Stomach Cancer Risk Among Black and White Men and Women: The Role of Occupation and Cigarette Smoking

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This population-based case-control study assesses the risk of stomach cancer among black and white men and women. The association of occupational risk factors and cigarette smoking with stomach cancer was analyzed using 739 stomach cancer cases and 3750 population controls. Complete occupational and tobacco-use histories were obtained by telephone interview. Significant increases in stomach cancer were observed among black men (odds ratio [OR] = 2.0), white women (OR = 1.7), and black women (OR = 1.4) who had ever smoked. The majority of occupations with significant increases in risk were among white men and included agricultural workers (OR = 2.6), driver sales (OR = 3.8), assemblers (OR = 2.0), mechanics (OR = 2.2), and material movers (OR = 2.9). Black women employed as assemblers (OR = 5.4) and white women employed as food workers (OR = 4.0) also had significant ORs. Evaluating occupations with possible dust exposure, we found no association between dust exposure and stomach cancer.

Stomach cancer incidence and mortality has been declining in the United States for the last 60 years.[1] The reason for this decline is partially documented, with socioeconomic status, diet, and environmental factors implicated. Various studies have observed excess stomach cancer risk in association with specific dietary factors such as increased intake of carbohydrates, nitrates, nitrites, salt, and smoked food, and reduced vegetable and fruit intake.[2–5] An association also has been shown between low socioeconomic status and stomach cancer.[1–5] Cigarette smoking has been investigated with mixed results.[3,4,6–12] Occupations such as coal miners,[13,14] millwrights,[15] metal molders,[15] painters,[15] forestry workers,[6] farmers,[5,6] wood-model makers,[16,17] foundry workers,[18–20] rubber workers,[21,22] glass blowers,[23] and cement workers[24] have shown some association with stomach cancer. Dusty occupations, in particular, have been studied in association with stomach cancer risk.[6,22,25–27]

This article presents the results of a population-based case-comparison study of stomach cancer among black and white men and women and its association with occupations, industries, and cigarette smoking.

Methods

The stomach cancer cases and population-comparison group included in the analysis were identified and enrolled into the Occupational Cancer Incidence Surveillance Study (OCISS). The OCISS has been de-

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scribed in detail elsewhere.[28] Briefly, the OCISS is a population-based case-comparison study of occupational risk factors for 11 selected cancers diagnosed among residents of the metropolitan Detroit area. Study subjects were identified through the Metropolitan Detroit Cancer Surveillance System (MDCSS), a participant in the Surveillance, Epidemiology, and End Results (SEER) program.[29] Incident stomach cancer cases diagnosed among black and white men and women between the ages of 40 and 84 years are included in this report. Population referents were selected using random-digit dialing.[30] Because OCISS includes 11 different cancer sites, the population-control selection was made on the basis of frequency matching to colon cancer cases. This site was chosen for frequency matching because comparisons with census data and national health survey data showed those cases to be most similar to the general population in terms of race, gender, age, occupation, and smoking habits. Controls were frequency-matched by age, race, and gender. This analysis includes 739 stomach cancer cases and 3750 population controls. The response rates for stomach cancer cases and population controls were 96% and 97%, respectively.

Data were collected by telephone interview with the subject or his or her surrogate (a first-degree relative). Interview data included lifetime work history, lifetime smoking history, medical history, demographic information, and residential history. Occupation and industry data were coded using the 1980 US Census Bureau classification codes.[31] Grouped codes were created by combining appropriate occupations or industries with probable similarities in work exposures. Before analysis, we selected occupations and industries with little or no exposure to carcinogens and defined this group as unexposed.[28] All other occupations and industries were treated as exposed in the analysis. In this analysis, stomach cancer risk was estimated for usual occupations and industries, defined as those with the greatest length of employment.

Maximum likelihood estimates of the odds ratios (ORs) for ever smoking, pack-years of smoking, and occupations and industries were obtained from multiple logistic regression analyses.[32] The risk of stomach cancer among exposed occupations and industries was estimated in comparison with those who were employed solely in unexposed occupations and industries during their lifetime. Stomach cancer risk was estimated by total employment and by years of employment. Analyses were performed for all men and all women and then separately for black and white men and women. The potential confounding effects of age and cigarette smoking, and race where appropriate, were controlled for in the model. ORs and their respective confidence intervals (CIs) were calculated for each occupation and industry category that included at least five cases.

Results

Table 1 shows the distribution of cases and controls by race and gender, age at interview, and interview outcome. More controls had subject interviews (92% versus 51%), whereas cases had a greater proportion of proxy interviews due to higher death rates among stomach cancer cases (31% versus <1%). Comparisons of the smoking histories and the occupation and industry histories of cases for which the interview was conducted with the subject to all cases (subject plus surrogate interview) produced similar distributions. Therefore, we include all cases in the study to ensure adequate numbers of cases for analysis.

ORs for cigarette smoking are shown in Tables 2 and 3. Subjects who ever smoked cigarettes had a significant increase in stomach cancer (OR = 1.5, 95% CI = 1.2 to 1.8). When looking at pack-years of smoking, we see an increase in risk with increasing levels of smoking. There are significant increases in stomach cancer associated with cig-

TABLE 1
Characteristics of stomach cancer cases and population control

Characteristics	Stomach Cancer Cases		Population Controls	
	N	%	N	%
Race and gender				
White men	335	46.0	1433	38.2
White women	203	27.9	1521	40.6
Black men	116	15.9	373	9.9
Black women	74	10.2	422	11.3
Total	728	100.0	3749	100.0
Age (yr) at interview				
40–49	32	4.3	275	7.3
50–59	94	12.8	697	18.6
60–69	231	31.4	1336	35.7
70–79	284	38.7	1107	29.5
80–84	94	12.8	332	8.9
Total	735	100.0	3747	100.0
Interview outcome				
Subject interview	374	50.6	3451	92.0
Surrogate interview (subject too ill)	133	18.0	298	7.9
Surrogate interview (subject deceased)	232	31.4	1	.1
Total	739	100.0	3750	100.0

TABLE 2
Risk of stomach cancer by cigarette smoking status and pack-years of smoking

	Stomach Cancer Cases	Population Controls	OR	95% CI
Never smoked	226	1504	1.0	
Ever smoked	494	2131	1.5	1.2–1.8
Pack-years				
<30	152	940	1.0	.8–1.2
30–59.9	170	738	1.3	1.0–1.6
60–89.9	73	248	1.5	1.1–2.1
90+	55	165	1.6	1.1–2.2

TABLE 3
Risk of stomach cancer by cigarette smoking status, gender and race

	Stomach Cancer Cases	Population Controls	OR	CI
All males				
Never smoked	81	382	1.0	
Ever smoked	356	1311	1.4	1.0–1.8
White men				
Never smoked	65	301	1.0	
Ever smoked	254	1044	1.2	.9–1.6
Black men				
Never smoked	15	80	1.0	
Ever smoked	99	267	2.0	1.1–3.7
All women				
Never smoked	145	1122	1.0	
Ever smoked	138	820	1.5	1.2–2.0
White women				
Never smoked	101	879	1.0	
Ever smoked	102	641	1.7	1.2–2.3
Black women				
Never smoked	39	243	1.0	
Ever smoked	35	179	1.4	.8–2.3

arette smoking in each pack-year category, except the group with the least number of pack-years of exposure. Men and women, when the risk from smoking is examined separately (Table 3), show similar increases in risk (men OR = 1.4, 95% CI = 1.0 to 1.8; women OR = 1.5, 95% CI = 1.2 to 2.0). However, when race was taken into account, black men (OR = 2.0) and white women (OR = 1.7) had higher ORs than white men (OR = 1.2) and black women (OR = 1.4), respectively.

Stomach cancer risk among occupation and industry groups of usual employment is shown in Tables 4 and 5. Significant increases in stomach cancer risk were observed among men whose usual occupation was farming (OR = 2.2, 95% CI = 1.1, 4.6), driver sales (OR = 3.8, 95% CI = 1.6, 9.0), production inspectors (OR = 2.1, 95% CI = 1.2, 3.8), tool and die workers (OR = 1.6, 95% CI = 1.0, 2.6), and material movers (OR = 1.9, 95% CI = 1.0, 3.7). When stomach cancer risk was examined separately by race, many of the increases observed were restricted to white men. Significant increases were observed for white men, but not all men, whose usual occupation was assembler (OR = 2.0, 95% CI = 1.1, 3.4), mechanic (OR = 2.2, 95% CI = 1.1, 4.2), or machine repairman (OR = 2.1, 95% CI = 1.0, 4.3). When we analyzed stomach cancer risk by the number of years of employment (tables not shown), in most cases the increase in risk was restricted to those employed 10 or more years in these usual-occupation groups. The only usual industry to show a significant increase in risk was farming (OR = 2.4, 95% CI = 1.0, 6.1). The increase was among white men employed 10 or more years.

Among women, significant increases were observed for black women whose usual occupation was assembler (OR = 5.4, 95% CI = 1.3, 22.0) and white women whose usual occupation was foodworker (OR = 4.0, 95% CI = 1.2, 13.4).

Discussion

This study has both strengths and limitations. Its strengths are considerable: a high response rate, population-based cases and comparison group, detailed information about job duties, lifetime history of tobacco use, and inclusion of women and blacks. The study was limited because, as in most occupational studies, we did not gather dietary information as part of the study and were therefore unable to control for diet in the analysis. The lack of specific exposure data is another limitation of the study.

The results of this analysis show some association between stomach cancer and occupation. White men whose usual occupation was farming or who were employed in the farming industry show a significant increase in stomach cancer risk. Men had to be employed as farmers 10 or more years before stomach risk became significantly elevated. The association between farming and stomach cancer has been noted in previous studies.[5,6]

Mechanics and driver sales workers also show elevated risk for stomach cancer. Neither of these occupations has shown an association with stomach cancer in previous studies. Exposure to exhaust from gasoline or diesel engines is common to these occupations but has not been associ-

TABLE 4
Stomach cancer risk by usual occupation groups

Occupation Groups	Race/Gender	Stomach Cancer Cases	Population Controls	OR	95% CI
Agriculture	All men	15	30	2.2	1.1, 4.6
	White men	11	22	2.6	1.2, 6.0
Driver sales	All men	12	14	3.8	1.6, 9.0
	White men	11	13	3.8	1.5, 9.5
Laborer	All men	22	49	1.7	.9, 3.3
	White men	10	24	2.2	.9, 5.2
	Black men	11	25	1.4	.5, 4.1
Assembler	All men	30	104	1.4	.8, 2.4
	White men	23	67	2.0	1.1, 3.4
	All women	9	29	1.8	.8, 4.1
	White women	4	24	1.0	.3, 3.3
	Black women	5	5	5.4	1.3, 22.0
Production inspector	All men	22	49	2.1	1.2, 3.8
	White men	16	42	1.9	1.0, 3.7
Private household workers	All women	9	49	.7	.3, 1.5
	Black women	8	43	.7	.3, 1.7
Janitors	All men	15	51	1.1	.5, 2.3
	Black men	11	32	1.0	.3, 3.2
Mechanic	All men	18	60	1.5	.8, 2.7
	White men	16	40	2.2	1.1, 4.2
Machine repair	All men	14	44	1.8	.9, 3.6
	White men	12	35	2.1	1.0, 4.3
Tool and die workers	All men	31	102	1.6	1.0, 2.6
	White men	25	94	1.4	0.8, 2.4
Craft workers	All men	11	41	0.9	.4, 2.1
Metal finisher	All men	23	93	1.0	.6, 1.9
	White men	15	64	1.2	.6, 2.3
	White women	4	17	1.8	.6, 5.3
Machine operator	All men	13	47	1.0	.5, 2.1
	White men	10	30	1.5	.7, 3.5
Welder	All men	12	38	1.4	.7, 3.0
Drivers	All men	11	90	.5	.2, 1.0
Material movers	All men	20	47	1.9	1.0, 3.7
	White men	12	21	2.9	1.2, 6.7
Health technician	Black women	5	21	.9	.3, 2.9
Food workers	White women	4	9	4.0	1.2, 13.4
Unexposed	All men	77	424		
	White men	62	380		
	Black men	13	44		
	All women	239	1604		
	White women	179	1342		
	Black women	55	262		

ated with stomach cancer.[33] Mechanics also are exposed to asbestos from brake linings.[34] Studies of asbestos exposure and stomach cancer have not shown any consistent association.[35]

Although the numbers were small, we did observe an increased stomach cancer risk for women for two usual-occupation groups. Significant ORs were reported for white women employed as food preparation workers and black women employed as assemblers. It is difficult to interpret these results, because both occupations are likely to involve multiple exposures.

Previous studies have shown an association between dust exposure and stomach cancer.[6,22,25–27] We were particularly interested in workers exposed to metal dust on the job. The difficulty with studying metal-dust exposure is that workers exposed to metal dust are also exposed to cutting oils, solvents, or other chemicals. It is unknown whether stomach cancer excess is due to metal dust or these other exposures. We identified occupations with dust exposure using groupings used in previous studies.[6,22,25–27] No excess of stomach cancer was found among the occupations we selected. We further identified occupations with metal dust exposure and again found no increase in stomach cancer. Because neither the previous studies nor this study measured dust exposure directly, and because previous studies did not always distinguish metal dusts from other forms of dust or from other exposures inherent in

TABLE 5
Stomach cancer risk by usual industry groups

Industry Groups	Race/ Gender	Stomach Cancer Cases	Population Controls	OR	95% CI
Farm	All men	11	22	1.6	.7, 3.8
	White men	9	16	2.4	1.0, 6.1
Construction	All men	32	141	.8	.5, 1.3
	White men	26	113	1.0	.6, 1.7
Ferrous metal manufacturing	All men	19	63	1.2	.7, 2.1
	White men	14	42	1.7	.9, 3.4
Food	All men	11	24	1.6	.7, 3.5
	White men	10	21	1.6	.7, 1.4
Fabricated metal manufacturing	All men	12	29	1.9	.9, 3.9
	White men	10	27	1.8	.8, 4.0
Machinery manufacturing	All men	18	68	.9	.5, 1.8
	White men	17	67	.9	.5, 1.8
Automobile manufacturing	All men	149	610	.9	.6, 1.2
	White men	101	431	1.1	.7, 1.6
	Black men	46	179	.5	.3, .8
	All women	16	92	1.0	.6, 1.9
	White women	11	73	1.0	.5, 2.1
	Black women	5	19	1.2	.4, 4.0
Post office	All men	10	32	1.2	.6, 2.7
Private household	All women	9	57	.6	.3, 1.3
	Black women	8	46	.7	.3, 1.6
Hospital	All women	8	73	.5	.2, 1.1
	Black women	6	37	.7	.2, 1.9
Unexposed	All men	87	345		
	White men	57	290		
	Black men	28	54		
	All women	240	1550		
	White women	182	1278		
	Black women	54	272		

the "dusty" jobs, it is clear that further investigation of the relationship between occupational dust exposure and stomach cancer must be based on direct measures of specific types of dust and must include assessment of other exposures in such occupations.

Our study did find an association between cigarette smoking and stomach cancer. Those that ever smoked cigarettes had a 50% increase in stomach cancer risk. Risk estimates for smoking differed by race and gender. Black men and white women show the largest increases in risk among the four race/gender groups analyzed. In addition, we saw an increase in stomach cancer risk with increasing levels of smoking. The overall increase in risk is not high compared with some cancers, but the association was significant. Previous studies have observed risk estimates for smoking ranging from 1.3 to 4.8.[6–12]

In conclusion, our study did find an association between cigarette smoking, occupation, and stomach cancer. Some of the occupations with elevated risk, such as mechanics, driver sales, and assemblers have not been observed in previous studies and should be investigated further. We found no association between dust exposure and stomach cancer. Information about specific exposures on the job would have allowed us to investigate dust exposure and its association with stomach cancer more thoroughly.

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A Possible Fix for What Ails Baseball?

"Margaret Thatcher would be my candidate," says former major-league Baseball Commissioner Bowie Kuhn, on who should fill the job next.

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