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Occupation and Cervical Cancer: An Opportunity for Prevention

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ABSTRACT

Cervical cancer remains an important health problem for women. Few published studies have examined cervical cancer with respect to a woman's occupation. This study examines the association of cervical cancer mortality and occupation in a large national database. The purpose of the study is to recommend which occupations may most require health promotion activities. Mortality data from the National Occupational Mortality Surveillance System were used to calculate the proportion of deaths from cervical cancer according to occupation. This study is based on standardized death certificate data for almost 2 million deaths among women in 27 states, covering the period 1985–1990. Our results are consistent with those in previous studies, with service and apparel manufacturing workers showing elevated risk. Data presented show a difference in cervical cancer mortality by occupational group. Identification of these occupations suggests which women could be targeted for preventive services. Women in occupations with low socioeconomic status are less likely to have access to health promotion programs. Resources should be directed to these women.

INTRODUCTION

CERVICAL CANCER REMAINS an important threat to women's health. Reduction in mortality from cervical cancer depends on early detection and treatment. The objective of screening is to detect and treat preinvasive lesions and, consequently, to reduce the incidence of and mortality from cervical cancer. Cervical disease generally follows a progression of abnormal cell types from dysplasia to carcinoma in situ to invasive cancer.[1] Death from cervical cancer is regarded as preventable because the likelihood of death is considered minimal if appropriate and timely medical care or preventive services are provided.[2] When detected early through the use of the Papanicolaou (Pap) smear, invasive cancer of the cervix is one of the most successfully treated cancers, with a 90% 5-year relative survival rate for localized disease, compared with 13% for distant disease.[1] Through screening with the Pap test at least once every 3 years, cervical cancer mortality for women aged 20–70 years may be reduced by an estimated 70%–95%.[3]

Risk factors for cervical cancer include early age at first intercourse, multiple sex partners, cigarette smoking, low socioeconomic status (SES), and infection with certain types of human papillomavirus (HPV).[4,5] A recent review

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of the literature[6] focused on only those studies of invasive cervical cancer in which HPV DNA was detected in cervical tissue or exfoliated cervical cells. The investigators calculated attributable fractions and estimated that infection with HPV is responsible for 82% of cervical cancers in developed countries.[6] Although the death rate for cervical cancer has declined during the past 30 years, there were 3433 deaths among white women and 1068 deaths among African American women in the United States in 1992.[7]

Occupation is a major predictor of SES and can serve as a focal point to target groups of individuals for workplace health promotion activities.[8–10] Occupation is closely linked with attitudes toward screening and health behaviors and with expectations about health outcomes, as well as with both barriers and opportunities to carry out screening and treatment regimens (e.g., lack of health insurance, availability of worksite screening). Few published studies have examined cervical cancer with respect to a woman's occupation.

A recent case-control study of the incidence of invasive cervical cancer and carcinoma in situ[11] found that, overall, working women had odds ratios (ORs) for invasive cervical cancer that were similar to those of homemakers ($OR \approx 1.0$), with several groups of service workers (particularly maids, cleaners, and cooks) and industrial workers (metal workers and machine operators) showing elevated risks ($OR > 2.0$). Risk of carcinoma in situ was slightly increased for working women, but no occupational groups had notable associations.

In another study,[12] industry-specific proportional cancer incidence ratios (PCIRs) were calculated from the New Jersey population-based cancer incidence registry containing information on occupation and industry for 4248 white women and 592 African American women, aged 20–79, diagnosed with cancer. A statistically significant excess ($PCIR > 135$; $p < 0.05$) of cancer of the cervix ($n = 182$) was found among women employed in manufacturing of apparel, stone, clay, glass, electrical equipment, lumber and wood products, and transportation equipment, particularly motor vehicle production.

Standardized incidence ratios (SIR), based on the nationwide population-based Finnish Cancer Registry for the period 1971–1985,[13] showed that the highest occupation-specific SIRs were observed among women working in hotels and restaurants, road transport, and woodworking ($SIR > 2$). SIRs were low ($SIR < 1.0$) among agricultural workers, livestock workers, nurses, and teachers. Waitresses in the Restaurant Workers' Union in Norway were found to have a high cervical cancer risk ($SIR = 1.6$), particularly those working in restaurants with a license to serve alcohol ($SIR = 1.8$).[14]

The present study examines the association of cervical cancer mortality and occupation in a large national database. The purpose of the study is to compare our data with findings from previous studies and to recommend which occupations may need to have better health promotion activities.

STUDY POPULATION AND METHODS

Mortality data from the National Occupational Mortality Surveillance System (NOMS)—a collaborative effort with the National Institute for Occupational Safety and Health (NIOSH), the National Center for Health Statistics (NCHS), and the National Cancer Institute (NCI)—were used for this study. This database represents about 5 million death certificates coded for usual occupation of the decedent, according to the 1980 Bureau of the Census classification system.[15] The Ninth Revision, *International Classification of Diseases* (ICD)[16] was used to code underlying cause of death. The current study is based on standardized death certificate data for almost 2 million deaths among women in 27 states, covering the period 1985–1990. Data on Hispanic women were coded inconsistently and were not available for states where the majority of the U.S. Hispanic population resides (e.g., Texas and California). Therefore, we did not look at this group separately. Death from cervical cancer was defined from data showing underlying cause of death as ICD number 180.

Age-standardized, race-specific proportional cancer mortality ratios (PCMRs) were calculated as the proportion of deaths from cervical cancer among all cancer deaths in an occupa-

tion divided by the proportion of deaths from cervical cancer among all cancer deaths in the study population using a computer program developed at NIOSH.[17] A PCMR above 100 indicates that cervical cancer occurs with greater proportional frequency among women in the occupational group under consideration than it occurs among all women.

PCMRs and test-based 95% confidence intervals (CIs) were calculated for broad occupational categories (e.g., executive, administrative, managerial, and professional specialty) and for specific occupations. If the observed number of deaths from cervical cancer within a specific occupational group was ≤1000, the statistical test for significance used in the calculation of test-based CI was the ratio of an observed value of a Poisson variable to its expectation.[18] If the observed number of deaths from cervical cancer within a specific occupational group was >1000, the Mantel-Haenszel Chi-square test was used in calculation of the CI.[19]

Because of the large number of proportions calculated, only those occupations with at least five deaths and a CI excluding 100 for one of the age/race categories are reported. PCMRs were calculated separately for women < age 65 and those aged ≥65 for purposes of identifying women who would most likely be in the workforce.

RESULTS

For the period 1985–1990, there were 198,870 deaths from all causes among African American women and 1,658,060 deaths among white women. Of these, 1715 deaths (0.86%) among African American women and 6788 deaths (0.41%) among white women were caused by cervical cancer.

Table 1 shows PCMRs for cervical cancer by race that were associated with broad occupational categories for women who died at <65 years of age and for women at ≥age 65. For African American women < age 65, PCMRs are highest for those in farming, forestry, and fishing (PCMR = 178; 95% CI 109-276), followed by homemakers (PCMR = 121; 95% CI 108-135) and service occupations (PCMR = 117; 95% CI 105-131). For African American women ≥65, the pattern is similar, except for women in service occupations. Among white women < age 65, those in occupations broadly classified under service (PCMR = 143; 95% CI 131-155) and operators, fabricators, and laborers (PCMR = 140; 95% CI 128-154) have the highest PCMR. Homemakers also have an elevated PCMR (PCMR = 115; 95% CI 111-119). Among white women ≥65, the pattern is the same, with the addition of an elevated PCMR based on only 12 deaths for farming, forestry, and fishing (PCMR = 140; 95% CI 72-244). PCMRs for

TABLE 1. PROPORTIONATE CANCER MORTALITY RATIOS (PCMRs) AND 95% CONFIDENCE INTERVALS (CIs) FOR CERVICAL CANCER BY RACE AND AGE GROUP, ASSOCIATED WITH BROAD OCCUPATIONAL GROUPS (NOMS 1985–1990)

	African American women						*White women*					
	<Age 65			*≥Age 65*			*<Age 65*			*≥Age 65*		
Occupation	*Deaths*	*PCMR*	*95% CI*	*Deaths*	*PCMR*	*95% CI*	*Deaths*	*PCMR*	*95% CI*	*Deaths*	*PCMR*	*95% CI*
Executive, administrative, and managerial	28	83	55–119	1	11	0–60	208	77	67–88	98	82	66–99
Professional specialty	58	60	46–78	32	65	45–92	204	50	44–58	153	62	52–72
Technical, sales, and administrative support	108	65	53–79	21	63	39–96	699	74	69–80	394	80	72–88
Service occupations	310	117	105–131	235	102	89–116	525	143	131–155	339	150	135–167
Farming, forestry, and fishing	20	178	109–276	36	238	167–330	11	104	52–185	12	140	72–244
Precision production, craft, and repair	23	112	71–168	5	56	18–130	72	108	84–136	50	108	80–143
Operators, fabricators, and laborers	140	97	81–114	36	66	46–92	482	140	128–154	289	119	105–133
Homemakers	329	121	108–135	318	112	100–125	1648	115	111–119	1570	104	100–107

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African American and white professional and executive women in both age groups are consistently <100.

Table 2 shows the PCMRs for more specific occupations for both African American and white women.

Service occupations

PCMRs for African American women <65 years working in service occupations are elevated for waitresses (PCMR = 186; 95% CI 102-312) and private household workers (PCMR = 128; 95% CI 104-155). Among African American women who died at age ≥65 working in service occupations, only child care workers (excluding those in a private household) have an elevated PCMR with a CI excluding 100 (PCMR = 259; 95% CI 118-492). Among white women in both age groups (<65 and ≥65), PCMRs are elevated, with CI excluding 100 for waitresses (PCMR = 184 and 204), janitors and cleaners (PCMR = 187 and 191), private household workers (PCMR = 149 and 146), and cooks (PCMR = 157 and 166). White women < age 65 employed as nurses' aides, orderlies, and attendants (PCMR = 143) had elevated PCMRs with CI excluding 100. The magnitude of PCMRs for maids differed for younger compared with older white women (PCMR = 188 and 114).

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TABLE 2. PROPORTIONATE CANCER MORTALITY RATIOS (PCMRS) AND 95% CONFIDENCE INTERVALS (CIS) FOR CERVICAL CANCER BY RACE AND AGE GROUP, ASSOCIATED WITH SPECIFIC OCCUPATIONS (NOMS 1985–1990)

	African American women						*White women*					
	<Age 65			*≥Age 65*			*<Age 65*			*≥Age 65*		
Occupation	*Deaths*	*PCMR*	*95% CI*	*Deaths*	*PCMR*	*95% CI*	*Deaths*	*PCMR*	*95% CI*	*Deaths*	*PCMR*	*95% CI*
Service occupations												
Child care workers (excluding private household	7	89	36–184	9	259	118–492	10	82	40–152	3	61	13–179
Janitors and cleaners	18	100	59–158	9	75	34–142	29	187	126–269	19	191	115–298
Private household	103	128	104–155	143	103	87–122	66	149	116–190	72	146	115–184
Maids	31	118	80–167	12	77	40–134	34	188	130–262	13	114	61–195
Waitresses	14	186	102–312	1	61	2–341	115	184	152–221	53	204	153–267
Cooks	42	126	91–171	34	136	94–190	67	157	122–200	60	166	126–213
Nurses aids, orderlies, and attendants	53	108	81–141	13	83	44–142	94	143	116–175	38	132	93–181
Machine operators and assemblers												
Assemblers	11	94	47–169	0	—	—	63	174	133–222	20	99	61–154
Winding and twisting machine	3	72	15–211	0	—	—	23	173	110–260	31	157	107–223
Textile sewing machine	20	88	54–136	5	78	25–182	57	110	84–143	64	132	102–169
Pressing machine	12	122	63–213	3	39	8–113	7	165	66–339	12	340	176–595
Machine operators assorted materials	18	72	43–115	9	122	56–231	86	145	116–179	41	118	84–160
Other occupations												
Farm operators and managers	8	195	84–384	26	271	177–396	3	61	13–179	9	132	60–250
Farm laborers	12	191	99–334	10	195	94–359	5	212	69–495	3	349	72–1019
Motor vehicle operators	4	72	20–184	0	—	—	26	153	100–224	2	81	10–293
Laborers (excluding construction)	38	127	90–174	0	—	—	85	141	113–175	32	89	61–126

Machine operators and assemblers

Also shown in Table 2 are PCMRs and CIs for machine operators and assemblers. PCMRs among African American machine operators and assemblers are elevated for only pressing machine operators < age 65 (PCMR = 122; 95% CI 63-213) and machine operators, assorted materials, ≥ age 65 (PCMR = 122; 95% CI 56-231). Among white women machine operators and assemblers, PCMRs are significantly elevated for those < age 65 for assemblers (PCMR = 174; 95% CI 133-222), winding and twisting machine operators (PCMR = 173; 95% CI 110-260), and machine operators, assorted materials (PCMR = 145; 95% CI 116-179). White women ≥ age 65 have elevated PCMRs for similar occupations. However, the magnitude was almost double for pressing machine operators (PCMR = 340; 95% CI 176-595), and CI included 100 for machine operators working with assorted materials. In addition, textile sewing machine operators had an elevated PCMR (PCMR = 132; 95% CI 102-169).

Other occupations

PCMRs for other occupations shown in Table 2 reveal that African American farm operators and managers had elevated risks for both age groups (PCMR = 195 and 271). Confidence intervals excluded 100 only for African American women ≥ age 65. PCMRs for farm laborers were high for all groups, although CIs include 100 and are very wide. PCMRs are elevated for white women < age 65 for motor vehicle operators (PCMR = 153; 95% CI 100-224) and laborers (PCMR = 141; 95% CI 113-175). For white women ≥ age 65, the PCMR for farm operators and managers is elevated (PCMR = 132; 95% CI 60-250). PCMRs are not elevated for older motor vehicle operators and laborers.

DISCUSSION

Our results for several occupations are consistent with those of previous studies, with service and manufacturing workers showing elevated risks,[11] and elevated risks shown among occupations in the apparel manufacturing industry.[12] Results are also consistent with elevated SIRs found for Finnish and Norse waitresses.[13] SIRs for cervical cancer were low among Finnish agricultural workers and were high for woodworkers, plywood makers, dressmakers, and spinners.[14] Results of the current study showed elevated PCMRs for several occupations in the textile and apparel industry, including textile sewing machine operators, winding and twisting machine operators, and pressing machine operators. In 1990, among the civilian labor force, there were 696,541 white women and 221,436 African American women who worked as textile, apparel, and furnishing machine operators.[20]

Excess deaths ascribed to cervical cancer among women in certain occupations seen in comparison with all occupations undoubtedly reflect socioeconomic differences among women workers. All of the 16 occupations identified with excess deaths from cervical cancer are classified as blue collar or service occupations. Service workers in such jobs as food handling and preparation, health/dental aides and assistants, and personal, cleaning, and building services account for >47% of all jobs held by women.[21] In addition, these excess deaths are unlikely to reflect specific occupational exposures, for which there is little evidence in the literature. Low SES has been associated with an array of sexual, behavioral, and dietary practices that may be risk factors for cancer of the cervix.[22] Because cervical cancer is preventable, screening behaviors, follow-up to treatment, and access to care are important issues that will need to be addressed in designing worksite interventions.

Predictors of screening behaviors

Many factors affect women's cancer screening rates, including sociodemographic characteristics, knowledge, attitudes, and beliefs about disease, screening and efficacy of treatment, and patient compliance with recommendations. However, Lurie et al.[23] found that the most common reason for not being screened was that it was not offered or recommended by the physicians. Several studies[24,25] have found that cervical cancer incidence was higher at lower educational levels and lower family income levels. A positive association between

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having had a Pap smear and having a health care plan has been demonstrated.[25,26]

In an analysis of national survey data (from the 1987 National Health Interview Survey Cancer Control Supplement), demographic characteristics that predicted not having a Pap smear in the last year were being widowed, divorced, or never married, ≥40, income less than poverty level, not being in the labor force, and education ≤12 years.[25] Predictors of never having had a Pap smear were never having been married, race other than white or African American, Hispanic ethnicity, age ≥65, education of <12 years, and income below poverty level. Results from a random survey of women aged 25–74 years (n = 2726) in six communities showed that ever having had a Pap smear was associated with having visited a physician within the past year, education, and marital status.[27] Intention to participate in screening and Medicaid insurance coverage were predictors of participation in screening in a primary care setting among elderly African American women of low SES.[28]

Worksite health promotion

Recommendations from the National Institutes of Health for increasing cervical cancer screening include increased efforts to identify high-risk populations along with better methods of communicating risk information.[29] Worksites provide health care access to ≥57% of women of varying age and health status.[30] Interventions at the worksite have the potential to reach significant subpopulations at high risk for specific types of cancer.[31] However, results from the National Survey of Worksite Health Promotion Activities showed that among worksites with ≥50 employees that offered cancer-related activities in 1985, only 4.5% of the activities were for cancer screening.[32] In Great Britain, a cervical cytology screening facility timed and located for the convenience of working women was found to be feasible and attracted a group of women who were found to have a high abnormal Pap smear rate.[33] We recognize that women in lower SES occupations are less likely to have access to health promotion programs. Resources should be directed to these women. Even with effective health promotion programs in the workplace, only a small fraction of the women targeted would be homemakers or those in small businesses.

Limitations

This analysis is potentially subject to several epidemiologic biases. The lower relative mortality in occupational groups when compared with standard reference populations, often named the *healthy worker effect*, may increase the chance for bias in a PMR study.[34] Proportionate mortality studies can be used with greater confidence when observed and expected distributions of specific diseases are compared within a disease category for which the healthy worker effect is weak or nonexistent.[35] Cancer mortality is generally less affected by the healthy worker effect than is mortality from heart disease.[36] Still, the use of PCMRs may underestimate (or overestimate) the true cancer-specific risk among women in an occupational group if the overall cancer mortality rate for that group is high (or low) in relation to the comparison occupations. However, a proportional approach to statistical analyses is useful when there is no estimate of the population at risk.[35]

There are also limitations inherent in the use of death certificate data. Recorded information on the death certificate may be inaccurate. Studies have found differences in usual occupation recorded on the death certificate and work histories supplied by cancer patients or close relatives[37] or work history records.[38] There is also evidence that classification of causes of death on death certificates may be incorrect. Studies evaluating the quality of cause of death information by comparing the underlying cause with autopsy reports and hospital records have found agreement for neoplasms to be approximately 85%–95%.[39–41] Percy et al.[40] found that more cases of cervical cancer were diagnosed in the hospital than were actually reported on death certificates.

Death certificates do not contain data on tobacco use or other confounders. Rates of tobacco use vary among different occupational groups and may contribute to elevated cervical cancer risk in these groups. Several epidemiologic studies have provided evidence

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supporting an association between cigarette smoking and cervical cancer, although many of these failed to control for HPV status.[42] Although further studies designed to assess the interaction of cigarette smoking, HPV, and other risk factors for cervical cancer are needed, smoking cessation programs in the workplace may provide primary prevention in reducing the risk of cervical cancer and other diseases.

The inability to analyze the data by ethnicity is another limitation. In Texas, Hispanic women have been shown to have cervical cancer incidence and mortality rates about two times higher than those for non-Hispanic whites.[43] Lack of access to health care, lack of health insurance, delay in early diagnosis, or other environmental and cultural factors may partially contribute to these ethnic differences. In addition, because of socioeconomic and cultural differences, Hispanics may encounter more barriers to use of health services.[44] Hispanics are less likely to obtain recommended cancer-screening services even when financial barriers are taken into account,[45] have less knowledge about cancer preventive practices,[46] and have greater misconceptions about the causes of cancer and effectiveness of preventive measures.[47] The lack of knowledge about cervical cancer screening examinations was found to be particularly pronounced among Mexican American women aged ≥65.[48] In addition, select attitudes about cancer among Hispanic women, such as beliefs regarding fatalism, need to be addressed in cancer control interventions at all levels.[47,48]

A large group (45%) of women were classified as homemakers. Although some homemakers may be classified with a lower SES than employed women because of their lack of earnings, there was no way to assess this factor in our study. Death certificates contain no information on the occupation of the husband, on family income, or until recently, on education.

The analyses conducted permit us to report associations that may stimulate further investigation. Despite the limitations of death certificates and proportional analyses, this study found occupational associations with cervical cancer that were in agreement with previous studies. The large number of deaths available in the NOMS database permitted an assessment of risk for even small occupational groups for both white and African American women. Our results, taken together with information on health behaviors, access to health care, and health insurance availability among women in high-risk occupational groups, can assist in pointing the way to effective health promotion activities for these groups. However, mortality differences in occupational groups may be related not only to Pap screening differences among these groups but also to differences in the availability of resources for treatment of invasive cervical cancer if diagnosed.

Future prevention strategies should include culturally sensitive education for women about screening, along with the primary risk factors for cervical cancer. Also important is the consistent use of barrier methods of contraception, which has been shown to lower the risk of cervical cancer, presumably because of the reduced opportunity for exposure to infectious agents.[5]

CONCLUSION

Data presented in this study suggest a difference in cervical cancer mortality by occupational group, regardless of whether this is the result of health behaviors, health insurance availability, or access to care. Identification of these occupations suggest women who could be targeted for preventive services. In the present study, service workers, textile, apparel, and machine operators, and assemblers were found to be at high risk of cervical cancer mortality. These are important occupations to which prevention efforts should be targeted. Many of these workers can be accessed through their trade unions or agreements with employers. There are unions for both service and apparel workers that could become involved in preventive and educational efforts. Interventions at the worksite can provide the means to reach significant subpopulations at high risk for cervical cancer mortality.[31]

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