surmised from the limited research that has investigated sex-related differences in exposure, that the direction and degree of differences in exposure that tend to be attributed to sex and/or gender are not always predictable.

Differences in occupational exposures between Montréal women and men have been previously determined in an IRSST-funded activity (Labrèche et al., 2015; Lacourt et al., 2018). This analysis used data from two case-control studies conducted in Montréal in the late 1990s. Specifically, experts retrospectively assigned exposure characteristics to a list of 243 possible substances for each occupation reported by 2,073 women and 1,657 men. Results of this study revealed different employment profiles between women and men. However, only 59 out of 439 4-digit Standard Industrial Classification (SIC) codes had enough occupations for both sexes to be included in the analysis of women and men within the same occupations (Lacourt et al., 2018). Overall, fairly good agreement was found between women and men in the proportion of occupations that are considered exposed to any given agent within an occupation. However, a quarter of the 326 notable differences identified could be attributed to a difference in tasks reported by women and men for a given 4-digit occupational code. For example, among women and men who held jobs as “Sales Clerks, Commodities” (SIC code: 5137), the jobs held by women were more often exposed to volatile organic compounds, organic solvents, isopropanol, and aliphatic alcohols than those held by men, as women reported using cleaning products to wipe the checkout conveyor belt - a task not reported by men. This analysis shed a much-needed light on the impact of gender on exposure among Québec workers. However, it was also limited in scope due to small numbers of overlapping jobs in women and men, which constrained the number of comparisons for chemical and physical exposures within the same occupation by sex.

As women do not necessarily experience the same workplace exposures as men holding jobs within the same occupation title, it is important that we characterize these differences in exposure as fully as possible, whether it be for the purpose of establishing policy aimed at prevention of health effects or understanding potential health risks. Given the limited data that exists on the relationship between sex and gender, and chemical exposure, the validity of applying exposure assessment tools developed in men (or primarily in men) to studies in women is unknown. The relationship between sex and gender, and chemical exposure is a key gap limiting further advancement in occupational hygiene. Therefore, it is clear that we must develop tools whereby we can equitably monitor and inform on the safety and health of our female workers.

Occupational exposure assessment

The main goal of industrial hygiene is to identify hazards such as chemicals, and evaluate, control, and manage risks in the workplace. Assessing the existence of chemical exposures, as well as estimating the intensity and frequency of these exposures is key to understanding potential health effects, thereby increasing our ability to reduce occupation-related disease. For occupational health practitioners and the research community, knowledge of the exposure of workers occurring both in the past and present is important in monitoring the health of workers.

Workplace exposure assessment may involve direct measurements in the workplace and/or personal exposure measurements through the use of portable air samplers or biomarkers. These methods, though precise, are generally costly and often only reflective of recent or current exposures. Moreover, biomarkers generally cannot differentiate the source of exposure whether it be occupational, environmental, or dietary. However, when studying occupational diseases with long latencies, indirect exposure assessment methods are essential. Several methods have been developed for this purpose, such as:

1) questioning the worker using a pre-established list of substances; 2) using job-exposure matrices (JEMs) or task-exposure matrices to estimate exposures for each job reported in an occupational history or; 3) conducting a detailed interview with the worker and having experts review the occupational history to estimate exposures (McGuire et al., 1998).

The expert assessment method, whereby experts assign occupational exposures based on the subject's reported occupational history, has been shown to be a more valid method than self-reported occupational exposures (McGuire et al., 1998; Teschke et al., 2002). In the context of exposures occurring in the past or over a long period of time, expert assessment is superior to self-reported exposures since experts can account for the time period of exposure, local peculiarities of production processes or materials used, as well as particular tasks reported by the subject (McGuire et al., 1998). Nevertheless, expert assessment remains costly in terms of resource time (Fritschi et al., 1996) and thus, several prominent researchers have advocated for the use of JEMs (Kauppinen, 1994; Kromhout & Vermeulen, 2001). The use of multiple sources of exposure measurements collected by government, industry, and from previously published literature can be used to construct a JEM, but is limited by the representativeness of the context in which measurements are made and interpretation of contexts wherein no measurements are made (Cheng et al., 2018; Fritschi et al., 1996; Sadhra et al., 2017; Sauvé, Davies, et al., 2019). A JEM can also be developed based on a JEM creator opining on the exposures present in each occupation of a classification system, which is considered less reliable (Fritschi et al., 1996). Alternatively, JEMs built from data from expert assessments have been proposed as a cost-efficient alternative to expert assessment (McGuire et al., 1998; Siemiatycki et al., 1997; Teschke et al., 2002).

A JEM is a database associating exposure to occupations. It can take a very simple binary form (Yes/No to any possibility of exposure) or more complex forms depending on the wealth of exposure information and the occupational coding system used. The range of chemicals and period of exposure that can be assessed will vary. The FINJEM, developed in the 1990s from a compilation of direct measurements performed by the Finnish Institute for Occupational Hygiene, was the first widely used generic multi-agent and industry JEM (Kauppinen et al., 1998; Kauppinen et al., 2014). Subsequently, a more recently developed general population JEM, the MATGÉNÉ (De Bree et al., 2002), addressed several exposures in a wide array of industrial sectors and occupational titles. Overall, both the FINJEM and MATGÉNÉ are limited in the number of occupational agents considered and neither provides sex-specific estimates of exposures. The few existing female-specific JEMs are either developed for one exposure, such as a lead exposure JEM in China (Koh et al., 2014), or for one industrial sector (Wernli et al., 2006).

Platforms on which this project was built

This research activity was made possible by the existence of two unique platforms: 1) expertise in retrospective occupational exposure assessment in epidemiologic studies that yielded the Canadian Job Exposure Matrix (CANJEM) based on expert assessment of occupational histories reported in four case-control studies conducted in Montréal between 1979 and 2004, and; 2), detailed occupational information collected from a large number of women that participated in the Montréal Breast Cancer Case-Control Study (2008-2011).

The Montréal case-control studies that contributed to CANJEM

Since the 1980s, our group has been involved in the conduct of four large, population-based case-control studies in the Montréal metropolitan area. Briefly, the Multisite Cancer Study (MCS; 1979-1986) investigated 19 different sites of cancer and included men aged 35-70 years (N=4,259 participants) (Siemiatycki et al., 1987). The Lung Cancer Study (LCS; 1996-2001) included women and men aged 35-75 years (N=2,746 participants) (Pintos et al., 2012). The Breast Cancer Study (BCS1; 1996-1997) included women aged 50-75 years (N=1,275 participants) (Labrèche et al., 2010). The Brain Cancer Study (BNCS; 2000-2004) represented the portions of participants from Québec and Ottawa in the multi-centric INTERPHONE study (Lacourt et al., 2013) in which occupational histories were collected and coded among women and men between 30 and 59 years of age (N=659 participants). One of the studies included only general population controls (LCS), one included only hospital controls (BCS1), and two included both (LCS and BNCS) (Labrèche et al., 2010; Lacourt et al., 2013).

Occupational exposure assessment by experts

The methodology of occupational exposure assessment by experts in the context of community-based case-control studies was first developed by Siemiatycki and Gérin in the context of the MCS. It is described in detail in Gérin et al. (1985), and Siemiatycki (1991). Briefly, complete occupational histories including occupational titles, employment duration, tasks performed, work environment, and product and equipment used were collected from questionnaires and extensive face-to-face or telephone interviews. Proxy respondents provided the information on occupational histories when subjects were unable to do so. For specific occupations that were relatively common among study subjects (e.g. nurses, sewing machine operators, farmers), specialized questionnaires were devised whereby specific task information, products and materials used, equipment, etc. were elicited from subjects.

Using this information, a team of trained chemists and industrial hygienists then reviewed the occupational histories (blinded to case/control status and sex (Lacourt et al., 2018) to assign standardized occupation and industry codes, and exposures for each occupation held, using a predefined list of approximately 300 agents. To achieve this, the team reviewed existing literature extensively, conducted site visits, and consulted with specialized industry experts, in addition to relying on their own expertise (Pintos et al., 2012).

The same methodology and the same team of experts were used in a series of subsequent case-control studies in Montréal, and the resulting data from this series of studies was used to develop CANJEM. This consisted of the Multisite Cancer Study (MCS) (Siemiatycki et al., 1987), the Lung Cancer Study (LCS) (Pintos et al., 2012), the Breast Cancer Study (BCS1) (Labrèche et al., 2010), and the Brain Cancer Study (BNCS) (Lacourt et al., 2013).

Development of the CANJEM database

CANJEM (http://canjem.ca/) was built from the expert occupational exposure assessments carried out in the series of four case-control studies of various cancers conducted in the greater Montréal area. One of the goals of CANJEM is to facilitate the dissemination and use of the Montréal expert assessment database by others. It may be the largest such database in the world, and it represents a unique fount of knowledge about occupational exposures in an urban North American population in the late 20th century. In these four studies, over 30,000 jobs held by close to 9,000 subjects from 1930 to 2000 were evaluated by experts who assigned exposures based on descriptions of tasks, processes, work environment, and exposure control measures. CANJEM provides Canadian-relevant information on the probability, confidence, intensity, and frequency of exposure to a list of 258 agents (including mostly chemicals but also some biological and physical hazards; see Table 21 in Appendix A) for given occupational codes in specific time periods. In addition, the exposure data in CANJEM is organized to be compatible with four occupational and three industry classifications. Although CANJEM has yet to be validated in workforces in other provinces, upon comparison with two national surveys conducted in 1986 and 2011, coverage of approximately 90% of the employed Canadian population in one time period (1930-2005) was achieved (Sauvé et al., 2018). However, when sub-periods were used and when a higher resolution of occupational and industry classifications was used, coverage of only approximately 50-60% of the Canadian population was accounted for. The application of CANJEM must be carefully evaluated based on the representativeness of the jobs in the CANJEM database compared with working populations beyond Montréal.

CANJEM includes exposure information from both cases and controls that participated in the Montreal-based studies; however, the inclusion of cases was not without consideration. Advantages include a twofold increase in the available data, thus increasing the precision of exposure estimates and allowing for better coverage of occupations. However, bias may occur in that exposure to a true risk factor is generally expected to be greater among cases than controls, which could lead to overestimation of exposures in a JEM. Agents themselves may also be correlated and thus, bias could extend towards exposure to agents correlated with a true risk factor. A former study assessed whether the inclusion of case data would bias a JEM (Kirkham et al., 2016); The agreement between a case JEM and control JEM was high (90%), therefore it is justifiable given the benefits of an increase in sample size. It is pertinent to note that although agents were coded individually, the focus of the data collected was the lifetime occupational history of study participants, which has been shown to be consistently reported (Teschke et al., 2002).

Female-specific exposure information in CANJEM

CANJEM was built from information obtained from 31,673 jobs held by cases and controls in the four Montréal studies. Of these jobs, only 26% were held by women. Therefore, it is unknown whether the exposures experienced by men can be applied to women holding the same occupational titles. Given that limited data exists on the relationship between sex and exposure, the validity of applying exposure assessment tools developed from information collected from men (or primarily from men) to studies in women is unknown.

Presently, sex-specific estimates are not available in the existing CANJEM database. A previous IRSST-funded activity found notable differences in the exposure proportion between jobs held by women and by men in LCS and BCS1, but that the frequency-weighted intensity of exposure was similar for both sexes within the same occupational groups (Labrèche et al., 2015). Though the results from this evaluation did not warrant the development of sex-specific versions of CANJEM, the authors emphasized the need for sex-differentiated analyses to highlight differences in occupational exposure as analyses based on occupation and economic sector alone is not sufficient to reveal the subtle differences in job-associated tasks that would be gender-related (Labrèche et al., 2015). Adding more female jobs evaluated by experts to CANJEM would increase the number of commonly held jobs between women and men to investigate whether exposures differ. Further, the addition of more female data would increase the number of occupations not currently covered by CANJEM, making it the largest JEM with potentially sex-differentiated data on occupational exposures. This refinement may therefore provide a better evaluation of the need for sex-specific versions of CANJEM.

1. RESEARCH OBJECTIVES

The general objective of this research activity was to improve the ability of CANJEM to evaluate workplace exposures in women. The specific objectives of this IRSST collaborative research activity were to:

1. Conduct expert evaluations of 4,362 job descriptions from lifetime occupational histories provided by women participating in the population-based Montréal Breast Cancer Case-Control Study between 2008 and 2011
2. Incorporate the new expert assessments of occupational exposures into CANJEM thereby improving CANJEM for the evaluation of workplace exposures in women in relation to men in order to:
   a. Conduct a descriptive comparison of sex-specific estimation of CANJEM exposure metrics
   b. Conduct a Bayesian comparison of sex-specific estimation of CANJEM exposure metrics
3. Based on enhanced information in CANJEM, derive estimates of the prevalence of exposure to 258 workplace agents among Montréal women

2. METHODOLOGY

2.1 Objective 1: Expert assessment of occupational exposures

2.1.1 The Montréal Breast Cancer Case-Control Study

The Montréal Breast Cancer Case-Control Study (BCS2; 2008 to 2011), directed by Mark S. Goldberg and France Labrèche, provided the occupational history data to this project. This study was population-based and used a similar methodology as the original four case-control studies that contributed to CANJEM. Briefly, eligible female participants of the BCS2 resided in Montréal at the time of recruitment, were post-menopausal, had never had a previous occurrence of any type of cancer, and were registered on the Provincial Electoral List (Goldberg et al., 2017). Incident, histologically-confirmed invasive cases of breast cancer were identified in 17 hospitals in Montréal (N=693). Controls were randomly selected from the Electoral List and frequency-matched to cases by 5-year age groups (N=604). Participants completed a detailed interview by telephone (26%) or face-to-face (74%) which assessed lifetime occupational history. A total of 4,362 remunerated jobs were reported in this study. For each job ever held, the questionnaire gathered information on the company's activities, raw materials and machines used, produced goods, responsibilities for machine maintenance, type of room or building in which the subject worked, activities of workmates, presence of gases, fumes or dusts, use of area, use of personal protective equipment, and a detailed description of the subject's typical activities at work. For some occupations that were relatively common among study subjects (e.g., nurses, sewing machine operators), specialized questionnaires were used to ascertain the specifics of these occupations.

2.1.2 Attribution of occupational codes and exposure assessment

The occupational assessment of this study involved expert assignment of occupational and industry codes and their evaluation of occupational exposure to 293 agents based on the information collected from participants. A recent development of our expert assessment method (Gérin et al., 1985; Siemiatycki, 1991) involves providing the experts at the start of the coding exercise with exposure information for a given occupation code derived from the vast database of exposures assigned in the four previous case-control studies (Sauvé, Lavoué, et al., 2019). These data, referred to as "job exposure profiles," are annotated to guide experts in their assignments according to job idiosyncrasies, in order to improve on the transparency of expert coding. In addition, as exposure profiles encompass only jobs held by men (Sauvé, Lavoué, et al., 2019), we developed a tool to compare chemical exposures among men and women holding the same jobs in the past four case-control studies (i.e., MCS, LCS, BCS, BNCS).

First, a trained industrial hygienist, blinded to case/control status, reviewed the occupational histories to assign standardized occupational codes (Canadian Classification and Dictionary of Occupations, CCDO7D; 1968 International Standard Classification of Occupations, ISCO-68; 2010 Standard Occupational Classification System, SOC 2010; 2011 National Occupation Classifications, NOC2011) and industry codes (International Standard Industrial Classification of all Economic Activities, ISIC71; 1980 Standard Industrial Classification System, SIC80; 2012 North American Industry Classification System, NAICS2012).

Then, using the tools mentioned above, two additional industrial hygienists (also blinded to case/control status) evaluated exposures for each occupation using a predefined list of 293 chemical and physical agents. The experts first retrieved the job exposure profile corresponding to the relevant CCDO7D codes and then used the descriptions of the job from the interview as well as the existing profile to assign exposures. Using this method, the experts could choose to omit exposures suggested by the job exposure profile and/or to assign additional exposures not listed in the profile. The experts could also use information from additional profiles. For example, the evaluation of exposures for a cashier reporting regular cleaning and maintenance tasks could entail the use of information from exposure profiles such as the one for cleaning occupations to cover a wider spectrum of exposures. When assessing exposures for occupations for which no job exposure profile was available, the experts could also choose to use data from comparable occupations to aid in their assessment. Occupations were divided between the two experts for a first evaluation, then each expert reviewed the other's first evaluations of the occupations, producing a second evaluation; the latter was then returned to the original first expert who accepted, rejected, or modified the changes, and this facilitated "consensus" coding.

A job was considered exposed if the expert determined that the agent was present in the workplace at levels above those found in the general environment. The experts coded exposures according to three dimensions: **confidence** that the exposure occurred ("possible", "probable", "definite"); relative **intensity** ("low", "medium", "high"), where low and high represented the extremes in the range of levels encountered in a work environment; and the **frequency** of exposure (ranging from more than 0% to 100% of an exposed work-week). The rating of confidence was subjective and relied on the level of detail provided by the respondent, and on the expert's opinion of the credibility of the interview, the amount of documentary evidence that the experts could find in the international literature on exposures in such a job, and the availability of local information concerning such jobs. Without fixed guidelines to assign categories of intensity, experts agreed that a ratio of 1:5:25, based on a lognormal distribution of exposure levels, appeared to be the best estimate of contrast between low, medium, and high for most agents (Sauvé et al., 2018).

2.2 Objective 2: Incorporation of the new expert assessments into CANJEM

New expert-assessed occupational data from the BCS2 was added to the CANJEM database. Table 1 illustrates the number of women and men in each case-control study included in CANJEM. In total, 12,630 jobs were held by women and 23,405 jobs were held by men.

Table 1. Number of participants, by sex, in each case-control study included in CANJEM expert assessments

	Women		Men	
Study	**Number of participants (n)**	**Number of jobs (n)**	**Number of participants (n)**	**Number of jobs (n)**
Multisite Cancer (MCS: 1979-1986) (De Bree et al., 2002)	0	0	4,259	15,067
Lung Cancer (LCS: 1996-2001) (Wernli et al., 2006)	1082	3,494	1,664	6,877
Brain Cancer (BNS: 2000-2004) (Pintos et al., 2012)	337	1,264	322	1,461
Breast Cancer 1 (BCS1: 1996-1997) (Siemiatycki et al., 1987)	1275	3,510	0	0
Breast Cancer 2 (BCS2: 2008-2011) (Siemiatycki, 1991)	1277	4,362	0	0

The core of CANJEM consists of three dimensions, the selection of which constitutes a “cell”: agent, occupational/industrial classification, and time period (Figure 1, Appendix A) (Sauvé et al., 2018). CANJEM dimension details are described in Table 2. Depending on the dimension categories of interest, several exposure metrics can be calculated by summarizing information from all individual jobs associated with a cell in the pooled database. The available exposure metrics include an estimated probability of exposure and, for exposed jobs, the confidence, intensity, frequency, and the frequency-weighted intensity (FWI) of exposure. A job is included in a time period when the employment dates covered at least one year. One time period (1933-2011) or different time periods (1933-1949, 1950-1969, 1970-1984, and 1985-2011) as well as user-specified time periods (e.g., 1956-2001) may be selected. An example of a CANJEM cell with the exposure metrics is described in Table 3. Full details of CANJEM can be found in Lavoué et al. (2012). Four different occupational classification codes were assigned to all jobs but, for the purpose of this report, statistical analyses were conducted using ISCO-68 job codes, as they come from an international classification and are commonly used in occupational epidemiology, whereas other classification systems, like CCDO, are specific to the Canadian context (Mannetje & Kromhout, 2003).

Table 2. CANJEM dimensions

Dimension	Dimension Categories
Agent	258 chemical and physical agents common to all contributing case-control studies (MCS, LCS, BCS1, BNCS and BCS2)
Occupational/industrial classification	Occupational coding systems[a]: CCDO7D ISCO-68 SOC2010 NOC2011 Industry classification systems[b]: ISIC71 SIC80 NAICS2012
Time period	One period: 1933-2011 Specific periods: 1933-1949 1950-1969 1970-1984 1985-2011 User-specified time period

[a] CCDO7D, Canadian Classification and Dictionary of Occupations; ISCO-68, 1968 International Standard Classification of Occupations; SOC 2010, 2010 Standard Occupational Classification System; NOC2011, 2011 National Occupation Classifications

[b] ISIC71, International Standard Industrial Classification of all Economic Activities; SIC80, 1980 Standard Industrial Classification System; NAICS2012, 2012 North American Industry Classification System

Adapted from “Development of and selected performance characteristics of CANJEM, a general population job-exposure matrix based on past expert assessment of exposure”, by J.-F. Sauvé, J. Siemiatycki, F. Labrèche, L. Richardson, J. Pintos, M.-P. Sylvestre . . . J. Lavoué, 2018, *Annals of Work Exposures and Health, 62*(7). ©OUP, 2018.

Table 3. Example[a] of a single CANJEM cell for cotton dust exposure among Fabrics Examiners (ISCO-68 code 7-54.70)

Exposure Metrics		Interpretation
Probability	Number of jobs: 14 Number of exposed jobs: 9 Probability: 64%	There are 14 Fabrics Examiners in CANJEM; 64% (9/14) of jobs are exposed to cotton dust among all Fabric Examiners.
Confidence	Possible: 0% Probable: 33% Definite: 67%	Expert's confidence that exposure to cotton dust occurred among exposed Fabric Examiners. This was distributed across categories of possible (0%), probable (33%), and definite (67%) confidence.
Intensity	Low: 78% Medium: 22% High: 0%	Intensity of exposure among exposed Fabric Examiners distributed across categories of low (78%), medium (22%), and high (0%) intensity.
Frequency	<2h/week: 0% 2 to <12h/week: 0% 12 to <40h/week: 22% ≥40h/week: 78%	The hours per week exposed to an agent among exposed Fabric examiners. 0% were exposed <2h/week and 2 to <12h/week while 22% of jobs were exposed 12 to <40h/week and 78% were exposed ≥40h/week.
Frequency-weighted intensity (FWI)	Median: 1.0 Average: 1.6	The cumulative exposure of exposed jobs over time, calculated by multiplying intensity by the proportion of hours exposed relative to a 40-hour work week (using a 1:5:25 ratio for low, medium and high). The median and arithmetic mean values were 1.0 and 1.6, respectively.

[a]Example based on a single time period 1930-2005.

2.2.1 Objective 2a. Descriptive comparison of sex-specific estimation of CANJEM exposure metrics

To compare female- and male-specific estimates of occupational exposure, CANJEM was stratified into two JEMs according to the sex of each job holder. These sex-specific were constructed using the same specifications as CANJEM described above. Analyses were limited to cells (i.e., unique combinations of an agent, occupational code, and a time period) common to both sex-specific CANJEMs. Cells with a probability of exposure <5% were considered as unexposed and thus, values of 0 were assigned to the frequency, intensity, and FWI of exposure in those cells. In all analyses, both female and male JEMs were built using CANJEM's default creation parameters (See Sauvé et al. (2018)). Specifically, each version of CANJEM was created using 5-digit ISCO-68 job codes in each of four sub-periods (1933-1949, 1950-1969, 1970-1984, and 1985-2011) as well as with one time period (1933-2011). Specifically, the female CANJEM was built from jobs held by women in the BCS1, BCS2, LCS, and BNCS. The male CANJEM was built from jobs held by men in the MCS, LCS, and BNCS.

Each metric of exposure was considered both as a continuous variable and categorized as follows:

- **Probability of exposure:** The probability of exposure was categorized as follows: 0-<5%, 5-<25%, 25-<50%, 50-<75%, and ≥75%. In addition, the probability of exposure was also categorized based on the threshold selected for ever exposure of 0-<5% and ≥5%. These categories were selected based on Sauvé et al. (2018).
- **Median frequency of exposure:** The median frequency of exposure was categorized based on the original categories used by experts to assess the frequency of exposure in the MCS study: 0, >0-<2 hours, 2-<12 hours, 12-<40 hours, and ≥40 hours.
- **Median intensity of exposure:** The median intensity of exposure was categorized based on the geometric mean of the medium (5) and high (25) intensity category: 0, >0-<2.24, 2.24-<5, and ≥5.
- **Median FWI of exposure:** The median FWI of exposure was categorized so that each cut point would be equivalent to being exposed for 40 hours per week at each intensity of exposure level (e.g. The FWI for a cell exposed at a medium intensity (5) for 40 hours per week would be 5*40/40 = 5). Due to the skewed distribution of observations, the ≥25 category was merged with the ≥5 category resulting in the following categories: 0 (unexposed), >0-<1, 1-<5, and ≥5.

Frequency of Occupational Codes

The most frequently held occupations were identified among: 1) all ISCO-68 codes in each sex-specific CANJEM; 2) all ISCO-68 codes for which the probability of exposure is ≥5% in each sex-specific CANJEM and; 3) all ISCO-68 codes for which the probability of exposure is ≥5% and present in both sex-specific CANJEMs.

Prevalence of Agents

Among 5-digit ISCO-68 codes considered as exposed, agents that were most often listed in each sex-specific CANJEMs were identified. Probability thresholds of ≥5% and ≥25% were used to define exposure to each agent. This analysis was conducted in each JEM separately and as such, was not limited to cells present in both JEMs.

Correlation Between Sex-Specific JEMs

The distributions of the probability, median intensity (using a 1:5:25 ratio for low, medium, and high), median frequency, and median FWI of exposure were presented by sex. Then, the percent agreement between women and men for each of these exposure metrics were determined. Analyses were restricted to cells considered as exposed in both female and male JEMs (i.e., cells that are concordantly exposed; defined as having an exposure probability threshold ≥5%). The Kendall rank correlation coefficient (τ) and the intra-class correlation coefficient (ICC) were used to estimate the correlation for the probability, frequency, intensity, and FWI of exposure. Kendall's τ was used to analyze the ordinal categories of exposure metrics with 95% confidence intervals (95%CI) calculated using the bootstrap approach. For continuous values of exposure metrics, ICC was used with a two-way mixed effects approach to calculate 95%CI. No ICC was calculated for the intensity of exposure due to the semi-quantitative nature of this exposure metric. For graphical comparison, empirical cumulative distribution functions (ECDFs) of the probability, frequency, intensity, and FWI of exposure for the female and male JEM were produced, as well as ECDFs of the matched differences across cells for the same metrics.

Sensitivity Analyses

Sensitivity analyses contrasted different versions of sex-specific JEMs by modifying one of the decisions made during the JEM creation process. Four sensitivity analyses were conducted (results are presented in Appendix C):

1. Using an exposure probability threshold of 25% to define ever exposure wherein any cell with a probability of exposure <25% had its median frequency, median intensity, and median FWI of exposure recoded as 0
2. Excluding exposures with a confidence of 1 (i.e., “possible”) in the initial exposure datasets
3. Using one time period (i.e., all years from 1933 to 2011)
4. Using 7-digit CCDO codes in the occupational code dimension

2.2.2 Objective 2b. Bayesian comparison of sex-specific estimation of the probability of exposure metric in CANJEM

Hierarchical Bayesian Models

Hierarchical Bayesian models were used to estimate differences in the probability of exposure with credible limits of 95% between corresponding female and male-specific JEMs. In Bayesian statistics, a credible interval is an interval within which an unobserved parameter value falls within a probability, given available data and any prior information (Rothman et al., 2008). The model used was a six-level hierarchical model. For the first level ($j = 0$), we modelled the overall probability of exposure and assigned it a non-informative uniform prior distribution on (0, 1). The next four levels modelled the probability of exposure for 1-, 2-, 3-, and 5-digit ISCO-68 codes, respectively. At each of these levels ($j = 1, 2, 3, 4$), the logit of the probability of exposure $\text{logit}(p_{jk})$ was given a normal conditional prior distribution with the mean equal to the logit of the probability of exposure at the preceding level - $\text{logit}(p_{(j-1,k)})$ - and a distinct standard deviation Σ_j. At the last level ($j = 5$), a male worker effect (male_o) is given a normal prior distribution with a mean of zero and a standard deviation equal to a between-gender standard deviation for each occupation, *o*. The parameter, $p_{(4,o)}$, is the probability of exposure among women in occupation, *o*, while the value $\text{inv.logit}(\text{logit}(p_{(4,o)}) + \text{male}_o)$ is the probability of exposure among men for the same occupation. The latter two sets of parameters (two parameters for each occupation) are directly used in the calculation of the likelihood. At each level, the normal distributions on the miscellaneous logit(p) parameters are left-truncated at logit(p)=-9.21 or, equivalently, at p=1/10,000 to protect against clinically meaningless low values and Markov Chain Monte Carlo sampling instability. A posterior sample of the differences in the predicted probability of exposure between women and men was generated for each agent (maximum 258 agents). The main analysis considered one time period (i.e., all years from 1933 to 2011) and was based on 5-digit ISCO-68 codes. Only one time period (1933-2011) was used due to the small number of cell sizes in four sub-periods (1933-1949, 1950-1969, 1970-1984, and 1985-2011).

<u>Notable Differences in the Probability of Exposure</u>

Notable differences were defined as cells with the greatest estimated difference in probability. Cells with a notable difference in the probability of exposure were identified based on the method used in Lacourt et al. (2018) (see Table 4). With the exception of the lowest category, for which the minimum notable difference was selected *a priori* by the research team, the notable difference for the remaining categories was selected to be a quarter of the upper limit of the range of values (e.g. if the lowest of the two values compared was 35%, then within the >30% to ≤50% range, and a notable difference was a difference of at least ¼ * 50% = 12.5%).

Table 4. Notable difference in the probability of exposure between women and men

Lowest of two values compared	Difference considered as notable
≤15%	≥5%
Between >15% and ≤30%	≥7.5%
Between >30% and ≤50%	≥12.5%
Between >50% and ≤80%	≥20.0%

In order to take uncertainty into account, a difference was notable only if the 95% lower credible limit on the estimated difference met the criteria in Table 4. The credible limit was used to indicate that there is a 95% probability that the true estimate would lie within the interval, given the evidence provided by the observed data.

From the identification of notable differences in the probability of exposure between sexes in one time period (1933-2011), occupations commonly held between sexes among the list of notable differences was compared. To be compared, at least one female and one male with a common occupation in the listed notable differences were included. The type of agent and the number of agents were identified for which a higher probability in exposure was observed in women and men, respectively.

Sensitivity Analyses

Sensitivity analyses were conducted by modifying the time period (i.e., two time periods: 1933-1969, 1970-2011; four time periods: (1933-1949, 1950-1969, 1970-1984, 1985-2011), the ISCO-68 code resolution (5- or 3-digit), and the credible limit (95% or 90%). The same criteria for notable differences (Lacourt et al., 2018) were applied to sensitivity analyses. Seven sensitivity analyses were conducted (results are presented in Appendix F):

1. Time period
   a. 5-digit ISCO-68 codes in two time periods, 95% credible interval
   b. 5-digit ISCO-68 codes in four time periods, 95% credible interval
2. ISCO-68 resolution
   a. 3-digit ISCO-68 codes in one time period, 95% credible interval
   b. 3-digit ISCO-68 codes in one time period, 90% credible interval
3. Credible limit
   a. 5-digit ISCO-68 codes in one time period, 90% credible interval
   b. 5-digit ISCO-68 codes in two time periods, 90% credible interval
   c. 5-digit ISCO-68 codes in four time periods, 90% credible interval

2.3 Objective 3: Estimation of prevalent occupational exposures among Montréal women

To create a portrait of workplace exposures among Montréal women, all female jobs within the enhanced CANJEM were used. Occupations considered as exposed (≥5% probability of exposure) were explored and only cells with a minimum of ten jobs per cell were retained. Distributions across occupations of the median intensity, median frequency, and median FWI (using a 1:5:25 ratio for low, medium, and high) of exposure were estimated. This included calculating the 25th and 75th percentiles, mean, and standard deviation of the intensity, frequency, and FWI for each unique agent across occupations.

Frequency of Occupational Codes

The frequency of a 5-digit ISCO-68 code in the enhanced CANJEM was calculated based on the number of unique jobs coded in that occupation. The most frequent occupations were identified among all exposed 5-digit ISCO-68 codes in CANJEM (≥5% probability of exposure). The frequency of ISCO-68 codes were identified in one time period (1933-2011) and in each of four sub-periods (1933-1949, 1950-1969, 1970-1984, and 1985-2011).

Prevalence of Agents

Agents that were most commonly listed among 5-digit ISCO-68 job codes held by women after the enhancement of CANJEM were obtained using a probability of exposure of ≥5% threshold to define ever exposure of workers in an occupation. Prevalent agents were identified in one time period (1933-2011) and in each of four sub-periods (1933-1949, 1950-1969, 1970-1984, and 1985-2011). The prevalence was estimated for each specific agent by dividing the number of ISCO-68 codes considered exposed to the specific agent by the total number of ISCO-68 codes in CANJEM.

3. RESULTS

3.1 Inter-rater reliability of expert assessment of occupational exposures

Experts conducted evaluations of 4,362 job descriptions from lifetime occupational histories provided by women participating in the Montréal Breast Cancer Case-Control Study from 2008 to 2011 (BCS2). One hundred and sixty-seven unique ISCO-68 job codes were assigned and the occupational coding of this study included the expert assessment of occupational exposure to 293 agents based on the information collected from participants.

An inter-rater reliability sub-study was conducted on ~3% of jobs from the BCS2 Study consisting of 185 jobs held by 32 participants, with the results published by Batisse et al. (2021). Briefly, these participants were purposefully sampled to represent coverage of the most frequent occupations of the main study. In contrast to the main study, both experts independently assessed all 185 jobs to assign exposures to the predefined list of 293 agents. The statistical unit of observation was the decision for each job-agent combination. Thus, given 185 (jobs) × 293 (agents). A total of 54,205 decisions were made by each expert. Overall, a high level of inter-rater agreement was found for identifying exposures and for coding intensity, but agreement was lower for the coding of the frequency of exposure (Batisse et al., 2021). Moderate agreement for the confidence of exposure was found in a sub-analysis restricted to job-agent combinations for which both experts agreed on the presence of exposure.

3.2 Incorporation of the new expert evaluations into CANJEM

3.2.1 Descriptive comparison of sex-specific estimation of CANJEM exposure metrics

After the enhancement of CANJEM with the addition of jobs held by women in BCS2, female and male CANJEMs for four sub-periods (1933-1949, 1950-1969, 1970-1984, and 1985-2011) and 5-digit ISCO-68 codes were created for the purpose of comparison. As seen in Table 5, each sex-specific CANJEM cell represents a unique agent-occupation combination and only cells based on a minimum of ten jobs and three subjects per cell were retained. Upon comparison, the female CANJEM contained fewer unique agent-occupation combinations relative to the male CANJEM (79,722 cells vs. 188,082 cells, respectively) while fewer cells were common to both JEMs (40,764 cells). Across four sub-periods (1933-1949, 1950-1969, 1970-1984, and 1985-2011), 140 unique ISCO-68 job codes were listed in the female CANJEM while 289 were listed in the male CANJEM, with 82 overlapping job codes between them.

Table 5 shows that in both sex-specific JEMs, most cells had a low probability of exposure (<5%). The majority of cells in both JEMs had median values of zero for the frequency, intensity, and FWI of exposure. This contributed to a high agreement of greater than 90% between sex-specific JEMs across all exposure metrics. In comparing cells representing disagreements (cells outside the diagonal from left to right of the table), more points of comparison lie in the number of cells in the bottom left triangle relative to those in the top right triangle, indicating that jobs held by females proportionally have lower values of exposure metrics (probability, median frequency, median intensity, and median FWI of exposure) relative to males.

Table 5. Comparison of cell counts according to exposure metrics of agent-occupation combinations between sex-specific JEMs with a resolution of 5-digit ISCO-68 codes (n=40,764 cells)

Female JEM (columns) / Male JEM (rows)

Number of cells[a,b] (n (%)) by probability of exposure (%)

	<5	5 to <25	25 to <50	50 to <75	≥75
<5	36,771 (90.20)	1,032 (2.53)	48 (0.12)	3 (0.01)	0 (0.00)
5 to <25	1,636 (4.01)	592 (1.45)	101 (0.25)	29 (0.07)	6 (0.01)
25 to <50	75 (0.18)	112 (0.27)	70 (0.17)	35 (0.09)	20 (0.05)
50 to <75	5 (0.01)	21 (0.05)	20 (0.05)	28 (0.07)	45 (0.11)
≥75	0 (0.00)	3 (0.01)	11 (0.03)	20 (0.05)	81 (0.20)

% agreement = 64.6 (among cells ≥5% probability between JEMs)

Number of cells[a,b] (n (%)) by median frequency of exposure (hours per week)

	0	0 to <2	2 to <12	12 to <40	≥40
0	36,771 (90.20)	48 (0.12)	551 (1.35)	236 (0.58)	248 (0.61)
0 to <2	120 (0.29)	4 (0.01)	20 (0.05)	3 (0.01)	2 (<0.01)
2 to <12	887 (2.18)	32 (0.08)	333 (0.82)	100 (0.25)	72 (0.18)
12 to <40	425 (1.04)	5 (0.01)	82 (0.20)	98 (0.24)	72 (0.18)
≥40	284 (0.70)	2 (<0.01)	26 (0.06)	125 (0.31)	218 (0.53)

% agreement = 54.7 (among cells >0 median frequency between JEMs)

Number of cells[a,b] (n (%)) by median intensity of exposure (1, 5, 25 intensity scale)

	0	>0 to <2.24	2.24 to <5	≥5
0	36,771 (90.20)	983 (2.41)	28 (0.07)	72 (0.18)
>0 to <2.24	1,106 (2.71)	788 (1.93)	23 (0.06)	18 (0.04)
2.24 to <5	166 (0.41)	78 (0.19)	13 (0.03)	10 (0.02)
≥5	444 (1.09)	215 (0.53)	18 (0.04)	31 (0.08)

% agreement = 69.7 (among cells >0 median intensity between JEMs)

Number of cells[a,b] (n (%)) by median FWI of exposure (1, 5, 25 intensity scale)

	0	0 to <1	1 to <5	≥ 5
0	36,771 (90.20)	809 (1.98)	240 (0.59)	34 (0.08)
0 to <1	1,256 (3.08)	574 (1.41)	144 (0.35)	3 (0.01)
1 to <5	387 (0.95)	197 (0.48)	211 (0.52)	16 (0.04)
≥5	73 (0.18)	8 (0.02)	30 (0.07)	11 (0.03)

% agreement = 66.7 (among cells >0 median FWI in both JEMs)

[a] Each cell represents a unique agent-occupation combination where the specific probability of exposure is calculated for each occupation by dividing # of jobs that were exposed to each agent by total # of jobs in that cell
[b] Only cells with a minimum of 10 jobs and 3 subjects per cell were retained

Upon further examination of exposed cells (n=3,993) in either JEM across four sub-periods (1933-1949, 1950-1969, 1970-1984, and 1985-2011) and with a resolution of 5-digit ISCO-68 codes, the agreement of exposure metrics between sex-specific JEMs was calculated for the probability, median frequency, median intensity and median FWI of exposure (Table 6). The 1, 5, 25 scale was used for both the median intensity and median FWI of exposure. Both Kendall's tau and the intraclass correlation coefficient (ICC) revealed that commonly held occupations between females and males had moderate agreement in the probability and median frequency of exposure while, agreements for median intensity, and median FWI of exposure were lower. The empirical cumulative density function (ECDF) plots were produced for all exposure metrics (Appendix B) to visually illustrate the differences in exposure metrics. Upon observation, the plots revealed that the probability and median frequency of exposure were slightly greater in the female JEM while the median intensity and median FWI of exposure were slightly greater in the male JEM. However, these differences were not clearly discernible as the plots for the female and male JEM overlapped.

Table 6. Agreement in concordantly exposed cells between sex-specific JEMs

Coefficient	Probability of exposure	Median frequency of exposure	Median intensity of exposure (1, 5, 25 scale)	Median FWI of exposure (1, 5, 25 scale)
Kendall's tau	0.42 (0.39 – 0.46)	0.44 (0.40 – 0.47)	0.25 (0.20 – 0.31)	0.38 (0.34 – 0.41)
ICC	0.75 (0.72 – 0.77)	0.53 (0.49 – 0.57)	-	0.17 (0.11 – 0.22)

ICC, Intraclass correlation coefficient; FWI, Frequency weighted intensity

<u>Descriptive comparisons among concordantly exposed cells between sex-specific JEMs</u>

Table 7 compares the dichotomous representation of exposure status between sex-specific JEMs; exposed cells were defined based on a 5% threshold for the probability of exposure. Most cells were concordantly unexposed (90.2% or 36,771) or exposed (2.9% or 1,194) in both female and male JEMs. Few cells (2.7% or 4.2%) were considered exposed in either one of the JEMs. A lower proportion of cells in the female JEM were classified as exposed relative to the male JEM (2.66% or 1,083 vs. 4.21% or 1,716, respectively).

Table 7. Comparison of cell counts between sex-specific JEMs according to exposure status with a resolution of 5-digit ISCO-68 codes

Probability of exposure male JEM (%)	Probability of exposure female JEM (%)		
	Unexposed (P <5%)	**Exposed (P ≥5%)**	**Total, male JEM**
Unexposed (P <5%)	36,771 (90.20)	1,083 (2.66)	37,854 (92.86)
Exposed (P ≥5%)	1,716 (4.21)	1,194 (2.93)	2,910 (7.14)
Total, female JEM	38,487 (94.41)	2,277 (5.59)	40,764 (100.00)

Frequency of Occupational Codes

After retaining only cells with a minimum of ten jobs and three subjects per cell, the frequency of ISCO-68 job codes were determined. Across four sub-periods (1933-1949, 1950-1969, 1970-1984, and 1985-2011), the female JEM accounted for 140 unique 5-digit ISCO-68 codes while the male JEM accounted for 290 ISCO-68 codes. Of these job codes, 82 were common between sex-specific JEMs. Among the five most frequent 5-digit ISCO-68 codes considered as exposed to any agent (probability of exposure ≥5%), *Retail Trade Salesperson* was the only occupation that was similar between sex-specific JEMs (Table 8). Further narrowing this observation to exposed ISCO-68 codes common to both JEMs, *Retail Trade Salesperson* remained commonly frequent between sex-specific JEMs with the addition of *Office Clerk (General)* overlapping between female and male JEMs. Overall, few of the most frequent job codes in each JEM overlap, which underscores the differing job profiles between women and men and suggests that some jobs may be present in one JEM, but not the other.

Table 8. Five most frequent exposed 5-digit ISCO-68 codes[a]

Among exposed ISCO-68 codes in each separate JEM				Among exposed ISCO-68 codes common to both JEMs			
Female	**n[a]**	**Male**	**n[a]**	**Female**	**n[a]**	**Male**	**n[a]**
Stenographic Secretary	1659	Lorry and Van Driver (Local Transport)	1188	Sewing-Machine Operator	967	Labourer	881
Sewing-Machine Operator	967	Labourer	881	Office Clerk (General)	690	Retail Trade Salesperson	755
Office Clerk (General)	690	Retail Trade Salesperson	755	Retail Trade Salesperson	655	Working Proprietor (Retail Trade)	462
Retail Trade Salesperson	655	Commercial Traveller	636	Server, General	592	Office Clerk (General)	439
Server, General	592	Lorry and Van Driver (Long-Distance Transport)	592	First-Level Education Teacher	346	Dispatching and Receiving Clerk	367

[a] Based on the total number of jobs in a code

Prevalence of Agents

The most prevalent agents (i.e. with the most occupations deemed as exposed) were identified using differing exposure probability thresholds of ≥5% and ≥25% to define ever exposure across all occupations (5-digit ISCO-68 codes) in each sex-specific JEM (Table 9). Only cells with a minimum of ten jobs and three subjects were retained. Of the five most prevalent agents from 1933 to 2011, only organic solvents overlapped between sex-specific JEMs, with fewer jobs held by women exposed relative to those held by males, regardless of the probability threshold used. Varying the different thresholds revealed that most of the prevalent agents listed in the female JEM remained the same, but a few minor differences were observed. In the female JEM, organic solvents, cleaning agents, and aliphatic aldehydes remained among the most prevalent agents irrespective of the threshold used. However, ozone and aliphatic alcohols were listed among the five most prevalent agents when a probability threshold of ≥5% was used whereas biocides and fabric dust emerged when a probability threshold of ≥25% was used. In the male JEM, most of the same agents were listed as the most prevalent regardless of the threshold used, albeit not in the same order. The only difference was that C5-C-17 alkanes were listed as the most prevalent with a probability threshold of ≥5% while C18+ alkanes were listed as the most prevalent with a probability threshold of ≥25%. It is also important to note that fewer agents were present in the female JEM relative to the male JEM.

Table 9. Five most prevalent agents from 1933-2011 in sex-specific JEMs using an exposure probability threshold of ≥5% and ≥25% for ever exposure in 5-digit ISCO-68 codes

Exposure probability threshold	Female JEM		Male JEM	
	Agent	n[a] (%)	Agent	n[b] (%)
P ≥ 5% threshold	Organic solvents	89 (47.6%)	PAHs from any source	279 (72.8%)
	Cleaning agents	75 (40.1%)	PAHs from petroleum	239 (62.4%)
	Ozone	72 (38.5%)	Organic solvents	231 (60.3%)
	Aliphatic alcohols	69 (36.9%)	Carbon monoxide	228 (59.5%)
	Aliphatic aldehydes	66 (35.3%)	Alkanes (C5-C17)	211 (55.1%)
P ≥ 25% threshold	Cleaning agents	38 (20.3%)	PAHs from any source	163 (42.6%)
	Organic solvents	32 (17.1%)	Organic solvents	135 (35.2%)
	Biocides	31 (16.6%)	PAHs from petroleum	119 (31.1%)
	Fabric dust	28 (15.0%)	Carbon monoxide	96 (25.1%)
	Aliphatic aldehydes	28 (15.0%)	Alkanes (C18+)	87 (22.7%)

[a] Among 187 distinct 5-digit ISCO-68 codes in the female JEM

[b] Among 383 distinct 5-digit ISCO-68 codes in the male JEM

Sensitivity Analyses

In addition to our main analyses, sensitivity analyses were conducted by modifying the exposure probability threshold (≥25%: see Table 23 in Appendix C), the exclusion of exposures with low confidence (rated as 1 or "possible"), using one time period (1933-2011), and using 7-digit CCDO codes in the occupational code axis. Results of these sensitivity analyses can be found in Appendix C.

Across all sensitivity analyses, most cells in each sex-specific JEM were considered concordantly unexposed (probability of exposure either <5% or <25%) with few cells considered exposed in at least one of the JEMs (Tables 24, 28, 32, and 36 in Appendix C & Table 5). Tables comparing the main analyses and sensitivity analyses can be found in Appendix D. The majority of cells in both JEMs had median values of zero for the frequency, intensity, and FWI of exposure, which contributed to a high agreement of greater than 90% between sex-specific JEMs across all exposure metrics. Consistent with our main findings, jobs held by women proportionally had lower values of exposure metrics relative to men.

Furthermore, a moderate agreement between JEMs was also evident across exposure metrics in sensitivity analyses (Tables 25, 29, 33, & 37 in Appendix C & Table 6). This finding was comparable with the results of our main analyses (Table 10). However, minor increases in agreement among exposure metrics between sex-specific JEMs were observed in some sensitivity analyses. For example, when the exposure probability threshold of ≥25% was used rather than that of ≥5%, the agreement slightly increased for all exposure metrics apart from the probability of exposure, which decreased. Such a slight increase in agreement was observed among Kendall's tau values only in the probability, median intensity, and median FWI of exposure when exposures with low confidence (rated as 1 or "possible" by experts) were excluded. This was dissimilar to ICC values wherein a slight increase in agreement was only observed in the FWI of exposure. When one time period (1933-2011) as opposed to four sub-periods was used, an increase in agreement across all exposure metrics was observed apart from the probability of exposure when ICC was computed. The same was observed when CCDO7D codes were used in place of 5-digit ISCO-68 codes. The ECDF plots were generally similar to those of the main analyses (Figures 2-6 in Appendix C). Although no drastic differences were observed, the probability and median frequency of exposure metrics were slightly greater in the female JEM while the median intensity and median FWI of exposure were slightly greater in the male JEM. However, these differences, like our main analysis, were not clearly discernible as the plots for the female and male JEM overlapped.

Table 10. Summary table of agreement statistics across sensitivity analyses

Agreement statistics	Sensitivity analyses	Probability of exposure	Median frequency of exposure	Median intensity of exposure (1, 5, 25 scale)	Median FWI of exposure (1, 5, 25 scale)
Kendall's tau					
	Main	0.42 (0.39 – 0.46)	0.44 (0.40 – 0.47)	0.25 (0.20 – 0.31)	0.38 (0.34 – 0.41)
	Probability ≥25[a]	0.40 (0.35 – 0.46)	0.67 (0.62 – 0.72)	0.29 (0.20 – 0.38)	0.52 (0.45 – 0.57)
	Confidence 2 & 3[b]	0.44 (0.41 – 0.48)	0.44 (0.40 – 0.48)	0.27 (0.21 – 0.33)	0.39 (0.35 – 0.43)
	One time period[c]	0.44 (0.39 – 0.47)	0.50 (0.46 – 0.53)	0.30 (0.24 – 0.36)	0.41 (0.37 – 0.46)
	CCDO 7-digit codes[d]	0.47 (0.43 – 0.51)	0.59 (0.54 – 0.63)	0.27 (0.19 – 0.35)	0.50 (0.46 – 0.55)
ICC					
	Main	0.75 (0.73 – 0.77)	0.53 (0.50 – 0.57)	-	0.17 (0.12 – 0.21)
	Probability ≥25[a]	0.58 (0.50 – 0.64)	0.81 (0.77 – 0.84)	-	0.30 (0.20 – 0.40)
	Confidence 2 & 3[b]	0.75 (0.73 – 0.78)	0.52 (0.47 – 0.57)	-	0.19 (0.13 – 0.25)
	One time period[c]	0.74 (0.70 – 0.77)	0.61 (0.56 – 0.65)	-	0.20 (0.14 – 0.27)
	CCDO 7-digit codes[d]	0.74 (0.70 – 0.77)	0.73 (0.69 – 0.77)	-	0.20 (0.12 – 0.27)

ICC, Intraclass correlation coefficient; FWI, Frequency-weighted intensity
[a] Using an exposure probability threshold of 25% to define ever exposure
[b] Excluding exposures with a confidence of 1 (i.e., "possible")
[c] Using 1 time period (1933-2011)
[d] Using 7-digit CCDO codes in the occupational code axis

3.2.2 Bayesian comparison of sex-specific estimation of exposure metrics in CANJEM

Notable differences between occupations held by women and men

Notable differences in the probability of exposure within agent-occupation combinations were investigated in one time period (from 1933 to 2011) between women and men in the main analysis using a 95% credible limit and a resolution of 5-digit ISCO-68 codes (Appendix E presents the exhaustive results). One time period was selected as the main analysis due to the small cell sizes in four sub-periods (1933-1949, 1950-1969, 1970-1984, and 1985-2011). The notable differences in one time period were also compared within agent-occupation combinations using two and four time periods (Table 11). From 1933 to 2011, 211 agent-occupation combinations were identified to be notably different between sexes, with 65 combinations with higher notable differences in females than males, and 146 combinations with higher notable differences in males than females. When truncating the time periods, we observe more minute differences. In using two time periods, it is observed that there were more notable differences between sexes in the more recent time period (1970-2011) relative to the earlier period (1933-1969). Similarly, when further parsing time periods into four, there were more notable differences in the latest time period (1985-2011). Overall, in the presence of a notable difference in exposure probability within agent-occupation combinations, males consistently had a higher probability of exposure than females across each configuration of time period considered.

Table 11. Notable differences[a] in the probability of exposure across different time periods

Number of Time Periods	Year	Notable differences		
		Female>Male[b]	Male>Female[c]	Total[d]
One	**1933-2011**	65	146	211
Two	**1933-1969**	10	14	24
	1970-2011	20	36	56
Four	**1933-1949**	21	45	66
	1950-1969	5	18	23
	1979-1984	27	42	69
	1985-2011	39	69	108

[a] As defined by Lacourt et al. (2018)
[b] Agent-occupation combinations with notable differences greater in females than males
[c] Agent-occupation combinations with notable differences greater in males than females

Notable differences in one time period (1933-2011)

Among notable differences identified from 1933 to 2011, most corresponded to men having a greater probability of exposure than women. Notable differences were defined as cells with the greatest difference in the probability of exposure. All notable differences within this time period are listed in Table 47 in Appendix E. The ten most notable differences for each sex are summarized in Tables 12 and 13 with estimated differences and 95% credible limits reported.

The most commonly listed occupations with higher probabilities of exposures to multiple agents in women than in men were those of *Farm Workers (General)* and *Other Salespersons, Shop Assistants, and Demonstrators.* Female *Farm Workers (General)* had a notably higher probability of exposure relative to males to six agents (ultraviolet radiation, methane, C1-C4 alkanes, hydrogen sulphide, ammonia, and cleaning agents) - five of which were listed among the ten most notable differences (Table 12). This is in contrast to male *Farm Workers (General)* that had a higher probability of exposure to only two agents (calcium oxide and copper) not among the ten most notable differences (Table 13 and Table 47 in Appendix E). Conversely, males working as *Other Salespersons, Shop Assistants, and Demonstrators* had a notably higher probability of exposure relative to females of the same occupation to 16 agents, seven of which were listed among the ten most notable differences (leaded gasoline, PAHs from any source, PAHs from petroleum, C5-C17 alkanes, carbon monoxide, engine emissions, and MAHs) (Table 13).

From the notable differences listed in one time period (1933-2011), occupations with notable differences were identified and agents that had a notable difference by sex are listed in Table 14. Overall, thirteen unique 5-digit ISCO-68 codes were identified, with a notable difference consisting of at least one female and one male, in which different agents were listed between sexes. Among females, four ISCO-68 codes had a greater number of agents that were notably different relative to males. Among males, seven job codes had a greater number of agents that were notably different relative to females. In particular, females working as *Retail Trade Salespersons* and *Charworkers* had a greater number of agents listed than males in the same occupation. In contrast, a greater number of agents were listed for males working as *Manager, Retail Trade* and *Labourers* in contrast to females of the same occupation. It may be that females and males have different exposures as greater probabilities of exposure to specific agents were discerned across commonly held job titles. However, smaller median differences in exposures were also observed among both women and men working as *Retail Trade Salespersons* (Table 47 in Appendix E). This includes small median exposure differences greater in women for polyester fibres, organic solvents, ammonia, and aliphatic alcohols, and greater in men for PAHs (from any source and from petroleum), lead, and carbon monoxide. The same can be said for women working as *Charworkers* as the median difference was smaller albeit greater in women. This may allude to the fact that overlapping tasks may not be entirely the same between women and men or illustrates that industry segregation between women and men may already be present. However, it may be that notable differences are less noticeable as more precise occupational codes of each job was considered, as has been previously observed (Lacourt et al., 2018).

Table 12. Ten most notable differences greater in women than in men according to agent-occupation combinations from 1933-2011

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	95%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Ultraviolet Radiation	Farm Worker (General)	14/16 (87.5)	16/316 (5.06)	68.5	5.9	-62.5	-79.2	-40.9
Methane	Farm Worker (General)	11/16 (68.75)	13/316 (4.11)	59.5	4.6	-54.7	-74.0	-32.4
Alkanes (C1-C4)	Farm Worker (General)	11/16 (68.75)	14/316 (4.43)	58.1	4.9	-53.1	-70.9	-32.2
Hydrogen Sulphide	Farm Worker (General)	10/16 (62.5)	23/316 (7.28)	54.8	7.7	-47.0	-67.5	-25.0
Ammonia	Farm Worker (General)	11/16 (68.75)	31/316 (9.81)	56.0	10.4	-45.6	-66.1	-24.2
Cleaning Agents	Server, General	316/428 (73.83)	54/189 (28.57)	73.3	29.6	-43.7	-51.0	-35.9
Aliphatic Alcohols	Janitor	15/18 (83.33)	39/159 (24.53)	66.2	25.6	-40.3	-57.0	-21.1
Aromatic Alcohols	Women's Hairdresser	48/66 (72.73)	3/15 (20)	66.9	28.2	-38.4	-58.0	-14.2
Isopropanol	Janitor	14/18 (77.78)	36/159 (22.64)	62.0	23.6	-38.2	-56.2	-17.4
Cleaning Agents	Bartender	37/49 (75.51)	25/80 (31.25)	71.5	33.2	-38.1	-52.2	-23.0

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

Table 13. Ten most notable differences greater in men than in women according to agent-occupation combinations from 1933-2011

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	95%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Leaded Gasoline	Other Salesperson, Shop Assistants and Demonstrators	1/29 (3.45)	70/94 (74.47)	1.3	71.5	69.7	59.4	78.5
PAHs From Any Source	Other Salesperson, Shop Assistants and Demonstrators	3/29 (10.34)	73/94 (77.66)	9.8	75.2	64.9	52.3	75.2
Alkanes (C5-C17)	Other Salesperson, Shop Assistants and Demonstrators	3/29 (10.34)	76/94 (80.85)	13.9	76.8	62.6	48.0	74.0
Calcium Oxide	Farm Worker (General)	4/16 (25)	277/316 (87.66)	24.0	87.2	63.1	43.6	75.9
PAHs From Petroleum	Other Salesperson, Shop Assistants and Demonstrators	3/29 (10.34)	70/94 (74.47)	8.6	72.2	63.1	50.0	73.5
Carbon Monoxide	Other Salesperson, Shop Assistants and Demonstrators	1/29 (3.45)	62/94 (65.96)	4.3	64.2	59.4	48.1	69.6
Cosmetic Talc	Women's Hairdresser	11/66 (16.67)	15/15 (100)	21.3	80.9	59.1	36.4	75.5
Engine Emissions	Other Salesperson, Shop Assistants and Demonstrators	5/29 (17.24)	76/94 (80.85)	22.0	78.3	56.0	39.7	69.4
Mononuclear Aromatic Hydrocarbons	Other Salesperson, Shop Assistants and Demonstrators	1/29 (3.45)	60/94 (63.83)	6.4	60.5	53.6	40.8	64.3
Calcium Sulphate	Building Painter	1/5 (20)	124/180 (68.89)	15.1	68.4	52.8	22.5	67.8

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

Table 14. Occupations and agents with notable differences in the probability of exposure by sex from 1933-2011

ISCO-68 code title and code	Probability of exposure greater in females		Probability of exposure greater in males	
	Number of agents (n)	Agents	Number of agents (n)	Agents
Manager, Retail Trade 4-00.30	3	Aliphatic Aldehydes, Fabric Dust, Formaldehyde	16	Alkanes (C1-C4, C5-C17, C18+), Benzene, Benzo-a-pyrene, Carbon Monoxide, Chrysotile asbestos, Engine Emissions, Lead, Leaded Gasoline, Metallic Dust, MAHs, Nitrogen Oxides, PAHs from any source, PAHs from Petroleum, Sulphur Dioxide
Retail Trade Salesperson 4-51.30	10	Aliphatic Alcohols, Aliphatic Aldehydes, Ammonia, Cleaning Agents, Cotton Dust, Fabric Dust, Formaldehyde, Organic Solvents, Polyester Fibres, Synthetic Fibres	5	Carbon Monoxide, Engine Emissions, Lead, PAHs from any source, PAHs from Petroleum
Labourer 9-99.10	1	Cleaning Agents	11	Benzo-a-pyrene, Brick Dust, Calcium Sulphate, Concrete Dust, Cristalline Silica, Diesel Engine Emissions, Engine Emissions, Mineral Wool Fibres, Portland Cement, Ultraviolet Radiation, Wood Dust
Working Proprietor (Restaurant) 5-10.30	3	Ashes, Biocides, Cleaning Agents	7	Alkanes (C1-C4), Methane, Natural Gas, Other Pyrolysis Fumes, PAHs from any source, PAHs from other sources, Propane
Charworker 5-52.20	7	Abrasives Dust, Aliphatic Alcohols, Ashes, Cotton Dust, Cristalline Silica, Hypochlorites, Isopropanol	1	Waxes Polishes
Cook, except Private Service 5-31.30	2	Biocides, Cleaning Agents	6	Alkanes (C1-C4), Methane, Other Pyrolysis Fumes, PAHs from any source, PAHs from other sources, Propane
Farm Worker (General) 6-21.05	6	Alkanes (C1-C4), Ammonia, Cleaning Agents, Hydrogen Sulphide, Methane, Ultraviolet Radiation	2	Calcium Oxide, Copper

ISCO-68 code title and code	Probability of exposure greater in females		Probability of exposure greater in males	
	Number of agents (n)	Agents	Number of agents (n)	Agents
Sales Manager (except Wholesale and Retail Trade) 2-19.30	1	Ozone	4	Carbon Monoxide, Lead, PAHs from any source, PAHs from Petroleum
Storeroom Clerk 3-91.40	2	Fabric Dust, Synthetic Fibres	3	Carbon Monoxide, PAHs from any source, PAHs from Petroleum
General Physician 0-61.05	2	Aliphatic Alcohols, Isopropanol	1	Cosmetic Talc
Sewing-Machine Operator 7-95.50	1	Radio Frequency Microwaves	2	Acetate Fibres, Wool Fibres
Other Cooks 5-31.90	1	Biocides	1	PAHs from any source
Women's Hairdresser 5-70.20	1	Aromatic Alcohols	1	Cosmetic Talc

MAHs, Monocyclic Aromatic Hydrocarbons; PAHs, Polycyclic Aromatic hydrocarbons

Sensitivity Analyses

In addition to our main analyses, sensitivity analyses were conducted by modifying the time period (i.e., to two and four time periods), the ISCO-68 code resolution (i.e., to 3-digits), and by changing the level of confidence for the notable difference criteria (credible limit of 95% or 90%). Results of these sensitivity analyses can be found in Appendix F. Comparison of results between our main analyses and sensitivity analyses can be found in Appendix G. Similar to our main analyses, women had a lower proportion of agent-occupation combinations that were notably different relative to men in all sensitivity analyses.

Time period. Comparison of results between our main analyses and sensitivity analyses can be found in Table 78 and 79 in Appendix G. Briefly, the notable difference analysis in two time periods (1933-1969 and 1970-2011) showed similar results to that of our main analysis (one period: 1933-2011) among women (Appendix F.I). However, female *Waiters, General* had a higher probability of exposure (cleaning agents, cooking fumes, aliphatic aldehydes, and formaldehyde) relative to males in both time periods, which was not listed in the main analyses. Contrastingly, men had more variability in occupations with significantly higher probabilities of exposure relative to females when using two time periods and occupations listed were not similar to those of the main analysis. Furthermore, the use of four time periods (1933-1949, 1950-1969, 1970-1984, and 1985-2011) reflected similarities to the main analyses (periods 1 and 2 for females and period 3 for males), but further revealed changes in exposures over time (Appendix F.II). It is observed that a higher probability of exposure in women and men were concentrated in particular jobs across time periods. Earlier time periods revealed a higher probability of exposure (aromatic amines, organic dyes and pigments, aromatic alcohols, and bleaches) in women relative to men among *Women's Hairdressers*, which then transitioned to a higher probability of exposure (ultraviolet radiation, alkanes (C1-C4), methane, and ammonia; lead fumes and tin fumes, respectively) in *Farm Workers (General)* then *Electronic Equipment Assemblers* over time. Higher probabilities in exposure (leaded gasoline, PAHs from any source, alkanes (C5-C17), and PAHs from petroleum) among men working as *Other Salesperson, Shop Assistants and Demonstrators* were observed in the earliest and latest time periods. Meanwhile, *Building Painters* had higher probabilities in exposure (titanium, titanium dioxide, iron oxides, and calcium sulphate) in the second time period (1950-1969).

ISCO-68 code. Comparison of results between our main analyses and sensitivity analyses can be found in Table 80 and 81 in Appendix G. The substitution of a 5-digit ISCO-68 code resolution for a lower occupational code resolution of 3-digits from the main analysis changed the most notable differences drastically (Appendix F.III). Women and men working as *Welders and Flame-Cutters* had very different exposures as females had notably higher probabilities of exposure to five agents (soldering fumes, tin, hydrogen chloride, lead, and tin fumes) relative to men while men had notably higher probabilities of exposure to eight different agents (nitrogen oxides, carbon monoxide, iron fumes, manganese fumes, manganese, metal oxide fumes, iron, and arc welding fumes) relative to women. Notable differences were not the same as the main analyses for either sex. The results were similar even when a 90% credible interval was applied in place of a 95% credible interval (Appendix F.IV).

Level of confidence for the notable difference criteria. Comparison of results between our main analyses and sensitivity analyses can be found in Table 82 and 83 in Appendix G. The use of a 90% credible limit for the notable difference criteria was used in place of a 95% credible limit from our main analysis (Appendix F.V). In doing so, notable differences were akin to those listed in our main analyses. Female *Farm Workers (General)* predominantly had notably higher probabilities of exposure (ultraviolet radiation, methane, alkanes (C1-C4), hydrogen sulphide, and ammonia) relative to males. Although more notable differences were listed with a lower credible limit of 90%, the same ten agent-occupations with notably higher probabilities of exposure among males relative to females as those listed in the main analysis were observed.

To further investigate these findings, analyses were conducted using a 90% credible limit for two (1933-1969 and 1970-2011) and four (1933-1949, 1950-1969, 1970-1984, and 1985-2011) time periods (Appendix F.VI). The use of two time periods and a 90% credible limit changed results wherein the notably different agent-occupations with higher probabilities in exposure in males relative to females were dissimilar to those of the main analyses. Meanwhile, notably different agent-occupations with higher probabilities in exposure in females relative to males were similar to those of the main analyses. More differences are observed when four time periods (1933-1949, 1950-1969, 1970-1984, and 1985-2011) with a 90% credible limit was used. Notable differences in the probability of exposure varied by period relative to the main analysis (Appendix F.VII). Female Farm Workers (General) were not listed as one of the ten occupations with the highest probabilities of exposure to certain agents relative to men in periods one, two, and four. Males working as Other Salespersons, Shop Assistants and Demonstrators were not among the ten occupations with the highest probabilities of exposure to certain agents relative to women in periods two and three. It is again observed that a higher probability of exposure to certain agents were concentrated in certain occupations among women and men, which was also observed over time.

3.3 Estimation of prevalent occupational exposures among Montréal women

The following results describe the content of the enhanced CANJEM from the Bayesian model that now includes 4,362 female jobs in addition to the existing female jobs in CANJEM. After female and male JEM comparisons, we aimed to characterize workplace exposures among women in CANJEM.

Estimates of the Frequency of Occupational Codes (5-digit ISCO-68 Job Codes)

Table 15 lists the most frequently-held jobs without an exposure probability threshold and Table 16 lists the most frequently held jobs that had an exposure probability ≥5% to at least one agent. From 1933 to 2011, the most frequently held jobs considered as exposed (exposure probability threshold ≥5%) among Montréal women tended to be in the textile and production, health care, retail, and service industries (Table 16). In particular, *Sewing-Machine Operators* and *Servers (General)* were the most frequently held occupations in this single time period. Compared to Table 15, only *Sewing-Machine Operators*, *Retail Trade Salesperson,* and *Nursing Aid* remained among the most frequent when a minimum exposure probability threshold of 5% was applied. The occupations in Table 16 remained the most frequent across four time periods (Table 17). In comparing different time periods, it was also observed that fewer women worked as *Housemaids* and *Women's Hairdressers* over time. Moreover, some occupations did not remain common among women after the first time period of 1933-1949 such as *Solderers (Hand)*, *Other Tailors and Dressmakers*, and *Other Production and Related Workers Not Elsewhere Classified*. It is evident that there was a transition of women working in the textile and production industry to the health care, retail, and service industries. For instance, the rise in female *Nursing Aids* was evident from the second time period of 1950-1969.

Table 15. Ten most frequent 5-digit ISCO-68 codes among Montréal women with no minimum probability of exposure to CANJEM agents from 1933-2011

ISCO-68 code	ISCO-68 code title	Number of jobs (n)
7-95.50	Sewing-Machine Operator	4,653
5-32.10	Server, General	1,990
4-51.30	Retail Trade Salesperson	1,278
5-70.20	Women's Hairdresser	1,118
5-99.40	Nursing Aid	1,066
5-40.20	Housemaid	1,004
9-71.50	Hand Packer	993
5-52.20	Charworker	853
3-21.20	Stenographic Secretary	743
5-31.30	Cook, except Private Service	716

Table 16. Ten most frequent 5-digit ISCO-68 codes among Montréal women with a minimum of 5% probability of exposure to one or more CANJEM agents from 1933-2011

ISCO-68 code	ISCO-68 code title	Number of jobs exposed (n)
7-95.50	Sewing-Machine Operator	4,314
5-32.10	Server, General	1,816
5-70.20	Women's Hairdresser	1,114
4-51.30	Retail Trade Salesperson	992
5-99.40	Nursing Aid	936
5-40.20	Housemaid	902
5-52.20	Charworker	800
5-31.30	Cook, except Private Service	633
9-71.50	Hand Packer	601
0-71.10	Professional Nurse (General)	576

Table 17. Top 10 prevalent 5-digit ISCO-68 codes among Montréal women with an exposure probability threshold of ≥5% in four time periods

1933-1949		1950-1969		1970-1984		1985-2011	
ISCO-68	**ISCO-68 code title**	**ISCO-68**	**ISCO-68 code title**	**ISCO-68**	**ISCO-68 code title**	**ISCO-68**	**ISCO-68 code title**
7-95.50	Sewing-Machine Operator	7-95.50	Sewing-Machine Operator	7-95.50	Sewing-Machine Operator	7-95.50	Sewing-Machine Operator
5-32.10	Server, General	5-32.10	Server, General	5-32.10	Server, General	5-32.10	Server, General
5-40.20	Housemaid	5-70.20	Women's Hairdresser	5-70.20	Women's Hairdresser	5-99.40	Nursing Aid
8-72.60	Solderer (Hand)	5-40.20	Housemaid	4-51.30	Retail Trade Salesperson	5-52.20	Charworker
9-71.50	Hand Packer	1-33.20	First-Level Education Teacher	5-52.20	Charworker	4-51.30	Retail Trade Salesperson
5-31.30	Cook, except Private Service	4-51.30	Retail Trade Salesperson	5-99.40	Nursing Aid	5-70.20	Women's Hairdresser
7-52.50	Winder	0-71.10	Professional Nurse (General)	5-40.20	Housemaid	5-40.20	Housemaid
5-60.60	Laundry Pressing-Machine Operator	5-99.40	Nursing Aid	0-71.10	Professional Nurse (General)	5-31.30	Cook, except Private Service
7-91.90	Other Tailors and Dressmakers	9-71.50	Hand Packer	1-33.20	First-Level Education Teacher	9-71.50	Hand Packer
9-49.90	Other Production and Related Workers n.e.c.	5-60.60	Laundry Pressing-Machine Operator	5-31.30	Cook except Private Service	5-40.50	Chambermaid

n.e.c, not elsewhere classified

Estimates of Agent Prevalence

From the enhanced information in CANJEM, we observed that organic solvents, cleaning agents, and ozone were among the twenty most prevalent agents among exposed job codes (exposure probability threshold ≥5%) held by Montréal women from 1933 to 2011 (Table 18). All agents among exposed jobs held by Montréal women from 1933-2011 are listed in Table 84 in Appendix H. Overall, 196 of 258 CANJEM agents were listed across exposed female jobs. Organic solvents consistently remained prevalent across four time periods (1933-1949, 1950-1969, 1970-1984, 1984-2011) (Table 19). Cleaning agents and ozone became increasingly more prevalent among working women over time while fabric dust became less prevalent, thus reflecting the changing exposure profiles of women in the workplace. Some agents were among the ten most prevalent in only one time period, including PAHs from any source from 1933-1949 and synthetic fibres from 1950-1969. Contrastingly, engine emissions became one of the ten most prevalent agents in the fourth time period (1985-2011), which was not listed in the previous time periods. This is in line with the gradual changes in occupations over time as illustrated in Table 17. As job profiles changed, exposure profiles changed in suit.

Table 18. Twenty most prevalent occupational exposures with an exposure probability threshold ≥5% among Montréal women from 1933-2011

IDCHEM	Agent	ISCO-68 job code exposed (n)	Prevalence of exposure (%)	Concentration of exposure (1, 5, 25 scale)				Frequency of exposure (hours per week)				FWI of exposure			
				Q1	Mean	Std	Q3	Q1	Mean	Std	Q3	Q1	Mean	Std	Q3
460003	Organic solvents	89	47.59	1.00	1.93	2.91	1.27	3.50	14.79	15.59	35.00	0.10	1.05	2.99	1.00
990005	Cleaning agents	75	40.11	1.00	1.09	0.47	1.00	2.90	8.13	10.32	7.44	0.07	0.25	0.42	0.19
210801	Ozone	72	38.50	1.00	1.04	0.35	1.00	2.24	4.71	6.41	3.50	0.06	0.14	0.29	0.09
520299	Aliphatic alcohols	69	36.90	1.00	1.63	1.62	1.00	2.50	8.96	11.95	6.50	0.08	0.47	1.09	0.22
520599	Aliphatic aldehydes	66	35.29	1.00	1.48	3.02	1.00	10.00	25.35	15.32	40.00	0.25	0.67	0.40	1.00
220501	Formaldehyde	63	33.69	1.00	1.51	3.09	1.00	10.00	25.77	15.21	40.00	0.25	0.68	0.39	1.00
990021	Biocides	60	32.09	1.00	1.50	1.79	1.00	3.50	8.55	10.09	7.34	0.09	0.35	0.69	0.30
160001	Fabric dust	58	31.02	1.00	1.10	0.56	1.00	20.00	28.80	13.31	40.00	0.50	0.82	0.69	1.00
170003	Cellulose	55	29.41	1.00	1.03	0.23	1.00	10.31	26.54	14.41	40.00	0.26	0.69	0.43	1.00
140001	Cotton dust	49	26.20	1.00	1.11	0.61	1.00	14.00	27.46	13.78	40.00	0.35	0.81	0.74	1.00
370004	Engine emissions	47	25.13	1.00	1.15	0.66	1.00	5.44	9.63	7.13	10.00	0.15	0.25	0.17	0.27
150001	Synthetic fibres	44	23.53	1.00	1.43	1.04	1.50	27.50	34.72	8.71	40.00	0.82	1.30	1.10	1.50
420204	Isopropanol	43	22.99	1.00	1.26	0.90	1.00	2.50	5.72	8.56	4.00	0.06	0.17	0.22	0.12
530193	PAHs from any source	35	18.72	1.00	1.37	1.07	1.00	5.50	26.08	17.29	40.00	0.14	1.05	1.34	1.00
150009	Polyester fibres	33	17.65	1.00	1.12	0.70	1.00	20.00	30.10	11.97	40.00	0.50	0.88	0.74	1.00
210701	Ammonia	32	17.11	1.00	1.20	0.59	1.00	2.50	12.15	14.04	15.50	0.06	0.41	0.58	0.53
520199	Alkanes (C5-C17)	32	17.11	1.00	3.03	3.76	3.25	6.00	20.88	14.14	35.00	0.25	1.73	3.00	1.31
510004	Hypochlorites	31	16.58	1.00	1.00	0.01	1.00	3.42	7.48	10.18	5.00	0.09	0.19	0.25	0.12
460002	Synthetic adhesives	30	16.04	1.00	2.29	4.46	1.23	26.04	29.56	14.20	40.00	0.71	2.01	4.53	1.00
530199	Mononuclear aromatic hydrocarbons	27	14.44	1.00	4.13	6.68	4.11	7.44	25.90	15.46	40.00	0.23	3.58	6.89	3.79

[a] FWI, Frequency weighted intensity of exposure was calculated by multiplying the concentration of exposure by the frequency of exposure

Table 19. **Top 10 prevalent agents among Montreal women with an exposure probability threshold of ≥5% in four time periods**

IDCHEM	Agent	ISCO-68 job code exposed (n)	Prevalence of exposure (%)	Concentration of exposure (ranging from 1 to 25)				Frequency of exposure (hours per week)				FWI of exposure			
				Q1	Mean	Std	Q3	Q1	Mean	Std	Q3	Q1	Mean	Std	Q3
1933-1949															
460003	Organic solvents	17	70.83	1.00	1.55	1.62	1.00	2.50	12.65	14.28	15.00	0.06	0.86	1.95	0.56
140001	Cotton dust	13	54.17	1.00	1.62	1.50	1.00	5.00	26.15	18.29	40.00	0.12	1.32	1.83	1.00
160001	Fabric dust	13	54.17	1.00	1.62	1.50	1.00	5.00	26.15	18.29	40.00	0.12	1.46	2.23	1.00
220501	Formaldehyde	13	54.17	1.00	1.00	0.00	1.00	37.50	32.92	13.37	40.00	0.94	0.82	0.33	1.00
520599	Aliphatic aldehydes	13	54.17	1.00	1.02	0.08	1.00	37.50	34.42	12.34	40.00	0.94	0.88	0.33	1.00
530193	PAHs from any source	10	41.67	1.00	1.40	1.26	1.00	19.62	26.83	12.83	39.38	0.49	1.07	1.41	0.98
990005	Cleaning agents	10	41.67	1.00	1.00	0.00	1.00	5.00	11.95	11.71	10.94	0.12	0.30	0.29	0.27
170003	Cellulose	9	37.50	1.00	1.44	1.33	1.00	20.00	27.60	13.57	40.00	0.50	1.13	1.48	1.00
370002	Cooking fumes	9	37.50	1.00	1.11	0.33	1.00	5.00	17.83	15.95	36.00	0.12	0.51	0.49	1.00
990021	Biocides	9	37.50	1.00	1.00	0.00	1.00	3.25	15.00	16.79	31.25	0.08	0.38	0.42	0.78
1950-1969															
460003	Organic solvents	40	52.63	1.00	1.88	1.71	1.71	2.69	15.19	15.82	32.54	0.07	0.78	1.38	1.00
990005	Cleaning agents	36	47.37	1.00	1.15	0.52	1.00	4.30	10.63	10.57	11.00	0.11	0.41	0.65	0.28
520599	Aliphatic aldehydes	35	46.05	1.00	1.44	1.17	1.00	8.00	27.06	16.18	40.00	0.30	0.72	0.38	1.00
220501	Formaldehyde	34	44.74	1.00	1.45	1.19	1.00	7.26	26.62	16.08	40.00	0.31	0.71	0.38	1.00
520299	Aliphatic alcohols	32	42.11	1.00	1.70	1.42	1.06	2.50	6.38	10.61	4.41	0.08	0.35	1.09	0.19
160001	Fabric dust	30	39.47	1.00	1.13	0.73	1.00	12.50	28.05	14.25	40.00	0.31	0.84	0.86	1.00
140001	Cotton dust	28	36.84	1.00	1.14	0.76	1.00	10.00	26.41	14.62	40.00	0.25	0.80	0.90	1.00
990021	Biocides	27	35.53	1.00	1.29	0.88	1.00	3.69	9.24	9.95	10.00	0.10	0.32	0.42	0.31
150001	Synthetic fibres	20	26.32	1.00	1.53	1.19	1.50	36.88	33.76	11.77	40.00	0.96	1.37	1.29	1.50
170003	Cellulose	20	26.32	1.00	1.16	0.73	1.00	16.00	28.52	14.70	40.00	0.40	0.88	0.87	1.00

IDCHEM	Agent	ISCO-68 job code exposed (n)	Prevalence of exposure (%)	Concentration of exposure (ranging from 1 to 25)				Frequency of exposure (hours per week)				FWI of exposure			
				Q1	Mean	Std	Q3	Q1	Mean	Std	Q3	Q1	Mean	Std	Q3
1970-1984															
460003	Organic solvents	54	52.43	1.00	1.60	2.08	1.00	3.00	11.50	12.94	11.65	0.09	0.50	0.82	0.56
210801	Ozone	42	40.78	1.00	1.00	0.00	1.00	2.25	4.62	6.75	3.94	0.06	0.12	0.17	0.10
220501	Formaldehyde	41	39.81	1.00	1.11	0.63	1.00	10.00	24.60	14.64	40.00	0.25	0.63	0.35	1.00
520599	Aliphatic aldehydes	41	39.81	1.00	1.10	0.62	1.00	10.00	25.01	14.42	40.00	0.25	0.65	0.36	1.00
990005	Cleaning agents	41	39.81	1.00	1.06	0.37	1.00	3.50	7.36	7.85	7.70	0.09	0.20	0.23	0.19
520299	Aliphatic alcohols	38	36.89	1.00	1.37	0.79	1.00	2.50	5.73	8.62	4.88	0.07	0.23	0.57	0.12
160001	Fabric dust	30	29.13	1.00	1.13	0.73	1.00	10.00	25.29	14.52	40.00	0.25	0.76	0.78	1.00
990021	Biocides	29	28.16	1.00	1.08	0.45	1.00	3.50	5.84	5.08	5.00	0.09	0.17	0.20	0.14
420204	Isopropanol	27	26.21	1.00	1.23	0.64	1.00	2.50	3.64	2.23	3.75	0.06	0.10	0.06	0.11
170003	Cellulose	26	25.24	1.00	1.07	0.34	1.00	10.00	20.72	12.63	33.86	0.25	0.58	0.48	0.85
1985-2011															
460003	Organic solvents	52	49.06	1.00	1.11	0.45	1.00	2.50	8.28	9.80	7.51	0.08	0.25	0.29	0.25
210801	Ozone	51	48.11	1.00	1.00	0.00	1.00	2.16	2.86	1.13	3.00	0.05	0.07	0.03	0.07
990005	Cleaning agents	43	40.57	1.00	1.09	0.61	1.00	4.00	6.33	6.12	7.20	0.10	0.16	0.15	0.19
520299	Aliphatic alcohols	38	35.85	1.00	1.11	0.65	1.00	2.50	6.00	7.35	5.00	0.06	0.16	0.20	0.12
370004	Engine emissions	35	33.02	1.00	1.08	0.35	1.00	4.94	10.30	10.27	10.00	0.13	0.27	0.26	0.28
990021	Biocides	34	32.08	1.00	1.18	0.76	1.00	2.94	6.60	8.23	5.00	0.09	0.18	0.21	0.16
420204	Isopropanol	30	28.30	1.00	1.01	0.04	1.00	2.50	4.04	3.26	4.44	0.06	0.10	0.08	0.12
520599	Aliphatic aldehydes	29	27.36	1.00	1.00	0.00	1.00	10.00	20.72	12.88	35.00	0.25	0.52	0.32	0.88
220501	Formaldehyde	27	25.47	1.00	1.00	0.00	1.00	10.62	21.38	12.89	35.50	0.27	0.53	0.32	0.89
160001	Fabric dust	26	24.53	1.00	1.00	0.00	1.00	10.66	23.54	13.59	38.75	0.27	0.59	0.34	0.97

[a] FWI, Frequency weighted intensity of exposure was calculated by multiplying the concentration of exposure by the frequency of exposure

Of the 258 agents from the enhanced information in CANJEM, 62 agents were not attributed to ISCO-68 job codes held by women from 1933-2011 therefore the exposure metrics could not be estimated (Table 20). It may also be that agents were not included as a minimum of ten jobs and three subjects in a cell were required to be included in analyses.

Table 20. CANJEM agents without exposed female jobs among Montréal women from 1933-2011

IDCHEM	Agent	IDCHEM	Agent
110012	Glass fibres	312801	Nickel fumes
110014	Brick dust	312901	Copper fumes
110017	Refractory brick dust	314801	Cadmium fumes
110019	Brass dust	370008	Liquid fuel combustion products
110020	Stainless steel dust	370016	Coke combustion products
110030	Mica	410005	Plating solutions
111401	Silicon carbide	420403	Formic acid
111600	Sulfur	420702	RDX
112601	Iron oxides	420804	1,1,1-Trichlorethane
118201	Lead oxides	421001	Carbon disulphide
118204	Basic lead carbonate	421302	Trichloroethylene
118205	Lead chromate	421404	Methyl methacrylate
140015	Felt dust	430104	Styrene
150014	Polyethylene	430701	Trinitrotoluene
150015	Polypropylene	460008	Heating oil
150016	Polystyrene	460011	Crude petroleum
150019	Polyamides	460015	Coal tar and pitch
150022	Alkyds	460017	Creosote
150024	Phenol-formaldehyde	460019	Hydraulic fluid
150025	Urea-formaldehyde	460026	Aviation gasoline
150026	Melamine-formaldehyde	460030	Cutting fluids pre-1955
150028	Polyester resins	510002	Fluorides
170001	Coal dust	510005	Nitrates
170005	Coke dust	510499	Beryllium Compounds
170008	Graphite dust	512399	Vanadium compounds
210901	Hydrogen fluoride	512799	Cobalt compounds
211702	Chlorine dioxide	513499	Selenium compounds
221102	Acetylene	515199	Antimony compounds
312001	Calcium oxide fumes	517499	Tungsten compounds
312201	Titanium dioxide fumes	521199	Unsaturated aliphatic hydrocarbons
312401	Chromium fumes	531799	Phthalates

4. DISCUSSION

4.1 Occupations

Our results show that women and men do not tend to work in the same occupations and therefore are exposed to different agents. This finding is comparable to the conclusion of Lacourt et al. (2018) and their sex-differentiated analysis of occupational exposures between women and men, and for which job information was also included in our analyses. In our study, through the creation of sex-specific JEMs from 1933 to 2011 with a resolution of 5-digit ISCO-68 job codes, the female JEM contained 187 job codes and the male JEM contained 383 job codes, with only 110 job codes listed commonly between both JEMs. Women were concentrated in occupations within the administrative and service industries. Men tended to work in the transport and service industries. Even with the inclusion of more jobs held by women, there remains more jobs held by men in CANJEM, and men are distributed across more occupational groups than women. This is in line with the 2014 *Portrait des Québécoises en 8 temps* by the *Conseil du statut de la femme* (CSF, Council on the Status of Women), which reported that women worked in a narrower range of occupations relative to men (Roy, 2014). The CSF had indicated that in 2011, 32.2% of women were concentrated in the top ten jobs among women while 20% of men were concentrated in the top ten jobs among men (Roy, 2014). Interestingly, such gender-segregation has even been identified among a number of industrial sectors and occupational classes in Finland from 2003 to 2015 despite gender-progressive employment policies (Leinonen et al., 2018).

From the enhancement of CANJEM, we were able to further highlight not only the most frequent 5-digit ISCO-68 job codes among Montréal women in one time period (1933-2011), but also to illustrate the gradual changes in job profiles over time in four sub-periods (1933-1949, 1950-1969, 1970-1984, 1985-2011). Occupations such as *Sewing Machine Operators* and *Servers (General)* were consistently the most prevalent across all time periods. Meanwhile, more gradual changes were seen as *Nurse Aids* increased in prevalence across time periods while *Housemaids* and *Hand Packers* decreased. These changes in job profiles are akin to those reported by Statistics Canada. From 1998 to 2018, Statistics Canada reported increases in the representation of women in several professional fields in industries related to law; social, community and government services; education; and business and finance (Pelletier et al., 2019). However, they also reported that women in professional occupations in natural and applied sciences, administrative and financial supervisors, and administrative occupations had decreased in the same time frame (Pelletier et al., 2019). It may be that certain social, political, or economic changes influenced job prevalence over time. For instance, Quebec's 1996 Educational Child Care Act had boosted the rate of workforce participation among women with children aged 0 to 5 from 64% to 80% from 1997 to 2018 (Fortin, 2018). Therefore, time period is an important factor to investigate as patterns of employment change over time, particularly for jobs in which one sex was historically predominant.

4.2 Prevalent exposures

Comparisons between women and men with respect to occupational exposures have been sparse. Studies tend to focus only on one sex and few studies investigate exposures across commonly held occupations between them. Occupational exposure studies tend to be concentrated in men and it has only been acknowledged in recent years that exposures among women with the same occupational titles may differ relative to their male counterparts. Our study was able to characterize the most prevalent agents between sexes through the use of female and male JEMs. In fact, the results from the comparison of these JEMs highlighted the different exposure profiles between sexes. Regardless of the exposure probability thresholds used (≥5% or ≥25%), similar agents were listed as the most prevalent in each sex-specific JEM. Generally, women were most frequently exposed to organic solvents, cleaning agents, and aliphatic aldehydes across occupations. Meanwhile, men were most exposed to PAHs (from any source and from petroleum specifically), carbon monoxide, organic solvents, and C5-C17 alkanes. There are overlaps observed in relation to the findings by Lacourt et al. (2018) in that women had greater exposure to fabric and textile fibre dust, and aliphatic aldehydes. Meanwhile, it was reported that men had greater exposure to motor vehicle exhaust, petroleum fractions, PAHs, building material dust, and abrasive dust (Lacourt et al., 2018). Our results comparing commonly-held occupations and agents with notable differences between sexes (Table 14) are akin to one finding of a scoping review of occupational hazards between sexes within the same occupation (Biswas et al., 2021) that concluded that women were more exposed to wet work (hand-washing and exposure to hands in liquids) (Keegel et al., 2012; Lund et al., 2019). In particular, women working as *Servers (General)* are more exposed to cleaning agents, aliphatic aldehydes, biocides, and formaldehyde; *Cooks (except Private Service)* are more exposed to cleaning agents and biocides; and *Physicians (General)* are more exposed to aliphatic alcohols and isopropanol (Table 14). However, our results diverge from the remainder of the study's conclusions that men were more exposed to medical radiation, solar radiation, and chemical hazards. These differences may be attributed to the fact that the studies included varied in their methodologies used to collect and categorize exposure measures. It may be that the overall workplace profiles included in the scoping review differed from our study. Furthermore, Scarselli et al. (2018) observed that differential exposures to carcinogens between sexes were due to characteristics of work and job segregation. Substantial differences were reported in co-exposures in certain sectors between women and men. In the manufacturing of rubber and plastics, women were proportionally more co-exposed to acrylamide, acrylonitrile, and vinyl chloride monomer while men were proportionally more co-exposed to ethylene oxide, propylene oxide, epichlorohydrin, trichloroethylene, and dinitrotoluene[55]. This study population may differ in relation to ours as 50% of the database represented craft and related trades workers and only 21 carcinogenic agents were measured. Moreover, the measurement data in the study was from mandatory monitoring of a small selection of carcinogens in Italian workplaces as opposed to our study wherein experts retrospectively assessed hundreds of agents.

The most prevalent CANJEM agents among working Montréal women were very consistent across the different time periods. Organic solvents were consistently the most prevalent across all exposed occupations held by women regardless of time period. The list of prevalent agents was also consistent across four sub-periods with only a few small differences between them. In particular, fabric dust became less prevalent while cleaning agents and ozone became increasingly more prevalent. Multiple factors are probably at play; one being that these changes in exposure follow a shift in industry over time from the manufacturing industry to the health care, retail, and service industries, as evidenced in our analysis of ISCO-68 job code frequency among jobs held by women. It may also be that investments in new technologies may have replaced certain jobs and outsourcing textile jobs to other countries has led to a decrease in the demand for textile and production industry jobs (Crompton & Vickers, 2000; Laframboise, 2021; Lindner, 2002; Shelton & Wachter, 2005; Truman & Keating, 1988). Interestingly, of the 258 agents present in CANJEM, only 196 agents were identified in female workplace exposures. The other 62 agents may be present in occupations that have few to no females. Agents may have been excluded from analyses due to our criteria for a minimum of ten jobs and three subjects per agent-occupation combination. Therefore, for exposures incurred by females for which information is available in CANJEM, gender-specific CANJEM may be used to estimate exposures while a genderless CANJEM may be used to estimate exposures for agents that were missing from the female-specific CANJEM or for which little information is available to produce robust estimates.

4.3 Notable differences in exposures by occupational group

In examining occupational exposures between commonly held occupations between sexes, notable differences were identified. Our study illustrated over the whole period (1933-2011) that notable differences between sexes were observed among *Farm Workers (General)*, *Other Salesperson, Shop Assistant and Demonstrators*, and *Women's Hairdressers*. Female *Farm Workers* had higher probabilities of exposures to ammonia, hydrogen sulphide, C1-C4 alkanes, methane, and ultraviolet radiation while male *Farm Workers* had a higher probability of exposures to calcium oxide. In this occupation, it may be that females also have a higher intensity of exposure to ultraviolet radiation as a previous dosimetry study in Danish farmers reported women having a higher mean daily solar ultraviolet exposure on working days when compared to men (3.65 standard erythemal dose vs 2.07 standard erythemal dose, $P < 0.05$) (Borup et al., 2020). A New Zealand study also reported similar exposures to our finding among matched occupational codes, detailing that females reported more exposures to disinfectants, hair dyes, and textile dust while males reported more exposure to welding fumes, herbicides, wood dust, and solvents (Eng et al., 2011). Our results indicated that females that worked as

Women's Hairdressers had a notably higher probability of exposure to aromatic alcohols while males had notably higher exposures to cosmetic talc. Ultimately, these exposures lead us to consider both contextual and biological differences between women and men that could play roles in the nature and magnitude of their exposure to environmental and/or occupational chemicals (Arbuckle, 2006). Moving beyond the identification of specific exposures, it is now important to consider workers' physical environments and personal attributes, the absorption of substances across biological barriers, and the amount of substance that reaches the target sites to substantiate health risks (Arbuckle, 2006).

The exposure differences amongst *Farm Workers (General)* and *Other Salespersons, Shop Assistants and Demonstrators* in our notable difference analyses may in part be attributable to differential task assignments within the same occupations. For instance, a study across three US population-based case-control studies cited that female janitors were significantly more likely to polish furniture (79% vs 44%) while male janitors were more likely to strip floors (73% vs 50%) according to self-reported occupational information (Locke et al., 2014). This may explain why our study observed that female *Janitors* had notably higher exposures to isopropanol and aliphatic alcohols relative to males. Although, it is important to note that the conclusions in the aforementioned study were made from pooled self-reported questionnaire data as opposed to expert-assessment of exposures according to occupational history like those in our study. Furthermore, we would expect a higher agreement in exposure metrics among commonly held occupations if tasks were the same between sexes. Yet, ECDF plots revealed that the probability and frequency of exposure tended to be slightly higher in the female JEM while the intensity and FWI of exposure tended to be slightly higher in the male JEM. Moreover, it may very well be that the differences in the distribution of tasks between sexes may not be an individual's choice. In fact, tradeswomen have voiced that discrimination related to unequal access to skill-building tasks within jobs have contributed to gender-segregation in the workplace (Curtis et al., 2018). Another explanation could be that when asked to describe common tasks in their job, women and men do not report the same tasks, even within the same occupations: Lacourt et al. (2018) reported for example that the jobs of *Sales Clerks* held by women were more often exposed to volatile organic compounds, organic solvents, isopropanol and aliphatic alcohols than those held by men, because women reported using cleaning products to wipe the checkout conveyor belt, a task not reported by men in the same occupations. Although, we simply cannot determine whether a difference is due to reporting or true task completion. On the other hand, we found that *Retail Trade Salespersons* had similar exposure in both men and women as shown by smaller median differences in our notable difference analyses. This indicates that tasks are likely quite similar between women and men. It has been formerly mentioned that anatomical characteristics (relative stature, muscular strength, dexterity, and precision) may influence what tasks women and men are assigned to, thus influencing the exposures incurred in the workplace (Eng et al., 2011). Although, personal protective equipment was part of the expert assessment process, any differential use between women and men in the workplace may have influenced the exposures incurred such as whether equipment was correctly used, which our analyses could not account for.

Aside from differences attributable to true task assignment, jobs held by men and women within different industries may also contribute to the differences observed. In a previous IRSST project, Lacourt et al. (2018) had used a combination of occupational groups (four-digit CCDO codes) and major industry groups (two-digit SIC codes) to identify notable differences among occupational group/industry pairs in the LCS and BCS1. Briefly, four-digit CCDO codes were matched to the respective major industry groups (two-digit SIC code) to describe the distribution of the industry of employment and identify notable differences. This analysis revealed that women and men did not work in the same industries. In particular, the most common industry groups among jobs held by men included the food, beverage and drug industries and transportation industry. Meanwhile, the most common industry groups among jobs held by women included the clothing industries; health and social service industries; and educational services. The notable differences in exposure between jobs held by women versus men were less noticeable when more precise occupational codes or the specific industry of each job was considered. Although, it is unlikely that exposure information sources such as CANJEM would be able to reach a resolution in which more precise classifications of tasks can make differences disappear. This is due to the sample size of data sources based on empirical databases. Further, as over 50% of jobs held by women in our current project are already included in this former analysis, we opted not to conduct analyses that grouped job codes into the industry of occupation (Lacourt et al., 2018).

From our notable differences analyses, we have illustrated that sex-specific exposure estimations using a JEM may be used for occupations in which median differences have been observed to be large. Therefore, estimates beyond 2011 are needed to add more contemporary occupational data and therefore update CANJEM. Future research may also explore the differences between women and men beyond the notable differences that we have identified, particularly among highly sex-stratified jobs, such that the reasons for female- or male-dominated jobs can be identified and characterized.

4.4 Strengths and limitations

The retrospective assessments of exposure completed by expert chemists and industrial hygienists based on the subjects' occupational histories are a more robust form of evaluating previous exposures in comparison to self-report via questionnaires. As the female-specific JEM was constructed like the available CANJEM database, both one time period and different sub-periods were explored. We were able to explore the frequency of occupational codes and the prevalence of exposures thereby also accounting for the variability in tasks and, therefore, exposures that may change over time. This expert assessment was based not only on occupational histories, but also on self-reported task descriptions, which helped refine the assessment; however, tasks may have been reported differentially between females and males as mentioned by Lacourt et al. (2018). A shift in occupational industry among women was observed across sub-periods (1933-1949, 1950-1969, 1970-1984, 1985-2011), but the main analysis focused on only one period (1933-1011); this produced an averaging of exposures across the period that may have masked higher or lower exposures in certain periods (e.g. World War Two) (Crompton & Vickers, 2000).

In the studies with participants including both sexes, expert coders may have become aware of the sex of the subjects, which may have influenced their exposure assessments. However, a previous comparison of exposures in occupations held by both women and men in two of the CANJEM studies (LCS and BCS1) showed that the frequency and intensity of exposure to a given agent was similar for both sexes within the same occupational group (Labrèche et al., 2015; Lacourt et al., 2018). The breast cancer studies (BCS1 and 2) consisted of women only and thus, could not be blinded by sex. Moreover, the validity of exposure assessment may vary with the level of details of the described tasks and the experience of the coders as has been reported previously (Sauvé, Lavoué*,* et al., 2019; Sauvé, Ramsay*,* et al., 2019). Jobs held more recently may be recalled with greater accuracy than those held earlier while several years of experience in assessing retrospective exposure and industrial hygiene experience will reduce variability between jobs and between agents among experts (Sauvé, Lavoué*,* et al., 2019; Sauvé, Ramsay*,* et al., 2019).

Furthermore, a more precise resolution of occupational codes may provide a better understanding of exposures in the workplace in that tasks may be more specific as opposed to less precise occupational code resolutions. By comparing different precisions of occupational job codes (5-digit vs. 3-digit ISCO-68 codes), differences in the most prevalent agent-occupation combinations were observed. For instance, a 5-digit resolution of ISCO-68 job codes between 1933 and 2011 illustrated notable differences in the probability of exposure to various agents between women and men working as *Welders and Flame Cutters*, than when a 3-digit resolution was used. The more precise 5-digit resolution illustrated notable differences in the probability of exposure to various agents between women and men working as *Farm Workers (General)* and *Other Salesperson, Shop Assistant and Demonstrators*. This was also observed in former studies (Eng et al., 2011; Labrèche et al., 2015).

We elected not to explore differences in the industry of employment between women and men, given that industry was investigated in a former study (Lacourt et al., 2018) using a large proportion of women also included in our study, of which the addition of BCS2 data would not drastically alter these results. Segregation was found to already be present by industry, which was similar to the results of our sensitivity analysis wherein notable differences using three-digit ISCO-68 codes differed relative to the use of 5-digit codes. Three-digit ISCO-68 codes group occupations by similarity of the characteristics of the work they entail such that a certain level of homogeneity is achieved and occupations with the same basic subject matter are grouped together (International Labour Office [ILO], 1968). Our higher-level analysis of 5-digit ISCO-68 codes was able to explore more minute differences in segregation by job title as this resolution identifies types of work and covers various jobs or positions that perform one or different combinations of duties or tasks.

The case-control studies that contributed data to CANJEM started between 1979 and 2008, at a time when gender identity was not explicitly collected in epidemiological studies; instead, information on sex was. As the sex-specific CANJEM may not entirely capture gender identity and as gender identity may change over time, it is not possible to conclude whether CANJEM is adequate to reflect gender identity sensitive occupational exposures or whether gender identity-specific JEMs are warranted.

Proxy respondents were used when participants could not provide information on occupational histories. For instance, if a subject had died or if a subject was too ill to participate directly, interviews were conducted with surrogate respondents – typically spouses and occasionally offspring (Labrèche et al., 2010; Lacourt et al., 2018). Our study did not exclude proxy information when making comparisons. It has been previously reported that proxy respondents tend to report significantly fewer jobs than the subject therefore it is possible that we may not have fully captured entire occupational histories from this specific subgroup (Soll-Johanning & Hannerz, 2002). The enhanced data from BCS2 had few proxy respondents (BCS2: 0.4%) while the previous studies had a greater proportion of proxy respondents (MCS: 19%; LCSC: 23%; BNCS: 0.04%; BCS1: 8.5%). Future analysis could incorporate stratified analyses to account for respondent status.

From our notable difference analyses, the exposure probability thresholds for comparison are arbitrary. The criteria did not rely solely on statistical significance but was dependent of the smallest of the two prevalence values between women and men in order to consider smaller differences for the least prevalent exposures and greater differences for the most prevalent exposures (Lacourt et al., 2018). By altering the thresholds, different results may be considered notably different. However, one previous IRSST-funded study has used these thresholds therefore allowing for comparisons with our results (Lacourt et al., 2018).

CONCLUSION

Women's health in the workplace continues to be an under-studied area and we are hindered particularly by the lack of understanding of how gender impacts workplace exposures. Previous studies on sex and gender differences in occupational exposures have highlighted differences in exposure between women and men in the same occupation. One of the key gaps limiting further advancement in occupational hygiene among women is the absence of reliable information on exposures incurred by women.

This is one of the first studies that have investigated differences in occupational exposures between women and men. By comparing sex-specific JEMs, we may be able to improve the precision with which exposures are assigned to occupations. Previous studies have alluded to gender-differences in tasks within the same occupations and our findings affirm that female exposures in the workplace do indeed differ relative to male exposures. Therefore, including jobs held by women into CANJEM will help improve exposure estimation among women in the workplace.

Our findings highlight the necessity of sex-specific JEMs to ascertain exposures in certain occupations and further illustrate that tasks differ between women and men that hold the same occupations. The use of sex-specific JEMs will enable the identification of harmful workplace agents and improve workplace safety measures accordingly and equitably.

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APPENDIX A Illustration of CANJEM dimensions and of its list of agents

Figure 1. Illustration of CANJEM dimensions

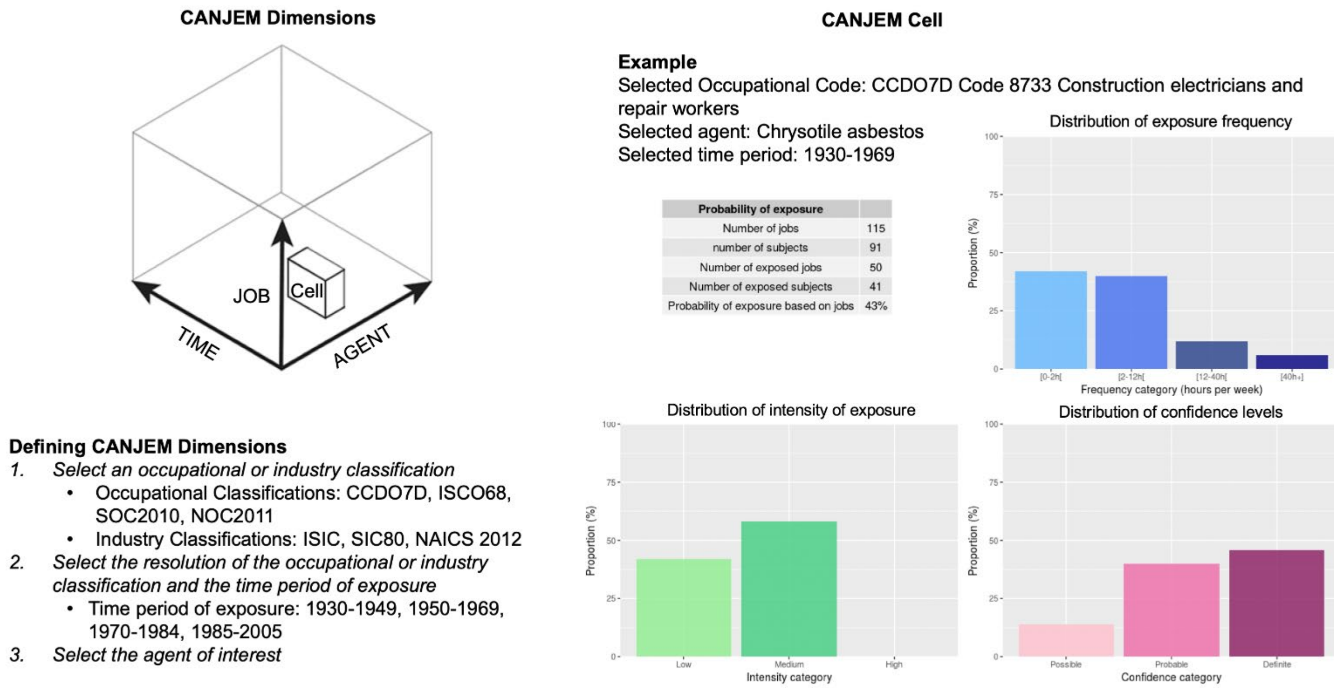


Table 21. List of 258 CANJEM agents

1,1,1-Trichlorethane	Calcium oxide	DDT
Abrasives dust	Calcium oxide fumes	Diesel engine emissions
Acetate fibres	Calcium sulphate	Diesel oil
Acetic acid	Carbon black	Diethyl ether
Acetone	Carbon disulphide	Engine emissions
Acetylene	Carbon monoxide	Epoxies
Acrylic fibres	Carbon tetrachloride	Ethanol
Aliphatic alcohols	Caustic alkali solutions	Ethylene glycol
Aliphatic aldehydes	Cellulose	Ethylene oxide
Aliphatic esters	Cellulose acetate	Extenders
Aliphatic ketones	Cellulose nitrate	Fabric dust
Alkanes (C_1-C_4)	Chlorinated alkanes	Felt dust
Alkanes (C_{18+})	Chlorinated alkenes	Fertilizers
Alkanes (C_5-C_{17})	Chlorine	Flax fibres
Alkyds	Chlorine dioxide	Flour dust
Alumina	Chloroform	Fluorides
Aluminium Compounds	Chromium (VI)	Fluorocarbons
Aluminium fumes	Chromium compounds	Formaldehyde
Ammonia	Chromium fumes	Formic acid
Amphibole asbestos	Chrysotile asbestos	Fur dust
Anaesthetic gases	Clay dust	Gas welding fumes
Animal, vegetable glues	Cleaning agents	Glass dust
Antimony compounds	Coal combustion products	Glass fibres
Arc welding fumes	Coal dust	Glycol ethers
Aromatic alcohols	Coal gas	Grain dust
Aromatic amines	Coal tar and pitch	Graphite dust
Arsenic compounds	Cobalt compounds	Hair dust
Ashes	Coke combustion products	Heating oil
Asphalt	Coke dust	Hydraulic fluid
Aviation gasoline	Concrete dust	Hydrogen
Basic lead carbonate	Cooking fumes	Hydrogen chloride
Benzene	Copper compounds	Hydrogen cyanide
Benzo[a]pyrene	Copper fumes	Hydrogen fluoride
Beryllium Compounds	Cork dust	Hydrogen peroxide
Biocides	Cosmetic talc	Hydrogen sulphide
Bleaches	Cotton dust	Hypochlorites
Brass dust	Creosote	Industrial talc

Brick dust	Cristalline silica	Inks
Bronze dust	Crude petroleum	Inorganic acid solutions
Cadmium compounds	Cutting fluids post-1955	Inorganic insulation dust
Cadmium fumes	Cutting fluids pre-1955	Inorganic pigments
Calcium carbonate	Cyanides	Ionizing radiation
Iron compounds	Nitrogen oxides	Propellant gases
Iron fumes	Nitroglycerine	Radio frequency, microwaves
Iron oxides	Nylon fibres	Rayon fibres
Isocyanates	Organic dyes and pigments	RDX
Isopropanol	Organic solvents	Refractory brick dust
Kerosene	Other mineral oils	Rubber dust
Lead chromate	Other paints, varnishes	Rubber pyrolysis fumes
Lead compounds	Other pyrolysis fumes	Selenium compounds
Lead fumes	Ozone	Silicon carbide
Lead oxides	PAHs from any source	Silk fibres
Leaded gasoline	PAHs from coal	Silver compounds
Leather dust	PAHs from other sources	Silver fumes
Linseed oil	PAHs from petroleum	Sodium carbonate
Liquid fuel combustion products	PAHs from wood	Sodium hydrosulphite
Lubricating oils and greases	Perchloroethylene	Soldering fumes
Magnesium compounds	Pesticides	Soot
Manganese compounds	Phenol	Stainless steel dust
Manganese fumes	Phenol-formaldehyde	Starch dust
Melamine-formaldehyde	Phosgene	Styrene
Mercury compounds	Phosphoric acid	Styrene-butadiene rubber
Metal coatings	Phthalates	Sugar dust
Metal oxide fumes	Plastic dusts	Sulfur
Metallic dust	Plastics pyrolysis fumes	Sulphur dioxide
Methane	Plating solutions	Sulphuric acid
Methanol	Poly(vinyl acetate)	Synthetic adhesives
Methyl methacrylate	Poly(vinyl chloride)	Synthetic fibres
Methylene chloride	Polyacrylates	Tannic acid
Mica	Polyamides	Tin compounds
Mild steel dust	Polychlorinated biphenyls or PCBs	Tin fumes
Mineral spirits post-1970	Polychloroprene	Titanium compounds
Mineral spirits pre-1970	Polyester fibres	Titanium dioxide

Mineral wool fibres	Polyester resins	Titanium dioxide fumes
Mononuclear aromatic hydrocarbons	Polyethylene	Tobacco dust
Natural gas	Polypropylene	Toluene
Natural gas combustion products	Polystyrene	Trichloroethylene
Natural rubber	Polyurethanes	Trinitrotoluene
Nickel compounds	Portland cement	Tungsten compounds
Nickel fumes	Propane	Turpentine
Nitrates	Propane combustion products	Ultraviolet radiation
Nitric acid	Propane engine emissions	Unsaturated aliphatic hydrocarbons
Urea-formaldehyde	Wood combustion products	Xylene
Vanadium compounds	Wood dust	Zinc compounds
Vinyl chloride	Wood varnishes, stains and paints	Zinc fumes
Waxes, polishes	Wool fibres	Zinc oxide

Table 22. List of 196 CANJEM agents in exposed jobs among Montreal women

Abrasives dust	Cellulose nitrate	Glycol ethers
Acetate fibres	Chlorinated alkanes	Grain dust
Acetic acid	Chlorinated alkenes	Hair dust
Acetone	Chlorine	Hydrogen
Acrylic fibres	Chloroform	Hydrogen chloride
Aliphatic alcohols	Chromium (VI)	Hydrogen cyanide
Aliphatic aldehydes	Chromium compounds	Hydrogen peroxide
Aliphatic esters	Chrysotile asbestos	Hydrogen sulphide
Aliphatic ketones	Clay dust	Hypochlorites
Alkanes (C1-C4)	Cleaning agents	Industrial talc
Alkanes (C18+)	Coal combustion products	Inks
Alkanes (C5-C17)	Coal gas	Inorganic acid solutions
Alumina	Concrete dust	Inorganic insulation dust
Aluminum compounds	Cooking fumes	Inorganic pigments
Aluminium fumes	Copper compounds	Ionizing radiation
Ammonia	Cork dust	Iron compounds
Amphibole asbestos	Cosmetic talc	Iron fumes
Anesthetic gases	Cotton dust	Isocyanates
Animal, vegetable glues	Cristalline silica	Isopropanol
Arc welding fumes	Cutting fluids post-1955	Kerosene
Aromatic alcohols	Cyanides	Lead compounds
Aromatic amines	DDT	Lead fumes
Arsenic compounds	Diesel engine emissions	Leaded gasoline
Ashes	Diesel oil	Leather dust
Asphalt	Diethyl ether	Linseed oil
Benzene	Engine emissions	Lubricating oils and greases
Benzo[a]pyrene	Epoxies	Magnesium compounds
Biocides	Ethanol	Manganese compounds
Bleaches	Ethylene glycol	Manganese fumes
Bronze dust	Ethylene oxide	Mercury compounds
Cadmium compounds	Extenders	Metal coatings
Calcium carbonate	Fabric dust	Metal oxide fumes
Calcium oxide	Fertilizers	Metallic dust
Calcium sulphate	Flax fibres	Methane
Carbon black	Flour dust	Methanol
Carbon monoxide	Fluorocarbons	Methylene chloride
Carbon tetrachloride	Formaldehyde	Mild steel dust

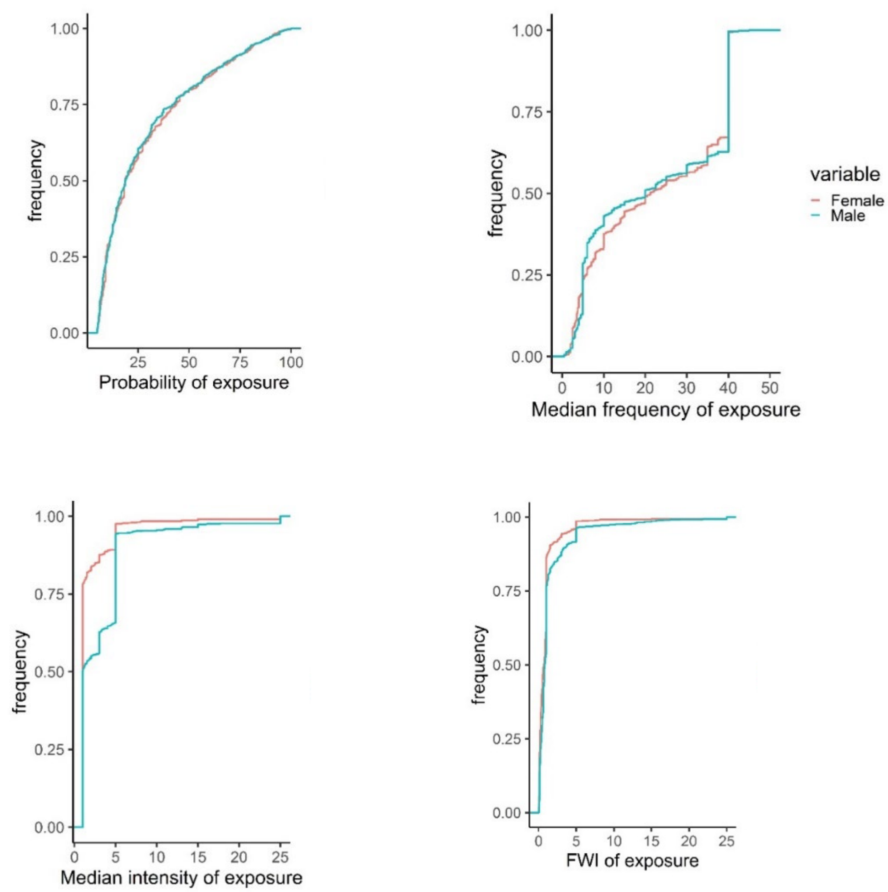
Caustic alkalis solutions	Fur dust	Mineral spirits post-1970
Cellulose	Gas welding fumes	Mineral spirits pre-1970
Cellulose acetate	Glass dust	Mineral wool fibres
Mononuclear aromatic hydrocarbons	Plastics pyrolysis fumes	Styrene-butadiene rubber
Natural gas	Poly(vinyl acetate)	Sugar dust
Natural gas combustion products	Poly(vinyl chloride)	Sulphuric acid
Natural rubber	Polyacrylates	Sulphur dioxide
Nickel compounds	Polychlorinated biphenyls (PCBs)	Synthetic adhesives
Nitric acid	Polychloroprene	Synthetic fibres
Nitrogen oxides	Polyester fibres	Tannic acid
Nitroglycerine	Polyurethanes	Tin compounds
Nylon fibres	Portland cement	Tin fumes
Organic dyes and pigments	Propane	Titanium compounds
Organic solvents	Propane combustion products	Titanium dioxide
Other mineral oils	Propane engine emissions	Tobacco dust
Other paints, varnishes	Propellant gases	Toluene
Other pyrolysis fumes	Radio frequency, microwave	Turpentine
Ozone	Rayon fibres	Ultraviolet radiation
PAHs from any source	Rubber dust	Vinyl chloride
PAHs from coal	Rubber pyrolysis fumes	Waxes, polishes
PAHs from other sources	Silk fibres	Wood combustion products
PAHs from petroleum	Silver compounds	Wood dust
PAHs from wood	Silver fumes	Wool fibers
Perchloroethylene	Sodium carbonate	Wood varnishes, stains and paints
Pesticides	Sodium hydrosulphite	Xylene
Phenol	Soldering fumes	Zinc compounds
Phosgene	Soot	Zinc fumes
Phosphoric acid	Starch dust	Zinc oxide
Plastic dust		

APPENDIX B Main Analysis: Empirical Cumulative Density Function (ECDF) plots

<u>Main Analysis: Empirical Cumulative Density Function (ECDF) plots</u>

Empirical cumulative density function (ECDF) plots seem to illustrate that the probability and median frequency of exposure was greater in the female JEM (Figures 2 & 3) while the median intensity and median FWI of exposure was greater in the male JEM (Figures 4 & 5). However, this is not particularly discernible as the ECDF plots for both JEMs cross. No discernable differences were evident in ECDF plots of the absolute probability of exposure difference and median FWI of exposure ratio of sex-specific JEMs (Figures 6 and 7).

Figure 2. ECDF plot comparing the probability, frequency, intensity (1, 5, 25 scale), and FWI (1, 5, 25 scale) of exposure between sex-specific JEMs using 5-digit ISCO-68 codes averaged across four sub-periods (1933-1949, 1950-1969, 1970-1984, and 1985-2011)



APPENDIX C Sensitivity analyses

Sensitivity Analyses

Methods

Different versions of male- and female-specific JEMs were created by modifying one of the decisions made during the JEM creation process. Four sensitivity analyses were conducted:

1. Using an exposure probability threshold of 25% to define ever exposure wherein any cell with a probability of exposure <25% had its frequency, intensity, and FWI of exposure recoded as 0
2. Excluding exposures with a confidence of 1 (i.e., “possible”)
3. Using 1 time period between male and female JEMs
4. Using 7-digit CCDO codes in the occupational code axis

Results

C.I Probability of exposure ≥25%

JEMs

4 time periods (1933-1949,1950-1969, 1970-1984, 1985-2011) overlapping between both JEMs and a 5-digit ISCO-68 code resolution were used when creating the JEMs.

Analyses

A cell was considered as exposed if its probability of exposure was ≥25%. Any cell with a probability of exposure <25% was considered as unexposed and had its intensity, frequency, and frequency weighted intensity of exposure recoded as 0.

C.I.I A descriptive comparison of sex-specific estimation of exposure metrics in CANJEM

Table 23. Agent-occupation combinations within and between sex-specific JEMs

Occupational code axis resolution	Number of cells[a, b]		
	Male JEM	Female JEM	Cells with job code common to both JEMs
5-digit ISCO-68	188,082	79,722	**40,764**

[a] Each cell represents a unique agent-occupation combination where the specific probability of exposure is calculated for each occupation by dividing # of jobs that were expose to each agent by total # of jobs.
[b] Only cells with a minimum of 10 jobs and 3 subjects per cell were retained

Table 24. Comparison of cell counts according to exposure metrics of agent-occupation combinations between sex-specific JEMs with a resolution of 5-digit ISCO-68 codes – Exposure probability threshold ≥25%

Male JEM (rows) × Female JEM (columns)

Number of cells[a,b] (n (%)) by probability of exposure (%)

	<25	25 to <50	50 to <75	≥75
<25	40,031 (98.20)	149 (0.37)	32 (0.08)	6 (0.01)
25 to 50	187 (0.46)	70 (0.17)	35 (0.09)	20 (0.05)
50 to <75	26 (0.06)	20 (0.05)	28 (0.07)	45 (0.11)
≥75	3 (0.01)	11 (0.03)	20 (0.05)	81 (0.20)

% exact agreement = 54.2 (among cells ≥25% probability between JEMs)

Number of cells[a,b] (n (%)) by frequency of exposure (hours per week)

	0	0 to <2	2 to <12	12 to <40	≥40
0	40,031 (98.20)	0 (0.00)	82 (0.20)	57 (0.14)	48 (0.12)
0 to <2	7 (0.02)	0 (0.00)	3 (0.01)	0 (0.00)	0 (0.00)
2 to <12	86 (0.21)	2 (<0.01)	91 (0.22)	27 (0.07)	5 (0.01)
12 to <40	78 (0.19)	0 (0.00)	17 (0.04)	32 (0.08)	5 (0.01)
≥40	45 (0.11)	0 (0.00)	3 (0.01)	36 (0.09)	109 (0.27)

% exact agreement = 70.3 (among cells >0 median frequency between JEMs)

Number of cells[a,b] (n (%)) by intensity of exposure (1, 5, 25 scale)

	0	>0 to <2.24	2.24 to <5	≥5
0	40,031 (98.20)	185 (0.45)	1 (<0.01)	1 (<0.01)
>0 to <2.24	148 (0.36)	195 (0.48)	6 (0.01)	8 (0.02)
2.24 to <5	21 (0.05)	18 (0.04)	3 (0.01)	7 (0.02)
≥5	47 (0.12)	75 (0.18)	4 (0.01)	14 (0.03)

% exact agreement = 64.2 (among cells >0 median intensity between JEMs)

Number of cells[a,b] (n (%)) by FWI of exposure (1, 5, 25 intensity scale)

	0	0 to <1	1 to <5	≥ 5
0	40,031 (98.20)	138 (0.34)	49 (0.12)	0 (0.00)
0 to <1	150 (0.37)	137 (0.34)	14 (0.03)	0 (0.00)
1 to <5	60 (0.15)	59 (0.14)	77 (0.19)	14 (0.03)
≥ 5	6 (0.01)	0 (0.00)	22 (0.05)	7 (0.02)

% exact agreement = 67.0 (among cells >0 median FWI in both JEMs)

[a] Each cell represents a unique agent-occupation combination where the specific probability of exposure is calculated for each occupation by dividing # of jobs that were exposed to each agent by total # of jobs

[b] Only cells with a minimum of 10 jobs and 3 subjects per cell were retained

Descriptive comparisons among concordantly exposed cells between sex-specific JEMs

Note: a cell is considered exposed with a probability of exposure ≥25%

Table 25. Agreement between concordantly exposed cells between sex-specific JEMs

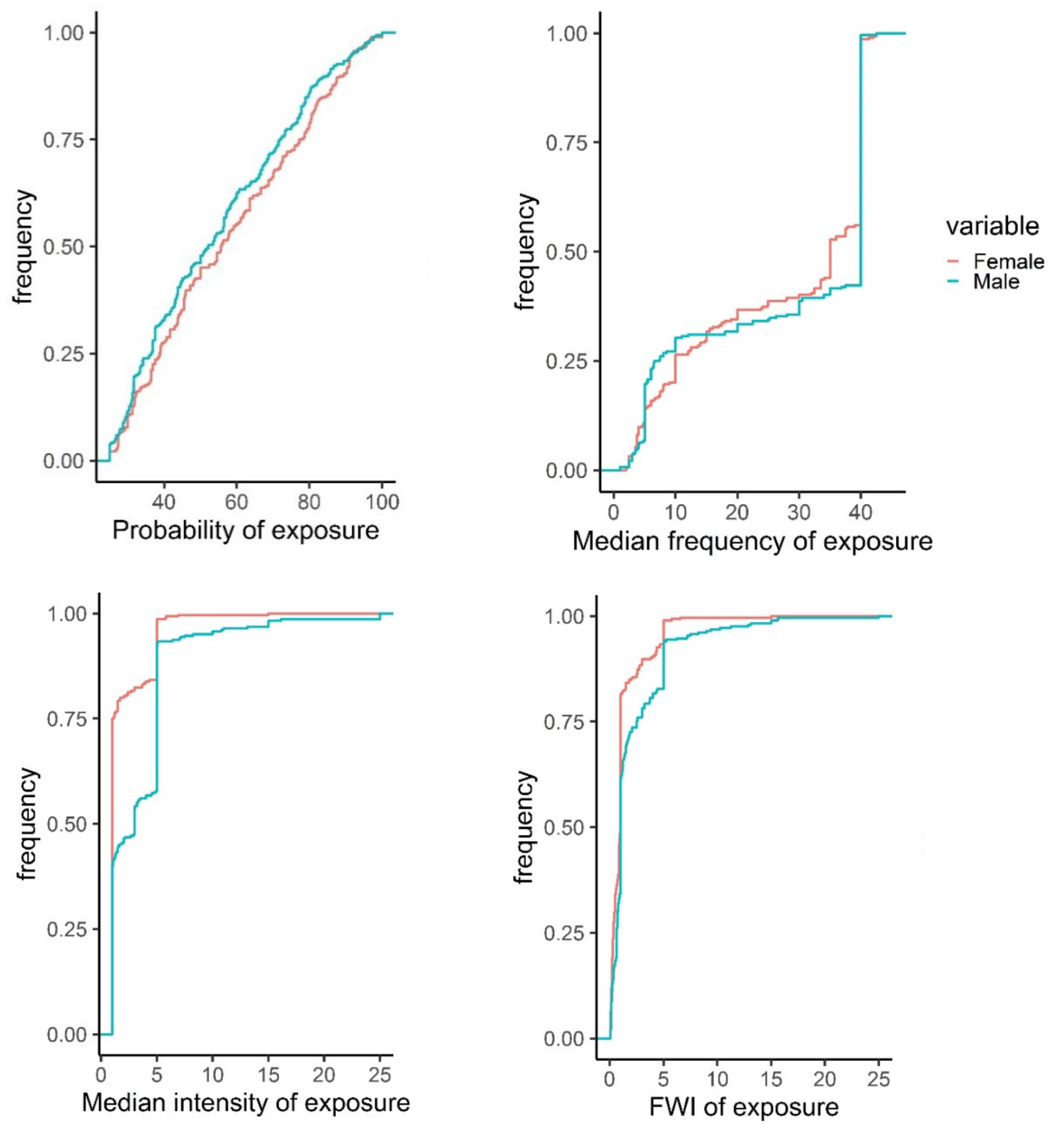
Coefficient	Probability of exposure	Frequency of exposure	Concentration of exposure	FWI of exposure
Kendall's tau	0.40 (0.35 – 0.46)	0.67 (0.62 – 0.72)	0.29 (0.20 – 0.38)	0.52 (0.45 – 0.57)
ICC	0.58 (0.50 – 0.64)	0.81 (0.77 – 0.84)	-	0.30 (0.20 – 0.40)

FWI, frequency weight intensity

Table 26. Number of cells between sex-specific JEMs according to exposure status with a resolution of 5-digit ISCO-68 codes

Probability of exposure male JEM (%)	Probability of exposure female JEM (%)		
	Unexposed (P <5%)	Exposed (P ≥5%)	Total, male JEM
Unexposed (P <25%)	40,031 (98.20)	187 (0.46)	40,218 (98.66)
Exposed (P ≥25%)	216 (0.53)	330 (0.81)	546 (1.34)
Total, female JEM	40,247 (98.73)	517 (1.27)	40,764 (100.00)

Figure 3. ECDF plot comparing the probability, frequency, intensity (1, 5, 25 scale), and FWI (1, 5, 25 scale) of exposure between sex-specific JEMs, using an exposure probability threshold ≥25%



C.II Excluding a confidence of 1 (“possible” confidence of exposure)

JEMs

4 time periods (1933-1949, 1950-1969, 1970-1984, 1985-2011) and a 5-digit ISCO-68 code resolution were used when creating the JEMs.

Analyses

A confidence of 1 (i.e., “possible) was excluded in the analyses. A cell was considered as exposed if its probability of exposure was ≥5%. Any cell with a probability of exposure <5% was considered as unexposed and had its intensity, frequency, and frequency weighted intensity of exposure recoded as 0.

C.II.I A descriptive comparison of sex-specific estimation of exposure metrics in CANJEM

Table 27. Agent-occupation combinations within and between sex-specific JEMs

Occupational code axis resolution	Number of cells[a, b]		
	Male JEM	Female JEM	Cells with job code common to both JEMs
5-digit ISCO-68	187,582	79,606	**40,679**

[a] Each cell represents a unique agent-occupation combination where the specific probability of exposure is calculated for each occupation by dividing # of jobs that were expose to each agent by total # of jobs.
[b] Only cells with a minimum of 10 jobs and 3 subjects per cell were retained

Table 28. Comparison of cell counts according to exposure metrics of agent-occupation combinations between sex-specific JEMs with a resolution of 5-digit ISCO-68 codes – Restricted to exposures with confidence > 1

Male JEM	Female JEM				
Number of cells[a,b] (n (%)) by probability of exposure (%)					
	<5	**5 to <25**	**25 to <50**	**50 to <75**	**≥75**
<5	37,251 (91.57)	859 (2.11)	38 (0.09)	3 (0.01)	1 (<0.01)
5 to <25	1,503 (3.69)	461 (1.13)	89 (0.22)	24 (0.06)	6 (0.01)
25 to <50	64 (0.16)	83 (0.2)	49 (0.12)	26 (0.06)	21 (0.05)
50 to <75	8 (0.02)	18 (0.04)	20 (0.05)	24 (0.06)	37 (0.09)
≥75	0 (0.00)	2 ((<0.01)	8 (0.02)	15 (0.04)	69 (0.17)
	% exact agreement = 63.3 (among cells ≥5% probability between JEMs)				
Number of cells[a,b] (n (%)) by frequency of exposure (hours per week)					
	0	**0 to <2**	**2 to <12**	**12 to <40**	**≥40**
0	37251 (91.57)	39 (0.1)	456 (1.12)	218 (0.54)	188 (0.46)
0 to <2	111 (0.27)	3 (0.01)	18 (0.04)	1 (0.00)	2 (0.00)
2 to <12	804 (1.98)	25 (0.06)	281 (0.69)	86 (0.21)	53 (0.13)
12 to <40	403 (0.99)	5 (0.01)	58 (0.14)	94 (0.23)	49 (0.12)
≥40	257 (0.63)	1 (0.00)	26 (0.06)	92 (0.23)	158 (0.39)
	% exact agreement = 56.3 (among cells >0 median frequency between JEMs)				
Number of cells[a,b] (n (%)) by intensity of exposure (1, 5, 25 scale)					
	0	**>0 to <2.24**	**2.24 to <5**	**≥5**	
0	37,251 (91.57)	813 (2)	27 (0.07)	61 (0.15)	
>0 to <2.24	983 (2.42)	600 (1.47)	16 (0.04)	16 (0.04)	
2.24 to <5	164 (0.40)	64 (0.16)	10 (0.02)	7 (0.02)	
≥5	428 (1.05)	189 (0.46)	20 (0.05)	30 (0.07)	
	% exact agreement = 67.2 (among cells >0 median intensity between JEMs)				
Number of cells[a,b] (n (%)) by FWI of exposure (1, 5, 25 intensity scale)					
	0	**0 to <1**	**1 to <5**	**≥ 5**	
0	37,251 (91.57)	686 (1.69)	189 (0.46)	26 (0.06)	
0 to <1	1,133 (2.79)	480 (1.18)	109 (0.27)	5 (0.01)	
1 to <5	371 (0.91)	152 (0.37)	150 (0.37)	12 (0.03)	
≥5	71 (0.17)	6 (0.01)	27 (0.07)	11 (0.03)	
	% exact agreement = 67.3 (among cells >0 median FWI in both JEMs)				

[a] Each cell represents a unique agent-occupation combination where the specific probability of exposure is calculated for each occupation by dividing # of jobs that were exposed to each agent by total # of jobs
[b] Only cells with a minimum of 10 jobs and 3 subjects per cell were retained

Descriptive comparisons among concordantly exposed cells between sex-specific JEMs

Note: a cell is considered exposed with a probability of exposure ≥5%

Table 29. Agreement between concordantly exposed cells between sex-specific JEMs

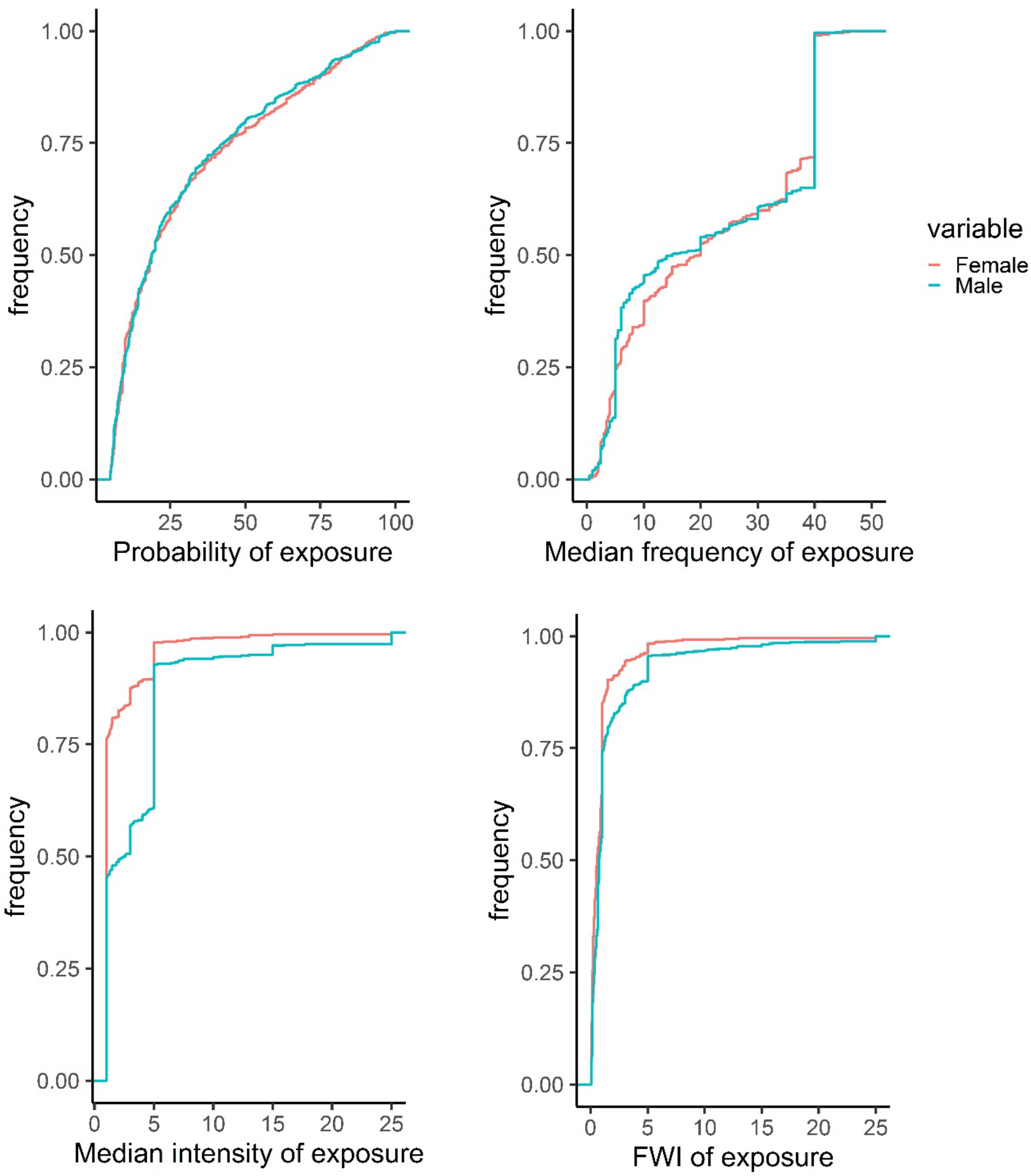
Coefficient	Probability of exposure	Median frequency of exposure	Median concentration of exposure (1, 5, 25 scale)	Median FWI of exposure (1, 5, 25 scale)
Kendall's tau	0.44 (0.41 – 0.48)	0.44 (0.40 – 0.48)	0.27 (0.21 – 0.33)	0.39 (0.35 – 0.43)
ICC	0.75 (0.73 – 0.78)	0.52 (0.47 – 0.57)	-	0.19 (0.13 – 0.25)

ICC, Intraclass correlation coefficient; FWI, Frequency weighted intensity

Table 30. Number of cells between sex-specific JEMs according to exposure status with a resolution of 5-digit ISCO-68 codes

Probability of exposure male JEM (%)	Probability of exposure female JEM (%)		
	Unexposed (P <5%)	**Exposed (P ≥5%)**	**Total, male JEM**
Unexposed (P <5%)	37,251 (91.57)	901 (2.21)	38,152 (93.78)
Exposed (P ≥5%)	1,575 (3.87)	952 (2.34)	2,527 (6.21)
Total, female JEM	38,826 (95.44)	1853 (4.55)	40,679 (100.0)

Figure 4. ECDF plot comparing the probability, frequency, intensity (1, 5, 25 scale) of exposure between sex-specific JEMs, excluding a confidence of 1 or "possible" confidence of exposure



C.III One time period (1933-2011)

JEMs

A single time period (1933-2011) and a 5-digit ISCO-68 code resolution were used when creating the JEMs.

Analyses

A cell was considered as exposed if its probability of exposure was ≥ 5%. Any cell with a probability of exposure <5% was considered as unexposed and had its intensity, frequency, and frequency weighted intensity of exposure recoded as 0.

C.III.I A descriptive comparison of sex-specific estimation of exposure metrics in CANJEM

Table 31. Agent-occupation combinations within and between sex-specific JEMs

Occupational code axis resolution	Number of cells[a, b]		
	Male JEM	Female JEM	Cells with job code common to both JEMs
5-digit ISCO-68	98,814	48,246	**28,380**

[a] Each cell represents a unique agent-occupation combination where the specific probability of exposure is calculated for each occupation by dividing # of jobs that were expose to each agent by total # of jobs.
[b] Only cells with a minimum of 10 jobs and 3 subjects per cell were retained

Table 32. Comparison of cell counts according to exposure metrics of agent-occupation combinations between sex-specific JEMs with a resolution of 5-digit ISCO-68 codes, jobs held between 1933-2011

	Female JEM				
Number of cells[a,b] (n (%)) by probability of exposure (%)					
Male JEM	**<5**	**5 to <25**	**25 to <50**	**50 to <75**	**≥75**
<5	25,880 (91.19)	650 (2.29)	33 (0.12)	3 (0.01)	0 (0.00)
5 to <25	932 (3.28)	376 (1.32)	70 (0.25)	12 (0.04)	3 (0.01)
25 to <50	56 (0.20)	88 (0.31)	61 (0.21)	23 (0.08)	16 (0.06)
50 to <75	7 (0.02)	15 (0.05)	22 (0.08)	21 (0.07)	29 (0.10)
≥75	0 (0.00)	6 (0.02)	8 (0.03)	12 (0.04)	57 (0.20)
	% exact agreement =62.9 (among cells ≥5% probability between JEMs)				
Number of cells[a,b] (n (%)) by frequency of exposure (hours per week)					
	0	**0 to <2**	**2 to <12**	**12 to <40**	**≥40**
0	25,880 (91.19)	35 (0.12)	342 (1.21)	158 (0.56)	151 (0.53)
0 to <2	54 (0.19)	4 (0.01)	18 (0.06)	1 (0.00)	1 (0.00)
2 to <12	557 (1.96)	22 (0.08)	207 (0.73)	83 (0.29)	31 (0.11)
12 to <40	229 (0.81)	1 (0.00)	59 (0.21)	69 (0.24)	53 (0.19)
≥40	155 (0.55)	1 (0.00)	15 (0.05)	71 (0.25)	183 (0.64)
	% exact agreement = 56.5 (among cells >0 median frequency between JEMs)				
Number of cells[a,b] (n (%)) by intensity of exposure (1, 5, 25 scale)					
	0	**>0 to <2.24**	**2.24 to <5**	**≥5**	
0	25,880 (91.19)	631 (2.22)	24 (0.08)	31 (0.11)	
>0 to <2.24	665 (2.34)	476 (1.68)	20 (0.07)	16 (0.06)	
2.24 to <5	76 (0.27)	67 (0.24)	10 (0.04)	9 (0.03)	
≥5	254 (0.89)	159 (0.56)	27 (0.10)	35 (0.12)	
	% exact agreement = 63.6 (among cells >0 median intensity between JEMs)				
Number of cells[a,b] (n (%)) by FWI of exposure (1, 5, 25 intensity scale)					
	0	**0 to <1**	**1 to <5**	**≥ 5**	
0	25,880 (91.19)	512 (1.80)	162 (0.57)	12 (0.04)	
0 to <1	753 (2.65)	371 (1.31)	86 (0.30)	3 (0.01)	
1 to <5	198 (0.70)	122 (0.43)	167 (0.59)	26 (0.09)	
≥ 5	44 (0.16)	10 (0.04)	27 (0.01)	7 (0.02)	
	% exact agreement = 66.5 (among cells >0 median FWI in both JEMs)				

[a] Each cell represents a unique agent-occupation combination where the specific probability of exposure is calculated for each occupation by dividing # of jobs that were exposed to each agent by total # of jobs
[b] Only cells with a minimum of 10 jobs and 3 subjects per cell were retained

Descriptive comparisons among concordantly exposed cells between sex-specific JEMs

Note: a cell is considered exposed with a probability of exposure ≥5%

Table 33. Agreement in concordantly exposed cells between sex-specific JEMs

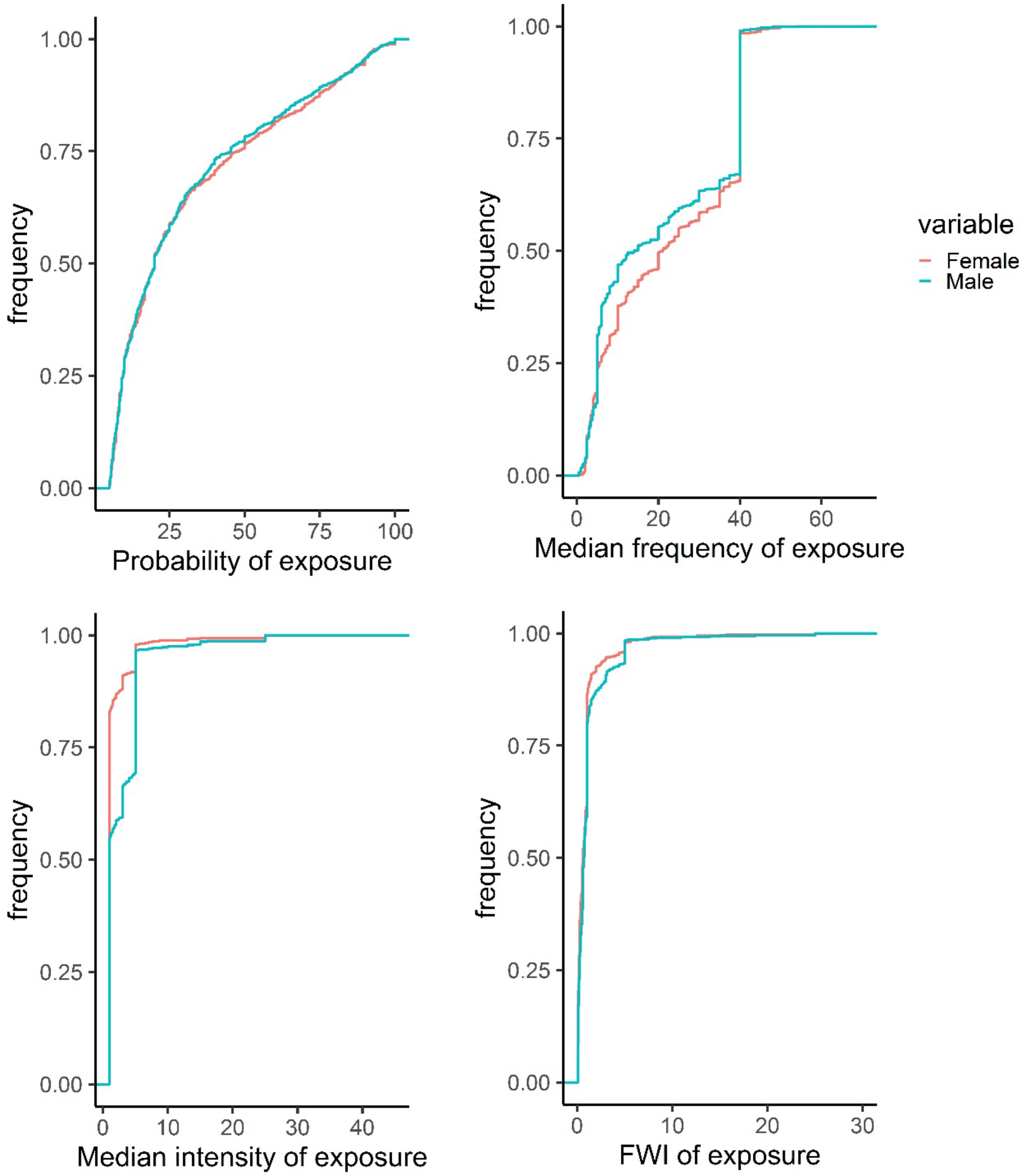
Coefficient	Probability of exposure	Median frequency of exposure	Median concentration of exposure (1, 5, 25 scale)	FWI of exposure (1, 5, 25 scale)
Kendall's tau	0.44 (0.39 – 0.47)	0.50 (0.46 – 0.53)	0.30 (0.24 – 0.36)	0.41 (0.37 – 0.46)
ICC	0.74 (0.70 – 0.77)	0.61 (0.56 – 0.65)	-	0.20 (0.14 – 0.27)

ICC, Intraclass correlation coefficient; FWI, Frequency weighted intensity

Table 34. Number of cells between sex-specific JEMs according to exposure status with a resolution of 5-digit ISCO-68 codes

Probability of exposure male JEM (%)	Probability of exposure female JEM (%)		
	Unexposed (P <5%)	Exposed (P ≥5%)	Total, male JEM
Unexposed (P <5%)	25,880 (91.19)	686 (2.42)	26,566 (93.61)
Exposed (P ≥5%)	995 (3.51)	819 (2.89)	1814 (6.40)
Total, female JEM	26,875 (94.70)	1,505 (5.31)	28,380 (100.0)

Figure 5. ECDF plot comparing the probability, frequency, intensity (1, 5, 25 scale), and FWI (1, 5, 25 scale) of exposure between sex-specific JEMs in one time period (1933-2011)



C.IV 7-digit CCDO codes

JEMs

4 time periods (1933-1949, 1950-1969, 1970-1984, 1985-2011) overlapping both JEMs and a 7-digit CCDO code resolution were used when creating the JEMs.

Analyses

A cell was considered as exposed if its probability of exposure was ≥ 5%. Any cell with a probability of exposure <5% was considered as unexposed and had its intensity, frequency, and frequency weighted intensity of exposure recoded as 0.

C.IV.I A descriptive comparison of sex-specific estimation of exposure metrics in CANJEM

Table 35. Agent-occupation combinations within and between sex-specific JEMs

Occupational code axis resolution	Number of cells[a, b]		
	Male JEM	Female JEM	Cells with job code common to both JEMs
7-digit CCDO	174,408	75,336	**23,220**

[a] Each cell represents a unique agent-occupation combination where the specific probability of exposure is calculated for each occupation by dividing # of jobs that were expose to each agent by total # of jobs.
[b] Only cells with a minimum of 10 jobs and 3 subjects per cell were retained

Table 36. Comparison of cell counts according to exposure metrics of agent-occupation combinations between sex-specific JEMs with a resolution of 7-digit CCDO codes

Female JEM (columns); Male JEM (rows)

Number of cells[a,b] (n (%)) by probability of exposure (%)

Male JEM	<5	5 to <25	25 to <50	50 to <75	≥75
<5	21,600 (93.02)	443 (1.91)	13 (0.06)	2 (0.01)	0 (0)
5 to <25	547 (2.36)	253 (1.09)	55 (0.24)	19 (0.08)	13 (0.06)
25 to <50	24 (0.1)	41 (0.18)	38 (0.16)	30 (0.13)	9 (0.04)
50 to <75	1 (0)	4 (0.02)	8 (0.03)	16 (0.07)	24 (0.1)
≥75	0 (0)	3 (0.01)	10 (0.04)	13 (0.06)	54 (0.23)

% exact agreement = 61.2 (among cells ≥5% probability between JEMs)

Number of cells[a,b] (n (%)) by frequency of exposure (hours per week)

Male JEM	0	0 to <2	2 to <12	12 to <40	≥40
0	21,600 (93.02)	28 (0.12)	264 (1.14)	85 (0.37)	81 (0.35)
0 to <2	40 (0.17)	5 (0.02)	7 (0.03)	2 (0.01)	0 (0)
2 to <12	290 (1.25)	13 (0.06)	232 (1)	45 (0.19)	16 (0.07)
12 to <40	127 (0.55)	0 (0)	36 (0.16)	45 (0.19)	14 (0.06)
≥40	115 (0.5)	0 (0)	9 (0.04)	53 (0.23)	113 (0.49)

% exact agreement = 66.9 (among cells >0 median frequency between JEMs)

Number of cells[a,b] (n (%)) by intensity of exposure (1, 5, 25 scale)

Male JEM	0	>0 to <2.24	2.24 to <5	≥5
0	21,600 (93.02)	439 (1.89)	9 (0.04)	10 (0.04)
>0 to <2.24	387 (1.67)	399 (1.72)	13 (0.06)	5 (0.02)
2.24 to <5	45 (0.19)	29 (0.12)	4 (0.02)	3 (0.01)
≥5	140 (0.6)	111 (0.48)	7 (0.03)	19 (0.08)

% exact agreement = 71.5 (among cells >0 median intensity between JEMs)

Number of cells[a,b] (n (%)) by FWI of exposure (1, 5, 25 intensity scale)

Male JEM	0	0 to <1	1 to <5	≥ 5
0	21,600 (93.02)	370 (1.59)	84 (0.36)	4 (0.02)
0 to <1	411 (1.77)	345 (1.49)	35 (0.15)	0 (0)
1 to <5	132 (0.57)	76 (0.33)	118 (0.51)	3 (0.01)
≥ 5	29 (0.12)	1 (0)	10 (0.04)	2 (0.01)

% exact agreement = 78.8 (among cells >0 median FWI in both JEMs)

[a] Each cell represents a unique agent-occupation combination where the specific probability of exposure is calculated for each occupation by dividing # of jobs that were exposed to each agent by total # of jobs

[b] Only cells with a minimum of 10 jobs and 3 subjects per cell were retained

Descriptive comparisons among concordantly exposed cells between sex-specific JEMs

Note: a cell is considered exposed with a probability of exposure ≥5%

Table 37. Agreement in concordantly exposed cells between sex-specific JEMs

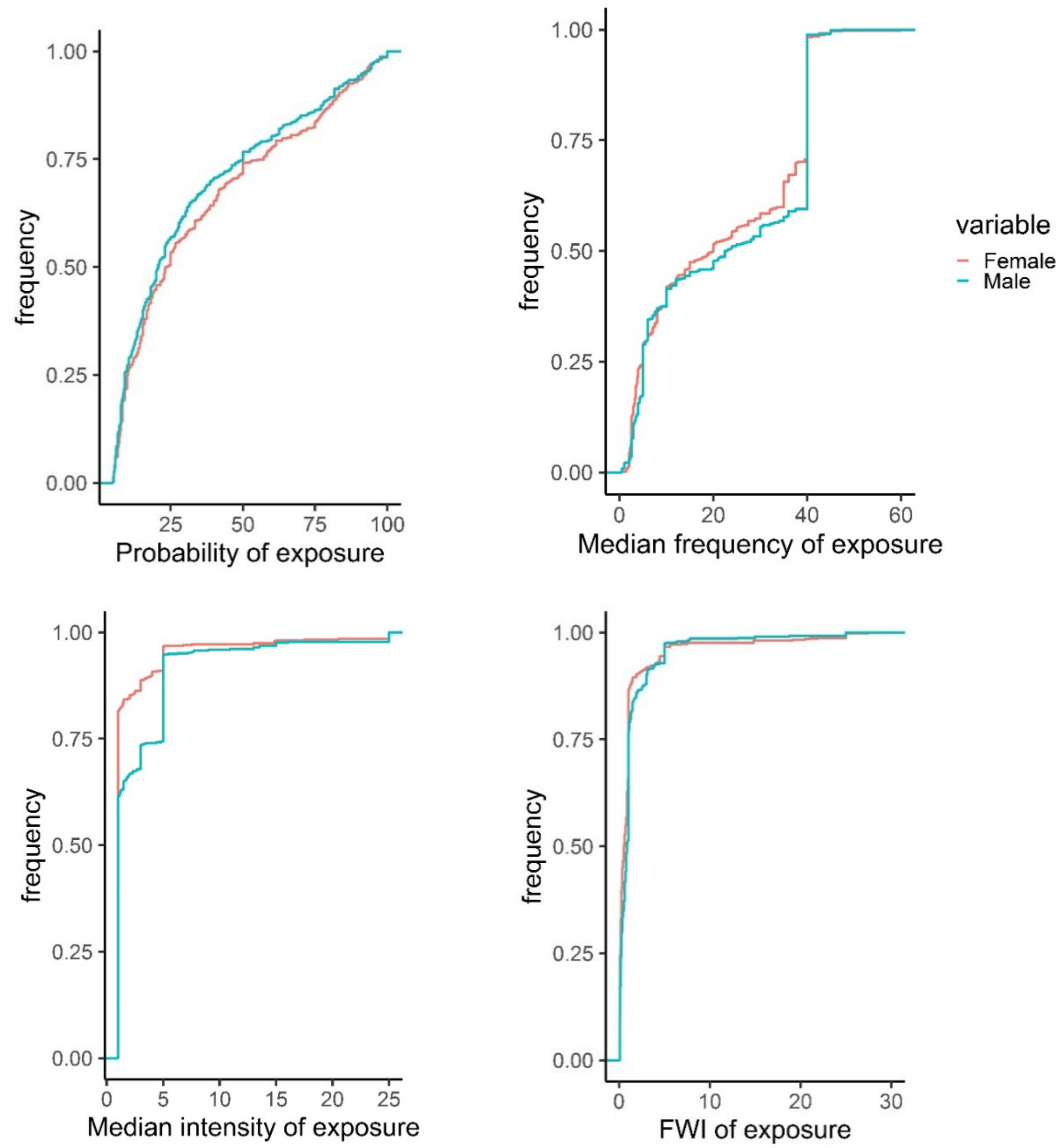
Coefficient	Probability of exposure	Median frequency of exposure	Median concentration of exposure (1, 5, 25 scale)	Median FWI of exposure (1, 5, 25 scale)
Kendall's tau	0.47 (0.43 – 0.51)	0.59 (0.54 – 0.63)	0.27 (0.19 – 0.35)	0.50 (0.46 – 0.55)
ICC	0.74 (0.70 – 0.77)	0.73 (0.69 – 0.77)	-	0.20 (0.12 – 0.27)

ICC, Intraclass correlation coefficient; FWI, Frequency weighted intensity

Table 38. Number of cells between sex-specific JEMs according to exposure status with a resolution of 7-digit CCDO codes

Probability of exposure male JEM (%)	Probability of exposure female JEM (%)		
	Unexposed (P <5%)	**Exposed (P ≥5%)**	**Total, male JEM**
Unexposed (P <5%)	21,600 (93.02)	458 (1.97)	22,058 (94.99)
Exposed (P ≥5%)	572 (2.46)	590 (2.54)	1,162 (5.00)
Total, female JEM	22,172 (95.48)	1,048 (4.51)	23,220 (100.0)

Figure 6. ECDF plot comparing the probability, frequency, intensity (1, 5, 25 scale), and FWI (1, 5, 25 scale) of exposure between sex-specific JEMs using 7-digit CCDO codes



APPENDIX D Comparison of exposures between sex-specific JEMs

Table 39. Comparison of cell counts (n (%)) by the probability of exposure (%) of agent-occupation combinations between sex-specific JEMs – Main analysis

		Female JEM				
	Number of cells[a,b] (n (%)) by probability of exposure (%)	<5	5 to <25	25 to <50	50 to <75	≥75
Male JEM	<5	36,771 (90.20)	1,032 (2.53)	48 (0.12)	3 (0.01)	0 (0.00)
	5 to <25	1,636 (4.01)	592 (1.45)	101 (0.25)	29 (0.07)	6 (0.01)
	25 to <50	75 (0.18)	112 (0.27)	70 (0.17)	35 (0.09)	20 (0.05)
	50 to <75	5 (0.01)	21 (0.05)	20 (0.05)	28 (0.07)	45 (0.11)
	≥75	0 (0.00)	3 (0.01)	11 (0.03)	20 (0.05)	81 (0.20)

Each cell represents a unique agent-occupation combination where the specific probability of exposure is calculated for each occupation by dividing # of jobs that were exposed to each agent by total # of jobs

% agreement = 64.6 (among cells ≥5% probability between JEMs)

Table 40. Comparison of cell counts (n (%)) by the probability of exposure (%) of agent-occupation combinations between sex-specific JEMs – Exposure probability threshold ≥25%

		Female JEM			
	Number of cells[a,b] (n (%)) by probability of exposure (%)	<25	25 to <50	50 to <75	≥75
Male JEM	<25	40,031 (98.20)	149 (0.37)	32 (0.08)	6 (0.01)
	25 to 50	187 (0.46)	70 (0.17)	35 (0.09)	20 (0.05)
	50 to <75	26 (0.06)	20 (0.05)	28 (0.07)	45 (0.11)
	≥75	3 (0.01)	11 (0.03)	20 (0.05)	81 (0.20)

Each cell represents a unique agent-occupation combination where the specific probability of exposure is calculated for each occupation by dividing # of jobs that were exposed to each agent by total # of jobs

% exact agreement = 54.2 (among cells ≥25% probability between JEMs)

Table 41. **Comparison of cell counts (n (%)) by the probability of exposure (%) of agent-occupation combinations between sex-specific JEMs - Excluding a confidence of 1 ("possible" confidence of exposure)**

		Female JEM				
	Number of cells[a,b] (n (%)) by probability of exposure (%)					
		<5	5 to <25	25 to <50	50 to <75	≥75
Male JEM	<5	37,251 (91.57)	859 (2.11)	38 (0.09)	3 (0.01)	1 (<0.01)
	5 to <25	1,503 (3.69)	461 (1.13)	89 (0.22)	24 (0.06)	6 (0.01)
	25 to <50	64 (0.16)	83 (0.2)	49 (0.12)	26 (0.06)	21 (0.05)
	50 to <75	8 (0.02)	18 (0.04)	20 (0.05)	24 (0.06)	37 (0.09)
	≥75	0 (0.00)	2 ((<0.01)	8 (0.02)	15 (0.04)	69 (0.17)

Each cell represents a unique agent-occupation combination where the specific probability of exposure is calculated for each occupation by dividing # of jobs that were exposed to each agent by total # of jobs
% exact agreement = 63.3 (among cells ≥5% probability between JEMs)

Table 42. **Comparison of cell counts (n (%)) by the probability of exposure (%) of agent-occupation combinations between sex-specific JEMs - One time period (1933-2011)**

		Female JEM				
	Number of cells[a,b] (n (%)) by probability of exposure (%)					
		<5	5 to <25	25 to <50	50 to <75	≥75
Male JEM	<5	25,880 (91.19)	650 (2.29)	33 (0.12)	3 (0.01)	0 (0.00)
	5 to <25	932 (3.28)	376 (1.32)	70 (0.25)	12 (0.04)	3 (0.01)
	25 to <50	56 (0.20)	88 (0.31)	61 (0.21)	23 (0.08)	16 (0.06)
	50 to <75	7 (0.02)	15 (0.05)	22 (0.08)	21 (0.07)	29 (0.10)
	≥75	0 (0.00)	6 (0.02)	8 (0.03)	12 (0.04)	57 (0.20)

Each cell represents a unique agent-occupation combination where the specific probability of exposure is calculated for each occupation by dividing # of jobs that were exposed to each agent by total # of jobs
% exact agreement =62.9 (among cells ≥5% probability between JEMs)

Table 43. Comparison of cell counts (n (%)) by the probability of exposure (%) of agent-occupation combinations between sex-specific JEMs - 7-digit CCDO codes

		Female JEM				
		Number of cells[a,b] (n (%)) by probability of exposure (%)				
		<5	**5 to <25**	**25 to <50**	**50 to <75**	**≥75**
Male JEM	**<5**	21,600 (93.02)	443 (1.91)	13 (0.06)	2 (0.01)	0 (0)
	5 to <25	547 (2.36)	253 (1.09)	55 (0.24)	19 (0.08)	13 (0.06)
	25 to <50	24 (0.1)	41 (0.18)	38 (0.16)	30 (0.13)	9 (0.04)
	50 to <75	1 (0)	4 (0.02)	8 (0.03)	16 (0.07)	24 (0.1)
	≥75	0 (0)	3 (0.01)	10 (0.04)	13 (0.06)	54 (0.23)

Each cell represents a unique agent-occupation combination where the specific probability of exposure is calculated for each occupation by dividing # of jobs that were exposed to each agent by total # of jobs

Only cells with a minimum of 10 jobs and 3 subjects per cell were retained

% exact agreement = 61.2 (among cells ≥5% probability between JEMs)

Table 44. Comparison of cell counts (n (%)) by the frequency of exposure (hours per week) of agent-occupation combinations between sex-specific JEMs

		Female JEM				
Male JEM	Analysis	0	0 to <2	2 to <12	12 to <40	≥40
0	Main[a]	36,771 (90.20)	48 (0.12)	551 (1.35)	236 (0.58)	248 (0.61)
	Probability ≥25[b]	40,031 (98.20)	0 (0.00)	82 (0.20)	57 (0.14)	48 (0.12)
	Confidence 2 & 3[c]	37251 (91.57)	39 (0.10)	456 (1.12)	218 (0.54)	188 (0.46)
	One time period[d]	25,880 (91.19)	35 (0.12)	342 (1.21)	158 (0.56)	151 (0.53)
	CCDO 7-digit codes[e]	21,600 (93.02)	28 (0.12)	264 (1.14)	85 (0.37)	81 (0.35)
0 to <2	Main[a]	120 (0.29)	4 (0.01)	20 (0.05)	3 (0.01)	2 (<0.01)
	Probability ≥25[b]	7 (0.02)	0 (0.00)	3 (0.01)	0 (0.00)	0 (0.00)
	Confidence 2 & 3[c]	111 (0.27)	3 (0.01)	18 (0.04)	1 (0.00)	2 (0.00)
	One time period[d]	54 (0.19)	4 (0.01)	18 (0.06)	1 (0.00)	1 (0.00)
	CCDO 7-digit codes[e]	40 (0.17)	5 (0.02)	7 (0.03)	2 (0.01)	0 (0.00)
2 to <12	Main[a]	887 (2.18)	32 (0.08)	333 (0.82)	100 (0.25)	72 (0.18)
	Probability ≥25[b]	86 (0.21)	2 (<0.01)	91 (0.22)	27 (0.07)	5 (0.01)
	Confidence 2 & 3[c]	804 (1.98)	25 (0.06)	281 (0.69)	86 (0.21)	53 (0.13)
	One time period[d]	557 (1.96)	22 (0.08)	207 (0.73)	83 (0.29)	31 (0.11)
	CCDO 7-digit codes[e]	290 (1.25)	13 (0.06)	232 (1.00)	45 (0.19)	16 (0.07)
12 to <40	Main[a]	425 (1.04)	5 (0.01)	82 (0.20)	98 (0.24)	72 (0.18)
	Probability ≥25[b]	78 (0.19)	0 (0.00)	17 (0.04)	32 (0.08)	5 (0.01)
	Confidence 2 & 3[c]	403 (0.99)	5 (0.01)	58 (0.14)	94 (0.23)	49 (0.12)
	One time period[d]	229 (0.81)	1 (0.00)	59 (0.21)	69 (0.24)	53 (0.19)
	CCDO 7-digit codes[e]	127 (0.55)	0 (0.00)	36 (0.16)	45 (0.19)	14 (0.06)
≥40	Main[a]	284 (0.70)	2 (<0.01)	26 (0.06)	125 (0.31)	218 (0.53)
	Probability ≥25[b]	45 (0.11)	0 (0.00)	3 (0.01)	36 (0.09)	109 (0.27)
	Confidence 2 & 3[c]	257 (0.63)	1 (0.00)	26 (0.06)	92 (0.23)	158 (0.39)
	One time period[d]	155 (0.55)	1 (0.00)	15 (0.05)	71 (0.25)	183 (0.64)
	CCDO 7-digit codes[e]	115 (0.50)	0 (0.00)	9 (0.04)	53 (0.23)	113 (0.49)

Each cell represents a unique agent-occupation combination where the specific probability of exposure is calculated for each occupation by dividing # of jobs that were exposed to each agent by total # of jobs
Only cells with a minimum of 10 jobs and 3 subjects per cell were retained
[a]Main % exact agreement = 54.7 (among cells >0 median frequency between JEMs)
[b]Probability ≥25 % exact agreement = 70.3 (among cells >0 median frequency between JEMs)
[c]Confidence 2 & 3 % exact agreement = 56.3 (among cells >0 median frequency between JEMs)
[d]One time period % exact agreement = 56.5 (among cells >0 median frequency between JEMs)
[e]CCDO 7-digit codes % exact agreement = 66.9 (among cells >0 median frequency between JEMs)

Table 45. Comparison of cell counts (n (%)) by the intensity of exposure (1, 5, 25 scale) of agent-occupation combinations between sex-specific JEMs

Male JEM	Analysis	Female JEM: 0	>0 to <2.24	2.24 to <5	≥5
0	Main[a]	36,771 (90.20)	983 (2.41)	28 (0.07)	72 (0.18)
	Probability ≥25[b]	40,031 (98.20)	185 (0.45)	1 (<0.01)	1 (<0.01)
	Confidence 2 & 3[c]	37,251 (91.57)	813 (2.00)	27 (0.07)	61 (0.15)
	One time period[d]	25,880 (91.19)	631 (2.22)	24 (0.08)	31 (0.11)
	CCDO 7-digit codes[e]	21,600 (93.02)	439 (1.89)	9 (0.04)	10 (0.04)
>0 to <2.24	Main[a]	1,106 (2.71)	788 (1.93)	23 (0.06)	18 (0.04)
	Probability ≥25[b]	148 (0.36)	195 (0.48)	6 (0.01)	8 (0.02)
	Confidence 2 & 3[c]	983 (2.42)	600 (1.47)	16 (0.04)	16 (0.04)
	One time period[d]	665 (2.34)	476 (1.68)	20 (0.07)	16 (0.06)
	CCDO 7-digit codes[e]	387 (1.67)	399 (1.72)	13 (0.06)	5 (0.02)
2.24 to <5	Main[a]	166 (0.41)	78 (0.19)	13 (0.03)	10 (0.02)
	Probability ≥25[b]	21 (0.05)	18 (0.04)	3 (0.01)	7 (0.02)
	Confidence 2 & 3[c]	164 (0.40)	64 (0.16)	10 (0.02)	7 (0.02)
	One time period[d]	76 (0.27)	67 (0.24)	10 (0.04)	9 (0.03)
	CCDO 7-digit codes[e]	45 (0.19)	29 (0.12)	4 (0.02)	3 (0.01)
≥5	Main[a]	444 (1.09)	215 (0.53)	18 (0.04)	31 (0.08)
	Probability ≥25[b]	47 (0.12)	75 (0.18)	4 (0.01)	14 (0.03)
	Confidence 2 & 3[c]	428 (1.05)	189 (0.46)	20 (0.05)	30 (0.07)
	One time period[d]	254 (0.89)	159 (0.56)	27 (0.10)	35 (0.12)
	CCDO 7-digit codes[e]	140 (0.60)	111 (0.48)	7 (0.03)	19 (0.08)

Each cell represents a unique agent-occupation combination where the specific probability of exposure is calculated for each occupation by dividing # of jobs that were exposed to each agent by total # of jobs
Only cells with a minimum of 10 jobs and 3 subjects per cell were retained
[a]Main % exact agreement = 69.7 (among cells >0 median intensity between JEMs)
[b]Probability ≥25 % exact agreement = 64.2 (among cells >0 median intensity between JEMs)
[c]Confidence 2 & 3 % exact agreement = 67.2 (among cells >0 median intensity between JEMs)
[d]One time period % exact agreement = 63.6 (among cells >0 median intensity between JEMs)
[e]CCDO 7-digit codes % exact agreement = 71.5 (among cells >0 median intensity between JEMs)

Table 46. Comparison of cell counts (n (%)) by the FWI of exposure (1, 5, 25 scale) of agent-occupation combinations between sex-specific JEMs

Male JEM	Analysis	Female JEM: 0	0 to <1	1 to <5	≥5
0	Main[a]	36,771 (90.20)	809 (1.98)	240 (0.59)	34 (0.08)
	Probability ≥25[b]	40,031 (98.20)	138 (0.34)	49 (0.12)	0 (0.00)
	Confidence 2 & 3[c]	37,251 (91.57)	686 (1.69)	189 (0.46)	26 (0.06)
	One time period[d]	25,880 (91.19)	512 (1.80)	162 (0.57)	12 (0.04)
	CCDO 7-digit codes[e]	21,600 (93.02)	370 (1.59)	84 (0.36)	4 (0.02)
0 to <1	Main[a]	1,256 (3.08)	574 (1.41)	144 (0.35)	3 (0.01)
	Probability ≥25[b]	150 (0.37)	137 (0.34)	14 (0.03)	0 (0.00)
	Confidence 2 & 3[c]	1,133 (2.79)	480 (1.18)	109 (0.27)	5 (0.01)
	One time period[d]	753 (2.65)	371 (1.31)	86 (0.30)	3 (0.01)
	CCDO 7-digit codes[e]	411 (1.77)	345 (1.49)	35 (0.15)	0 (0.00)
1 to <5	Main[a]	387 (0.95)	197 (0.48)	211 (0.52)	16 (0.04)
	Probability ≥25[b]	60 (0.15)	59 (0.14)	77 (0.19)	14 (0.03)
	Confidence 2 & 3[c]	371 (0.91)	152 (0.37)	150 (0.37)	12 (0.03)
	One time period[d]	198 (0.70)	122 (0.43)	167 (0.59)	26 (0.09)
	CCDO 7-digit codes[e]	132 (0.57)	76 (0.33)	118 (0.51)	3 (0.01)
≥5	Main[a]	73 (0.18)	8 (0.02)	30 (0.07)	11 (0.03)
	Probability ≥25[b]	6 (0.01)	0 (0.00)	22 (0.05)	7 (0.02)
	Confidence 2 & 3[c]	71 (0.17)	6 (0.01)	27 (0.07)	11 (0.03)
	One time period[d]	44 (0.16)	10 (0.04)	27 (0.01)	7 (0.02)
	CCDO 7-digit codes[e]	29 (0.12)	1 (0.00)	10 (0.04)	2 (0.01)

Each cell represents a unique agent-occupation combination where the specific probability of exposure is calculated for each occupation by dividing # of jobs that were exposed to each agent by total # of jobs
Only cells with a minimum of 10 jobs and 3 subjects per cell were retained
[a]Main % exact agreement = 66.7 (among cells >0 median FWI in both JEMs)
[b]Probability ≥25 % exact agreement = 67.0 (among cells >0 median FWI in both JEMs)
[c]Confidence 2 & 3 % exact agreement = 67.3 (among cells >0 median FWI in both JEMs)
[d]One time period % exact agreement = 66.5 (among cells >0 median FWI in both JEMs)
[e]CCDO 7-digit codes % exact agreement = 78.8 (among cells >0 median FWI in both JEMs)

APPENDIX E Notable differences across agent-occupation combinations between sexes

Table 47. All notable differences across agent-occupation combinations between sexes in one time period (1933-2011) – 5-digit ISCO-68 codes

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	95%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Leaded Gasoline	Other Salesperson, Shop Assistants and Demonstrators	1/29 (3.45)	70/94 (74.47)	1.3	71.5	69.7	59.4	78.5
PAHs From Any Source	Other Salesperson, Shop Assistants and Demonstrators	3/29 (10.34)	73/94 (77.66)	9.8	75.2	64.9	52.3	75.2
PAHs From Petroleum	Other Salesperson, Shop Assistants and Demonstrators	3/29 (10.34)	70/94 (74.47)	8.6	72.2	63.1	50.0	73.5
Calcium Oxide	Farm Worker (General)	4/16 (25)	277/316 (87.66)	24.0	87.2	63.1	43.6	75.9
Alkanes (C5-C17)	Other Salesperson, Shop Assistants and Demonstrators	3/29 (10.34)	76/94 (80.85)	13.9	76.8	62.6	48.0	74.0
Carbon Monoxide	Other Salesperson, Shop Assistants and Demonstrators	1/29 (3.45)	62/94 (65.96)	4.3	64.2	59.4	48.1	69.6
Cosmetic Talc	Women's Hairdresser	11/66 (16.67)	15/15 (100)	21.3	80.9	59.1	36.4	75.5
Engine Emissions	Other Salesperson, Shop Assistants and Demonstrators	5/29 (17.24)	76/94 (80.85)	22.0	78.3	56.0	39.7	69.4
Mononuclear Aromatic Hydrocarbons	Other Salesperson, Shop Assistants and Demonstrators	1/29 (3.45)	60/94 (63.83)	6.4	60.5	53.6	40.8	64.3
Calcium Sulphate	Building Painter	1/5 (20)	124/180 (68.89)	15.1	68.4	52.8	22.5	67.8
Lead	Other Salesperson, Shop Assistants and Demonstrators	1/29 (3.45)	55/94 (58.51)	3.6	56.8	52.6	41.3	63.0
Calcium Oxide	Dairy Farm Worker (General)	0/6 (0)	28/41 (68.29)	14.5	65.6	49.9	23.9	68.0
Aromatic Amines	Fur Hand Sewer	1/6 (16.67)	12/15 (80)	16.0	65.9	47.8	18.6	72.1
Acetate Fibres	Fur Hand Sewer	3/6 (50)	11/15 (73.33)	17.6	65.3	45.9	13.4	70.7
Engine Emissions	Canvasser	6/33 (18.18)	59/78 (75.64)	27.6	73.3	45.3	28.3	60.4
Cosmetic Talc	Professional Nurse (General)	95/273 (34.8)	9/9 (100)	35.2	78.7	43.4	17.2	60.1
Engine Emissions	Manager, Retail Trade	4/65 (6.15)	49/87 (56.32)	9.9	53.4	43.3	31.2	54.4

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	95%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Aromatic Amines	Other Printing Pressperson	1/11 (9.09)	17/23 (73.91)	23.5	66.4	42.1	16.0	64.9
Lead	Manager, Retail Trade	0/65 (0)	41/87 (47.13)	2.8	45.2	42.0	31.1	52.6
Carbon Monoxide	Manager, Retail Trade	0/65 (0)	41/87 (47.13)	3.0	45.1	41.8	31.1	52.4
Chlorine	Launderer (General)	0/15 (0)	12/24 (50)	1.5	43.8	41.7	22.9	61.4
Lead	Canvasser	0/33 (0)	38/78 (48.72)	5.9	46.8	40.5	27.8	52.4
Carbon Monoxide	Canvasser	0/33 (0)	38/78 (48.72)	6.3	47.1	40.3	27.2	52.3
Wool Fibres	Sewing-Machine Operator	244/673 (36.26)	52/66 (78.79)	36.5	76.5	40.0	28.7	49.7
PAHs From Any Source	Manager, Retail Trade	1/65 (1.54)	41/87 (47.13)	5.0	44.6	39.3	28.5	50.3
Alkanes (C18+)	Other Salesperson, Shop Assistants and Demonstrators	3/29 (10.34)	47/94 (50)	7.1	46.7	39.2	26.7	50.2
PAHs From Petroleum	Manager, Retail Trade	1/65 (1.54)	40/87 (45.98)	4.6	43.8	38.9	28.1	49.7
PAHs From Petroleum	Canvasser	1/33 (3.03)	38/78 (48.72)	9.0	46.7	37.2	23.4	49.7
Carbon Monoxide	Commercial Traveller	4/38 (10.53)	200/404 (49.5)	12.0	49.2	37.1	24.9	45.7
PAHs From Any Source	Canvasser	1/33 (3.03)	38/78 (48.72)	9.6	46.6	36.6	22.9	49.2
Formaldehyde	Professional Nurse (General)	34/273 (12.45)	7/9 (77.78)	12.9	49.4	36.3	12.4	62.1
Lead	Commercial Traveller	4/38 (10.53)	192/404 (47.52)	11.1	47.2	36.0	24.9	44.4
PAHs From Petroleum	Commercial Traveller	4/38 (10.53)	196/404 (48.51)	12.2	48.2	35.9	24.4	44.6
Calcium Carbonate	Teacher in History, Philosophy, Sociology and Related Social Sciences	8/24 (33.33)	20/21 (95.24)	46.1	82.6	35.8	13.1	56.1
PAHs From Any Source	Commercial Traveller	4/38 (10.53)	198/404 (49.01)	12.8	48.7	35.7	24.6	44.7
Aliphatic Aldehydes	Professional Nurse (General)	35/273 (12.82)	7/9 (77.78)	13.2	48.9	35.5	11.3	61.8
Lead	Motor Bus Driver	3/19 (15.79)	71/124 (57.26)	21.0	56.6	35.5	17.6	50.1
Mineral Spirits Pre 1970	Building Painter	0/5 (0)	105/180 (58.33)	22.1	57.5	35.3	8.7	52.3
Leaded Gasoline	Manager, Retail Trade	1/65 (1.54)	34/87 (39.08)	2.2	36.8	34.4	24.4	45.0
Mononuclear Aromatic Hydrocarbons	Manager, Retail Trade	2/65 (3.08)	37/87 (42.53)	5.1	39.4	34.1	23.5	45.2
Wood Dust	Labourer	0/37 (0)	244/637 (38.3)	4.4	38.0	33.4	25.2	38.7

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	95%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Alkanes (C5-C17)	Manager, Retail Trade	3/65 (4.62)	38/87 (43.68)	7.2	40.4	32.8	21.8	44.1
Ammonia	Launderer (General)	2/15 (13.33)	14/24 (58.33)	19.3	52.6	32.6	9.1	53.9
Cosmetic Talc	General Physician	0/14 (0)	12/23 (52.17)	12.2	44.1	31.0	9.7	51.6
Concrete Dust	Labourer	0/37 (0)	213/637 (33.44)	3.3	33.1	29.7	23.1	34.8
Lead	Insurance Salesperson	0/14 (0)	45/129 (34.88)	4.4	34.0	29.0	17.8	38.4
Chloroform	Professional Nurse (General)	3/273 (1.1)	4/9 (44.44)	1.0	29.9	28.9	7.5	60.1
Lead	Appraiser	0/7 (0)	15/37 (40.54)	8.8	37.7	27.9	7.3	46.0
PAHs From Petroleum	Insurance Salesperson	0/14 (0)	45/129 (34.88)	6.0	33.6	27.1	15.6	37.0
PAHs From Any Source	Baker, General	1/5 (20)	29/68 (42.65)	13.4	40.9	27.0	7.5	41.7
PAHs From Any Source	Insurance Salesperson	0/14 (0)	45/129 (34.88)	6.5	33.6	26.7	15.2	36.7
Biocides	Fur Hand Sewer	0/6 (0)	7/15 (46.67)	5.4	33.5	26.5	7.5	50.1
PAHs From Petroleum	Appraiser	0/7 (0)	15/37 (40.54)	9.8	37.4	26.5	6.1	43.8
Lubricating Oils and Greases	Other Salesperson, Shop Assistants and Demonstrators	3/29 (10.34)	34/94 (36.17)	6.3	33.3	26.4	14.5	37.4
Cristalline Silica	Labourer	3/37 (8.11)	244/637 (38.3)	11.6	38.0	26.4	14.0	34.7
Benzo A Pyrene	Other Salesperson, Shop Assistants and Demonstrators	0/29 (0)	28/94 (29.79)	0.7	27.2	26.3	18.1	35.6
Alkanes (C1-C4)	Working Proprietor (Restaurant)	0/28 (0)	34/112 (30.36)	3.5	28.9	24.9	15.1	34.3
Wood Dust	Other Production Supervisors and General Foremen	1/6 (16.67)	26/73 (35.62)	8.7	34.0	24.5	7.1	37.8
Formaldehyde	Auxiliary Nurse	5/58 (8.62)	6/11 (54.55)	10.8	35.5	24.4	5.1	48.4
Carbon Monoxide	Technical Salesperson	0/16 (0)	44/135 (32.59)	7.5	31.9	23.9	9.9	34.1
Benzo A Pyrene	Baker, General	0/5 (0)	20/68 (29.41)	3.1	27.3	23.7	12.2	34.8
Alkanes (C1-C4)	Cook, except Private Service	5/123 (4.07)	58/206 (28.16)	4.4	27.5	22.9	16.3	29.7
Carbon Monoxide	Insurance Salesperson	1/14 (7.14)	45/129 (34.88)	11.5	34.1	22.4	6.9	33.9
Antimony	Other Printers and Related Workers	0/10 (0)	5/15 (33.33)	3.2	26.2	22.3	5.5	46.7

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	95%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Copper	Farm Worker (General)	0/16 (0)	90/316 (28.48)	5.3	27.9	22.3	11.0	29.0
PAHs From Petroleum	Advertising Salesperson	0/11 (0)	14/42 (33.33)	7.1	30.1	22.3	7.1	37.7
Lead	Advertising Salesperson	0/11 (0)	13/42 (30.95)	5.7	28.4	21.8	7.0	37.1
PAHs From Any Source	Advertising Salesperson	0/11 (0)	14/42 (33.33)	8.0	30.2	21.5	5.7	37.2
PAHs From Any Source	Cook, except Private Service	9/123 (7.32)	62/206 (30.1)	7.8	29.5	21.5	13.9	28.6
Engine Emissions	Government Executive Official	5/71 (7.04)	34/109 (31.19)	8.3	29.6	21.1	11.0	31.0
Carbon Monoxide	Messenger	0/12 (0)	17/61 (27.87)	4.8	26.2	20.7	8.2	33.0
Alkanes (C18+)	Manager, Retail Trade	2/65 (3.08)	25/87 (28.74)	5.0	25.8	20.5	11.5	30.6
Lead	Technical Salesperson	0/16 (0)	36/135 (26.67)	4.9	25.8	20.4	8.7	29.4
PAHs From Petroleum	Warehouse Porter	1/18 (5.56)	97/296 (32.77)	12.4	32.4	20.0	7.2	29.0
PAHs From Petroleum	Technical Salesperson	0/16 (0)	37/135 (27.41)	6.1	26.4	19.9	6.8	29.2
Benzene	Other Salesperson, Shop Assistants and Demonstrators	1/29 (3.45)	24/94 (25.53)	2.7	22.9	19.8	11.0	29.0
Nitrogen Oxides	Manager, Retail Trade	0/65 (0)	21/87 (24.14)	1.7	21.7	19.8	12.0	29.1
PAHs From Any Source	Technical Salesperson	0/16 (0)	38/135 (28.15)	7.1	27.1	19.7	7.3	29.3
Alkanes (C1-C4)	Manager, Retail Trade	0/65 (0)	20/87 (22.99)	1.2	20.8	19.3	11.7	28.5
Portland Cement	Labourer	0/37 (0)	139/637 (21.82)	2.1	21.6	19.3	13.0	23.3
Carbon Monoxide	Other Service Workers Not Elsewhere Classified	4/39 (10.26)	27/104 (25.96)	5.4	24.9	19.2	9.4	28.9
PAHs From Any Source	Other Production and Related Workers Not Elsewhere	7/78 (8.97)	14/43 (32.56)	10.8	30.1	19.0	5.7	34.0
Metallic Dust	Quality Inspector	7/52 (13.46)	36/104 (34.62)	14.4	33.4	18.9	6.5	30.5
Benzene	Manager, Retail Trade	0/65 (0)	21/87 (24.14)	2.0	21.2	18.9	10.8	28.3
Methanol	Other Salesperson, Shop Assistants and Demonstrators	0/29 (0)	23/94 (24.47)	2.7	22.0	18.8	10.4	28.1
PAHs From Any Source	Other Service Workers Not Elsewhere Classified	4/39 (10.26)	28/104 (26.92)	6.5	25.7	18.8	8.4	28.7
PAHs From Wood	Baker, General	0/5 (0)	17/68 (25)	3.3	22.8	18.7	6.8	30.0

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	95%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Carbon Monoxide	Baker, General	0/5 (0)	17/68 (25)	3.9	23.2	18.7	6.8	30.0
Nitrogen Oxides	Other Salesperson, Shop Assistants and Demonstrators	0/29 (0)	21/94 (22.34)	1.4	20.2	18.4	10.8	27.6
Engine Emissions	Retail Trade Salesperson	11/501 (2.2)	111/508 (21.85)	3.0	21.3	18.3	14.6	22.3
Benzo A Pyrene	Manager, Retail Trade	0/65 (0)	19/87 (21.84)	1.1	19.5	18.2	10.7	27.2
Sulphur Dioxide	Manager, Retail Trade	0/65 (0)	19/87 (21.84)	1.0	19.5	18.2	10.9	27.0
Acetate Fibres	Supervisor and General Foreman (Production of Textiles and Clothing Manufacturing)	0/28 (0)	15/67 (22.39)	0.7	19.0	18.0	9.9	28.2
Wood Combustion Products	Baker, General	0/5 (0)	17/68 (25)	3.8	22.5	18.0	6.3	29.2
Ultraviolet Radiation	Labourer	3/37 (8.11)	170/637 (26.69)	8.9	26.5	17.5	7.1	24.2
Propane	Working Proprietor (Restaurant)	0/28 (0)	24/112 (21.43)	2.1	20.0	17.5	9.5	25.9
Chloroform	Chemistry Technician	0/16 (0)	6/26 (23.08)	1.1	18.8	17.4	5.8	34.5
Lead	Manager, Wholesale Trade	0/10 (0)	23/100 (23)	4.0	21.9	17.2	5.9	26.7
PAHs From Petroleum	Other Service Workers Not Elsewhere Classified	2/39 (5.13)	23/104 (22.12)	3.2	20.6	17.1	9.2	25.9
Carbon Monoxide	Manager, Wholesale Trade	0/10 (0)	23/100 (23)	4.3	21.8	17.0	5.0	26.7
Alkanes (C1-C4)	Other Salesperson, Shop Assistants and Demonstrators	0/29 (0)	19/94 (20.21)	1.0	18.0	16.9	9.8	25.5
Lead	Other Service Workers Not Elsewhere Classified	2/39 (5.13)	22/104 (21.15)	2.7	19.9	16.8	9.0	25.4
Acetate Fibres	Sewing-Machine Operator	37/673 (5.5)	16/66 (24.24)	5.7	22.6	16.8	7.9	27.7
Carbon Monoxide	Warehouse Porter	0/18 (0)	71/296 (23.99)	6.7	23.7	16.7	6.4	23.7
Iron	Quality Inspector	2/52 (3.85)	26/104 (25)	6.2	23.1	16.7	7.7	26.0
PAHs From Any Source	Other Cooks	3/89 (3.37)	26/112 (23.21)	5.3	22.0	16.5	8.7	24.8
PAHs From Petroleum	Quality Inspector	7/52 (13.46)	31/104 (29.81)	12.5	28.9	16.4	5.1	26.9
Lead	Real Estate Salesperson	0/48 (0)	14/66 (21.21)	3.0	19.4	16.0	7.2	26.7

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	95%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
PAHs From Other Sources	Cook, except Private Service	0/123 (0)	38/206 (18.45)	1.2	17.4	16.0	11.1	21.5
Sulphur Dioxide	Other Salesperson, Shop Assistants and Demonstrators	0/29 (0)	18/94 (19.15)	0.5	16.5	15.9	9.4	24.6
Other Pyrolysis Fumes	Cook, except Private Service	0/123 (0)	38/206 (18.45)	1.3	17.3	15.9	11.1	21.5
Nitrates	Other Production and Related Workers Not Elsewhere	0/78 (0)	9/43 (20.93)	0.1	16.0	15.8	7.1	28.4
Calcium Sulphate	Labourer	0/37 (0)	113/637 (17.74)	1.6	17.5	15.7	10.6	19.3
Engine Emissions	Labourer	2/37 (5.41)	148/637 (23.23)	7.2	23.0	15.7	6.4	21.6
Waxes Polishes	Charworker	18/132 (13.64)	82/264 (31.06)	14.6	30.2	15.6	7.5	23.4
Metallic Dust	Manager, Retail Trade	2/65 (3.08)	19/87 (21.84)	4.5	19.6	14.9	6.7	24.2
PAHs From Petroleum	Real Estate Salesperson	0/48 (0)	14/66 (21.21)	3.7	18.9	14.9	6.1	25.3
Diesel Engine Emissions	Labourer	3/37 (8.11)	158/637 (24.8)	9.8	24.6	14.7	5.4	21.6
Mild Steel Dust	Quality Inspector	1/52 (1.92)	23/104 (22.12)	4.8	19.8	14.7	6.6	23.6
PAHs From Any Source	Real Estate Saleperson	0/48 (0)	14/66 (21.21)	3.9	18.9	14.6	5.9	25.2
Propane	Cook, except Private Service	0/123 (0)	34/206 (16.5)	1.2	15.7	14.4	9.7	19.7
PAHs From Petroleum	Storeroom Clerk	0/37 (0)	34/183 (18.58)	3.4	17.8	14.1	7.5	20.4
PAHs From Any Source	Working Proprietor (Restaurant)	0/28 (0)	21/112 (18.75)	3.1	17.3	13.9	5.9	21.9
PAHs From Any Source	Storeroom Clerk	1/37 (2.7)	36/183 (19.67)	4.9	18.9	13.8	5.9	20.7
Methane	Cook, except Private Service	5/123 (4.07)	36/206 (17.48)	3.9	17.0	12.9	7.1	19.0
Methane	Working Proprietor (Restaurant)	0/28 (0)	18/112 (16.07)	1.5	14.7	12.9	6.4	20.4
Chrysotile Asbestos	Manager, Retail Trade	0/65 (0)	14/87 (16.09)	1.2	14.2	12.8	6.4	21.1
Benzo A Pyrene	Labourer	0/37 (0)	97/637 (15.23)	2.5	15.0	12.4	6.6	16.0
PAHs From Any Source	Sales Manager (except Wholesale and Retail Trade)	0/44 (0)	22/138 (15.94)	2.4	14.7	12.1	6.2	18.7
Natural Gas	Working Proprietor (Restaurant)	0/28 (0)	17/112 (15.18)	1.3	13.4	11.8	5.7	19.1

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	95%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
PAHs From Petroleum	Sales Manager (except Wholesale and Retail Trade)	0/44 (0)	21/138 (15.22)	2.1	14.1	11.7	6.2	18.2
PAHs From Other Sources	Working Proprietor (Restaurant)	0/28 (0)	17/112 (15.18)	1.8	13.6	11.5	5.2	18.5
Abrasives Dust	Other University and Higher Education Teachers	0/87 (0)	12/73 (16.44)	1.5	13.0	11.3	5.2	19.9
Other Pyrolysis Fumes	Working Proprietor (Restaurant)	0/28 (0)	17/112 (15.18)	1.8	13.5	11.3	5.1	18.3
Carbon Monoxide	Sales Manager (except Wholesale and Retail Trade)	0/44 (0)	19/138 (13.77)	1.5	12.8	11.1	5.9	17.5
Wood Dust	General Manager	1/81 (1.23)	34/241 (14.11)	2.4	13.4	10.8	5.5	15.8
Carbon Monoxide	Government Executive Official	0/71 (0)	15/109 (13.76)	1.4	12.5	10.8	5.2	17.9
Lead	Sales Manager (except Wholesale and Retail Trade)	0/44 (0)	18/138 (13.04)	1.5	12.1	10.3	5.3	16.5
Carbon Monoxide	Storeroom Clerk	0/37 (0)	24/183 (13.11)	1.9	12.5	10.3	5.2	15.9
PAHs From Any Source	Retail Trade Salesperson	4/501 (0.8)	62/508 (12.2)	1.6	11.8	10.2	7.4	13.4
PAHs From Petroleum	Retail Trade Salesperson	1/501 (0.2)	59/508 (11.61)	1.0	11.2	10.2	7.5	13.1
Cristalline Silica	General Manager	0/81 (0)	29/241 (12.03)	1.8	11.1	9.1	5.0	13.6
Mineral Wool Fibres	Labourer	0/37 (0)	65/637 (10.2)	0.9	10.0	8.9	5.0	11.7
Brick Dust	Labourer	0/37 (0)	63/637 (9.89)	0.6	9.7	8.9	5.9	11.5
Lead	Retail Trade Salesperson	0/501 (0)	46/508 (9.06)	0.6	8.7	8.1	5.7	10.7
Carbon Monoxide	Retail Trade Salesperson	0/501 (0)	46/508 (9.06)	0.7	8.7	7.9	5.6	10.7
Polyester Fibres	Retail Trade Salesperson	49/501 (9.78)	4/508 (0.79)	8.9	1.3	-7.5	-10.2	-5.0
Organic Solvents	Retail Trade Salesperson	81/501 (16.17)	32/508 (6.3)	15.7	6.7	-9.0	-12.8	-5.4
Ammonia	Retail Trade Salesperson	55/501 (10.98)	5/508 (0.98)	10.4	1.3	-9.1	-12.0	-6.4
Aliphatic Alcohols	Retail Trade Salesperson	66/501 (13.17)	15/508 (2.95)	12.8	3.2	-9.5	-12.9	-6.4
Cotton Dust	Charworker	21/132 (15.91)	8/264 (3.03)	14.2	3.4	-10.7	-17.2	-5.3
Ozone	Bookkeeper (General)	28/189 (14.81)	1/86 (1.16)	13.5	2.1	-11.2	-16.7	-5.9
Ozone	Other Managers	32/231 (13.85)	2/199 (1.01)	13.2	1.5	-11.6	-16.2	-7.3

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	95%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Ozone	Office Clerk (General)	85/537 (15.83)	10/314 (3.18)	15.5	3.4	-12.1	-15.6	-8.5
Ozone	Accountant (General)	14/81 (17.28)	2/205 (0.98)	14.2	1.5	-12.5	-20.7	-6.3
Cleaning Agents	Retail Trade Salesperson	97/501 (19.36)	31/508 (6.1)	19.0	6.3	-12.7	-16.6	-8.7
Ozone	Sales Manager (except Wholesale and Retail Trade)	8/44 (18.18)	1/138 (0.72)	14.5	1.5	-12.8	-23.9	-5.0
Cleaning Agents	Cash Desk Cashier	42/216 (19.44)	1/54 (1.85)	17.4	4.4	-12.9	-19.1	-5.8
Biocides	Server, General	72/428 (16.82)	4/189 (2.12)	16.3	2.9	-13.4	-17.5	-9.2
Cleaning Agents	Working Proprietor (Retail Trade)	22/86 (25.58)	30/324 (9.26)	23.0	9.5	-13.5	-22.9	-5.3
Cotton Dust	Retail Trade Salesperson	79/501 (15.77)	4/508 (0.79)	15.0	1.2	-13.8	-17.2	-10.6
Plastics Pyrolysis Fumes	Hand Packer	42/211 (19.91)	4/119 (3.36)	18.3	4.3	-13.9	-20.2	-7.7
Synthetic Fibres	Retail Trade Salesperson	88/501 (17.56)	6/508 (1.18)	16.7	1.6	-15.1	-18.4	-11.9
Ashes	Charworker	37/132 (28.03)	30/264 (11.36)	26.7	11.5	-15.2	-23.8	-7.3
Radio Frequency Microwaves	Sewing-Machine Operator	132/673 (19.61)	0/66 (0)	19.0	3.6	-15.3	-19.5	-9.5
Biocides	Cook, except Private Service	33/123 (26.83)	21/206 (10.19)	26.0	10.5	-15.4	-24.0	-7.3
Fabric Dust	Nursing Aid	57/249 (22.89)	3/62 (4.84)	22.0	6.1	-15.7	-22.3	-7.7
Cleaning Agents	Labourer	11/37 (29.73)	49/637 (7.69)	23.7	7.9	-15.7	-29.8	-5.0
Aliphatic Aldehydes	Manager, Retail Trade	18/65 (27.69)	2/87 (2.3)	21.3	4.7	-16.3	-26.7	-7.6
Formaldehyde	Manager, Retail Trade	18/65 (27.69)	2/87 (2.3)	21.4	4.7	-16.5	-27.3	-7.7
Cotton Dust	Nursing Aid	61/249 (24.5)	3/62 (4.84)	23.4	6.5	-16.8	-23.7	-8.6
Aliphatic Aldehydes	Retail Trade Salesperson	115/501 (22.95)	25/508 (4.92)	22.2	5.3	-16.9	-21.0	-12.9
Biocides	Other Cooks	21/89 (23.6)	4/112 (3.57)	21.7	4.7	-16.9	-26.2	-8.4
Formaldehyde	Retail Trade Salesperson	114/501 (22.75)	24/508 (4.72)	22.0	5.1	-16.9	-20.9	-12.9
Fabric Dust	Retail Trade Salesperson	113/501 (22.55)	13/508 (2.56)	22.0	2.8	-19.2	-23.1	-15.4
Plastics Pyrolysis Fumes	Machine Packer	15/42 (35.71)	4/70 (5.71)	27.3	7.3	-19.8	-34.4	-7.3
Isopropanol	Nursing Aid	111/249 (44.58)	13/62 (20.97)	43.4	22.4	-20.9	-31.6	-8.9

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	95%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Synthetic Fibres	Storeroom Clerk	13/37 (35.14)	7/183 (3.83)	26.2	4.7	-21.3	-36.3	-9.8
Fabric Dust	Manager, Retail Trade	19/65 (29.23)	0/87 (0)	25.0	2.0	-22.7	-33.8	-13.2
Cristalline Silica	Charworker	44/132 (33.33)	19/264 (7.2)	30.7	7.8	-22.9	-31.3	-14.7
Abrasives Dust	Charworker	49/132 (37.12)	27/264 (10.23)	34.3	10.7	-23.5	-32.4	-15.4
Fabric Dust	Storeroom Clerk	14/37 (37.84)	14/183 (7.65)	32.1	8.2	-23.9	-39.3	-10.8
Aliphatic Alcohols	Charworker	53/132 (40.15)	33/264 (12.5)	38.4	13.0	-25.3	-34.2	-16.5
Cellulose	Machine Packer	24/42 (57.14)	14/70 (20)	49.5	23.1	-26.2	-41.9	-10.2
Isopropanol	Charworker	52/132 (39.39)	27/264 (10.23)	37.6	10.8	-26.7	-35.6	-18.2
Aliphatic Aldehydes	Server, General	255/428 (59.58)	56/189 (29.63)	58.8	30.5	-28.3	-35.9	-20.2
Biocides	Working Proprietor (Restaurant)	13/28 (46.43)	9/112 (8.04)	38.1	9.2	-28.7	-46.2	-12.5
Cleaning Agents	Farm Worker (General)	8/16 (50)	27/316 (8.54)	37.8	9.0	-28.7	-50.3	-11.1
Formaldehyde	Server, General	246/428 (57.48)	49/189 (25.93)	56.7	26.8	-29.8	-37.4	-21.9
Tin Fumes	Electronic Equipment Assembler	18/27 (66.67)	4/23 (17.39)	55.2	22.1	-32.6	-53.1	-9.5
Hypochlorites	Janitor	11/18 (61.11)	25/159 (15.72)	49.2	16.4	-32.7	-52.5	-12.3
Aliphatic Alcohols	General Physician	10/14 (71.43)	3/23 (13.04)	53.8	20.0	-33.1	-55.3	-9.3
Isopropanol	General Physician	10/14 (71.43)	3/23 (13.04)	53.3	19.4	-33.2	-55.7	-9.3
Ammonia	Janitor	14/18 (77.78)	51/159 (32.08)	66.3	32.7	-33.3	-51.4	-12.9
Cleaning Agents	Working Proprietor (Restaurant)	22/28 (78.57)	39/112 (34.82)	70.2	36.2	-33.9	-50.2	-15.8
Cleaning Agents	Cook, except Private Service	104/123 (84.55)	98/206 (47.57)	82.9	48.4	-34.4	-43.3	-24.8
Cleaning Agents	Specialized Physician	7/9 (77.78)	0/20 (0)	46.5	9.7	-35.7	-60.7	-12.1
Cooking Fumes	Server, General	346/428 (80.84)	81/189 (42.86)	80.2	44.1	-36.0	-43.8	-28.1
Hypochlorites	Charworker	65/132 (49.24)	23/264 (8.71)	46.6	9.3	-37.3	-46.4	-28.6
Fabric Dust	Winder	31/34 (91.18)	12/28 (42.86)	85.8	47.5	-37.9	-57.0	-17.8
Ashes	Working Proprietor (Restaurant)	15/28 (53.57)	5/112 (4.46)	43.9	5.7	-37.9	-55.9	-21.0

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	95%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Cleaning Agents	Bartender	37/49 (75.51)	25/80 (31.25)	71.5	33.2	-38.1	-52.2	-23.0
Isopropanol	Janitor	14/18 (77.78)	36/159 (22.64)	62.0	23.6	-38.2	-56.2	-17.4
Aromatic Alcohols	Women's Hairdresser	48/66 (72.73)	3/15 (20)	66.9	28.2	-38.4	-58.0	-14.2
Aliphatic Alcohols	Janitor	15/18 (83.33)	39/159 (24.53)	66.2	25.6	-40.3	-57.0	-21.1
Cleaning Agents	Server, General	316/428 (73.83)	54/189 (28.57)	73.3	29.6	-43.7	-51.0	-35.9
Ammonia	Farm Worker (General)	11/16 (68.75)	31/316 (9.81)	56.0	10.4	-45.6	-66.1	-24.2
Hydrogen Sulphide	Farm Worker (General)	10/16 (62.5)	23/316 (7.28)	54.8	7.7	-47.0	-67.5	-25.0
Alkanes (C1-C4)	Farm Worker (General)	11/16 (68.75)	14/316 (4.43)	58.1	4.9	-53.1	-70.9	-32.2
Methane	Farm Worker (General)	11/16 (68.75)	13/316 (4.11)	59.5	4.6	-54.7	-74.0	-32.4
Ultraviolet Radiation	Farm Worker (General)	14/16 (87.5)	16/316 (5.06)	68.5	5.9	-62.5	-79.2	-40.9

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

APPENDIX F Bayesian comparison of sex-specific estimation of exposure metrics

Sensitivity Analyses: A Bayesian comparison of sex-specific estimation of exposure metrics in CANJEM

Methods

Sensitivity analyses were conducted by modifying the time period, the ISCO-68 code resolution, and the credible limit. The same criteria for notable differences (Lacourt et al., 2018) was applied to sensitivity analyses. Seven sensitivity analyses were conducted:

1. Time period
   a. 5-digit ISCO-68 codes in two time periods, 95% credible interval
   b. 5-digit ISCO-68 codes in four time periods, 95% credible interval
2. ISCO-68 resolution
   a. 3-digit ISCO-68 codes in one time period, 95% credible interval
   b. 3-digit ISCO-68 codes in one time period, 90% credible interval
3. Credible limit
   a. 5-digit ISCO-68 codes in one time period, 90% credible interval
   b. 5-digit ISCO-68 codes in two time periods, 90% credible interval
   c. 5-digit ISCO-68 codes in four time periods, 90% credible interval

F.I 95% credible interval of 5-digit ISCO-68 codes in two time periods (1933-1969 and 1970-2011)

Table 48. Notable differences greater in men than women according to agent-occupation combinations from 1933-1969

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	95%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Calcium Oxide	Farm Worker (General)	1/9 (11.11)	256/282 (90.78)	20.3	90.3	69.9	45.4	83.4
Wool Fibres	Sewing-Machine Operator	37/117 (31.62)	25/30 (83.33)	32.8	79.3	46.4	28.7	60.6
Alkanes (C1-C4)	Cook. except Private Service	0/13 (0)	29/65 (44.62)	4.4	42.5	37.5	23.4	50.1
Cristalline Silica	Labourer	0/11 (0)	78/200 (39)	10.3	38.2	27.6	8.7	38.7
Chlorinated Alkanes	Nursing Aid	0/12 (0)	7/19 (36.84)	1.7	28.7	26.3	9.5	47.9
Chloroform	Nursing Aid	0/12 (0)	7/19 (36.84)	0.9	27.5	25.8	9.7	47.8
Wood Dust	Labourer	0/11 (0)	67/200 (33.5)	8.6	32.8	23.9	6.1	34.5
Methane	Cook. except Private Service	0/13 (0)	18/65 (27.69)	2.1	26.1	23.4	12.6	35.1
PAHs From Other Sources	Cook. except Private Service	0/13 (0)	22/65 (33.85)	6.4	30.2	23.1	9.1	36.0
Concrete Dust	Labourer	0/11 (0)	57/200 (28.5)	5.2	27.7	22.0	7.5	30.9

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

Table 49. Notable differences greater in women than men according to agent-occupation combinations from 1933-1969

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	95%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Ultraviolet Radiation	Farm Worker (General)	7/9 (77.78)	6/282 (2.13)	67.6	2.6	-64.8	-85.4	-35.8
Hydrogen Sulphide	Farm Worker (General)	7/9 (77.78)	15/282 (5.32)	63.7	5.6	-58.1	-79.7	-29.6
Methane	Farm Worker (General)	7/9 (77.78)	5/282 (1.77)	58.4	2.2	-56.2	-78.4	-28.9
Alkanes (C1-C4)	Farm Worker (General)	7/9 (77.78)	5/282 (1.77)	53.3	2.4	-50.9	-72.5	-26.4
Ammonia	Farm Worker (General)	7/9 (77.78)	24/282 (8.51)	58.7	9.0	-49.6	-74.3	-21.3
Fabric Dust	Winder	13/14 (92.86)	5/20 (25)	76.2	33.1	-41.9	-65.6	-15.1
Cleaning Agents	Server, General	34/51 (66.67)	12/63 (19.05)	63.6	21.6	-41.7	-56.5	-25.4
Cooking Fumes	Server, General	40/51 (78.43)	17/63 (26.98)	70.5	32.6	-37.9	-54.2	-18.9
Cleaning Agents	Farm Worker (General)	6/9 (66.67)	21/282 (7.45)	41.4	8.1	-33.3	-59.7	-10.8
Aliphatic Aldehydes	Server, General	30/51 (58.82)	12/63 (19.05)	50.2	23.1	-26.9	-41.7	-12.0

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

Table 50. Notable differences greater in men than women according to agent-occupation combinations from 1970-2011

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	95%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Cosmetic Talc	Women's Hairdresser	4/36 (11.11)	12/12 (100)	20.0	76.1	55.4	24.2	76.7
Chlorine	Launderer (General)	0/6 (0)	10/16 (62.5)	0.8	53.7	51.7	26.3	74.8
Wool Fibres	Sewing-Machine Operator	123/337 (36.5)	41/47 (87.23)	37.0	83,8	46.7	34.2	56.5
Leaded Gasoline	Manager, Retail Trade	0/5 (0)	25/54 (46.3)	4.9	43.2	37.1	20.8	51.5
Chloroform	Professional Nurse (General)	2/117 (1.71)	4/8 (50)	1.8	35.2	33.2	8.7	66.7
Concrete Dust	Labourer	0/21 (0)	158/423 (37.35)	3.5	36.9	33.0	20.4	39.0
Wood Dust	Labourer	0/21 (0)	163/423 (38.53)	6.2	38.1	31.7	18.2	38.8
Mononuclear Aromatic Hydrocarbons	Manager, Retail Trade	0/5 (0)	26/54 (48.15)	12.7	43.9	30.1	6.8	47.4
Alkanes (C1-C4)	Cook, except Private Service	2/35 (5.71)	43/112 (38.39)	7.0	37.2	29.9	19.2	40.1
Rayon Fibres	Supervisor and General Foreman (Production of text	1/11 (9.09)	17/47 (36.17)	2.3	31.9	28.7	14.8	42.7

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

Table 51. Notable differences greater in women than men according to agent-occupation combinations from 1970-2011

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	95%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Ultraviolet Radiation	Farm Worker (General)	9/10 (90)	8/138 (5.8)	69.0	7.1	-61.7	-79.6	-37.1
Hypochlorites	Charworker	29/44 (65.91)	7/114 (6.14)	56.4	7.9	-48.3	-62.5	-33.5
Alkanes (C1-C4)	Farm Worker (General)	7/10 (70)	7/138 (5.07)	54.4	6.1	-48.0	-66.9	-25.3
Methane	Farm Worker (General)	7/10 (70)	6/138 (4.35)	53.4	5.3	-47.8	-70.2	-23.2
Cleaning Agents	Bartender	14/16 (87.5)	10/50 (20)	70.5	24.8	-45.2	-63.4	-22.8
Cleaning Agents	Server, General	133/196 (67.86)	26/107 (24.3)	66.7	26.4	-40.2	-50.2	-29.5
Hydrogen Sulphide	Farm Worker (General)	6/10 (60)	11/138 (7.97)	47.2	8.8	-38.3	-62.9	-11.5
Ammonia	Farm Worker (General)	7/10 (70)	15/138 (10.87)	49.5	12.1	-37.3	-61.8	-12.2
Cooking Fumes	Server, General	155/196 (79.08)	42/107 (39.25)	77.5	41.6	-35.8	-46.3	-24.7
Formaldehyde	Server, General	110/196 (56.12)	22/107 (20.56)	53.8	23.0	-30.7	-40.4	-20.4

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

F.II 95% credible interval of 5-digit ISCO-68 codes in four time periods (1933-1949, 1950-1969, 1970-1984, and 1985-2011)

Table 52. Notable differences greater in men than women according to agent-occupation combinations in period 1 (1933-1949)

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	95%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Aromatic Amines	Other Printing Pressperson	0/5 (0)	8/9 (88.89)	25.4	75.3	47.7	11.0	76.3
Leaded Gasoline	Other Salesperson, Shop Assistants and Demonstrators	1/12 (8.33)	20/36 (55.56)	2.0	50.1	47.2	30.2	63.4
PAHs From Any Source	Other Salesperson, Shop Assistants and Demonstrators	2/12 (16.67)	21/36 (58.33)	8.5	53.4	44.0	26.0	60.9
Alkanes (C5-C17)	Other Salesperson, Shop Assistants and Demonstrators	2/12 (16.67)	22/36 (61.11)	10.1	54.3	43.3	23.3	60.7
Engine Emissions	Manager, Retail Trade	0/32 (0)	28/50 (56)	8.5	51.1	42.2	27.0	56.9
PAHs From Petroleum	Other Salesperson, Shop Assistants and Demonstrators	2/12 (16.67)	19/36 (52.78)	5.1	47.8	41.6	24.2	58.1
Ethanol	Biological Technician	1/11 (9.09)	7/8 (87.5)	22.0	63.2	39.3	7.7	68.8
Carbon Monoxide	Other Salesperson, Shop Assistants and Demonstrators	1/12 (8.33)	17/36 (47.22)	5.6	43.8	37.7	20.0	54.5
Carbon Monoxide	Manager, Retail Trade	0/32 (0)	22/50 (44)	4.4	41.5	36.6	22.9	50.8
Cosmetic Talc	Women's Hairdresser	6/35 (17.14)	9/11 (81.82)	23.7	61.5	37.0	9.6	63.4

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

Table 53. Notable differences greater in women than men according to agent-occupation combinations in period 1 (1933-1949)

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	95%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Aromatic Amines	Women's Hairdresser	25/35 (71.43)	1/11 (9.09)	63.2	18.9	-43.4	-64.5	-15.2
Organic Dyes and Pigments	Women's Hairdresser	28/35 (80)	1/11 (9.09)	69.6	25.2	-43.3	-66.4	-15.8
Aromatic Alcohols	Women's Hairdresser	24/35 (68.57)	1/11 (9.09)	60.0	17.5	-41.7	-62.3	-14.7
Cleaning Agents	Server, General	134/193 (69.43)	18/61 (29.51)	68.3	32.6	-35.5	-47.8	-22.7
Bleaches	Women's Hairdresser	25/35 (71.43)	1/11 (9.09)	59.1	22.6	-35.5	-58.3	-9.8
Cleaning Agents	Cook, except Private Service	38/43 (88.37)	42/94 (44.68)	81.8	47.2	-34.4	-47.5	-20.3
Cooking Fumes	Server, General	143/193 (74.09)	22/61 (36.07)	72.5	40.4	-31.9	-44.9	-18.3
Isopropanol	Charworker	29/73 (39.73)	14/179 (7.82)	36.1	8.6	-27.3	-38.6	-16.6
Hypochlorites	Charworker	30/73 (41.1)	18/179 (10.06)	37.4	10.7	-26.6	-38.2	-15.4
Aliphatic Alcohols	Charworker	30/73 (41.1)	20/179 (11.17)	38.2	11.8	-26.2	-37.8	-15.1

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

Table 54. Notable differences greater in men than women according to agent-occupation combinations in period 2 (1950-1969)

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	95%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Anaesthetic Gases	Auxiliary Nurse	2/23 (8.7)	7/7 (100)	12.4	68.4	54.7	18.6	83.0
Titanium	Building Painter	2/5 (40)	18/24 (75)	21.4	72.3	49.6	16.4	73.2
Titanium Dioxide	Building Painter	2/5 (40)	18/24 (75)	21.3	71.5	48.8	14.4	74.0
Iron Oxides	Building Painter	0/5 (0)	15/24 (62.5)	6.7	56.7	48.3	23.7	69.0
Calcium Sulphate	Building Painter	0/5 (0)	13/24 (54.17)	2.2	50.3	46.5	25.0	66.6
Chromium Vi	Building Painter	0/5 (0)	14/24 (58.33)	7.5	54.5	45.2	18.2	66.5
Chromium	Building Painter	0/5 (0)	15/24 (62.5)	12.0	58.3	44.4	12.6	67.0
Selenium	Building Painter	1/5 (20)	13/24 (54.17)	7.0	46.8	37.4	7.9	60.8
Natural Gas Combustion Products	Cook, except Private Service	19/58 (32.76)	28/37 (75.68)	34.9	70.8	35.6	16.4	53.3
Wood Dust	Labourer	0/7 (0)	31/68 (45.59)	9.0	44.0	34.1	9.7	49.4

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

Table 55. Notable differences greater in women than men according to agent-occupation combinations in period 2 (1950-1969)

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	95%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Cleaning Agents	Server, General	117/152 (76.97)	12/36 (33.33)	75.0	39.8	-35.1	-50.5	-18.7
Biocides	Server, General	39/152 (25.66)	1/36 (2.78)	24.0	7.0	-16.7	-25.8	-6.2
Formaldehyde	Retail Trade Salesperson	43/189 (22.75)	2/65 (3.08)	21.1	5.9	-15.0	-22.3	-7.0
Aliphatic Aldehydes	Retail Trade Salesperson	44/189 (23.28)	2/65 (3.08)	21.4	6.6	-14.6	-22.0	-6.9
Cleaning Agents	Retail Trade Salesperson	43/189 (22.75)	3/65 (4.62)	21.2	7.3	-13.7	-21.1	-5.8

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

Table 56. Notable differences greater in men than women according to agent-occupation combinations in period 3 (1970-1984)

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	95%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Calcium Oxide	Farm Worker (General)	4/16 (25)	275/310 (88.71)	23.7	88.2	64.4	43.5	77.9
Cosmetic Talc	Women's Hairdresser	4/38 (10.53)	12/12 (100)	20.1	73.9	53.1	25.8	75.0
Calcium Oxide	Dairy Farm Worker (General)	0/6 (0)	27/38 (71.05)	16.5	67.9	50.4	24.0	69.3
Wool Fibres	Sewing-Machine Operator	144/395 (36.46)	48/57 (84.21)	36.9	81.3	44.4	32.3	54.1
Chlorine	Launderer (General)	0/6 (0)	11/21 (52.38)	1.0	45.5	44.1	24.2	65.1
Leaded Gasoline	Manager, Retail Trade	0/7 (0)	26/57 (45.61)	4.6	42.5	36.9	21.5	50.7
Carbon Monoxide	Manager, Retail Trade	0/7 (0)	31/57 (54.39)	16.5	51.8	34.8	10.2	52.6
Mononuclear Aromatic Hydrocarbons	Manager, Retail Trade	0/7 (0)	28/57 (49.12)	11.8	44.9	32.4	11.1	48.7
Antimony	Other Printers and Related Workers	0/5 (0)	5/10 (50)	6.5	39.4	31.7	6.3	60.6
Wood Dust	Labourer	0/26 (0)	200/538 (37.17)	5.2	36.8	31.4	20.8	37.4

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

Table 57. Notable differences greater in women than men according to agent-occupation combinations in period 3 (1970-1984)

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	95%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Ultraviolet Radiation	Farm Worker (General)	14/16 (87.5)	12/310 (3.87)	72.3	4.6	-67.6	-83.5	-46.2
Alkanes (C1-C4)	Farm Worker (General)	11/16 (68.75)	11/310 (3.55)	59.3	4.1	-55.2	-72.2	-35.0
Methane	Farm Worker (General)	11/16 (68.75)	10/310 (3.23)	57.9	3.7	-54.1	-73.3	-31.2
Hypochlorites	Charworker	30/47 (63.83)	7/131 (5.34)	55.3	6.8	-48.3	-62.1	-34.5
Ammonia	Farm Worker (General)	11/16 (68.75)	29/310 (9.35)	57.1	9.9	-47.1	-67.8	-25.4
Hydrogen Sulphide	Farm Worker (General)	10/16 (62.5)	20/310 (6.45)	53.5	7.0	-46.5	-67.9	-23.7
Cleaning Agents	Bartender	14/16 (87.5)	14/63 (22.22)	72.5	25.6	-46.4	-63.8	-25.2
Cleaning Agents	Server, General	154/224 (68.75)	33/137 (24.09)	67.8	25.4	-42.3	-51.0	-32.7
Ultraviolet Radiation	Dairy Farm Worker (General)	6/6 (100)	10/38 (26.32)	71.2	29.0	-41.6	-64.8	-10.3
Cooking Fumes	Server, General	183/224 (81.7)	52/137 (37.96)	80.3	39.8	-40.5	-49.7	-30.8

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

Table 58. Notable differences greater in men than women according to agent-occupation combinations in period 4 (1985-2011)

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	95%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Calcium Sulphate	Building Painter	1/5 (20)	59/87 (67.82)	12.7	66.9	53.5	23.2	69.1
Aromatic Amines	Other Printing Pressperson	0/6 (0)	9/11 (81.82)	21.7	70.5	46.8	13.1	73.2
PAHs From Any Source	Other Salesperson, Shop Assistants and Demonstrators	3/28 (10.71)	25/43 (58.14)	8.0	54.4	45.8	29.2	61.4
PAHs From Petroleum	Other Salesperson, Shop Assistants and Demonstrators	3/28 (10.71)	23/43 (53.49)	5.7	49.8	43.5	27.5	59.0
Mononuclear Aromatic Hydrocarbons	Chemistry Technician	2/13 (15.38)	6/7 (85.71)	20.4	64.3	42.6	10.3	69.6
Carbon Monoxide	Other Salesperson, Shop Assistants and Demonstrators	1/28 (3.57)	21/43 (48.84)	4.2	45.9	41.0	25.6	56.0
Cosmetic Talc	Women's Hairdresser	9/46 (19.57)	10/12 (83.33)	24.2	65.2	40.5	13.8	63.6
Leaded Gasoline	Other Salesperson, Shop Assistants and Demonstrators	1/28 (3.57)	20/43 (46.51)	1.0	41.5	40.2	26.3	55.1
Alkanes (C5-C17)	Other Salesperson, Shop Assistants and Demonstrators	3/28 (10.71)	23/43 (53.49)	9.7	47.8	37.5	21.4	53.0
Lead	Motor Bus Driver	2/15 (13.33)	37/71 (52.11)	14.9	51.2	35.7	16.1	51.3

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

Table 59. Notable differences greater in women than men according to agent-occupation combinations in period 4 (1985-2011)

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	95%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Lead Fumes	Electronic Equipment Assembler	13/17 (76.47)	0/11 (0)	59.3	12.0	-45.8	-68.2	-19.1
Tin Fumes	Electronic Equipment Assembler	13/17 (76.47)	0/11 (0)	58.2	13.1	-43.6	-66.4	-16.8
Aliphatic Alcohols	Janitor	13/15 (86.67)	37/142 (26.06)	69.4	27.0	-42.3	-60.4	-20.3
Aromatic Alcohols	Women's Hairdresser	30/46 (65.22)	1/12 (8.33)	58.4	17.8	-40.0	-58.7	-14.2
Cleaning Agents	Server, General	201/269 (74.72)	28/85 (32.94)	73.7	35.4	-38.4	-49.0	-26.9
Hypochlorites	Janitor	11/15 (73.33)	24/142 (16.9)	55.5	17.9	-37.4	-58.6	-15.2
Isopropanol	Janitor	12/15 (80)	35/142 (24.65)	63.0	25.6	-37.3	-56.9	-14.5
Aromatic Amines	Women's Hairdresser	31/46 (67.39)	2/12 (16.67)	61.5	24.1	-36.7	-57.8	-10.3
Aliphatic Alcohols	General Physician	9/12 (75)	3/22 (13.64)	55.1	19.4	-34.6	-58.6	-10.0
Cleaning Agents	Cook, except Private Service	73/86 (84.88)	53/116 (45.69)	81.9	47.5	-34.2	-45.5	-22.3

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

F.III 95% credible Interval for 3-digit ISCO-68 codes in one time period (1933-2011)

Table 60. Notable differences greater in men than women according to agent-occupation combinations from 1933-2011

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	95%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Nitrogen Oxides	Welders and flame-Cutters	2/37 (5.41)	254/284 (89.44)	8.2	89.1	80.7	70.8	87.2
Carbon Monoxide	Welders and flame-Cutters	2/37 (5.41)	252/284 (88.73)	9.9	88.4	78.4	67.4	85.6
Iron Fumes	Welders and flame-Cutters	2/37 (5.41)	247/284 (86.97)	9.2	86.6	77.1	66.4	84.0
Manganese Fumes	Welders and flame-Cutters	2/37 (5.41)	238/284 (83.8)	8.8	83.3	74.2	64.2	81.4
Antimony	Compositors and Type-Setters	1/9 (11.11)	23/29 (79.31)	2.3	75.8	72.5	54.3	86.3
Manganese	Welders and flame-Cutters	3/37 (8.11)	240/284 (84.51)	11.6	83.9	72.1	60.3	80.3
Cosmetic Talc	Hairdressers, Barbers, Beauticians and Related Wor	20/87 (22.99)	55/56 (98.21)	24.3	94.4	69.7	57.9	79.3
Metal Oxide Fumes	Welders and flame-Cutters	8/37 (21.62)	269/284 (94.72)	26.0	94.3	68.1	54.5	79.6
Iron	Welders and flame-Cutters	5/37 (13.51)	256/284 (90.14)	22.5	89.5	67.0	52.2	78.5
Arc Welding Fumes	Welders and flame-Cutters	2/37 (5.41)	218/284 (76.76)	13.0	76.1	62.9	50.9	71.7

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

Table 61. Notable differences greater in women than men according to agent-occupation combinations from 1933-2011

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	95%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Soldering Fumes	Welders and flame-Cutters	35/37 (94.59)	25/284 (8.8)	81.8	9.6	-72.1	-82.5	-58.2
Tin	Welders and flame-Cutters	34/37 (91.89)	45/284 (15.85)	82.2	16.4	-65.7	-75.7	-51.7
Hydrogen Chloride	Welders and flame-Cutters	28/37 (75.68)	16/284 (5.63)	64.5	6.7	-57.7	-71.6	-41.8
Lead	Welders and flame-Cutters	32/37 (86.49)	57/284 (20.07)	76.9	20.3	-56.5	-68.6	-42.2
Tin Fumes	Welders and flame-Cutters	30/37 (81.08)	41/284 (14.44)	69.8	14.9	-54.7	-67.6	-39.5
Ultraviolet Radiation	General Farm Workers	30/33 (90.91)	113/423 (26.71)	81.8	27.1	-54.5	-65.2	-40.3
Bleaches	Hairdressers, Barbers, Beauticians and Related Wor	59/87 (67.82)	5/56 (8.93)	65.2	11.2	-53.7	-65.3	-40.4
Organic Dyes and Pigments	Hairdressers, Barbers, Beauticians and Related Wor	62/87 (71.26)	6/56 (10.71)	67.0	14.7	-52.1	-64.4	-38.4
Aromatic Amines	Hairdressers, Barbers, Beauticians and Related Wor	58/87 (66.67)	5/56 (8.93)	63.5	11.3	-52.0	-63.5	-38.4
Fabric Dust	Fur Tailors and Related Workers	8/9 (88.89)	7/30 (23.33)	79.0	26.8	-51.2	-72.2	-23.8

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

F.IV 90% credible Interval for 3-digit ISCO-68 codes in one time period (1933-2011)

Table 62. Notable differences greater in men than women according to agent-occupation combinations from 1933-2011

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	90%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Nitrogen Oxides	Welders and flame-Cutters	2/37 (5.41)	254/284 (89.44)	8.2	89.1	80.7	72.7	86.3
Carbon Monoxide	Welders and flame-Cutters	2/37 (5.41)	252/284 (88.73)	9.9	88.4	78.4	69.5	84.6
Iron Fumes	Welders and flame-Cutters	2/37 (5.41)	247/284 (86.97)	9.2	86.6	77.1	68.4	83.0
Manganese Fumes	Welders and flame-Cutters	2/37 (5.41)	238/284 (83.8)	8.8	83.3	74.2	66.1	80.4
Antimony	Compositors and Type-Setters	1/9 (11.11)	23/29 (79.31)	2.3	75.8	72.5	57.5	84.4
Manganese	Welders and flame-Cutters	3/37 (8.11)	240/284 (84.51)	11.6	83.9	72.1	62.7	79.2
Cosmetic Talc	Hairdressers, Barbers, Beauticians and Related Wor	20/87 (22.99)	55/56 (98.21)	24.3	94.4	69.7	60.0	77.8
Metal Oxide Fumes	Welders and flame-Cutters	8/37 (21.62)	269/284 (94.72)	26.0	94.3	68.1	56.6	77.8
Iron	Welders and flame-Cutters	5/37 (13.51)	256/284 (90.14)	22.5	89.5	67.0	54.8	76.9
Arc Welding Fumes	Welders and flame-Cutters	2/37 (5.41)	218/284 (76.76)	13.0	76.1	62.9	53.0	70.6

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

Table 63. Notable differences greater in women than men according to agent-occupation combinations from 1933-2011

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	90%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Soldering Fumes	Welders and flame-Cutters	35/37 (94.59)	25/284 (8.8)	81.8	9.6	-72.1	-81.0	-61.0
Tin	Welders and flame-Cutters	34/37 (91.89)	45/284 (15.85)	82.2	16.4	-65.7	-74.4	-54.0
Hydrogen Chloride	Welders and flame-Cutters	28/37 (75.68)	16/284 (5.63)	64.5	6.7	-57.7	-69.5	-44.3
Lead	Welders and flame-Cutters	32/37 (86.49)	57/284 (20.07)	76.9	20.3	-56.5	-66.8	-44.6
Tin Fumes	Welders and flame-Cutters	30/37 (81.08)	41/284 (14.44)	69.8	14.9	-54.7	-66.0	-41.9
Ultraviolet Radiation	General Farm Workers	30/33 (90.91)	113/423 (26.71)	81.8	27.1	-54.5	-63.6	-42.6
Bleaches	Hairdressers, Barbers, Beauticians and Related Wor	59/87 (67.82)	5/56 (8.93)	65.2	11.2	-53.7	-63.4	-42.8
Organic Dyes and Pigments	Hairdressers, Barbers, Beauticians and Related Wor	62/87 (71.26)	6/56 (10.71)	67.0	14.7	-52.1	-62.4	-40.8
Aromatic Amines	Hairdressers, Barbers, Beauticians and Related Wor	58/87 (66.67)	5/56 (8.93)	63.5	11.3	-52.0	-61.7	-40.7
Fabric Dust	Fur Tailors and Related Workers	8/9 (88.89)	7/30 (23.33)	79.0	26.8	-51.2	-69.5	-28.3

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

F.V 90% credible Interval for 5-digit ISCO-68 codes in one time period (1933-2011)

Table 64. Notable differences greater in men than women according to agent-occupation combinations from 1933-2011

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	90%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Leaded Gasoline	Other Salesperson, Shop Assistants and Demonstrators	1/29 (3.45)	70/94 (74.47)	1.3	71.5	69.7	61.1	77.3
PAHs From Any Source	Other Salesperson, Shop Assistants and Demonstrators	3/29 (10.34)	73/94 (77.66)	9.8	75.2	64.9	54.5	73.7
Alkanes (C5-C17)	Other Salesperson, Shop Assistants and Demonstrators	3/29 (10.34)	76/94 (80.85)	13.9	76.8	62.6	50.6	72.3
Calcium Oxide	Farm Worker (General)	4/16 (25)	277/316 (87.66)	24.0	87.2	63.1	47.1	74.3
PAHs From Petroleum	Other Salesperson, Shop Assistants and Demonstrators	3/29 (10.34)	70/94 (74.47)	8.6	72.2	63.1	52.2	72.0
Carbon Monoxide	Other Salesperson, Shop Assistants and Demonstrators	1/29 (3.45)	62/94 (65.96)	4.3	64.2	59.4	50.1	68.1
Cosmetic Talc	Women's Hairdresser	11/66 (16.67)	15/15 (100)	21.3	80.9	59.1	40.1	73.3
Engine Emissions	Other Salesperson, Shop Assistants and Demonstrators	5/29 (17.24)	76/94 (80.85)	22.0	78.3	56.0	42.5	67.2
Mononuclear Aromatic Hydrocarbons	Other Salesperson, Shop Assistants and Demonstrators	1/29 (3.45)	60/94 (63.83)	6.4	60.5	53.6	43.0	62.7
Calcium Sulphate	Building Painter	1/5 (20)	124/180 (68.89)	15.1	68.4	52.8	28.0	66.2

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

Table 65. Notable differences greater in women than men according to agent-occupation combinations from 1933-2011

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	90%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Ultraviolet Radiation	Farm Worker (General)	14/16 (87.5)	16/316 (5.06)	68.5	5.9	-62.5	-77.0	-44.5
Methane	Farm Worker (General)	11/16 (68.75)	13/316 (4.11)	59.5	4.6	-54.7	-71.3	-35.9
Alkanes (C1-C4)	Farm Worker (General)	11/16 (68.75)	14/316 (4.43)	58.1	4.9	-53.1	-68.6	-35.3
Hydrogen Sulphide	Farm Worker (General)	10/16 (62.5)	23/316 (7.28)	54.8	7.7	-47.0	-64.8	-28.1
Ammonia	Farm Worker (General)	11/16 (68.75)	31/316 (9.81)	56.0	10.4	-45.6	-63.3	-27.1
Cleaning Agents	Server, General	316/428 (73.83)	54/189 (28.57)	73.3	29.6	-43.7	-49.9	-37.1
Fabric Dust	Other Spinners, Weavers, Knitters, Dyers and Relat	9/10 (90)	1/7 (14.29)	76.5	32.5	-42.0	-66.5	-14.5
Aliphatic Alcohols	Janitor	15/18 (83.33)	39/159 (24.53)	66.2	25.6	-40.3	-54.7	-24.3
Aromatic Alcohols	Women's Hairdresser	48/66 (72.73)	3/15 (20)	66.9	28.2	-38.4	-55.2	-18.2
Isopropanol	Janitor	14/18 (77.78)	36/159 (22.64)	62.0	23.6	-38.2	-53.5	-20.7

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

F.VI 90% credible interval for 5-digit ISCO-68 codes in two time periods (1933-1969 and 1970-2011)

Table 66. Notable differences greater in men than women according to agent-occupation combinations from 1933-1969

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	90%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Calcium Oxide	Farm Worker (General)	1/9 (11.11)	256/282 (90.78)	20.3	90.3	69.9	50.6	81.9
Wool Fibres	Sewing-Machine Operator	37/117 (31.62)	25/30 (83.33)	32.8	79.3	46.4	31.8	58.6
Wool Fibres	Laundry Pressing-Machine Operator	4/13 (30.77)	21/28 (75)	32.7	71.9	38.4	15.2	59.3
Alkanes (C1-C4)	Cook, except Private Service	0/13 (0)	29/65 (44.62)	4.4	42.5	37.5	25.9	48.2
Cristalline Silica	Labourer	0/11 (0)	78/200 (39)	10.3	38.2	27.6	12.2	37.1
Chlorinated Alkanes	Nursing Aid	0/12 (0)	7/19 (36.84)	1.7	28.7	26.3	11.7	44.3
Chloroform	Nursing Aid	0/12 (0)	7/19 (36.84)	0.9	27.5	25.8	12.1	44.0
Wood Dust	Labourer	0/11 (0)	67/200 (33.5)	8.6	32.8	23.9	9.8	33.2
Methane	Cook, except Private Service	0/13 (0)	18/65 (27.69)	2.1	26.1	23.4	14.3	33.1
PAHs From Other Sources	Cook, except Private Service	0/13 (0)	22/65 (33.85)	6.4	30.2	23.1	11.6	34.0

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

Table 67. Notable differences greater in women than men according to agent-occupation combinations from 1933-1969

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	90%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Ultraviolet Radiation	Farm Worker (General)	7/9 (77.78)	6/282 (2.13)	67.6	2.6	-64.8	-82.9	-40.9
Hydrogen Sulphide	Farm Worker (General)	7/9 (77.78)	15/282 (5.32)	63.7	5.6	-58.1	-77.1	-34.0
Methane	Farm Worker (General)	7/9 (77.78)	5/282 (1.77)	58.4	2.2	-56.2	-75.1	-33.2
Alkanes (C1-C4)	Farm Worker (General)	7/9 (77.78)	5/282 (1.77)	53.3	2.4	-50.9	-69.5	-30.8
Ammonia	Farm Worker (General)	7/9 (77.78)	24/282 (8.51)	58.7	9.0	-49.6	-71.0	-25.7
Fabric Dust	Winder	13/14 (92.86)	5/20 (25)	76.2	33.1	-41.9	-62.1	-19.5
Cleaning Agents	Server, General	34/51 (66.67)	12/63 (19.05)	63.6	21.6	-41.7	-54.3	-28.1
Cooking Fumes	Server, General	40/51 (78.43)	17/63 (26.98)	70.5	32.6	-37.9	-51.6	-21.9
Cleaning Agents	Nursing Aid	11/12 (91.67)	5/19 (26.32)	71.1	33.8	-36.6	-57.0	-13.7
Cleaning Agents	Cook, except Private Service	12/13 (92.31)	26/65 (40)	77.3	42.3	-34.6	-49.4	-16.0

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

Table 68. Notable differences greater in men than women according to agent-occupation combinations from 1970-2011

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	90%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Cosmetic Talc	Women's Hairdresser	4/36 (11.11)	12/12 (100)	20.0	76.1	55.4	29.5	73.9
Chlorine	Launderer (General)	0/6 (0)	10/16 (62.5)	0.8	53.7	51.7	30.4	71.5
Wool Fibres	Sewing-Machine Operator	123/337 (36.5)	41/47 (87.23)	37.0	83.8	46.7	36.2	55.2
Calcium Oxide	Farm Worker (General)	4/10 (40)	99/138 (71.74)	31.0	71.0	39.9	15.9	57.6
Calcium Oxide	Dairy Farm Worker (General)	0/5 (0)	9/13 (69.23)	18.2	59.1	39.0	11.9	62.8
Leaded Gasoline	Manager, Retail Trade	0/5 (0)	25/54 (46.3)	4.9	43.2	37.1	23.7	49.3
Chloroform	Professional Nurse (General)	2/117 (1.71)	4/8 (50)	1.8	35.2	33.2	11.6	61.4
Concrete Dust	Labourer	0/21 (0)	158/423 (37.35)	3.5	36.9	33.0	23.3	38.1
Wood Dust	Labourer	0/21 (0)	163/423 (38.53)	6.2	38.1	31.7	21.1	37.9
Carbon Monoxide	Manager, Retail Trade	0/5 (0)	28/54 (51.85)	17.8	49.5	31.0	9.0	46.8

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

Table 69. Notable differences greater in women than men according to agent-occupation combinations from 1970-2011

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	90%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Ultraviolet Radiation	Farm Worker (General)	9/10 (90)	8/138 (5.8)	69.0	7.1	-61.7	-77.6	-40.8
Hypochlorites	Charworker	29/44 (65.91)	7/114 (6.14)	56.4	7.9	-48.3	-60.4	-35.8
Alkanes (C1-C4)	Farm Worker (General)	7/10 (70)	7/138 (5.07)	54.4	6.1	-48.0	-64.1	-29.2
Methane	Farm Worker (General)	7/10 (70)	6/138 (4.35)	53.4	5.3	-47.8	-67.3	-26.9
Cleaning Agents	Bartender	14/16 (87.5)	10/50 (20)	70.5	24.8	-45.2	-60.9	-26.5
Cleaning Agents	Server, General	133/196 (67.86)	26/107 (24.3)	66.7	26.4	-40.2	-48.6	-31.3
Bleaches	Women's Hairdresser	31/36 (86.11)	3/12 (25)	76.3	36.7	-38.9	-59.6	-16.1
Hydrogen Sulphide	Farm Worker (General)	6/10 (60)	11/138 (7.97)	47.2	8.8	-38.3	-59.5	-15.2
Ammonia	Farm Worker (General)	7/10 (70)	15/138 (10.87)	49.5	12.1	-37.3	-58.2	-15.7
Cooking Fumes	Server, General	155/196 (79.08)	42/107 (39.25)	77.5	41.6	-35.8	-44.6	-26.5

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

F.VII 90% credible Interval for 5-digit ISCO-68 codes in four time periods (1933-1949, 1950-1969, 1970-1984, and 1985-2011)

Table 70. Notable differences greater in men than women according to agent-occupation combinations in period 1 (1933-1949)

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	90%CrI[a]	
		$N_{exposed}/N$ (%)	$N_{exposed}/N$ (%)				LCL[b]	UCL[c]
Aromatic Amines	Other Printing Pressperson	0/5 (0)	8/9 (88.89)	25.4	75.3	47.7	17.1	72.8
Leaded Gasoline	Other Salesperson, Shop Assistants and Demonstrators	1/12 (8.33)	20/36 (55.56)	2.0	50.1	47.2	33.1	61.0
PAHs From Any Source	Other Salesperson, Shop Assistants and Demonstrators	2/12 (16.67)	21/36 (58.33)	8.5	53.4	44.0	29.1	58.2
Alkanes (C5-C17)	Other Salesperson, Shop Assistants and Demonstrators	2/12 (16.67)	22/36 (61.11)	10.1	54.3	43.3	26.7	58.0
Engine Emissions	Manager, Retail Trade	0/32 (0)	28/50 (56)	8.5	51.1	42.2	29.4	54.3
PAHs From Petroleum	Other Salesperson, Shop Assistants and Demonstrators	2/12 (16.67)	19/36 (52.78)	5.1	47.8	41.6	27.3	55.7
Ethanol	Biological Technician	1/11 (9.09)	7/8 (87.5)	22.0	63.2	39.3	12.3	64.3
Mononuclear Aromatic Hydrocarbons	Chemistry Technician	1/10 (10)	5/6 (83.33)	19.2	58.9	38.1	10.6	63.6
Carbon Monoxide	Other Salesperson, Shop Assistants and Demonstrators	1/12 (8.33)	17/36 (47.22)	5.6	43.8	37.7	22.8	51.7
Cosmetic Talc	Women's Hairdresser	6/35 (17.14)	9/11 (81.82)	23.7	61.5	37.0	13.5	59.4

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

Table 71. Notable differences greater in women than men according to agent-occupation combinations in period 1 (1933-1949)

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	90%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Aromatic Amines	Women's Hairdresser	25/35 (71.43)	1/11 (9.09)	63.2	18.9	-43.4	-61.5	-20.4
Organic Dyes and Pigments	Women's Hairdresser	28/35 (80)	1/11 (9.09)	69.6	25.2	-43.3	-63.1	-20.2
Aromatic Alcohols	Women's Hairdresser	24/35 (68.57)	1/11 (9.09)	60.0	17.5	-41.7	-59.6	-19.6
Cleaning Agents	Server, General	134/193 (69.43)	18/61 (29.51)	68.3	32.6	-35.5	-46.0	-24.6
Bleaches	Women's Hairdresser	25/35 (71.43)	1/11 (9.09)	59.1	22.6	-35.5	-55.0	-13.6
Cleaning Agents	Cook, except Private Service	38/43 (88.37)	42/94 (44.68)	81.8	47.2	-34.4	-45.6	-22.7
Tin Fumes	Electronic Equipment Assembler	9/12 (75)	0/9 (0)	50.2	16.4	-32.2	-54.7	-9.4
Cooking Fumes	Server, General	143/193 (74.09)	22/61 (36.07)	72.5	40.4	-31.9	-42.9	-20.5
Isopropanol	Charworker	29/73 (39.73)	14/179 (7.82)	36.1	8.6	-27.3	-36.8	-18.3
Hypochlorites	Charworker	30/73 (41.1)	18/179 (10.06)	37.4	10.7	-26.6	-36.4	-17.2

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

Table 72. Notable differences greater in men than women according to agent-occupation combinations in period 2 (1950-1969)

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimateddif ference (%)	90%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Anaesthetic Gases	Auxiliary Nurse	2/23 (8.7)	7/7 (100)	12.4	68.4	54.7	24.2	80.0
Titanium	Building Painter	2/5 (40)	18/24 (75)	21.4	72.3	49.6	22.1	69.8
Titanium Dioxide	Building Painter	2/5 (40)	18/24 (75)	21.3	71.5	48.8	20.1	70.8
Iron Oxides	Building Painter	0/5 (0)	15/24 (62.5)	6.7	56.7	48.3	28.3	66.0
Calcium Sulphate	Building Painter	0/5 (0)	13/24 (54.17)	2.2	50.3	46.5	28.9	63.5
Chromium Vi	Building Painter	0/5 (0)	14/24 (58.33)	7.5	54.5	45.2	23.1	63.3
Chromium	Building Painter	0/5 (0)	15/24 (62.5)	12.0	58.3	44.4	18.6	64.1
Selenium	Building Painter	1/5 (20)	13/24 (54.17)	7.0	46.8	37.4	13.9	57.4
Isopropanol	Charworker	29/73 (39.73)	14/179 (7.82)	36.1	8.6	-27.3	-36.8	-18.3
Hypochlorites	Charworker	30/73 (41.1)	18/179 (10.06)	37.4	10.7	-26.6	-36.4	-17.2

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

Table 73. Notable differences greater in women than men according to agent-occupation combinations in period 2 (1950-1969)

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	90%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Cleaning Agents	Server, General	117/152 (76.97)	12/36 (33.33)	75.0	39.8	-35.1	-48.3	-21.1
Biocides	Charworker	53/68 (77.94)	25/55 (45.45)	74.8	48.0	-26.6	-39.5	-13.3
Biocides	Server, General	39/152 (25.66)	1/36 (2.78)	24.0	7.0	-16.7	-24.3	-8.1
Formaldehyde	Retail Trade Salesperson	43/189 (22.75)	2/65 (3.08)	21.1	5.9	-15.0	-21.0	-8.5
Aliphatic Aldehydes	Retail Trade Salesperson	44/189 (23.28)	2/65 (3.08)	21.4	6.6	-14.6	-20.9	-8.1
Cleaning Agents	Retail Trade Salesperson	43/189 (22.75)	3/65 (4.62)	21.2	7.3	-13.7	-19.9	-7.0
Fabric Dust	Retail Trade Salesperson	38/189 (20.11)	2/65 (3.08)	18.4	6.2	-12.1	-18.1	-5.5
Aliphatic Alcohols	Retail Trade Salesperson	30/189 (15.87)	0/65 (0)	14.3	2.9	-11.2	-16.1	-6.1

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

Table 74. Notable differences greater in men than women according to agent-occupation combinations in period 3 (1970-1984)

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	90%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Calcium Oxide	Farm Worker (General)	4/16 (25)	275/310 (88.71)	23.7	88.2	64.4	47.3	76.2
Cosmetic Talc	Women's Hairdresser	4/38 (10.53)	12/12 (100)	20.1	73.9	53.1	29.9	72.1
Calcium Oxide	Dairy Farm Worker (General)	0/6 (0)	27/38 (71.05)	16.5	67.9	50.4	28.6	66.3
Wool Fibres	Sewing-Machine Operator	144/395 (36.46)	48/57 (84.21)	36.9	81.3	44.4	34.2	52.8
Chlorine	Launderer (General)	0/6 (0)	11/21 (52.38)	1.0	45.5	44.1	27.1	61.9
Leaded Gasoline	Manager, Retail Trade	0/7 (0)	26/57 (45.61)	4.6	42.5	36.9	24.0	48.5
Carbon Monoxide	Manager, Retail Trade	0/7 (0)	31/57 (54.39)	16.5	51.8	34.8	15.1	50.2
Mononuclear Aromatic Hydrocarbons	Manager, Retail Trade	0/7 (0)	28/57 (49.12)	11.8	44.9	32.4	15.1	46.0
Engine Emissions	Manager, Retail Trade	1/7 (14.29)	35/57 (61.4)	26.9	59.4	31.9	8.4	50.3
Antimony	Other Printers and Related Workers	0/5 (0)	5/10 (50)	6.5	39.4	31.7	10.1	56.4

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

Table 75. Notable differences greater in women than men according to agent-occupation combinations in period 3 (1970-1984)

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	90%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Ultraviolet Radiation	Farm Worker (General)	14/16 (87.5)	12/310 (3.87)	72.3	4.6	-67.6	-81.4	-49.6
Alkanes (C1-C4)	Farm Worker (General)	11/16 (68.75)	11/310 (3.55)	59.3	4.1	-55.2	-69.7	-38.1
Methane	Farm Worker (General)	11/16 (68.75)	10/310 (3.23)	57.9	3.7	-54.1	-70.6	-35.0
Hypochlorites	Charworker	30/47 (63.83)	7/131 (5.34)	55.3	6.8	-48.3	-60.1	-36.5
Ammonia	Farm Worker (General)	11/16 (68.75)	29/310 (9.35)	57.1	9.9	-47.1	-65.0	-28.8
Hydrogen Sulphide	Farm Worker (General)	10/16 (62.5)	20/310 (6.45)	53.5	7.0	-46.5	-64.9	-27.0
Cleaning Agents	Bartender	14/16 (87.5)	14/63 (22.22)	72.5	25.6	-46.4	-61.5	-28.3
Cleaning Agents	Server, General	154/224 (68.75)	33/137 (24.09)	67.8	25.4	-42.3	-49.8	-34.4
Ultraviolet Radiation	Dairy Farm Worker (General)	6/6 (100)	10/38 (26.32)	71.2	29.0	-41.6	-62.0	-15.9
Cooking Fumes	Server, General	183/224 (81.7)	52/137 (37.96)	80.3	39.8	-40.5	-48.1	-32.4

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

Table 76. Notable differences greater in men than women according to agent-occupation combinations in period 4 (1985-2011)

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	90%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Calcium Sulphate	Building Painter	1/5 (20)	59/87 (67.82)	12.7	66.9	53.5	28.8	67.3
Aromatic Amines	Other Printing Pressperson	0/6 (0)	9/11 (81.82)	21.7	70.5	46.8	19.2	69.7
PAHs From Any Source	Other Salesperson, Shop Assistants and Demonstrators	3/28 (10.71)	25/43 (58.14)	8.0	54.4	45.8	31.9	58.9
PAHs From Petroleum	Other Salesperson, Shop Assistants and Demonstrators	3/28 (10.71)	23/43 (53.49)	5.7	49.8	43.5	30.1	56.6
Mononuclear Aromatic Hydrocarbons	Chemistry Technician	2/13 (15.38)	6/7 (85.71)	20.4	64.3	42.6	15.3	65.8
Carbon Monoxide	Other Salesperson, Shop Assistants and Demonstrators	1/28 (3.57)	21/43 (48.84)	4.2	45.9	41.0	28.2	53.7
Cosmetic Talc	Women's Hairdresser	9/46 (19.57)	10/12 (83.33)	24.2	65.2	40.5	18.1	60.4
Leaded Gasoline	Other Salesperson, Shop Assistants and Demonstrators	1/28 (3.57)	20/43 (46.51)	1.0	41.5	40.2	28.3	52.7
Cosmetic Talc	Professional Nurse (General)	59/203 (29.06)	6/6 (100)	29.6	67.7	38.0	11.9	59.3
Alkanes (C5-C17)	Other Salesperson, Shop Assistants and Demonstrators	3/28 (10.71)	23/43 (53.49)	9.7	47.8	37.5	24.0	50.7

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

Table 77. Notable differences greater in women than men according to agent-occupation combinations in period 4 (1985-2011)

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	90%CrI[a]	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Lead Fumes	Electronic Equipment Assembler	13/17 (76.47)	0/11 (0)	59.3	12.0	-45.8	-64.9	-23.7
Tin Fumes	Electronic Equipment Assembler	13/17 (76.47)	0/11 (0)	58.2	13.1	-43.6	-63.3	-21.2
Aliphatic Alcohols	Janitor	13/15 (86.67)	37/142 (26.06)	69.4	27.0	-42.3	-57.9	-24.1
Aromatic Alcohols	Women's Hairdresser	30/46 (65.22)	1/12 (8.33)	58.4	17.8	-40.0	-56.2	-19.2
Cleaning Agents	Server, General	201/269 (74.72)	28/85 (32.94)	73.7	35.4	-38.4	-47.2	-28.7
Hypochlorites	Janitor	11/15 (73.33)	24/142 (16.9)	55.5	17.9	-37.4	-55.6	-18.9
Isopropanol	Janitor	12/15 (80)	35/142 (24.65)	63.0	25.6	-37.3	-54.0	-18.0
Organic Dyes and Pigments	Women's Hairdresser	36/46 (78.26)	2/12 (16.67)	70.3	32.5	-37.2	-57.8	-14.6
Aromatic Amines	Women's Hairdresser	31/46 (67.39)	2/12 (16.67)	61.5	24.1	-36.7	-54.7	-14.8
Aliphatic Alcohols	General Physician	9/12 (75)	3/22 (13.64)	55.1	19.4	-34.6	-54.9	-13.8

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

APPENDIX G Comparison of most notable differences greater in women or in men when modifying time period

Table 78. Comparison of the five most notable differences greater in women than in men when modifying time period across analyses

Number of time periods	Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	95%CrI[a]	
			$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
	Main (5-digit ISCO-68 codes from 1933-2011, 95% credible interval)								
One time period	Ultraviolet Radiation	Farm Worker (General)	14/16 (87.5)	16/316 (5.06)	68.5	5.9	-62.5	-79.2	-40.9
	Methane	Farm Worker (General)	11/16 (68.75)	13/316 (4.11)	59.5	4.6	-54.7	-74.0	-32.4
	Alkanes (C1-C4)	Farm Worker (General)	11/16 (68.75)	14/316 (4.43)	58.1	4.9	-53.1	-70.9	-32.2
	Hydrogen Sulphide	Farm Worker (General)	10/16 (62.5)	23/316 (7.28)	54.8	7.7	-47.0	-67.5	-25.0
	Ammonia	Farm Worker (General)	11/16 (68.75)	31/316 (9.81)	56.0	10.4	-45.6	-66.1	-24.2
Two time periods	**5-digit ISCO-68 codes from 1933-1969, 95% credible interval**								
	Ultraviolet Radiation	Farm Worker (General)	7/9 (77.78)	6/282 (2.13)	67.6	2.6	-64.8	-85.4	-35.8
	Hydrogen Sulphide	Farm Worker (General)	7/9 (77.78)	15/282 (5.32)	63.7	5.6	-58.1	-79.7	-29.6
	Methane	Farm Worker (General)	7/9 (77.78)	5/282 (1.77)	58.4	2.2	-56.2	-78.4	-28.9
	Alkanes (C1-C4)	Farm Worker (General)	7/9 (77.78)	5/282 (1.77)	53.3	2.4	-50.9	-72.5	-26.4
	Ammonia	Farm Worker (General)	7/9 (77.78)	24/282 (8.51)	58.7	9.0	-49.6	-74.3	-21.3
	5-digit ISCO-68 codes from 1970-2011, 95% credible interval								
	Ultraviolet Radiation	Farm Worker (General)	9/10 (90)	8/138 (5.8)	69.0	7.1	-61.7	-79.6	-37.1
	Hypochlorites	Charworker	29/44 (65.91)	7/114 (6.14)	56.4	7.9	-48.3	-62.5	-33.5
	Alkanes (C1-C4)	Farm Worker (General)	7/10 (70)	7/138 (5.07)	54.4	6.1	-48.0	-66.9	-25.3
	Methane	Farm Worker (General)	7/10 (70)	6/138 (4.35)	53.4	5.3	-47.8	-70.2	-23.2
	Cleaning Agents	Bartender	14/16 (87.5)	10/50 (20)	70.5	24.8	-45.2	-63.4	-22.8
Four time periods	**5-digit ISCO-68 codes from 1933-1949, 95% credible interval**								
	Aromatic Amines	Women's Hairdresser	25/35 (71.43)	1/11 (9.09)	63.2	18.9	-43.4	-64.5	-15.2
	Organic Dyes and Pigments	Women's Hairdresser	28/35 (80)	1/11 (9.09)	69.6	25.2	-43.3	-66.4	-15.8
	Aromatic Alcohols	Women's Hairdresser	24/35 (68.57)	1/11 (9.09)	60.0	17.5	-41.7	-62.3	-14.7
	Cleaning Agents	Server, General	134/193 (69.43)	18/61 (29.51)	68.3	32.6	-35.5	-47.8	-22.7
	Bleaches	Women's Hairdresser	25/35 (71.43)	1/11 (9.09)	59.1	22.6	-35.5	-58.3	-9.8

Number of time periods	Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	95%CrI[a]	
			$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Four time periods (cont.)	**5-digit ISCO-68 codes from 1950-1969, 95% credible interval**								
	Cleaning Agents	Server, General	117/152 (76.97)	12/36 (33.33)	75.0	39.8	-35.1	-50.5	-18.7
	Biocides	Server, General	39/152 (25.66)	1/36 (2.78)	24.0	7.0	-16.7	-25.8	-6.2
	Formaldehyde	Retail Trade Salesperson	43/189 (22.75)	2/65 (3.08)	21.1	5.9	-15.0	-22.3	-7.0
	Aliphatic Aldehydes	Retail Trade Salesperson	44/189 (23.28)	2/65 (3.08)	21.4	6.6	-14.6	-22.0	-6.9
	Cleaning Agents	Retail Trade Salesperson	43/189 (22.75)	3/65 (4.62)	21.2	7.3	-13.7	-21.1	-5.8
	5-digit ISCO-68 codes from 1970-1984, 95% credible interval								
	Ultraviolet Radiation	Farm Worker (General)	14/16 (87.5)	12/310 (3.87)	72.3	4.6	-67.6	-83.5	-46.2
	Alkanes (C1-C4)	Farm Worker (General)	11/16 (68.75)	11/310 (3.55)	59.3	4.1	-55.2	-72.2	-35.0
	Methane	Farm Worker (General)	11/16 (68.75)	10/310 (3.23)	57.9	3.7	-54.1	-73.3	-31.2
	Hypochlorites	Charworker	30/47 (63.83)	7/131 (5.34)	55.3	6.8	-48.3	-62.1	-34.5
	Ammonia	Farm Worker (General)	11/16 (68.75)	29/310 (9.35)	57.1	9.9	-47.1	-67.8	-25.4
	5-digit ISCO-68 codes from 1985-2011, 95% credible interval								
	Lead Fumes	Electronic Equipment Assembler	13/17 (76.47)	0/11 (0)	59.3	12.0	-45.8	-68.2	-19.1
	Tin Fumes	Electronic Equipment Assembler	13/17 (76.47)	0/11 (0)	58.2	13.1	-43.6	-66.4	-16.8
	Aliphatic Alcohols	Janitor	13/15 (86.67)	37/142 (26.06)	69.4	27.0	-42.3	-60.4	-20.3
	Aromatic Alcohols	Women's Hairdresser	30/46 (65.22)	1/12 (8.33)	58.4	17.8	-40.0	-58.7	-14.2
	Cleaning Agents	Server, General	201/269 (74.72)	28/85 (32.94)	73.7	35.4	-38.4	-49.0	-26.9

[b] 95% credible limit
[c] Lower credible limit
[d] Upper credible limit

Table 79. Comparison of five most notable differences greater in men than in women when modifying time period across analyses

Number of time periods	Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	95%CrI[a]	
			$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
One time period	**Main (5-digit ISCO-68 codes from 1933-2011, 95% credible interval)**								
	Leaded Gasoline	Other Salesperson, Shop Assistants and Demonstrators	1/29 (3.45)	70/94 (74.47)	1.3	71.5	69.7	59.4	78.5
	PAHs From Any Source	Other Salesperson, Shop Assistants and Demonstrators	3/29 (10.34)	73/94 (77.66)	9.8	75.2	64.9	52.3	75.2
	Alkanes (C5-C17)	Other Salesperson, Shop Assistants and Demonstrators	3/29 (10.34)	76/94 (80.85)	13.9	76.8	62.6	48.0	74.0
	Calcium Oxide	Farm Worker (General)	4/16 (25)	277/316 (87.66)	24.0	87.2	63.1	43.6	75.9
	PAHs From Petroleum	Other Salesperson, Shop Assistants and Demonstrators	3/29 (10.34)	70/94 (74.47)	8.6	72.2	63.1	50.0	73.5
Two time periods	**5-digit ISCO-68 codes from 1933-1969, 95% credible interval**								
	Calcium Oxide	Farm Worker (General)	1/9 (11.11)	256/282 (90.78)	20.3	90.3	69.9	45.4	83.4
	Wool Fibres	Sewing-Machine Operator	37/117 (31.62)	25/30 (83.33)	32.8	79.3	46.4	28.7	60.6
	Alkanes (C1-C4)	Cook. except Private Service	0/13 (0)	29/65 (44.62)	4.4	42.5	37.5	23.4	50.1
	Cristalline Silica	Labourer	0/11 (0)	78/200 (39)	10.3	38.2	27.6	8.7	38.7
	Chlorinated Alkanes	Nursing Aid	0/12 (0)	7/19 (36.84)	1.7	28.7	26.3	9.5	47.9
	5-digit ISCO-68 codes from 1970-2011, 95% credible interval								
	Cosmetic Talc	Women's Hairdresser	4/36 (11.11)	12/12 (100)	20.0	76.1	55.4	24.2	76.7
	Chlorine	Launderer (General)	0/6 (0)	10/16 (62.5)	0.8	53.7	51.7	26.3	74.8
	Wool Fibres	Sewing-Machine Operator	123/337 (36.5)	41/47 (87.23)	37.0	83,8	46.7	34.2	56.5
	Leaded Gasoline	Manager, Retail Trade	0/5 (0)	25/54 (46.3)	4.9	43.2	37.1	20.8	51.5
	Chloroform	Professional Nurse (General)	2/117 (1.71)	4/8 (50)	1.8	35.2	33.2	8.7	66.7

Number of time periods	Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	95%CrI[a]	
			$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Four time periods	**5-digit ISCO-68 codes from 1933-1949, 95% credible interval**								
	Aromatic Amines	Other Printing Pressperson	0/5 (0)	8/9 (88.89)	25.4	75.3	47.7	11.0	76.3
	Leaded Gasoline	Other Salesperson, Shop Assistants and Demonstrators	1/12 (8.33)	20/36 (55.56)	2.0	50.1	47.2	30.2	63.4
	PAHs From Any Source	Other Salesperson, Shop Assistants and Demonstrators	2/12 (16.67)	21/36 (58.33)	8.5	53.4	44.0	26.0	60.9
	Alkanes (C5-C17)	Other Salesperson, Shop Assistants and Demonstrators	2/12 (16.67)	22/36 (61.11)	10.1	54.3	43.3	23.3	60.7
	Engine Emissions	Manager, Retail Trade	0/32 (0)	28/50 (56)	8.5	51.1	42.2	27.0	56.9
	5-digit ISCO-68 codes from 1950-1969, 95% credible interval								
	Anaesthetic Gases	Auxiliary Nurse	2/23 (8.7)	7/7 (100)	12.4	68.4	54.7	18.6	83.0
	Titanium	Building Painter	2/5 (40)	18/24 (75)	21.4	72.3	49.6	16.4	73.2
	Titanium Dioxide	Building Painter	2/5 (40)	18/24 (75)	21.3	71.5	48.8	14.4	74.0
	Iron Oxides	Building Painter	0/5 (0)	15/24 (62.5)	6.7	56.7	48.3	23.7	69.0
	Calcium Sulphate	Building Painter	0/5 (0)	13/24 (54.17)	2.2	50.3	46.5	25.0	66.6
	5-digit ISCO-68 codes from 1970-1984, 95% credible interval								
	Calcium Oxide	Farm Worker (General)	4/16 (25)	275/310 (88.71)	23.7	88.2	64.4	43.5	77.9
	Cosmetic Talc	Women's Hairdresser	4/38 (10.53)	12/12 (100)	20.1	73.9	53.1	25.8	75.0
	Calcium Oxide	Dairy Farm Worker (General)	0/6 (0)	27/38 (71.05)	16.5	67.9	50.4	24.0	69.3
	Wool Fibres	Sewing-Machine Operator	144/395 (36.46)	48/57 (84.21)	36.9	81.3	44.4	32.3	54.1
	Chlorine	Launderer (General)	0/6 (0)	11/21 (52.38)	1.0	45.5	44.1	24.2	65.1

Number of time periods	Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	95%CrI[a]	
			$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Four time periods (cont.)	**5-digit ISCO-68 codes from 1985-2011, 95% credible interval**								
	Calcium Sulphate	Building Painter	1/5 (20)	59/87 (67.82)	12.7	66.9	53.5	23.2	69.1
	Aromatic Amines	Other Printing Pressperson	0/6 (0)	9/11 (81.82)	21.7	70.5	46.8	13.1	73.2
	PAHs From Any Source	Other Salesperson, Shop Assistants and Demonstrators	3/28 (10.71)	25/43 (58.14)	8.0	54.4	45.8	29.2	61.4
	PAHs From Petroleum	Other Salesperson, Shop Assistants and Demonstrators	3/28 (10.71)	23/43 (53.49)	5.7	49.8	43.5	27.5	59.0
	Mononuclear Aromatic Hydrocarbons	Chemistry Technician	2/13 (15.38)	6/7 (85.71)	20.4	64.3	42.6	10.3	69.6

[a] 95% credible limit
[b] Lower credible limit
[c] Upper credible limit

Table 80. Comparison of five most notable differences greater in women than in men when modifying ISCO-68 resolution across analyses

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	CrI[a] (%)	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Main (5-digit ISCO-68 codes from 1933-2011, 95% credible interval)								
Ultraviolet Radiation	Farm Worker (General)	14/16 (87.5)	16/316 (5.06)	68.5	5.9	-62.5	-79.2	-40.9
Methane	Farm Worker (General)	11/16 (68.75)	13/316 (4.11)	59.5	4.6	-54.7	-74.0	-32.4
Alkanes (C1-C4)	Farm Worker (General)	11/16 (68.75)	14/316 (4.43)	58.1	4.9	-53.1	-70.9	-32.2
Hydrogen Sulphide	Farm Worker (General)	10/16 (62.5)	23/316 (7.28)	54.8	7.7	-47.0	-67.5	-25.0
Ammonia	Farm Worker (General)	11/16 (68.75)	31/316 (9.81)	56.0	10.4	-45.6	-66.1	-24.2
3-digit ISCO-68 codes from 1933-2011, 95% credible interval								
Soldering Fumes	Welders and flame-Cutters	35/37 (94.59)	25/284 (8.8)	81.8	9.6	-72.1	-82.5	-58.2
Tin	Welders and flame-Cutters	34/37 (91.89)	45/284 (15.85)	82.2	16.4	-65.7	-75.7	-51.7
Hydrogen Chloride	Welders and flame-Cutters	28/37 (75.68)	16/284 (5.63)	64.5	6.7	-57.7	-71.6	-41.8
Lead	Welders and flame-Cutters	32/37 (86.49)	57/284 (20.07)	76.9	20.3	-56.5	-68.6	-42.2
Ammonia	Farm Worker (General)	11/16 (68.75)	31/316 (9.81)	56.0	10.4	-45.6	-66.1	-24.2
3-digit ISCO-68 codes from 1933-2011, 90% credible interval								
Soldering Fumes	Welders and flame-Cutters	35/37 (94.59)	25/284 (8.8)	81.8	9.6	-72.1	-81.0	-61.0
Tin	Welders and flame-Cutters	34/37 (91.89)	45/284 (15.85)	82.2	16.4	-65.7	-74.4	-54.0
Hydrogen Chloride	Welders and flame-Cutters	28/37 (75.68)	16/284 (5.63)	64.5	6.7	-57.7	-69.5	-44.3
Lead	Welders and flame-Cutters	32/37 (86.49)	57/284 (20.07)	76.9	20.3	-56.5	-66.8	-44.6
Tin Fumes	Welders and flame-Cutters	30/37 (81.08)	41/284 (14.44)	69.8	14.9	-54.7	-66.0	-41.9

[a] Credible limit
[b] Lower credible limit
[c] Upper credible limit

Table 81. Comparison of five most notable differences greater in men than in women when modifying ISCO-68 resolution across analyses

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	CrI[a] (%)	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Main (5-digit ISCO-68 codes from 1933-2011, 95% credible interval)								
Leaded Gasoline	Other Salesperson, Shop Assistants and Demonstrators	1/29 (3.45)	70/94 (74.47)	1.3	71.5	69.7	59.4	78.5
PAHs From Any Source	Other Salesperson, Shop Assistants and Demonstrators	3/29 (10.34)	73/94 (77.66)	9.8	75.2	64.9	52.3	75.2
Alkanes (C5-C17)	Other Salesperson, Shop Assistants and Demonstrators	3/29 (10.34)	76/94 (80.85)	13.9	76.8	62.6	48.0	74.0
Calcium Oxide	Farm Worker (General)	4/16 (25)	277/316 (87.66)	24.0	87.2	63.1	43.6	75.9
PAHs From Petroleum	Other Salesperson, Shop Assistants and Demonstrators	3/29 (10.34)	70/94 (74.47)	8.6	72.2	63.1	50.0	73.5
3-digit ISCO-68 codes from 1933-2011, 95% credible interval								
Nitrogen Oxides	Welders and flame-Cutters	2/37 (5.41)	254/284 (89.44)	8.2	89.1	80.7	70.8	87.2
Carbon Monoxide	Welders and flame-Cutters	2/37 (5.41)	252/284 (88.73)	9.9	88.4	78.4	67.4	85.6
Iron Fumes	Welders and flame-Cutters	2/37 (5.41)	247/284 (86.97)	9.2	86.6	77.1	66.4	84.0
Manganese Fumes	Welders and flame-Cutters	2/37 (5.41)	238/284 (83.8)	8.8	83.3	74.2	64.2	81.4
Antimony	Compositors and Type-Setters	1/9 (11.11)	23/29 (79.31)	2.3	75.8	72.5	54.3	86.3
3-digit ISCO-68 codes from 1933-2011, 90% credible interval								
Nitrogen Oxides	Welders and flame-Cutters	2/37 (5.41)	254/284 (89.44)	8.2	89.1	80.7	72.7	86.3
Carbon Monoxide	Welders and flame-Cutters	2/37 (5.41)	252/284 (88.73)	9.9	88.4	78.4	69.5	84.6
Iron Fumes	Welders and flame-Cutters	2/37 (5.41)	247/284 (86.97)	9.2	86.6	77.1	68.4	83.0
Manganese Fumes	Welders and flame-Cutters	2/37 (5.41)	238/284 (83.8)	8.8	83.3	74.2	66.1	80.4
Antimony	Compositors and Type-Setters	1/9 (11.11)	23/29 (79.31)	2.3	75.8	72.5	57.5	84.4

[a] Credible limit
[b] Lower credible limit
[c] Upper credible limit

Table 82. **Comparison of five most notable differences greater in women than in men when modifying the credible limit across analyses**

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	Crl[a] (%)	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Main (5-digit ISCO-68 codes from 1933-2011, 95% credible interval)								
Ultraviolet Radiation	Farm Worker (General)	14/16 (87.5)	16/316 (5.06)	68.5	5.9	-62.5	-79.2	-40.9
Methane	Farm Worker (General)	11/16 (68.75)	13/316 (4.11)	59.5	4.6	-54.7	-74.0	-32.4
Alkanes (C1-C4)	Farm Worker (General)	11/16 (68.75)	14/316 (4.43)	58.1	4.9	-53.1	-70.9	-32.2
Hydrogen Sulphide	Farm Worker (General)	10/16 (62.5)	23/316 (7.28)	54.8	7.7	-47.0	-67.5	-25.0
Ammonia	Farm Worker (General)	11/16 (68.75)	31/316 (9.81)	56.0	10.4	-45.6	-66.1	-24.2
5-digit ISCO-68 codes from 1933-2011, 90% credible interval								
Ultraviolet Radiation	Farm Worker (General)	14/16 (87.5)	16/316 (5.06)	68.5	5.9	-62.5	-77.0	-44.5
Methane	Farm Worker (General)	11/16 (68.75)	13/316 (4.11)	59.5	4.6	-54.7	-71.3	-35.9
Alkanes (C1-C4)	Farm Worker (General)	11/16 (68.75)	14/316 (4.43)	58.1	4.9	-53.1	-68.6	-35.3
Hydrogen Sulphide	Farm Worker (General)	10/16 (62.5)	23/316 (7.28)	54.8	7.7	-47.0	-64.8	-28.1
Ammonia	Farm Worker (General)	11/16 (68.75)	31/316 (9.81)	56.0	10.4	-45.6	-63.3	-27.1
5-digit ISCO-68 codes from 1933-1969, 90% credible interval								
Ultraviolet Radiation	Farm Worker (General)	7/9 (77.78)	6/282 (2.13)	67.6	2.6	-64.8	-82.9	-40.9
Hydrogen Sulphide	Farm Worker (General)	7/9 (77.78)	15/282 (5.32)	63.7	5.6	-58.1	-77.1	-34.0
Methane	Farm Worker (General)	7/9 (77.78)	5/282 (1.77)	58.4	2.2	-56.2	-75.1	-33.2
Alkanes (C1-C4)	Farm Worker (General)	7/9 (77.78)	5/282 (1.77)	53.3	2.4	-50.9	-69.5	-30.8
Ammonia	Farm Worker (General)	7/9 (77.78)	24/282 (8.51)	58.7	9.0	-49.6	-71.0	-25.7
5-digit ISCO-68 codes from 1970-2011, 90% credible interval								
Ultraviolet Radiation	Farm Worker (General)	9/10 (90)	8/138 (5.8)	69.0	7.1	-61.7	-77.6	-40.8
Hypochlorites	Charworker	29/44 (65.91)	7/114 (6.14)	56.4	7.9	-48.3	-60.4	-35.8
Alkanes (C1-C4)	Farm Worker (General)	7/10 (70)	7/138 (5.07)	54.4	6.1	-48.0	-64.1	-29.2
Methane	Farm Worker (General)	7/10 (70)	6/138 (4.35)	53.4	5.3	-47.8	-67.3	-26.9
Cleaning Agents	Bartender	14/16 (87.5)	10/50 (20)	70.5	24.8	-45.2	-60.9	-26.5
5-digit ISCO-68 codes from 1933-1949, 90% credible interval								
Aromatic Amines	Women's Hairdresser	25/35 (71.43)	1/11 (9.09)	63.2	18.9	-43.4	-61.5	-20.4
Organic Dyes and Pigments	Women's Hairdresser	28/35 (80)	1/11 (9.09)	69.6	25.2	-43.3	-63.1	-20.2
Aromatic Alcohols	Women's Hairdresser	24/35 (68.57)	1/11 (9.09)	60.0	17.5	-41.7	-59.6	-19.6
Cleaning Agents	Server, General	134/193 (69.43)	18/61 (29.51)	68.3	32.6	-35.5	-46.0	-24.6

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	CrI[a] (%)	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Bleaches	Women's Hairdresser	25/35 (71.43)	1/11 (9.09)	59.1	22.6	-35.5	-55.0	-13.6
5-digit ISCO-68 codes from 1950-1969, 90% credible interval								
Cleaning Agents	Server, General	117/152 (76.97)	12/36 (33.33)	75.0	39.8	-35.1	-48.3	-21.1
Biocides	Charworker	53/68 (77.94)	25/55 (45.45)	74.8	48.0	-26.6	-39.5	-13.3
Biocides	Server, General	39/152 (25.66)	1/36 (2.78)	24.0	7.0	-16.7	-24.3	-8.1
Formaldehyde	Retail Trade Salesperson	43/189 (22.75)	2/65 (3.08)	21.1	5.9	-15.0	-21.0	-8.5
Aliphatic Aldehydes	Retail Trade Salesperson	44/189 (23.28)	2/65 (3.08)	21.4	6.6	-14.6	-20.9	-8.1
5-digit ISCO-68 codes from 1970-1984, 90% credible interval								
Ultraviolet Radiation	Farm Worker (General)	14/16 (87.5)	12/310 (3.87)	72.3	4.6	-67.6	-81.4	-49.6
Alkanes (C1-C4)	Farm Worker (General)	11/16 (68.75)	11/310 (3.55)	59.3	4.1	-55.2	-69.7	-38.1
Methane	Farm Worker (General)	11/16 (68.75)	10/310 (3.23)	57.9	3.7	-54.1	-70.6	-35.0
Hypochlorites	Charworker	30/47 (63.83)	7/131 (5.34)	55.3	6.8	-48.3	-60.1	-36.5
Ammonia	Farm Worker (General)	11/16 (68.75)	29/310 (9.35)	57.1	9.9	-47.1	-65.0	-28.8
5-digit ISCO-68 codes from 1985-2011, 90% credible interval								
Lead Fumes	Electronic Equipment Assembler	13/17 (76.47)	0/11 (0)	59.3	12.0	-45.8	-64.9	-23.7
Tin Fumes	Electronic Equipment Assembler	13/17 (76.47)	0/11 (0)	58.2	13.1	-43.6	-63.3	-21.2
Aliphatic Alcohols	Janitor	13/15 (86.67)	37/142 (26.06)	69.4	27.0	-42.3	-57.9	-24.1
Aromatic Alcohols	Women's Hairdresser	30/46 (65.22)	1/12 (8.33)	58.4	17.8	-40.0	-56.2	-19.2
Cleaning Agents	Server, General	201/269 (74.72)	28/85 (32.94)	73.7	35.4	-38.4	-47.2	-28.7

[a] Credible limit
[b] Lower credible limit
[c] Upper credible limit

Table 83. Comparison of five most notable differences greater in men than in women when modifying the credible limit across analyses

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	CrI[a] (%)	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
Main (5-digit ISCO-68 codes from 1933-2011, 95% credible interval)								
Leaded Gasoline	Other Salesperson, Shop Assistants and Demonstrators	1/29 (3.45)	70/94 (74.47)	1.3	71.5	69.7	59.4	78.5
PAHs From Any Source	Other Salesperson, Shop Assistants and Demonstrators	3/29 (10.34)	73/94 (77.66)	9.8	75.2	64.9	52.3	75.2
Alkanes (C5-C17)	Other Salesperson, Shop Assistants and Demonstrators	3/29 (10.34)	76/94 (80.85)	13.9	76.8	62.6	48.0	74.0
Calcium Oxide	Farm Worker (General)	4/16 (25)	277/316 (87.66)	24.0	87.2	63.1	43.6	75.9
PAHs From Petroleum	Other Salesperson, Shop Assistants and Demonstrators	3/29 (10.34)	70/94 (74.47)	8.6	72.2	63.1	50.0	73.5
5-digit ISCO-68 codes from 1933-2011, 90% credible interval								
Leaded Gasoline	Other Salesperson, Shop Assistants and Demonstrators	1/29 (3.45)	70/94 (74.47)	1.3	71.5	69.7	61.1	77.3
PAHs From Any Source	Other Salesperson, Shop Assistants and Demonstrators	3/29 (10.34)	73/94 (77.66)	9.8	75.2	64.9	54.5	73.7
Alkanes (C5-C17)	Other Salesperson, Shop Assistants and Demonstrators	3/29 (10.34)	76/94 (80.85)	13.9	76.8	62.6	50.6	72.3
Calcium Oxide	Farm Worker (General)	4/16 (25)	277/316 (87.66)	24.0	87.2	63.1	47.1	74.3
PAHs From Petroleum	Other Salesperson, Shop Assistants and Demonstrators	3/29 (10.34)	70/94 (74.47)	8.6	72.2	63.1	52.2	72.0

Agent	Occupational group	Female	Male	Estimated probability among females (%)	Estimated probability among males (%)	Estimated difference (%)	CrI[a] (%)	
		$N_{exposed}$/N (%)	$N_{exposed}$/N (%)				LCL[b]	UCL[c]
5-digit ISCO-68 codes from 1933-1969, 90% credible interval								
Calcium Oxide	Farm Worker (General)	1/9 (11.11)	256/282 (90.78)	20.3	90.3	69.9	50.6	81.9
Wool Fibres	Sewing-Machine Operator	37/117 (31.62)	25/30 (83.33)	32.8	79.3	46.4	31.8	58.6
Wool Fibres	Laundry Pressing-Machine Operator	4/13 (30.77)	21/28 (75)	32.7	71.9	38.4	15.2	59.3
Alkanes (C1-C4)	Cook, except Private Service	0/13 (0)	29/65 (44.62)	4.4	42.5	37.5	25.9	48.2
Cristalline Silica	Labourer	0/11 (0)	78/200 (39)	10.3	38.2	27.6	12.2	37.1
5-digit ISCO-68 codes from 1970-2011, 90% credible interval								
Cosmetic Talc	Women's Hairdresser	4/36 (11.11)	12/12 (100)	20.0	76.1	55.4	29.5	73.9
Chlorine	Launderer (General)	0/6 (0)	10/16 (62.5)	0.8	53.7	51.7	30.4	71.5
Wool Fibres	Sewing-Machine Operator	123/337 (36.5)	41/47 (87.23)	37.0	83.8	46.7	36.2	55.2
Calcium Oxide	Farm Worker (General)	4/10 (40)	99/138 (71.74)	31.0	71.0	39.9	15.9	57.6
Calcium Oxide	Dairy Farm Worker (General)	0/5 (0)	9/13 (69.23)	18.2	59.1	39.0	11.9	62.8
5-digit ISCO-68 codes from 1933-1949, 90% credible interval								
Aromatic Amines	Other Printing Pressperson	0/5 (0)	8/9 (88.89)	25.4	75.3	47.7	17.1	72.8
Leaded Gasoline	Other Salesperson, Shop Assistants and Demonstrators	1/12 (8.33)	20/36 (55.56)	2.0	50.1	47.2	33.1	61.0
PAHs From Any Source	Other Salesperson, Shop Assistants and Demonstrators	2/12 (16.67)	21/36 (58.33)	8.5	53.4	44.0	29.1	58.2
Alkanes (C5-C17)	Other Salesperson, Shop Assistants and Demonstrators	2/12 (16.67)	22/36 (61.11)	10.1	54.3	43.3	26.7	58.0
Engine Emissions	Manager, Retail Trade	0/32 (0)	28/50 (56)	8.5	51.1	42.2	29.4	54.3
5-digit ISCO-68 codes from 1950-1969, 90% credible interval								
Anaesthetic Gases	Auxiliary Nurse	2/23 (8.7)	7/7 (100)	12.4	68.4	54.7	24.2	80.0
Titanium	Building Painter	2/5 (40)	18/24 (75)	21.4	72.3	49.6	22.1	69.8
Titanium Dioxide	Building Painter	2/5 (40)	18/24 (75)	21.3	71.5	48.8	20.1	70.8
Iron Oxides	Building Painter	0/5 (0)	15/24 (62.5)	6.7	56.7	48.3	28.3	66.0

Calcium Sulphate	Building Painter	0/5 (0)	13/24 (54.17)	2.2	50.3	46.5	28.9	63.5
5-digit ISCO-68 codes from 1970-1984, 90% credible interval								
Calcium Oxide	Farm Worker (General)	4/16 (25)	275/310 (88.71)	23.7	88.2	64.4	47.3	76.2
Cosmetic Talc	Women's Hairdresser	4/38 (10.53)	12/12 (100)	20.1	73.9	53.1	29.9	72.1
Calcium Oxide	Dairy Farm Worker (General)	0/6 (0)	27/38 (71.05)	16.5	67.9	50.4	28.6	66.3
Wool Fibres	Sewing-Machine Operator	144/395 (36.46)	48/57 (84.21)	36.9	81.3	44.4	34.2	52.8
Ammonia	Farm Worker (General)	11/16 (68.75)	31/316 (9.81)	56.0	10.4	-45.6	-66.1	-24.2
5-digit ISCO-68 codes from 1985-2011, 90% credible interval								
Calcium Sulphate	Building Painter	1/5 (20)	59/87 (67.82)	12.7	66.9	53.5	28.8	67.3
Aromatic Amines	Other Printing Pressperson	0/6 (0)	9/11 (81.82)	21.7	70.5	46.8	19.2	69.7
PAHs From Any Source	Other Salesperson, Shop Assistants and Demonstrators	3/28 (10.71)	25/43 (58.14)	8.0	54.4	45.8	31.9	58.9
PAHs From Petroleum	Other Salesperson, Shop Assistants and Demonstrators	3/28 (10.71)	23/43 (53.49)	5.7	49.8	43.5	30.1	56.6
Mononuclear Aromatic Hydrocarbons	Chemistry Technician	2/13 (15.38)	6/7 (85.71)	20.4	64.3	42.6	15.3	65.8

[a] Credible limit
[b] Lower credible limit
[c] Upper credible limit

APPENDIX H Exposure metrics of agents with probability of exposure ≥ 5% among Montreal women

Table 84. Agents with an exposure probability threshold of ≥5% among Montréal women from 1933-2011

IDCHEM	Agent	ISCO-68 job code (n)	Prevalence of exposure (%)	Concentration of exposure (1, 5, 25 scale)				Frequency of exposure (hours per week)				FWI of exposure[a]			
				Q1	Mean	Std	Q3	Q1	Mean	Std	Q3	Q1	Mean	Std	Q3
460003	Organic solvents	89	47.59	1.00	1.93	2.91	1.27	3.50	14.79	15.59	35.00	0.10	1.05	2.99	1.00
990005	Cleaning agents	75	40.11	1.00	1.09	0.47	1.00	2.90	8.13	10.32	7.44	0.07	0.25	0.42	0.19
210801	Ozone	72	38.50	1.00	1.04	0.35	1.00	2.24	4.71	6.41	3.50	0.06	0.14	0.29	0.09
520299	Aliphatic alcohols	69	36.90	1.00	1.63	1.62	1.00	2.50	8.96	11.95	6.50	0.08	0.47	1.09	0.22
520599	Aliphatic aldehydes	66	35.29	1.00	1.48	3.02	1.00	10.00	25.35	15.32	40.00	0.25	0.67	0.40	1.00
220501	Formaldehyde	63	33.69	1.00	1.51	3.09	1.00	10.00	25.77	15.21	40.00	0.25	0.68	0.39	1.00
990021	Biocides	60	32.09	1.00	1.50	1.79	1.00	3.50	8.55	10.09	7.34	0.09	0.35	0.69	0.30
160001	Fabric dust	58	31.02	1.00	1.10	0.56	1.00	20.00	28.80	13.31	40.00	0.50	0.82	0.69	1.00
170003	Cellulose	55	29.41	1.00	1.03	0.23	1.00	10.31	26.54	14.41	40.00	0.26	0.69	0.43	1.00
140001	Cotton dust	49	26.20	1.00	1.11	0.61	1.00	14.00	27.46	13.78	40.00	0.35	0.81	0.74	1.00
370004	Engine emissions	47	25.13	1.00	1.15	0.66	1.00	5.44	9.63	7.13	10.00	0.15	0.25	0.17	0.27
150001	Synthetic fibres	44	23.53	1.00	1.43	1.04	1.50	27.50	34.72	8.71	40.00	0.82	1.30	1.10	1.50
420204	Isopropanol	43	22.99	1.00	1.26	0.90	1.00	2.50	5.72	8.56	4.00	0.06	0.17	0.22	0.12
530193	PAHs from any source	35	18.72	1.00	1.37	1.07	1.00	5.50	26.08	17.29	40.00	0.14	1.05	1.34	1.00
150009	Polyester fibres	33	17.65	1.00	1.12	0.70	1.00	20.00	30.10	11.97	40.00	0.50	0.88	0.74	1.00
210701	Ammonia	32	17.11	1.00	1.20	0.59	1.00	2.50	12.15	14.04	15.50	0.06	0.41	0.58	0.53
520199	Alkanes (C5-C17)	32	17.11	1.00	3.03	3.76	3.25	6.00	20.88	14.14	35.00	0.25	1.73	3.00	1.31
510004	Hypochlorites	31	16.58	1.00	1.00	0.01	1.00	3.42	7.48	10.18	5.00	0.09	0.19	0.25	0.12
460002	Synthetic adhesives	30	16.04	1.00	2.29	4.46	1.23	26.04	29.56	14.20	40.00	0.71	2.01	4.53	1.00
530199	Mononuclear aromatic hydrocarbons	27	14.44	1.00	4.13	6.68	4.11	7.44	25.90	15.46	40.00	0.23	3.58	6.89	3.79

IDCHEM	Agent	ISCO-68 job code (n)	Prevalence of exposure (%)	Concentration of exposure (1, 5, 25 scale)				Frequency of exposure (hours per week)				FWI of exposure[a]			
				Q1	Mean	Std	Q3	Q1	Mean	Std	Q3	Q1	Mean	Std	Q3
521599	Aliphatic ketones	26	13.90	1.00	6.07	10.36	4.90	5.00	16.30	14.12	22.50	0.14	3.59	9.74	1.95
530196	PAHs from petroleum	26	13.90	1.00	1.31	1.09	1.00	6.50	24.02	15.86	40.00	0.16	0.93	1.35	1.00
150010	Nylon fibres	25	13.37	1.00	1.24	0.88	1.00	30.00	32.95	11.00	40.00	0.88	1.03	0.70	1.00
520197	Alkanes (C18+)	25	13.37	1.00	1.32	1.11	1.00	5.00	21.85	16.51	40.00	0.12	0.89	1.39	1.00
110024	Inorganic pigments	24	12.83	1.00	1.26	0.90	1.00	3.28	21.24	17.34	40.00	0.12	0.56	0.43	1.00
370002	Cooking fumes	24	12.83	1.00	1.19	0.53	1.00	10.00	20.17	14.16	36.25	0.25	0.67	0.64	1.00
140002	Wool fibres	23	12.3	1.00	1.26	0.92	1.00	19.38	26.67	12.65	37.38	048	0.96	1.09	0.98
421501	Acetone	22	11.76	1.00	5.70	8.01	5.00	5.00	19.06	17.12	40.00	0.22	3.58	7.90	2.42
110001	Abrasives dust	20	10.70	1.00	1.00	0.00	1.00	2.95	7.00	7.47	7.54	0.07	0.18	0.19	0.19
110033	Cosmetic talc	20	10.70	1.00	1.53	1.09	1.17	2.00	3.27	1.99	3.87	0.06	0.10	0.05	0.12
112005	Calcium carbonate	20	10.70	1.00	1.07	0.30	1.00	5.00	9.13	4.75	13.62	0.12	0.25	0.19	0.34
140008	Flax fibres	20	10.70	1.00	1.18	0.56	1.00	9.50	22.83	14.38	36.00	0.24	0.66	0.54	0.92
470003	Inks	20	10.70	1.00	1.11	0.50	1.00	3.00	24.08	16.79	40.00	0.07	0.67	0.55	1.00
130001	Organic dyes and pigments	19	10.16	1.00	1.38	1.02	1.00	11.00	22.20	14.18	35.88	0.40	0.61	0.34	0.90
470001	Other paints, varnishes	19	10.16	1.00	2.25	2.88	2.10	6.02	21.44	16.66	40.00	0.18	1.52	2.94	1.20
370013	Plastics pyrolysis fumes	18	9.63	1.00	1.37	1.01	1.00	4.25	21.20	17.34	40.00	0.11	0.71	0.68	1.00
410002	Caustic alkali solutions	18	9.63	1.00	1.98	1.54	2.76	2.50	4.07	2.78	4.75	0.07	0.16	0.14	0.16
430102	Toluene	18	9.63	1.00	3.17	3.46	3.19	13.50	27.04	14.08	40.00	0.69	2.54	3.62	2.88
140003	Silk fibres	17	9.09	1.00	1.25	0.97	1.00	10.80	24.67	14.81	40.00	0.27	0.86	1.12	1.00
370010	Natural gas combustion products	17	9.09	1.00	1.47	1.33	1.00	6.00	22.21	17.54	40.00	0.15	0.84	1.16	1.00
420401	Acetic acid	17	9.09	1.00	1.45	1.10	1.00	4.50	20.64	16.53	40.00	0.13	0.82	1.18	1.00
150002	Plastic dusts	16	8.56	1.00	1.00	0.00	1.00	7.25	27.09	16.34	40.00	0.41	0.70	0.39	1.00
150007	Rayon fibres	16	8.56	1.00	1.00	0.00	1.00	7.75	24.44	14.06	35.12	0.19	0.62	0.36	0.90
460009	Mineral spirits post-1970	16	8.56	1.00	4.38	6.27	3.50	4.75	16.07	15.10	27.75	0.22	1.09	1.25	1.14

IDCHEM	Agent	ISCO-68 job code (n)	Prevalence of exposure (%)	Concentration of exposure (1, 5, 25 scale)				Frequency of exposure (hours per week)				FWI of exposure[a]			
				Q1	Mean	Std	Q3	Q1	Mean	Std	Q3	Q1	Mean	Std	Q3
110009	Cristalline silica	15	8.02	1.00	1.27	1.03	1.00	2.75	9.14	11.57	7.50	0.07	0.26	0.29	0.32
210601	Carbon monoxide	15	8.02	1.00	1.00	0.00	1.00	3.38	13.43	18.45	10.00	0.08	0.34	0.46	0.25
260002	Propellant gases	15	8.02	1.00	1.34	1.05	1.00	2.50	5.81	7.75	5.30	0.07	0.22	0.40	0.15
530194	PAHs from other sources	15	8.02	1.00	1.29	0.82	1.00	5.47	25.26	17.81	40.00	0.14	0.94	1.11	1.00
110005	Metallic dust	14	7.49	1.00	1.03	0.11	1.00	5.19	26.89	17.18	40.00	0.13	0.70	0.46	1.00
140012	Starch dust	14	7.49	1.00	1.57	1.45	1.00	12.50	26.59	15.80	40.00	0.31	1.27	1.75	1.00
211701	Hydrogen chloride	14	7.49	1.00	1.07	0.27	1.00	3.81	18.54	17.41	38.75	0.10	0.51	0.43	0.97
370015	Propane combustion products	14	7.49	1.00	1.29	0.73	1.00	10.00	26.07	16.62	39.50	0.25	0.95	0.96	1.15
410001	Inorganic acid solutions	14	7.49	1.00	1.19	0.49	1.00	2.50	11.56	15.55	8.75	0.06	0.38	0.46	0.82
420201	Methanol	14	7.49	1.00	2.63	3.20	2.83	2.00	7.75	10.04	6.50	0.06	1.11	2.88	0.21
460027	Mineral spirits pre-1970	14	7.49	1.00	5.32	7.27	4.75	6.22	22.37	16.63	37.50	0.38	3.84	8.09	2.17
460004	Waxes, polishes	13	6.95	1.00	1.62	1.26	1.00	4.00	14.87	13.56	23.75	0.10	0.59	0.75	0.60
518299	Lead compounds	13	6.95	1.00	1.00	0.00	1.00	3.20	18.57	15.82	35.00	0.08	0.47	0.41	0.88
890003	Ultraviolet radiation	13	6.95	1.00	1.00	0.00	1.00	5.00	10.15	10.01	10.00	0.12	0.25	0.25	0.25
150008	Acrylic fibres	12	6.42	1.00	1.00	0.00	1.00	10.00	23.32	13.50	36.25	0.25	0.59	0.35	1.00
370006	Diesel engine emissions	12	6.42	1.00	1.19	0.58	1.00	3.99	10.52	8.29	14.75	0.12	0.36	0.29	0.57
370012	Propane engine emissions	12	6.42	1.00	1.00	0.00	1.00	4.50	21.69	18.36	40.00	0.11	0.54	0.46	1.00
430103	Xylene	12	6.42	1.00	3.33	4.15	3.54	5.81	26.83	16.44	40.00	0.45	2.72	4.29	2.35
460012	Lubricating oils and greases	12	6.42	1.00	1.00	0.00	1.00	2.50	16.48	16.77	35.62	0.06	0.42	0.44	0.89
520899	Chlorinated alkanes	12	6.42	1.00	5.09	7.62	5.00	3.62	10.43	12.21	12.47	0.11	1.36	3.05	1.12
521399	Chlorinated alkenes	12	6.42	1.00	2.74	4.28	2.17	8.62	26.69	23.04	40.00	0.26	1.78	3.04	1.26
530399	Aromatic amines	12	6.42	1.00	1.33	1.15	1.00	11.50	28.26	17.49	41.25	0.50	0.75	0.39	1.03
890002	Radio frequency, microwaves	12	6.42	1.00	1.00	0.00	1.00	6.64	15.89	13.33	26.31	0.17	0.40	0.33	0.66
990022	Bleaches	12	6.42	1.00	1.00	0.00	1.00	3.81	10.17	11.06	12.00	0.10	0.27	0.28	0.41

IDCHEM	Agent	ISCO-68 job code (n)	Prevalence of exposure (%)	Concentration of exposure (1, 5, 25 scale)				Frequency of exposure (hours per week)				FWI of exposure[a]			
				Q1	Mean	Std	Q3	Q1	Mean	Std	Q3	Q1	Mean	Std	Q3
140006	Flour dust	11	5.88	1.00	1.56	1.29	1.09	7.88	25.69	16.83	40.00	0.31	1.22	1.50	1.00
420202	Ethanol	11	5.88	1.00	1.21	0.60	1.00	4.75	15.09	15.65	25.00	0.12	0.59	0.89	0.69
140013	Sugar dust	10	5.35	1.00	1.00	0.00	1.00	4.06	19.57	16.52	37.50	0.10	0.54	0.44	1.00
140016	Leather dust	10	5.35	1.00	1.00	0.00	1.00	40.00	35.57	11.39	40.00	1.00	0.89	0.28	1.00
430101	Benzene	10	5.35	1.00	5.51	8.31	4.25	14.02	29.44	17.01	40.00	0.35	5.30	8.48	4.69
110021	Mild steel dust	9	4.81	1.00	1.04	0.13	1.00	40.00	34.03	12.65	40.00	1.00	0.90	0.36	1.00
110029	Ashes	9	4.81	1.00	1.00	0.00	1.00	2.50	2.64	0.38	2.50	0.06	0.07	0.01	0.06
150011	Acetate fibres	9	4.81	1.00	1.22	0.67	1.00	21.50	30.56	11.26	40.00	0.81	0.96	0.56	1.00
210703	Nitrogen oxides	9	4.81	1.00	1.03	0.08	1.00	6.00	17.22	16.23	35.50	0.15	0.46	0.46	0.89
460022	Other mineral oils	9	4.81	1.00	1.89	1.76	1.00	35.00	37.67	7.16	40.00	0.88	1.89	1.96	1.20
511399	Aluminium Compounds	9	4.81	1.00	1.01	0.04	1.00	7.39	22.69	17.30	40.00	0.18	0.58	0.45	1.00
512699	Iron compounds	9	4.81	1.00	1.05	0.15	1.00	35.00	33.58	12.36	40.00	0.88	0.90	0.37	1.00
520198	Alkanes (C1-C4)	9	4.81	1.00	1.00	0.00	1.00	4.38	6.59	3.51	8.00	0.11	0.16	0.09	0.20
140004	Wood dust	8	4.28	1.00	1.00	0.00	1.00	3.42	17.43	17.72	25.62	0.09	0.44	0.44	0.64
170002	Carbon black	8	4.28	1.00	1.00	0.00	1.00	9.62	20.81	15.68	36.25	0.25	0.53	0.39	0.91
260001	Anaesthetic gases	8	4.28	1.00	3.40	4.74	2.50	4.00	8.24	5.70	10.00	0.14	0.70	1.23	0.41
318201	Lead fumes	8	4.28	1.00	1.00	0.00	1.00	4.38	21.25	16.81	38.12	0.11	0.54	0.44	0.95
112001	Calcium oxide	7	3.74	1.00	1.57	1.51	1.00	2.38	3.39	1.97	4.25	0.06	0.10	0.04	0.12
150027	Polyurethanes	7	3.74	1.00	1.00	0.00	1.00	15.00	25.43	14.36	40.00	0.38	0.64	0.36	1.00
411603	Sulphuric acid	7	3.74	1.00	1.28	0.49	1.40	5.00	8.14	6.38	9.12	0.12	0.39	0.47	0.49
110026	Extenders	6	3.21	1.00	1.00	0.00	1.00	32.00	30.17	14.17	37.50	0.80	0.75	0.35	0.94
370001	Other pyrolysis fumes	6	3.21	1.00	1.00	0.00	1.00	40.00	39.17	2.04	40.00	1.00	0.98	0.05	1.00
420602	Diethyl ether	6	3.21	1.00	2.03	1.13	3.00	5.35	10.55	9.02	10.00	0.17	0.55	0.81	0.34
512999	Copper compounds	6	3.21	1.00	1.00	0.00	1.00	15.00	25.53	15.48	37.50	0.38	0.64	0.39	0.94
513099	Zinc compounds	6	3.21	1.00	1.00	0.00	1.00	7.00	22.83	17.74	38.75	0.18	0.57	0.44	0.97
515099	Tin compounds	6	3.21	1.00	1.13	0.22	1.19	25.00	28.03	13.93	38.75	0.62	0.86	0.54	1.19

IDCHEM	Agent	ISCO-68 job code (n)	Prevalence of exposure (%)	Concentration of exposure (1, 5, 25 scale)				Frequency of exposure (hours per week)				FWI of exposure[a]			
				Q1	Mean	Std	Q3	Q1	Mean	Std	Q3	Q1	Mean	Std	Q3
890001	Ionizing radiation	6	3.21	1.00	4.11	4.67	4.67	2.50	11.31	14.96	14.73	0.11	3.47	8.04	0.39
111101	Sodium carbonate	5	2.67	1.00	1.00	0.00	1.00	3.00	4.60	1.98	5.00	0.07	0.12	0.05	0.12
111301	Alumina	5	2.67	1.00	1.00	0.00	1.00	7.39	16.04	15.20	22.00	0.18	0.40	0.38	0.55
170006	Rubber dust	5	2.67	1.00	1.00	0.00	1.00	40.00	39.75	0.56	40.00	1.00	0.99	0.01	1.00
220603	Ethylene oxide	5	2.67	1.00	2.20	1.79	3.00	2.00	4.01	3.67	5.00	0.05	0.26	0.24	0.31
310003	Soldering fumes	5	2.67	1.00	2.20	1.79	3.00	30.00	33.50	8.59	40.00	0.75	2.05	1.92	3.00
310004	Metal oxide fumes	5	2.67	1.00	1.40	0.89	1.00	10.00	26.60	17.90	40.00	0.25	0.97	0.95	1.00
410704	Nitric acid	5	2.67	1.00	1.67	0.94	2.33	2.50	6.90	5.12	7.50	0.06	0.32	0.34	0.44
410802	Hydrogen peroxide	5	2.67	1.00	1.80	1.79	1.00	2.00	5.68	5.43	5.73	0.06	0.19	0.24	0.14
421303	Perchloroethylene	5	2.67	1.00	1.66	0.83	1.89	32.00	40.60	25.71	40.00	0.80	1.48	1.32	1.00
440001	Animal, vegetable glues	5	2.67	1.00	1.00	0.00	1.00	26.25	34.25	7.89	40.00	1.00	0.94	0.16	1.00
470005	Metal coatings	5	2.67	1.00	1.14	0.22	1.20	5.00	21.56	18.09	40.00	0.12	0.68	0.64	1.20
530299	Aromatic alcohols	5	2.67	1.00	1.80	1.79	1.00	5.25	14.75	15.67	20.00	0.15	0.42	0.36	0.50
110016	Concrete dust	4	2.14	1.00	1.00	0.00	1.00	6.10	17.60	16.55	25.00	0.15	0.44	0.41	0.62
150017	Poly(vinyl chloride)	4	2.14	1.00	1.00	0.00	1.00	35.00	35.00	10.00	40.00	0.88	0.88	0.25	1.00
220101	Methane	4	2.14	1.00	1.00	0.00	1.00	3.91	7.72	5.26	11.00	0.10	0.19	0.13	0.28
315001	Tin fumes	4	2.14	1.00	1.20	0.25	1.32	34.38	35.62	7.18	40.00	0.91	1.12	0.41	1.34
411501	Phosphoric acid	4	2.14	1.00	1.00	0.00	1.00	24.62	27.38	16.91	36.25	0.62	0.68	0.42	0.91
420203	Ethylene glycol	4	2.14	1.00	2.00	2.00	2.00	2.38	3.06	1.48	3.19	0.06	0.14	0.12	0.18
440003	Linseed oil	4	2.14	1.00	1.50	1.00	1.50	22.23	27.23	14.66	37.50	0.56	1.18	1.22	1.44
460006	Kerosene	4	2.14	1.00	1.50	1.00	1.50	9.38	26.38	20.64	42.00	0.23	1.16	1.31	1.65
512499	Chromium compounds	4	2.14	1.00	1.12	0.25	1.12	15.70	20.70	15.21	25.00	0.39	0.64	0.61	0.75
521999	Glycol ethers	4	2.14	1.00	2.52	1.92	3.57	2.50	4.22	2.07	5.60	0.11	0.24	0.17	0.34
530198	Benzo[a]pyrene	4	2.14	1.00	1.00	0.00	1.00	4.62	36.62	44.26	54.50	0.12	0.92	1.11	1.36
990013	Fertilizers	4	2.14	2.75	3.75	1.50	5.00	1.58	11.39	19.08	11.84	0.11	0.62	0.92	0.73
990014	Pesticides	4	2.14	1.00	2.00	2.00	2.00	1.90	6.59	9.12	6.94	0.06	0.19	0.21	0.24

IDCHEM	Agent	ISCO-68 job code (n)	Prevalence of exposure (%)	Concentration of exposure (1, 5, 25 scale)				Frequency of exposure (hours per week)				FWI of exposure[a]			
				Q1	Mean	Std	Q3	Q1	Mean	Std	Q3	Q1	Mean	Std	Q3
110007	Chrysotile asbestos	3	1.60	1.00	1.00	0.00	1.00	3.75	14.17	18.09	20.00	0.09	0.35	0.45	0.50
110008	Amphibole asbestos	3	1.60	1.00	1.00	0.00	1.00	37.50	38.33	2.89	40.00	0.94	0.96	0.07	1.00
140005	Grain dust	3	1.60	1.49	2.66	2.08	3.49	5.25	23.50	31.61	32.90	0.36	2.74	4.13	3.98
140017	Tobacco dust	3	1.60	3.00	7.00	7.21	10.00	38.00	38.67	2.31	40.00	2.95	4.47	3.33	6.25
140018	Natural rubber	3	1.60	1.00	1.00	0.00	1.00	32.50	35.00	8.66	40.00	0.81	0.88	0.22	1.00
211602	Hydrogen sulphide	3	1.60	1.00	1.00	0.00	1.00	13.25	20.50	12.58	24.50	0.33	0.51	0.31	0.61
220102	Propane	3	1.60	1.00	1.00	0.00	1.00	3.75	4.17	1.44	5.00	0.09	0.10	0.04	0.12
370014	Rubber pyrolysis fumes	3	1.60	1.75	2.45	1.43	3.18	38.75	39.17	1.44	40.00	1.72	2.48	1.53	3.25
430201	Phenol	3	1.60	1.00	2.33	2.31	3.00	4.25	16.17	20.71	23.00	0.23	0.49	0.45	0.66
514799	Silver compounds	3	1.60	1.00	1.00	0.00	1.00	22.50	28.33	20.21	40.00	0.56	0.71	0.51	1.00
514899	Cadmium compounds	3	1.60	1.00	1.00	0.00	1.00	21.40	27.60	21.48	40.00	0.54	0.69	0.54	1.00
521499	Aliphatic esters	3	1.60	1.00	2.33	2.31	3.00	5.38	6.25	2.05	7.38	0.13	0.42	0.50	0.58
110011	Glass dust	2	1.07	1.00	1.00	0.00	1.00	17.49	24.98	21.18	32.46	0.44	0.62	0.53	0.81
112002	Calcium sulphate	2	1.07	1.00	1.00	0.00	1.00	3.90	4.60	1.98	5.30	0.10	0.11	0.05	0.13
140010	Hair dust	2	1.07	1.00	1.00	0.00	1.00	9.38	16.25	19.45	23.12	0.27	0.48	0.59	0.69
150012	Cellulose acetate	2	1.07	1.00	1.00	0.00	1.00	40.00	40.00	0.00	40.00	1.00	1.00	0.00	1.00
150018	Poly(vinyl acetate)	2	1.07	1.00	1.00	0.00	1.00	15.38	26.25	30.76	37.12	0.38	0.66	0.77	0.93
150030	Polychloroprene	2	1.07	1.00	1.00	0.00	1.00	34.00	36.00	5.66	38.00	0.85	0.90	0.14	0.95
210100	Hydrogen	2	1.07	2.00	3.00	2.83	4.00	1.38	1.75	1.06	2.12	0.08	0.09	0.04	0.11
211601	Sulphur dioxide	2	1.07	1.00	1.00	0.00	1.00	11.38	19.25	22.27	27.12	0.28	0.48	0.56	0.68
220001	Natural gas	2	1.07	1.00	1.00	0.00	1.00	2.81	3.12	0.88	3.44	0.07	0.08	0.02	0.09
225001	Phosgene	2	1.07	1.00	1.00	0.00	1.00	26.48	30.99	12.74	35.49	0.66	0.77	0.32	0.89
310002	Arc welding fumes	2	1.07	1.00	1.00	0.00	1.00	17.50	25.00	21.21	32.50	0.44	0.62	0.53	0.81
313001	Zinc fumes	2	1.07	1.00	1.00	0.00	1.00	36.25	37.50	3.54	38.75	0.91	0.94	0.09	0.97
314701	Silver fumes	2	1.07	1.00	1.00	0.00	1.00	40.00	40.00	0.00	40.00	1.00	1.00	0.00	1.00

IDCHEM	Agent	ISCO-68 job code (n)	Prevalence of exposure (%)	Concentration of exposure (1, 5, 25 scale)				Frequency of exposure (hours per week)				FWI of exposure[a]			
				Q1	Mean	Std	Q3	Q1	Mean	Std	Q3	Q1	Mean	Std	Q3
370005	Coal combustion products	2	1.07	1.00	1.00	0.00	1.00	54.50	69.00	41.01	83.50	1.36	1.73	1.03	2.09
370009	Wood combustion products	2	1.07	2.00	3.00	2.83	4.00	24.00	28.00	11.31	32.00	1.50	2.50	2.83	3.50
420801	Carbon tetrachloride	2	1.07	5.00	5.00	0.00	5.00	1.38	2.25	2.47	3.12	0.17	0.28	0.31	0.39
420803	Methylene chloride	2	1.07	1.50	2.00	1.41	2.50	12.47	14.98	7.10	17.49	0.63	0.92	0.82	1.21
440002	Turpentine	2	1.07	10.00	15.00	14.14	20.00	16.50	27.00	29.70	37.50	8.06	15.38	20.68	22.69
460005	Leaded gasoline	2	1.07	7.00	13.00	16.97	19.00	12.81	21.88	25.63	30.94	6.32	12.55	17.61	18.77
460031	Cutting fluids post-1955	2	1.07	1.00	1.00	0.00	1.00	13.00	22.00	25.46	31.00	0.32	0.55	0.64	0.78
470002	Wood varnishes, stains and paints	2	1.07	1.00	1.00	0.00	1.00	15.54	23.70	23.06	31.85	0.39	0.59	0.58	0.80
510003	Chromium (VI)	2	1.07	1.20	1.40	0.57	1.60	28.56	32.38	10.78	36.19	1.09	1.18	0.26	1.28
518099	Mercury compounds	2	1.07	1.00	1.00	0.00	1.00	4.25	4.50	0.71	4.75	0.11	0.11	0.02	0.12
530195	PAH's from wood	2	1.07	2.00	3.00	2.83	4.00	24.00	28.00	11.31	32.00	1.50	2.50	2.83	3.50
530197	PAH's from coal	2	1.07	1.00	1.00	0.00	1.00	54.50	69.00	41.01	83.50	1.36	1.73	1.03	2.09
110002	Inorganic insulation dust	1	0.53	1.00	1.00		1.00	21.25	21.25		21.25	0.53	0.53		0.53
110010	Portland cement	1	0.53	1.00	1.00		1.00	2.00	2.00		2.00	0.05	0.05		0.05
110013	Industrial talc	1	0.53	1.00	1.00		1.00	20.00	20.00		20.00	0.50	0.50		0.50
110015	Clay dust	1	0.53	1.00	1.00		1.00	8.00	8.00		8.00	0.20	0.20		0.20
110018	Bronze dust	1	0.53	1.00	1.00		1.00	3.20	3.20		3.20	0.08	0.08		0.08
110025	Mineral wool fibers	1	0.53	25.00	25.00		25.00	40.00	40.00		40.00	25.00	25.00		25.00
111102	Sodium hydrosulphite	1	0.53	1.00	1.00		1.00	5.25	5.25		5.25	0.13	0.13		0.13
112201	Titanium dioxide	1	0.53	1.00	1.00		1.00	30.00	30.00		30.00	0.75	0.75		0.75
113001	Zinc oxide	1	0.53	1.00	1.00		1.00	4.00	4.00		4.00	0.10	0.10		0.10
130101	DDT	1	0.53	1.00	1.00		1.00	6.00	6.00		6.00	0.15	0.15		0.15
140007	Fur dust	1	0.53	1.00	1.00		1.00	8.00	8.00		8.00	0.20	0.20		0.20
140009	Cork dust	1	0.53	1.00	1.00		1.00	37.50	37.50		37.50	0.94	0.94		0.94

IDCHEM	Agent	ISCO-68 job code (n)	Prevalence of exposure (%)	Concentration of exposure (1, 5, 25 scale)				Frequency of exposure (hours per week)				FWI of exposure[a]			
				Q1	Mean	Std	Q3	Q1	Mean	Std	Q3	Q1	Mean	Std	Q3
145001	Tannic acid	1	0.53	1.00	1.00		1.00	2.00	2.00		2.00	0.05	0.05		0.05
150013	Cellulose nitrate	1	0.53	1.00	1.00		1.00	40.00	40.00		40.00	1.00	1.00		1.00
150020	Polyacrylates	1	0.53	5.00	5.00		5.00	8.00	8.00		8.00	1.00	1.00		1.00
150023	Epoxies	1	0.53	1.00	1.00		1.00	48.00	48.00		48.00	1.20	1.20		1.20
150029	Styrene-butadiene rubber	1	0.53	2.50	2.50		2.50	25.50	25.50		25.50	1.24	1.24		1.24
170004	Soot	1	0.53	1.00	1.00		1.00	3.50	3.50		3.50	0.09	0.09		0.09
210602	Hydrogen cyanide	1	0.53	1.00	1.00		1.00	40.00	40.00		40.00	1.00	1.00		1.00
211700	Chlorine	1	0.53	1.12	1.12		1.12	40.00	40.00		40.00	1.12	1.12		1.12
221301	Vinyl chloride	1	0.53	1.00	1.00		1.00	10.00	10.00		10.00	0.31	0.31		0.31
270001	Coal gas	1	0.53	1.00	1.00		1.00	2.50	2.50		2.50	0.06	0.06		0.06
310001	Gas welding fumes	1	0.53	1.00	1.00		1.00	4.20	4.20		4.20	0.10	0.10		0.10
311301	Aluminium fumes	1	0.53	1.00	1.00		1.00	10.00	10.00		10.00	0.25	0.25		0.25
312501	Manganese fumes	1	0.53	1.00	1.00		1.00	40.00	40.00		40.00	1.00	1.00		1.00
312601	Iron fumes	1	0.53	1.00	1.00		1.00	40.00	40.00		40.00	1.00	1.00		1.00
420701	Nitroglycerine	1	0.53	1.00	1.00		1.00	600	6.00		6.00	0.15	0.15		0.15
420802	Chloroform	1	0.53	1.00	1.00		1.00	5.25	5.25		5.25	0.13	0.13		0.13
460007	Diesel oil	1	0.53	1.00	1.00		1.00	5.50	5.50		5.50	0.14	0.14		0.14
460014	Asphalt	1	0.53	1.00	1.00		1.00	3.40	3.40		3.40	0.09	0.09		0.09
460029	Polychlorinated biphenyls or PCBs	1	0.53	5.00	5.00		5.00	2.50	2.50		2.50	0.31	0.31		0.31
510001	Cyanides	1	0.53	1.00	1.00		1.00	40.00	40.00		40.00	1.00	1.00		1.00
511299	Magnesium compounds	1	0.53	1.00	1.00		1.00	10.00	10.00		10.00	0.25	0.25		0.25
512299	Titanium compounds	1	0.53	1.00	1.00		1.00	30.00	30.00		30.00	0.75	0.75		0.75
512599	Manganese compounds	1	0.53	1.00	1.00		1.00	40.00	40.00		40.00	1.00	1.00		1.00
512899	Nickel compounds	1	0.53	1.00	1.00		1.00	20.00	20.00		20.00	0.50	0.50		0.50
513399	Arsenic compounds	1	0.53	1.00	1.00		1.00	3.20	3.20		3.20	0.08	0.08		0.08

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				Q1	Mean	Std	Q3	Q1	Mean	Std	Q3	Q1	Mean	Std	Q3
521699	Fluorocarbons	1	0.53	1.00	1.00		1.00	10.00	10.00		10.00	0.30	0.30		0.30
531899	Isocyanates	1	0.53	1.00	1.00		1.00	32.00	32.00		32.00	0.80	0.80		0.80

[a] FWI, Frequency weighted intensity of exposure was calculated by multiplying the concentration of exposure by the frequency of exposure