A JOB EXPOSURE MATRIX FOR IDENTIFICATION OF POTENTIAL EXPOSURES IN OCCUPATIONAL SETTINGS

W.K. Sieber, J.A. Seta, R.O.Young

National Institute for Occupational Safety and Health, (NIOSH), 4676 Columbia Parkway, M.S. R-19, Cincinnati, Ohio 45226

Introduction

In studying occupational health, a knowledge of occupation-specific exposures is useful since exposures to many potentially hazardous substances may occur in the workplace at high concentrations. Because exposures vary for occupations and industries, several approaches have been used to identify occupation-specific exposure information. Direct quantitative exposure measurements, if available, have been used to determine exposure categories. However, many studies of mortality or morbidity are conducted by using vital statistics or other record systems where the only exposure data recorded are the decedent's or respondent's occupation or industry. For analysis of such studies, a classification system or matrix linking industry, occupation, and exposure would be useful. A Job Exposure Matrix (JEM) is such a classification system linking occupational titles with occupational exposures.

The JEM developed by researchers at the National Institute for Occupational Safety and Health (NIOSH) uses data collected during the 1981-1983 National Occupational Exposure Survey (NOES) (1). Previous occupational exposure classification systems have been based on reports from the literature (2) or on exposures assigned by panels of chemists of industrial hygienists (3). Such efforts have been hampered by the lack of a national profile of occupational exposures and by a lack of standardization in job titles. The classification system used at NIOSH was developed using field data collected during walk-through surveys of a probability sample of American industries, and was coded using Bureau of the Census occupation codes and Standard Industrial Classification codes.

Development of the JEM

Data: The 1981-1983 National Occupational Exposure Survey (NOES) was a two year field study conducted by NIOSH. Like its predecessor, the 1971-1973 National Occupational Hazard Survey (NOHS) (4), the NOES was intended to describe health and safety conditions in the American workplace and to determine the extent of potential worker exposure to chemical, physical, and biological agents. The NOES was a cross-sectional survey representative of all non-agricultural businesses covered under the Occupational Safety and Health Act of 1970 and employing 8 or more employees. The survey sample consisted of 4,490 establishments throughout the United States.

Data were collected by 21 industrial hygienists and occupational health specialists specifically trained for the NOES. Potential exposure information was collected during walk-through inspections of each establishment. Potential exposure to continuous noise was recorded if its measured level was equal to or greater than 85 dBA (slow response), and to impact noise if noises occurred one second or more apart and the intensity was greater than 130 dBC (fast response). Potential exposure to other agents was recorded if certain guidelines were met: 1) a chemical, physical, or biological agent or a trade-named product must have been observed in sufficient proximity to an employee such that one or more physical phases of the agent or product was likely to enter or contact the body of the employee, and 2) the agent or product must have presented a potential exposure for at least 30 minutes per week on an annual average, or be used at least once per week for 90% of the work weeks of the work year. The number and gender of employees in each occupational group potentially exposed to the agent was recorded, as well as data on the duration of potential exposure and presence of control measures over exposure. In cases where the exposure agent was a trade-named product, ingredient information was obtained from the manufacturer. Roughly 80% of the data collected in the NOES was associated with trade-named products, and considerable effort was expended in the trade-named product component determination process.

Industry, occupation, and agent were coded using standard coding systems. Establishment activity was coded by 4-digit 1972 Standard Industrial Classification (SIC) code, occupation by 1980 Bureau of

the Census occupation codes, and agent by a 5-digit code ('Hazard code') assigned at NIOSH. Unique agent codes were assigned because many agents were observed during the NOES which had not been assigned codes by other conventions (such as Chemical Abstracts (CAS) number or by the Registry of Toxic Effects of Chemical Substances (RTECS) number). Cross referencing of agent codes by CAS and RTECS numbers is possible, however. Potential exposures to 14,000 chemical, physical, or biological agents observed across 377 occupations and 521 industries are included in the JEM.

Construction of the JEM

The JEM is a three-level classification system in which potential occupational exposure information collected during the NOES walk-through inspection is classified by industry and occupation. Each level of classification is nested within the previous one. The three levels of classification in the JEM are thus industry, occupation within industry, and potential exposure within occupation within industry. The nested structure is important for flexibility in the use of the JEM since the maximum data may be included at each level of classification, and data may be easily obtained at each level of classification. For example, information about agent exposure may be obtained for a given occupation in a given industry, across all industries, or across all occupations.

Different information is included at each level of classification in the JEM. The first two levels, industry and occupation within industry, include employment data for the industry or industry-occupation group. Information about potential worker exposure in the industry-occupation group is included at the third level. The percent of employees exposed to the agent, percent exposed full time to the agent, percent exposed to the agent through the agent's presence in a trade-named product, and percent of employees working in facilities with no form of control over exposure may be found using data at the third level. All information in the JEM is broken down by gender and size of establishment. Size is defined by the number of employees: small, 8-99 employees; medium, 100-499 employees; large, 500 or more employees.

The JEM consists of a computer file of 590,000 records stored on magnetic tape. The matrix is so large because many of the same

agents may be found in different occupations and industries. The JEM system consists of the JEM file, appropriate documentation, and sample computer programs to access data from the JEM. Parts of the JEM file specific to individual industries or agents have also been abstracted from it for use on a microcomputer. JEMs containing exposure information for the construction industry and for physical agents have been developed.

Uses of the JEM

The Job Exposure Matrix may be used to profile potential exposures to specific agents in occupational settings. For example, occupational settings where potential exposure to inorganic lead or its ores occurs may be determined. Using the matrix, more than 50 employees in each of 53 occupations across 73 industries had potential exposure to inorganic lead or its ores. Those occupational groups where more than 500 employees were observed, and the percentage of employees in those groups with potential exposure are shown in Table 1. All assemblers engaged in manufacturing wire telephone and telegraph equipment (193 observed) were found to be potentially exposed, while 38.9% of assemblers engaged in manufacturing radio and TV apparatus (718 observed) were potentially exposed. Seventy-seven percent of the telephone equipment assemblers (1459 observed) were females and all were potentially exposed, while 81.2% of the radio and TV assemblers were females, of which 31.7% (583 observed) were potentially exposed. Lists of all potential exposure agents observed in the specific occupational groups may also be obtained from the JEM.

Potential exposure data from the JEM may be used to determine occupational groups for studies of exposure (5). Such data may also be used for an objective measure of exposure in occupational health research studies. Data from the JEM may also be linked to other data sets because of the use of standard coding conventions. Linkage of the JEM to Health Interview Survey (HIS), Occupational Safety and Health Administration (OSHA), or census data would provide exposure data in these data bases for a more thorough analysis of data already collected for these surveys.

Summary and conclusions

The Job Exposure Matrix is a compact representation of data

collected during the 1981-1983 National Occupational Exposure Survey. The JEM contains an inventory of occupational exposure agents cross-classified by industry and occupation. Potential exposure data by gender and size of establishment is included. The occupational information is coded using standard systems for ease in retrieving occupation-specific data. Use of a standard system also allows for the conversion of occupational codes into other coding systems and the possibility of linkage of data from the JEM with other data sets. Potential occupational exposures in the JEM were catalogued during field surveys, rather than constructed from secondary sources.

Since it is based on survey data, the JEM has some limitations. Data from the JEM are limited to those facilities and employees originally surveyed in the NOES. No indication of individual workers exposed to agents is included and the potential for misclassification within occupational groups exists. Except for noise exposure and certain other physical agents, exposures in the JEM are potential rather than measured ones. Nevertheless, the large inventory of agents included in the JEM and the use of data from a large national survey coded in a standard manner make the JEM a useful tool for the study of occupational disease.

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Table 1. Occupational groups with potential exposure to elemental lead and its ores

Manufacturing		All Employees Potentially Exposed		Females Potentially Exposed	
Industry	Occupation	N	Percent	N	Percent
Telegraph Apparatus	Assembler	1,903	100.0	1,459	100.0
Industrial Controls	Technician	200	92.6	150	91.5
Measuring Instruments	Assembler	938	70.2	606	75.6
Ship Building/ Repair	Carpenter	381	49.5	0	0.0
Radio and TV Apparatus	Assembler	718	38.9	583	31.7

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