Mortality Patterns of US Female Construction Workers by Race, 1979–1990

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In 1990, the US construction industry employed 7.6 million workers, of whom 8% were women. Only one epidemiologic study for women employed in the construction industry was previously published. We analyzed usual occupation and industry codes on death certificates from 28 states between 1979 and 1990 to evaluate mortality patterns among both black and white female construction industry workers. Proportionate mortality for cancer and several other chronic diseases was significantly elevated among 2,273 white female and 197 black female construction workers. White women younger than age 65 at death had significantly elevated proportionate mortality ratios (PMRs) for all cancer, lung cancer, and traumatic fatalities. Black women younger than age 65 at death had a significantly elevated PMR for traumatic fatalities. Elevated mortality for specific cancer sites and other diseases was observed for white and black women employed in construction trades. These results suggest that more detailed investigations that include women and other minorities should be undertaken.

There are 7.6 million construction workers in the United States who are employed by 550,000 construction and demolition companies.[1] This workforce includes a growing percentage of female workers, workers from ethnic minorities, and immigrants. In 1990, about 8% of all construction industry workers were women.

Most of the companies are small businesses, 96% of them employing fewer than 50 workers. Few have safety and health programs.[1] These factors have made it difficult to conduct epidemiologic and surveillance studies of construction workers for occupational health problems.

Available evidence from the states of Washington and California and from England and Wales has suggested that male construction industry workers are experiencing elevated mortality for cancer, lung disease, mental conditions, homicide, and fatal injuries.[2–4] Only one published study[3] has reported mortality patterns for female construction industry workers. No studies have been reported that evaluated risks for women who were usually employed in the construction trades occupations.

This article reports results of a mortality study of female construction workers. The women were identified using occupation-coded death certificate data from the National Occupational Mortality Surveillance (NOMS) data system maintained by the National Institute for Occupational Safety and Health (NIOSH) and described elsewhere in this volume.[5] Our objectives were to identify causes of death associated with potential excess mortality for women in construction trades and to estimate the magnitude of any excess mortality.

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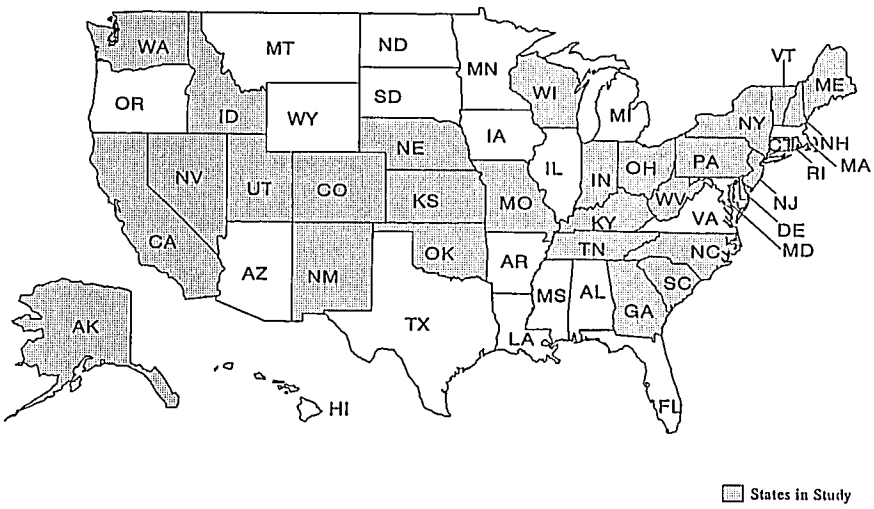


Fig. 1. States included in study, 1979–1990.

Methods

The source of data for age, sex, race, cause of death, and occupation was death certificates for deaths occurring at age 20 years or over from the 28 US states shown in Fig. 1. These data were obtained from individual state vital statistics departments, which, together with the National Center for Health Statistics, the National Cancer Institute, and NIOSH, have shared the added costs of coding occupation and industry.

From a total of 4.9 million death certificates between 1979 and 1990, we selected those of 2,273 white women and 197 black women who were usually employed in the construction industry and died at age 16–64 from total deaths of 5,504 white women and 304 black women (Fig. 2). The construction industry employs workers in demolition; hazardous waste; renovation; highway, residential, industrial, and commercial construction; and office/management, in addition to the construction special trades. We reported the highest proportionate mortality ratios (PMRs) with number of observed deaths of at least 2.

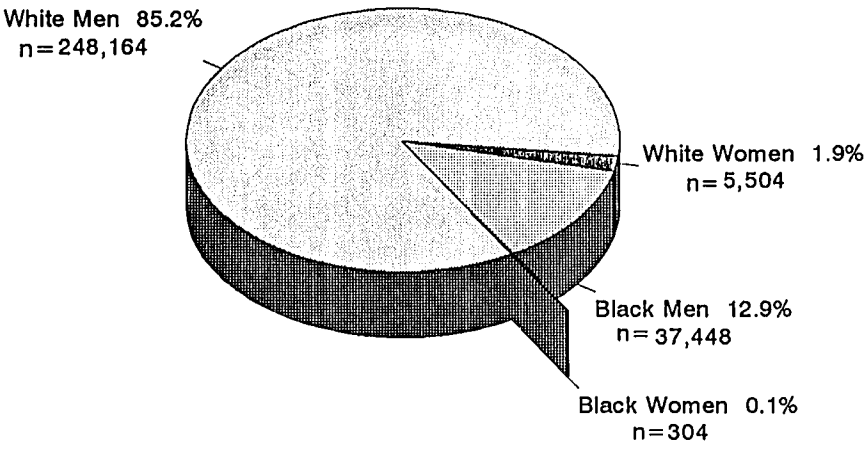
Results for specific occupations are based on 1,247 white women and 245 black women who were reported to have a construction trade as their lifetime usual occupation (reported as usual or longest-held occupation on the death certificate) (Fig. 3). Because of the small numbers of women employed in the construction trades, we included all deaths in the analyses.

Because data were not available for the population of construction workers at risk, PMR analysis based on the underlying cause of death was used to evaluate the mortality patterns of female construction workers. In order to manage the large number of comparisons, our report focuses on results for the highest PMRs and causes of death for which women differed from men and/or that represented risks not previously identified for construction trades workers. Underlying causes of death were coded by state nosologists according to the International Classification of Diseases, 9th Revision.[6]

The PMR is defined as 100 times the number of observed deaths, divided by the number to be expected if deceased women in all occupations in our study population experienced the same age-specific mortality. Housewives were included. A NIOSH computer program designed to calculate age-adjusted PMRs for occupations or industries for population-based data was used.[7] PMRs were computed after stratification by age (15–64, 65+), race (black, white), and gender. Statistical significance ($P < 0.05$ for a two-sided test) and 95% two-sided confidence intervals (CIs) were determined; however, the P values should be evaluated in the context of hypothesis generation because multiple comparisons were made.[8]

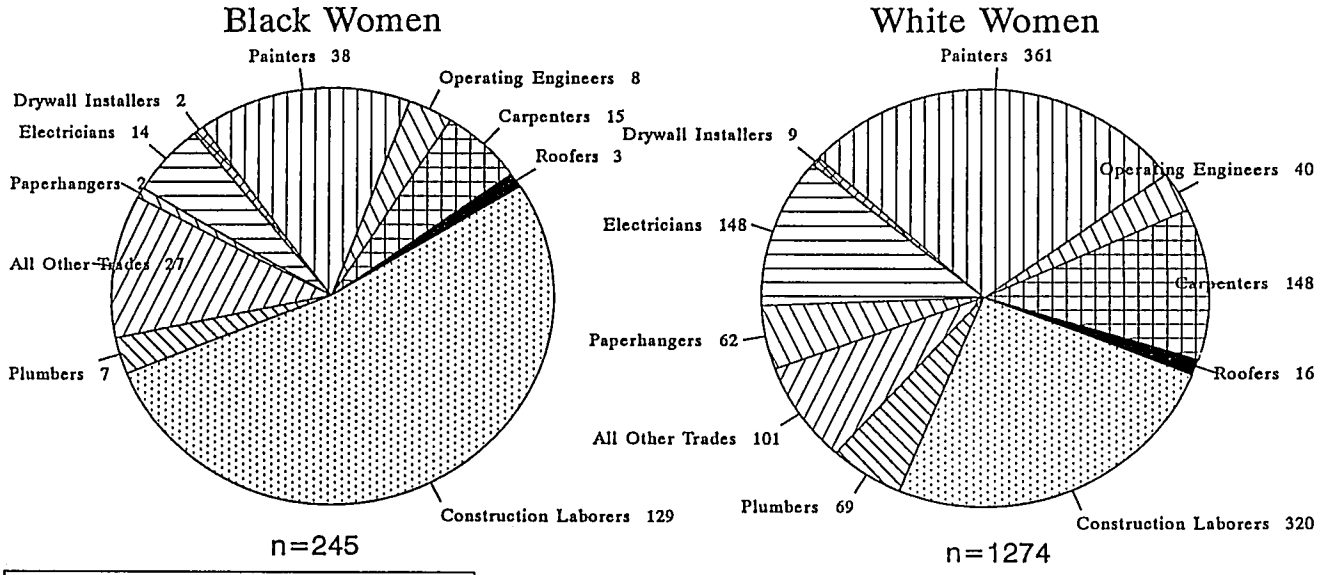
Results

Table 1 summarizes the elevated mortality of white and black women who died before age 65 and were construction industry workers. Among white women, PMRs were elevated, with 95% CIs excluding 100 for all cancer (PMR = 107), lung cancer (PMR = 118), and traumatic fatalities (PMR = 138). PMRs were elevated



% DISTRIBUTION, U.S. 1980 EMPLOYED POPULATION							
All Industries				Construction Industry			
White Men	52	White Women	38	White Men	84.6	White Women	8.0
Black Men	5	Black Women	5	Black Men	7.0	Black Women	0.4

Fig. 2. Construction industry deaths by race and sex.



US 1980 Employed Population (%)

Construction Trades:	Black Women	White Women
Carpenters	16	18
Electricians	13	12
Painters	16	22
Plumbers	6	7
Laborers	30	19
Other Trades	19	21

Fig. 3. Distribution of female construction deaths by occupation and race, 1979–1990.

with borderline statistical significance for colon cancer (PMR = 123), bone/skin/connective tissue/breast cancer (PMR = 109), and suicide (PMR = 121). For black women, the PMR for traumatic fatalities (PMR = 138) was elevated, with 95% CIs exceeding 100. An elevated PMR for lung cancer was of borderline significance (PMR = 178).

Table 2 shows excess mortality for white and black women employed in specific construction trades. Among white women, statistically significant PMRs were observed for lymphatic cancer among drywall installers (PMR = 860), for non-Hodgkin's lymphoma among paperhangers (PMR = 600), for diseases of the musculoskeletal system and connective tissue among plumbers (PMR = 854), and for nonmalignant lung disease among roofers (PMR = 475). Among black women, the PMR for lymphatic cancer was significantly elevated among carpenters (PMR = 828), with two observed deaths. The PMR for nonmalignant lung disease among construction laborers was significantly raised (PMR = 373), as was their PMR for unintentional poisonings (PMR = 375).

Discussion

The one previous report[3] that described the mortality experience of California construction industry workers stated that female mortality was generally not elevated for the years 1979–1981, although this conclusion was based on small numbers of deaths. Our current study found that the mortality experience during 1979–1990 of female construction industry workers was elevated for lung cancer, mental disorders, and fatalities, which is similar to the experience reported in our previous study for male construction industry workers.[9] However, mortality due to ischemic heart disease, previously reported to be low, was elevated slightly among black women in our study (Table 1). Black women generally experience higher heart disease mortality rates than whites.[10] However, using a comparison group of black women should have controlled for this, but not for socioeconomic status and lifestyle factors that are major risk factors for heart disease mortality for women and men.[11]

In our study, women who were employed in construction occupations experienced increased mortality similar to that reported previously[2–4] for men for some causes of death (lung cancer in carpenters, lung cancer in painters, nonmalignant respiratory disease in roofers, acute myocardial infarction in operating engineers, and lung cancer and fatality due to poisoning in laborers) (Table 2).

New findings we observed were excesses for suicide in white construction industry women who died before age 65, heart disease and lymphatic cancer in drywall installers, ovarian cancer in electricians, non-Hodgkin's lymphoma in paperhangers, and musculoskeletal disease in plumbers and laborers (Table 2).

Even given the "healthy worker" effect, usually observed as a decreased death rate for cardiovascular disease that is experienced by workers relative to the general population,[12] we observed greater heart disease mortality for drywall installers (Table 2). Additionally, black women construction workers who died before age 65 experienced excess mortality for ischemic heart disease; and operating engineers experienced excess mortal-

TABLE 1
Elevated Mortality Among White and Black Women (Ages 20–64) Usually Employed in Construction Industry in 28 US States, 1979–1990

Cause of Death*	Under Age 65		
	Proportionate Mortality Ratio	Number Observed	95% Confidence Interval
White women			
All deaths	100	2,273	—
All cancer (140–208)	107†	960	(101–114)
Colon cancer (153)	123	78	(97–153)
Lung cancer (162)	118†	216	(102–134)
Bone, connective tissue, skin, or breast cancer (170–175)	109	291	(97–122)
Ischemic heart disease (411–414)	92	89	(74–113)
Traumatic injuries (800–999)	138†	482	(126–151)
Suicide (950–959)	121	107	(99–146)
Black women			
All deaths	100	197	—
All cancer (140–208)	112	52	(84–147)
Stomach cancer (151)	165	2	(20–597)
Lung cancer (162)	178	13	(95–305)
Leukemia (204–208)	195	3	(40–569)
Mental disorders (290–319)	187	7	(75–385)
Ischemic heart disease (411–414)	128	9	(58–243)
Pneumoconioses and other lung diseases (470–478, 494–519)	95	3	(20–277)
Chronic liver disease and cirrhosis (571)	74	5	(24–172)
Traumatic injuries (800–999)	138†	45	(101–185)

* Numbers in parentheses represent codes according to the International Classification of Diseases, 9th Revision.
† $P < 0.05$.
‡ $P < 0.01$.

ity for acute myocardial infarction (Table 2). Excess heart disease mortality has been previously reported for male operating engineers.[3] Drywall installers may be exposed to solvents and other toxins that may contribute to cardiovascular mortality. In case reports, some solvents have been associated with sudden cardiac deaths and arrhythmias.[10]

We observed elevated PMRs for non-Hodgkin's lymphoma and lymphatic cancer among paperhangers and for lymphatic cancer among drywall installers. Both of these trades have potential exposures to known or suspected carcinogens (eg, wood dust, asbestos, silica) and to toxins that may be present in glues, adhesives, and preservatives in joint compound.

We observed excess mortality for asbestos-related disease among female construction industry workers. PMRs were elevated for lung cancer among black and white women employed as construction workers who died before age 65 (Table 1) and among white women employed as carpenters and painters. Although not reported in the tables, three deaths diagnosed as mesothelioma occurred among white female construction workers (PMR = 215, 95% CI = 44–627). Additionally, nonmalignant lung disease was seen among white women employed as roofers and black women employed as construction laborers (Table 2). Construction workers are exposed to pulmonary hazards such as asbestos, mineral wool, and other fibers.[13–15] Roofers have been reported to have potential exposures to pulmonary hazards such as asbestos and hydrocarbons in roofing tar.[16] Carpenters are exposed to occupational lung carcinogens, such as asbestos, and have been previously found to experience elevated lung cancer and mesothelioma mortality.[17] Lymphatic cancer has occurred among male carpenters[17,18] and was observed to disproportionately occur among black female carpenters in our study.

The dangers of construction sites are well known for catastrophic outcomes. In our study, both black and white women who died before age 65 experienced elevated risk for traumatic fatalities. High fatality rates among men and women on construction sites has been previously documented, but not by occupation and gender.[19,20]

PMRs are useful tools for surveillance and research because they estimate mortality rates when population data are not available.[12] However, since they are based on the statistical analysis of death certificates and may yield false positives, PMRs have known limitations. PMRs are best interpreted in conjunction with results from other studies. Other advantages include their low cost when conducting surveillance studies. In addition, PMRs permit evaluation of risks for minorities and difficult-to-study working groups (such as blue-collar women), allow evaluation of mortality due to extremely rare diseases having a high fatality rate (eg, mesothelioma), and facilitate the identification of occupational groups with excess risks for whom the quantification of the magnitude of any excess can be estimated.

The limitations of death certificate-based PMR studies include ascertainment problems, such as inaccuracy of cause of death, and imprecise exposure classification based on usual occupation. The latter is also true, in another sense, for women because of the large percentage who indicate homemaker or housewife as an occupation, for which the hazards are undocumented. Another limitation to the interpretation of death certificate-based studies is lack of data on socioeconomic status and lifestyle factors. In this study, the outcomes potentially affected include lung cancer, nonmalignant respiratory disease, and heart disease. Nonetheless, since death certificates lack direct information about

TABLE 2
Elevated Mortality Among White and Black Women Usually Employed in Construction Trades, 1979–1990

Occupation and Cause of Death [Census Code]	Number of Deaths	Proportionate Mortality Ratio	95% Confidence Interval
White women			
Carpenters [554, 567, 569]			
Lung cancer (162)*	12	179	(93–313)
Dry wall installers [573]			
Heart disease (420–429)*	3	448	(93–1,310)
Lymphatic and hematopoetic cancer (200–208)*	2	860†	(104–3,107)
Electricians [555, 575–576]			
Ovarian cancer (183)*	6	245	(90–533)
Painters [556, 579]			
Lung cancer (162)*	25	145	(94–215)
Paperhangers [583]			
Non-Hodgkin's lymphoma (200, 202)*	3	600†	(124–1,753)
Plumbers [557, 585, 587]			
Musculoskeletal diseases (710–739)*	3	854†	(176–2,495)
Roofers [595]			
All nonmalignant lung disease (460–519)*	5	475†	(154–1,108)
Operating engineers [844]			
Acute myocardial infarction (410)*	7	175	(70–360)
Construction laborers [869]			
Rheumatoid arthritis (714)*	3	806†	(166–2,355)
Black women			
Carpenters [554, 567, 569]			
Lymphatic cancer (202, 203)*	2	828†	(100–2,990)
Construction laborers [869]			
Nonmalignant lung disease (510–519)*	4	373†	(102–955)
Unintentional poisonings (850–869, 9292)*	4	375†	(102–960)

* Codes from the International Classification of Diseases, 9th Revision.
† $P < 0.05$.
‡ $P < 0.01$.

medical diagnosis, risk factors, or measured exposures, interpretation of PMRs often involves specification of areas or occupations in which detailed studies would be most productive.

This report presents the mortality patterns of female US construction workers who died during the last decade. Many of the PMRs are based on small numbers of observed deaths, because of the small proportion of working women whose usual occupation was in the construction trades. Because only one previous report exists,[3] the consistency of our findings with other studies cannot be evaluated. Sustained mortality surveillance over long periods of time will probably be the most effective means of identifying construction industry hazards among women, in comparison with inevitable fluctuations in rates due to chance or bias.

As part of the NIOSH Construction Initiative, the Division of Surveillance, Hazard Evaluations, and Field Studies has begun to conduct surveillance studies using union death benefit records that include women and other minority workers. Studies of the Laborers, the Carpenters, the Electrical Workers, and the Iron Workers National Unions were begun in 1991; the Sheet Metal Workers, Bricklayers, and Painters Unions in 1992; and the Roofers and Operating Engineers Unions in 1993.

Conclusions

We observed women's mortality to be generally similar to that of men in the construction industry for lung cancer, mental disorders, and fatalities. Some new findings based on small numbers of women with usual occupations in the construction trades were observed: suicide among women who worked in the construction industry who died before age 65; heart disease and lymphatic cancer in drywall installers; ovarian cancer in female electricians; non-Hodgkin's lymphoma in paperhangers; and musculoskeletal disease in plumbers and laborers. These results should encourage further investigations of hazards among women and other minority construction industry workers.

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