Using Occupational Mortality Data for Surveillance of Work-related Diseases of Women

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A recently developed source of occupational mortality data from 28 states for the years 1979 through 1990 can be used to meet goals for the surveillance of women's work-related diseases. A proportionate cancer mortality ratio analysis is used to illustrate use of the data to address the goals of identifying previously unrecognized work-related disease and targeting consultation or health promotion programs to appropriate occupations. Strengths of the data include broad geographical coverage and coverage of all causes of death and numerous industries and occupations. The data set is current and very large, with annual additions. The data have certain limitations. Death certificate information collected regarding occupation and cause of death may not be accurate; furthermore, death certificates have little information on potential confounding factors, such as smoking.

The use of occupational mortality data for the surveillance of work-related diseases has a long history. William Farr, in the *Third Annual Report of the Registrar General*, analyzed the occupations of men committing suicide in 1838.[1] Since then, the Registrar General has put out a series of reports on occupational mortality, the latest being the 1979 through 1983 report.[2]

In the United States, occupational information has not been routinely included in the national vital statistics system. A national occupational mortality report limited to men was produced for 1950.[3] Since then, several states have coded and analyzed their data, with some, such as California[4] and Washington,[5] including analyses for women. Until recently, no attempt was made to develop a national occupational mortality system. During the last decade, the National Institute for Occupational Safety and Health (NIOSH), the National Center for Health Statistics (NCHS), and the National Cancer Institute have worked to provide a resource for surveillance of occupational health conditions by adding coded occupation and industry information to death certificate data.[6]

This article has two purposes: (1) to illustrate methods of using occupational mortality data to address two of the goals of surveillance for occupational groups of women; and (2) to address strengths and limitations of these data. In an October 1993 written communication, W. E. Halperin, MD, MPH, described the six NIOSH goals for the surveillance of work-related disease: (1) identify new or previously unrecognized occupational

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diseases; (2) identify occupational diseases whose occurrences represent failure of prevention; (3) determine the magnitude of occupational disease; (4) track trends in magnitude over time; (5) effectively target occupations and industries for consultative services or inspections; and (6) provide information to the public so that rational personal choices can be made in dealing with the hazards encountered. This report addresses the first and fifth goals.

Methods

Data Sources

Twenty-eight states are included in the NIOSH's National Occupational Mortality Surveillance (NOMS) system for 2 or more years from 1979 through 1990. Between 1984 and 1990, 25 of these states (Alaska, Colorado, Georgia, Idaho, Indiana, Kansas, Kentucky, Maine, Missouri, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, North Carolina, Ohio, Oklahoma, Rhode Island, South Carolina, Tennessee, Utah, Vermont, Washington, West Virginia, and Wisconsin) submitted coded occupation and industry information to the NCHS along with the standard coded variables from death certificates.[6] In addition to the data processed by NCHS, three states provided data directly to the NIOSH (California, New York (except New York City), and Pennsylvania). Three of the states that submitted data to the NCHS also provided data to the NIOSH for earlier years (Maine, North Carolina, and Rhode Island). The NOMS data base currently contains about 5 million records. Data submitted to the NCHS for 1985 through 1990 are available via public-use multiple-cause-of-death mainframe computer tapes.[7]

The usual industry and occupation, as reported on the death certificate, were coded according to the 1980 Bureau of the Census classification system.[8,9] The underlying cause of death was coded according to the *International Classification of Diseases, Ninth Revision.*[10]

Statistical Analysis

Analysis of the 1985 through 1990 NOMS data included all female decedents 20 years and older. All states in the NOMS system, except California, contributed data for one or more of these years. Race-specific, indirectly age-standardized proportionate cancer mortality ratios (PCMRs) were calculated for 65 causes of death and 473 occupations using a computer program developed at the NIOSH.[11] PCMRs were calculated by comparing the proportion of all deaths caused by specific cancers in specific occupations with the proportion of all deaths caused by specific cancers for all decedents. The 95% confidence intervals were calculated based on the Poisson distribution[12] if the observed number of deaths was 1000 or less; otherwise, the Mantel-Haenszel χ^2 analysis[13] was used.

Results

Death certificate data for 369,739 white female decedents and 40,080 black female decedents were used in the analysis. The results demonstrate possible uses of the data to address the goals of surveillance.

Screening

Although the NOMS system cannot be used directly to identify new occupational diseases, it is useful to screen for associations that seem to be biologically plausible. For example, Table 1 shows occupations with statistically significantly elevated PCMRs for leukemia in white and black women. Possible causative agents for leukemia include benzene, ionizing radiation, and viruses.[14] Although some of the elevated PCMRs may be attributed to chance, others raise the possibility of occupational associations. Clinical laboratory technicians may have exposure to benzene and other chemicals. Production supervisors and production testers may have multiple exposures; however, we

TABLE 1
Selected Proportionate Cancer Mortality Ratios for Leukemia by Occupation for Women by Race: 27 States, 1985 through 1990

Occupation (Census Codes)	White			Black		
	Deaths	Proportionate Cancer Mortality Ratio	95% Confidence Interval	Deaths	Proportionate Cancer Mortality Ratio	95% Confidence Interval
Pharmacists (096)	11	209	105, 375			
Teachers, except postsecondary (155–159)	645	113	104, 122	41	108	78, 147
Librarians, archivists, and curators (164, 165)	53	148	111, 194	1	96	2, 535
Clinical laboratory technologists and technicians (203)	25	162	105, 239	6	272	100, 592
Private household cooks (404)	1	60	2, 335	8	234	101, 460
Supervisors, production occupations (633)	54	148	111, 193	1	48	1, 269
Production testers (797)	7	409	165, 843			

lacked information to develop this further. This illustration demonstrates use of the data to identify occupations with potential risk for specific causes of death that may warrant follow-up studies.

Description of the Cancer Mortality Pattern of an Occupation

The data can be used to describe the mortality pattern of occupations or industries difficult to study by other methods (eg, cohort studies). Descriptive analyses can be used to address the NIOSH goal of targeting industries or occupations for consultation. Using the restaurant industry as an example, we will focus on waitresses. There were 4023 white waitresses and 160 black waitresses in the analysis. Table 2 lists the results for causes for which the PCMR was statistically significant for at least one of the races or was 120 or greater, with 10 or more observed deaths. PCMRs were elevated, although not necessarily significant, in both racial groups for cancer of the lip, oral cavity, and pharynx; cancer of the esophagus; lung cancer; cervical cancer; and cancer of other and unspecified sites. PCMRs were also elevated in white waitresses for cancer of the larynx. Previous studies indicate that many of these causes are associated with lifestyle factors, although it has been suggested that the risk for lung cancer in restaurant occupations may be elevated because of passive smoking.[15] Evidence strongly suggests that cancers of the oral cavity and esophagus are associated with tobacco use and consumption of alcoholic beverages.[14] Sexual practices have been identified as risk factors for cervical cancer.[14] Risk factors for diseases associated with smoking, alcohol consumption, and certain sexual practices are probably related to the lower socioeconomic status of waitresses as well as the potential easy availability of alcohol on the job. This is an example of how the NOMS system could be used to target workers for health promotion programs such as smoking cessation and programs to prevent excessive alcohol use. Easy access for screening programs such as mammography and Papanicolaou tests also could be targeted to the appropriate occupational groups.

Discussion

Limitations

Death certificates collect information on the usual occupations and usual industries of decedents. This information is provided by an informant, usually the next of kin, to the funeral director at the time of death. The data have two types of limitations. The usual occupation or industry may be inaccurate or may not be a good summary of the decedent's occupational history. Most studies of the accuracy of the data have focused on men or have not been race or gender specific. The studies are small, geographically limited, and may be limited to specific industries or causes of death. A cancer registry study that collected work history information through interviewing patients or their next of kin found a 73.3% agreement for death certificate information with either usual or current occupation for white women and 64.2% for black women, matching on broad occupational groups.[16]

The other important element from the death certificate used in this analy-

TABLE 2
Selected Proportionate Cancer Mortality Ratios for Waitresses by Race: 27 States, 1985 through 1990

Cause of Death*	White			Black		
	Deaths	Proportionate Cancer Mortality Ratio	95% Confidence Interval	Deaths	Proportionate Cancer Mortality Ratio	95% Confidence Interval
Malignant neoplasm, lip, oral cavity, and pharynx (140–149)	76	169	133, 212	4	150	41, 385
Malignant neoplasm, esophagus (150)	44	136	99, 183	6	175	64, 380
Malignant neoplasm, colon (153)	293	75	67, 84	11	73	36, 130
Malignant neoplasm, pancreas (157)	152	80	68, 94	7	86	34, 176
Malignant neoplasm, larynx (161)	28	212	141, 307			
Malignant neoplasm, trachea, bronchus, and lung (162)	1306	151	145, 157	32	127	87, 179
Malignant melanoma of skin (172)	35	64	44, 88			
Malignant neoplasm, breast (174)	605	74	68, 80	29	80	54, 115
Malignant neoplasm, cervix uteri (180)	168	190	162, 221	15	164	92, 270
Malignant neoplasm, ovary and other uterine adnexa (183)	168	70	59, 81	4	65	18, 168
Malignant neoplasm, brain and nervous system (191–192)	74	68	53, 85	2	77	9, 279
Malignant neoplasm, other and unspecified sites (194–199)	331	121	108, 135	14	114	63, 192
Malignant neoplasm, lymphatic and hematopoietic tissue (200–208)	264	74	65, 83	13	97	52, 166

* Numbers in parentheses are codes according to the *International Classification of Diseases, Ninth Revision.*

sis is underlying cause of death. A number of studies have focused on the quality of this information by comparing the specified underlying cause of death to various sources, including autopsy reports and hospital records.[17-19] Studies evaluating the quality of cause-of-death information have limitations similar to those found in the previously mentioned studies of employment-information quality. In general, the studies have found a high quality of reporting for neoplasms, with agreement from 65% to 95%.[17-19]

Death certificates contain little information on potential confounding factors, such as tobacco and alcohol use or socioeconomic status. Tobacco and alcohol use patterns are known to vary among occupations.[20,21] Socioeconomic status is usually described using measures of income and years of education, which are also associated with occupation. Without this information, it is not possible to directly control for these possible confounders in the analysis; therefore, spuriously elevated or decreased measures of association may result. Methods of indirect adjustment have been described.[22,23]

Lack of information on confounders is starting to be addressed. The Standard Certificate of Death, as revised in 1989, now collects information on education of the decedent. The coded information was added to the 1989 mortality files for 21 states. Four states have added items collecting information on contribution of tobacco use to the death (L. Washington, personal communication, 1992).

In addition to these general limitations of death certificate data, women are subject to additional problems. More than half of certificates of women have "housewife" reported as the usual occupation, reducing the sample size considerably. Because women tend to enter and exit the work force more frequently than men, the single descriptive item of "usual occupation" on the death certificate may be even less likely to reflect work history. Indirect adjustment for socioeconomic status is more difficult for women, because occupation is less likely to reflect status for women than for men (eg, women with the same job titles earning less than men and the effect of being part of a two-income family).

Strengths

The NOMS system is a valuable addition to the data available for surveillance of occupational health outcomes for women. It: (1) has broad geographical coverage of the United States; (2) includes all diseases that result in death; (3) can be used for many occupations and industries; and (4) is a very large, current data set with yearly additions. The data set also includes demographic information on race, gender, marital status, place of death, and, since 1989, education and Hispanic origin. In addition to the underlying cause of death, all causes mentioned on the death certificate are available. This is useful when examining certain diseases or conditions not likely to be recorded as underlying causes. A subset of the data is available to researchers on the public-use multiple-cause-of-death tapes produced by the NCHS.[7] These data have been used in several hypothesis-generating reports.[24-29]

As illustrated by examples in this article, many of the causes of death for which occupational groups of women have excess risk are thought to be associated with lifestyle factors, particularly smoking, alcohol use, sexual practices, and child-bearing history. Some lifestyle factors may be exacerbated by elements of the work environment. Easy access to alcohol may increase its use by waitresses. Information on occupations at high risk can be used to target health-promotion programs to appropriate occupational groups. For example, an analysis of breast cancer using the NOMS data[30] identified teachers as a high-risk group. This was followed by discussions with National Education Association and an article in a union newsletter.[31] Local unions plan to work on including mammography in health-promotion programs.

Several studies underway at the NIOSH and the National Cancer Institute use NOMS data to look at work-related mortality among women. A study of the telephone industry is being conducted in response to a case report of soft-tissue sarcoma and concerns about modern technological exposures.[32] A study of non-Hodgkin's lymphoma and multiple myeloma among elementary school teachers looks at the possibility of an association. Descriptive studies of three preventable diseases—lung cancer, breast cancer, and cervical cancer—will be used to suggest targeting health-promotion programs. A study describing the mortality of black and white female construction workers provides needed information about the risks of women in this occupation.[33] We anticipate that the NOMS system will make a significant contribution to the surveillance and study of women's work-related health conditions.

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