

Occupation and Lung Cancer Mortality Among Women: Using Occupation to Target Smoking Cessation Programs for Women

Carol Hogfoss Rubin, DVM, MPH

Carol A. Burnett, MS

William E. Halperin, MD, MPH

Paul J. Seligman, MD, MPH

Lung cancer mortality rates are increasing for women, despite the fact that 90% of these deaths could be prevented by smoking cessation. Targeted workplace smoking cessation programs may increase the effectiveness of lung cancer prevention for women. This study uses proportionate mortality ratio analysis of occupationally coded death certificates, from 28 states between 1979 and 1990, to identify occupations in which women are at high risk of lung cancer mortality. The study found gender and racial variation in the results for broad occupational groups. Blue-collar occupations associated with potentially carcinogenic workplace exposures also had elevated proportionate mortality ratios, probably reflecting both occupational and tobacco exposure. For women, specific occupations such as managers and financial officers revealed significant elevations in lung cancer mortality. Cessation programs targeting women in these occupational groups may increase the effectiveness of lung cancer prevention.

Lung cancer is the leading cause of cancer deaths in women. Tobacco alone is responsible for more than 90% of all lung cancer.¹ Although a preventable disease, the rate of lung cancer mortality for females continues to rise. Since 1976, the rate of smoking initiation for women has surpassed the rate for men,² whereas the success of antismoking efforts, as measured by "quit ratios," is consistently lower for women.³ There seems to be an opportunity for improved lung cancer prevention programs for women.

Identification of occupations with increased risk of lung cancer is one method of targeting defined female subpopulations for more effective smoking prevention and cessation programs. Although the workplace itself may contain exposures associated with increased risk of lung cancer, the strong correlation between tobacco use and lung cancer means that occupational profiles of lung cancer death⁴⁻⁷ also may be interpreted as profiles of smoking patterns according to occupation.^{8,9} Moreover, a prevention message based on mortality data, rather than smoking incidence, may carry a more powerful smoking cessation message. The purpose of this study is to identify the occupations in which women are at high risk of lung cancer mortality.

Materials and Methods

An occupationally coded mortality data base supported by the National Institute for Occupational Safety and Health, the National Cancer Institute,

From the National Center for Environmental Health, Centers for Disease Control and Prevention, Atlanta, Georgia (Dr Rubin); and the National Institute for Occupational Safety and Health, Cincinnati, Ohio (Ms Burnett, Dr Halperin, Dr Seligman).

Address correspondence to: Carol Rubin, DVM, MPH, Centers for Disease Control and Prevention, Mailstop F-46, 4770 Buford Highway NE, Atlanta, GA 30341-3724.

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and the National Center for Health Statistics was used in this analysis. Deaths attributed to malignancies of the trachea, bronchus, and lung (*International Classification of Diseases, Ninth Revision*) were selected from almost 5 million death certificates, contributed by 28 states and spanning the years 1979 through 1990 (Table 1). Using previously described methods, age-adjusted, race-specific, and gender-specific proportionate mortality ratios (PMRs) and 95% confidence intervals were calculated for 11 broad occupational groups, including homemakers, and more than 400 specific occupations.¹⁰ The observed proportion of lung cancer deaths within a selected occupational group was compared with the expected proportion of lung cancer deaths across all occupations in the study population.

Results

Analysis identified lung cancer deaths in white women ($n = 92,964$), white men ($n = 194,420$), black women ($n = 8,315$), and black men ($n = 22,720$). As shown in Table 2, racial and gender variation occurs in results for broad occupational categories. The proportion of deaths attributed to lung cancer was in excess for blue-collar occupational groups, such as precision production workers and operators and laborers, and in deficit for farming occupations and homemakers across all gender and racial categories. In other white-collar occupational categories, however, the patterns differed between women and men. Female executives and managers, technicians, sales workers, and administrative support clerical workers had significant excesses of lung cancer deaths. In contrast, men in these occupational categories had a smaller proportion of lung cancer deaths than expected.

Overall, elevated PMRs for white men were restricted to service and labor categories; most occupations associated with higher levels of education had significantly decreased PMRs for men. Black men revealed significantly elevated proportions of lung cancer deaths in only the two broad occupational categories that recorded

TABLE 1

Years of Data and Numbers of Deaths According to State of Residence in the National Occupational Mortality Surveillance System, 1979 through 1990

State	Years	Number of Deaths
Alaska	1987-1988	3,527
California*	1979-1981	173,445
Colorado	1985-1990	139,113
Georgia	1984-1990	330,108
Idaho	1988-1990	21,025
Indiana	1986-1990	235,849
Kansas	1984-1990	146,771
Kentucky	1984-1990	233,103
Maine	1982-1983;* 1984-1990	96,117
Missouri	1984-1986	143,181
Nebraska	1984-1985	28,025
Nevada	1984-1990	51,653
New Hampshire	1984-1990	53,332
New Jersey	1988-1990	199,974
New Mexico	1986-1990	47,725
New York†	1980-1987	350,499
North Carolina	1984-1986;* 1990	368,839
Ohio	1985-1990	571,718
Oklahoma	1985-1990	167,255
Pennsylvania‡	1983-1987	590,277
Rhode Island	1979-1983;* 1984-1990	106,431
South Carolina	1984-1990	190,398
Tennessee	1985-1988	171,358
Utah	1984-1990	51,093
Vermont	1986-1990	22,263
Washington	1989-1990	69,516
West Virginia	1988-1990	54,626
Wisconsin	1984-1990	279,816
Total number of deaths		4,897,037

* Data provided directly to the National Institute for Occupational Safety and Health, restricted to ages 15 to 64.

† Data obtained by the National Institute for Occupational Safety and Health through state cooperative agreement, restricted to ages 15 to 74.

‡ Data obtained by the National Institute for Occupational Safety and Health through state cooperative agreement.

excess for both genders and all race groups (ie, precision production workers and operators and laborers). However, the pattern for women revealed excess proportions of lung cancer deaths in most of the broad occupational categories, the exceptions being farmers, homemakers, and, for white women, professionals. Black women in the broad category of professional occupations showed a nonsignificant excess, whereas white women exhibited a deficit in lung cancer mortality.

Table 3 shows all specific occupations for women with significantly elevated PMRs for at least one race and age group. Results are shown for only those groups with more than 10 deaths. Specific occupations with excess risk are seen within all the broad

categories. In the specific occupational groups showing the greatest excess lung cancer deaths, there is agreement in the direction of the PMRs for women older and younger than 65 years.

Because PMR analysis is proportional, a deficit in one category will result in an elevation in other categories. Because 45% of the females in this data base fall into the category of homemaker—a group with low smoking prevalence⁸ and less-than-expected lung cancer—we repeated our analysis, excluding homemakers, to assess the effect of our proportional method. Most of the categories that had shown excess lung cancer mortality in white women continued to be elevated, although the magnitude of

TABLE 2

Race-specific and Gender-specific Proportionate Mortality Ratios and Confidence Intervals* for Lung Cancer,† According to 11 Broad Occupational Categories

Occupational Category	White Women	White Men	Black Women	Black Men
Executive, managerial	134 (131, 137)	98 (97, 99)	142 (123, 164)	103 (94, 112)
Professional	92 (89, 94)	77 (75, 78)	104 (96, 114)	75 (69, 81)
Technician	108 (102, 113)	90 (86, 94)	127 (108, 149)	105 (87, 126)
Sales	118 (116, 121)	96 (95, 97)	123 (103, 145)	93 (83, 103)
Administrative support (clerical)	113 (111, 114)	97 (95, 99)	165 (151, 180)	98 (101, 96)
Service	112 (110, 114)	102 (100, 103)	102 (99, 105)	98 (95, 101)
Farming, forestry, fishing	94 (83, 107)	82 (80, 83)	55 (44, 67)	86 (82, 89)
Precision production	115 (110, 120)	112 (111, 113)	137 (116, 160)	112 (109, 115)
Operator, laborer	103 (101, 105)	107 (106, 108)	118 (111, 126)	105 (103, 106)
Armed forces	132 (98, 173)	110 (107, 114)	45 (1, 250)	101 (90, 113)
Homemaker	92 (91, 93)	55 (43, 69)	85 (82, 87)	88 (58, 128)

* 95% confidence intervals appear in parentheses.

† International Classification of Diseases, 9th Rev, code 162.

elevation was decreased. Categories that had shown deficits (eg, professionals and farmers) revealed even greater deficits. Only the category of technicians changed direction by decreasing to less than 100 (PMR, 98 (93, 103)). When homemakers were excluded from the analysis of black women, the categories of professional and service occupations revealed less-than-expected lung cancer (PMR, 94 (86, 103) and 93 (90, 95), respectively), whereas technicians and sales workers ceased to exhibit statistically significant excesses.

Discussion

This study demonstrates the importance of gender-specific analyses in occupational targeting of disease prevention. The distribution of lung cancer mortality by occupational group, as observed in this study, differs by gender and is similar to published distributions of smoking by occupation and gender. A personal interview study of almost 5000 white men and women found smoking patterns similar to the lung cancer mortality patterns. For men, a greater percentage of blue-collar (32%) than white-collar (23%) workers were current smokers, and a greater percentage of white-collar (36%) than blue-collar (25%) workers were former smokers.⁸ Just as with the mortality data, there was much less variation by white-collar or blue-collar status (or within the selection of more defined occupational

groups) among women, both in terms of current and past smoking habits. Similarly, tobacco use by occupation as reported by almost 50,000 respondents in the 1978 through 1989 Health Interview Survey found that although 39% of managers 20 to 44 years old (both men and women) were current smokers; this drops to 30% for men but remains essentially unchanged at 40% for women in the 45- to 64-year age group.⁹ This supports the theory that current smoking cessation efforts are more successful for men and also suggests that women have more smoking years, which could lead to higher lung cancer mortality for female managers.

Many of the occupational categories with highest PMRs also have recognized workplace exposures that increase lung cancer risk. For example, asbestos exposure in construction occupations,¹¹ vehicle exhaust exposure in transportation occupations,¹² and second-hand smoke exposure of food service workers¹³ may contribute to excess lung disease in exposed workers. However, reports of smoking by occupation also found smoking percentages among these blue-collar workers to be at or above the smoking percentages in the total employed population.^{8,9} Because the combined effect of tobacco and occupational exposure may intensify adverse health outcomes, cessation programs (as well as minimizing occupational exposure) may be of particular public health importance in such workplaces. The gen-

der-specific lung cancer analysis provides greater occupational specificity and, thus, the information to target smoking cessation programs to women in occupations where they experience excess risk of lung cancer.

Microtargeting of health promotion is similar, strategically, to the practices successfully used by tobacco merchandisers, who focus their advertising messages on specific subpopulations. Our study results show that occupationally coded lung cancer mortality data may be useful in microtargeting groups of working women who are in need of lung cancer prevention programs and are accessible for such intervention at their workplaces or through programs that target their occupations.

The utility of workplace health promotion has been demonstrated in general and across disparate racial, marital, and economic groups.¹⁴⁻¹⁷ Gender-specific workplace health promotion may enhance the effectiveness of health-promotion programs. The need for such gender targeting is illustrated by the finding that patterns of excess lung cancer mortality in women do not mirror those in men and that the rate of initiation of smoking is now higher for women than men. Since 1973, quit ratios were consistently lower among women;² the intensity of smoking advertisements directed toward females was escalated.¹⁸ Tobacco companies continue to sponsor female-oriented athletic events and to feature females in the

majority of campaigns that portray young-looking models.¹⁹ Microtargeting by occupation may provide one method of accessing the same women who are targeted by tobacco companies.

Limitations and Strengths

There are inherent limitations to death certificate data²⁰⁻²⁴ and PMR analysis.^{25,26} Such proportional methods can be misleading when a large

category, such as homemakers, exhibits low smoking prevalence and less-than-expected lung cancer. When we controlled for this in our analysis, we found a change in magnitude more so than in direction.

TABLE 3

Proportionate Mortality Ratios* and Confidence Intervals for All Occupations with Significantly Elevated Proportionate Mortality Ratios for Lung Cancer† in Women Stratified by Age

Occupation	Proportionate Mortality Ratio (95% Confidence Interval)			
	White Women		Black Women	
	Younger than 65	65 and Older	Younger than 65	65 and Older
Managers	127 (122, 132)	142 (137, 147)	135 (108, 166)	135 (100, 178)
Management related	126 (117, 136)	137 (126, 149)	170 (118, 236)	168 (77, 319)
Financial officers	127 (115, 140)	130 (116, 146)	165 (96, 264)	
Purchasing agents	128 (103, 159)	134 (111, 160)		
Registered nurses	86 (79, 92)	116 (110, 122)	118 (96, 143)	130 (101, 164)
Social workers	108 (90, 120)	111 (92, 134)	138 (96, 192)	199 (125, 302)
Lawyers/judges	105 (62, 166)	170 (110, 251)		
Writers	105 (82, 132)	152 (122, 186)		
Entertainers	93 (69, 123)	136 (108, 170)		
Painters/sculptors	97 (73, 125)	162 (127, 203)		
Photographers	154 (84, 258)	166 (103, 254)		
Public relations	108 (59, 181)	202 (118, 324)		
Health technicians	90 (81, 100)	109 (100, 120)	130 (105, 161)	116 (83, 157)
Engineering technicians	142 (115, 173)	130 (98, 169)		
Science technicians	160 (112, 223)	141 (94, 202)		
Sales supervisors	133 (123, 143)	122 (114, 131)	119 (68, 193)	
Sales representatives (finance)	143 (129, 158)	161 (143, 182)		
Sales workers (retail)	109 (104, 114)	111 (106, 115)	138 (108, 173)	128 (87, 180)
Administrative support (supervisory)	120 (102, 141)	140 (118, 164)	225 (138, 348)	184 (60, 429)
Computer operators	128 (106, 154)	140 (101, 189)	275 (168, 425)	
Secretaries	101 (98, 105)	121 (117, 126)	149 (119, 183)	173 (114, 252)
Information clerks	115 (101, 130)	120 (104, 138)	159 (94, 251)	310 (165, 531)
Records processing	113 (95, 132)	136 (114, 159)	136 (70, 237)	
Financial records processors	112 (105, 119)	122 (116, 129)	192 (126, 279)	
Distributing clerks	127 (112, 144)	124 (107, 143)	173 (116, 249)	
Adjusters/investigators	113 (93, 135)	135 (105, 170)		
Bank tellers	102 (84, 123)	128 (105, 156)		
Police	124 (86, 173)	150 (105, 207)		
Crossing guards	157 (112, 214)	98 (60, 152)	128 (47, 278)	68 (2, 379)
Food preparation, supervisors	140 (114, 171)	161 (132, 194)	97 (36, 211)	107 (29, 274)
Bartenders	163 (127, 206)	163 (109, 234)		
Waitresses	142 (133, 151)	151 (141, 162)	107 (66, 163)	179 (104, 287)
Cooks	115 (105, 125)	97 (90, 105)	81 (68, 97)	96 (80, 113)
Dental assistants	140 (101, 188)	115 (79, 162)		
Nurses aides	102 (95, 110)	107 (99, 116)	112 (98, 128)	124 (101, 151)
Cleaning service	116 (105, 127)	106 (97, 116)	123 (107, 139)	103 (87, 122)
Hairdressers	116 (104, 129)	139 (127, 151)	113 (85, 148)	135 (104, 172)
Construction	147 (106, 200)	129 (88, 182)		
Precision production supervisor	121 (103, 141)	119 (101, 139)	147 (86, 235)	132 (49, 288)
Precision metal workers	118 (96, 145)	137 (113, 165)	179 (103, 291)	
Machinists	204 (108, 348)		204 (108, 348)	
Sheet metal workers	226 (117, 394)			
Machine operators	113 (109, 116)	94 (91, 97)	114 (103, 126)	122 (107, 139)
Motor vehicle operators	120 (101, 142)	118 (89, 153)	155 (96, 237)	
Bus drivers	120 (96, 147)	116 (78, 167)	195 (111, 316)	
Material moving equipment operators	161 (108, 231)	125 (81, 183)		

* Proportionate mortality rates are reported only for stratified groups with more than 10 deaths.

† International Classification of Diseases code 162.

Another limitation is that lung cancer mortality may not reflect current smoking patterns because of the latency between initiation of smoking and death from lung cancer. Patterns of smoking may change during this interval.

However, an analysis of occupationally coded death certificate data also has several strengths that are particularly relevant to this study. Although some cause-of-death listings may be ambiguous, lung cancer designation is highly accurate.²⁴ Given the strong correlation between lung cancer and smoking, mortality may be an accurate reflection of smoking patterns, free from the bias associated with self-reported behaviors.

Occupationally coded lung cancer mortality data and smoking cessation programs that specifically target working (and smoking) women can be useful additions to increasing the effectiveness of lung cancer prevention programs. Such workplace cancer prevention programs may be especially important for workers who experience occupational exposures, such as asbestos, that can intensify the effects of smoking. Occupationally relevant and lifestyle-compatible smoking cessation programs directed toward high-risk women may be useful tools for reaching working women at risk of dying of lung cancer.

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