

The Job Exposure Matrix as a Public Health Translational Tool

Matriz empleo-exposición como herramienta traslacional de salud pública

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Abstract

Job Exposure Matrices (JEM) have been developed by occupational epidemiologists to estimate worker exposures based on job classifications. Since their inception in the 1980s, JEMs have evolved significantly, expanding from chemical exposures associated with cancer and chronic diseases to physical, biological, and psychosocial factors relevant to musculoskeletal, mental, cardiovascular, and autoimmune disorders. Recent developments highlight their role beyond research in public health as a helping tool for clinicians, policymakers, occupational practitioners (physician, nurses, preventionists, and hygiene and safety officers), or even workers as an information source. Notable contemporary examples include JEM initiatives for healthcare workers, employing advanced methods such as machine learning and creating web-accessible platforms on occupational exposure for stakeholders. Despite their utility, caution is necessary regarding variability in exposure levels, and explicit ethical guidelines must govern their use to prevent misleading interpretations.

Keywords: JEM ; Exposure; evaluation; policy; occupational; workers.

Resumen

Las matrices empleo-exposición (JEM, por sus siglas en inglés) han sido desarrolladas por epidemiólogos ocupacionales para estimar la exposición de los trabajadores en función de la clasificación de los puestos de trabajo. Desde su creación en la década de 1980, las JEM han evolucionado significativamente, pasando de ceñirse a la exposición a sustancias

químicas asociadas al cáncer y a enfermedades crónicas, a incorporar también factores físicos, biológicos y psicosociales relevantes para los trastornos musculoesqueléticos, mentales, cardiovasculares y autoinmunes.

Los avances recientes ponen de relieve su papel más allá de la investigación en salud pública como herramienta de ayuda para los médicos, los responsables políticos, los profesionales de la salud laboral (médicos, enfermeros, preventistas y responsables de higiene y seguridad) o incluso los propios trabajadores para obtener información. Entre los ejemplos contemporáneos más destacados se encuentran las iniciativas de JEM para los trabajadores sanitarios, que emplean métodos avanzados como el aprendizaje automático y la creación de plataformas accesibles en la web sobre la exposición laboral dirigida a las partes interesadas. A pesar de su utilidad, es necesario actuar con cautela ante la variabilidad de los niveles de exposición, y su uso debe regirse por directrices éticas explícitas para evitar interpretaciones erróneas.

Palabras clave: Matriz de Exposición Laboral; Exposición; Evaluación; Política; Ocupacional; Trabajadores.

Job exposure matrices (JEM) are used extensively by occupational health epidemiologists to estimate exposure among groups of workers based on job codes, data and/or expert opinion regarding working conditions. JEMs have a long history, with various periods of development and way of uses.⁽¹⁾ Since the early days of occupational pioneers, such as Ramazzini in 1713, there have been descriptions of harmful exposure for groups of workers.⁽²⁾ In the 1980s, Hoar described JEM methodology for the first time, and made major developments for chemicals JEM for chronic diseases where life course cumulative work history is important, such as cancers.⁽³⁾ Since then, development of large data with improvement of efficiency of exposure evaluation, JEM have become a major tool for occupation research.⁽⁴⁾ Indeed, in the absence of past individual-level exposure or historical data, these tools are very interesting, as they are not subject to recall bias. ⁽¹⁾ In the last two decades (2005-2020), a significant number of JEMs have been developed to explore physical, biological, psychosocial exposure with musculoskeletal, mental, cardiovascular, and autoimmune disorders.⁽⁵⁾ However, driven by the growing need of exposome assessment and field applicability, we are entering a new era of JEM use as a public health translational tool, such as the study well illustrated by Gonzalez et al on health care workers.⁽⁶⁾

Firstly, major initiatives were observed to develop international JEMs and to promote the use of JEMs in countries where no exposure data exists.⁽⁷⁾ Naturally, JEMs would require local working groups and data to adapt the potential international JEMs for specific applications. However, it provides a minimum level of evaluation exposure when no other possibility exists for national JEMs or other exposure evaluation.⁽⁸⁾ Furthermore, it provides public health researchers from other fields than occupational epidemiology with the opportunity to consider working exposure in their models. In the field of exposome research, Wild explicitly recognized the potential of JEMs as an improved conventional measurement tool.⁽⁹⁾ This approach offers a novel perspective on understanding how working conditions can

be integrated within a life course framework, and how it can interact with other determinants of health.⁽¹⁰⁾

Secondly, JEMs could also be used outside of research, for public health purposes as translational tools.⁽¹¹⁾ JEMs could assist clinicians in conducting preliminary evaluations for prevention, return-to-work assessments, and worker compensation or other social benefit processes by providing a baseline assessment of relevant exposures in different jobs. The capacity of JEMs to summarize multiple lifetime and current exposures at the job level also has the potential to assist policymakers in establishing priorities for the prevention of occupational risk, job retention, retirement, and even for occupational practitioners.⁽¹²⁾ Furthermore, these JEMs can be used directly by employees and employers for information, like for example the O*Net initiatives.⁽¹³⁾ In order to give a concrete illustration, two examples with healthcare workers will be detailed here.

A pilot study aimed to develop a JEM focused on chemical hygiene-related risks on hospital care.⁽⁶⁾ The study was conducted at Hospital del Mar in Barcelona, based on assessments of six toxic chemical agents for which data was available (formaldehyde, tamoxifen, cyclophosphamide, cisplatin, sevoflurane, and desflurane), and for 46 homogeneous functional groups (HFGs). This allowed obtaining an exposure assessment for type of job classification that were confronted with overall prevalence rates to validate the JEM. Another example is JEM Soignances.^(14,15) JEM Soignances was based on self-reported data of a large population-based cohort in France. The JEM was constructed using data from 12,489 healthcare workers within the CONSTANCES cohort, according to job titles and sectors of activity. Twenty-four exposures, covering organizational, psychosocial, physical, biological, and one chemical factors (formaldehyde). Machine learning (“artificial intelligence”) techniques were used on a training sample (group-based frequency, Classification and regression tree - CART, random forest and extreme gradient boosting machine) and confronted to a validation sample. JEM Soignances showed globally good internal performance (including biomechanical, formaldehyde, etc.), though nine exposures showed poor-to-moderate discriminatory power (e.g. psychosocial factors). JEM assessments were evaluated using association between JEM, self-report and some relevant health outcomes (i.e., pain, depressive symptoms, hypertension, cancer, use of psychoactive drugs), which showed good consistency except for psychosocial exposure which also failed. Based on the results, a web interface has been developed to allow access to the JEM (<https://jemsoignances.shinyapps.io/jem-soignances/>).

These two JEMs appear as useful tools for guiding preventive interventions, prioritizing resources and planning control strategies adapted to actual exposure conditions in healthcare environments for occupational practitioners, physicians, nurses, preventionists, and hygiene and safety officers. JEMs are a basic tool for those who carry out risk assessments within companies. Indeed, these occupational practitioners can use these JEM as a first step exposure assessment and proposing preventive measures. It can also be used as a tool for training and awareness of stakeholders, from administration and management to workers. However, users

should understand and consider the limitations of such use, from their validation to their application.⁽¹⁶⁾ For instance, psychosocial factors should be used with important caution, whereas biomechanical or formaldehyde exposure assessment are robust. Furthermore, significant variations in exposure levels may exist depending on the context, which justifies not misusing such JEM as a direct decision-making tool. To avoid confusion, terms of references have clearly indicated and any use of commercial, mercantile, or financial purposes, including insurance, is strictly prohibited, as is any use contrary to medical, scientific, or social ethics.

In conclusion, JEMs have entered into a new era of use as a translational tool for public health epidemiological research and for on field use by preventionists, clinicians, occupational practitioners, as well as decision-makers, workers and stakeholders.⁽¹⁾ However, limitation and caution should be clearly reminded for users about the importance of occupational practitioners to be involved.

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Contributions

All authors have all initiated and conducted the work, written and approved the manuscript

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