

Published in final edited form as:

Am J Ind Med. 2006 December ; 49(12): 1013–1020.

Smoking Behavior in Trucking Industry Workers

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Abstract

Background— In retrospective occupational studies, the degree of confounding by smoking depends on variation in smoking among job-related exposure groups. We assessed the relationship between job title and smoking behavior as part of a study on occupational exposures and lung cancer.

Methods— A questionnaire on smoking was mailed to a sample of 11,986 trucking industry. Company records were used to gather other relevant information.

Results— The response rate was 40.5%. Among white males, the age-adjusted prevalence of ever smoking was highest among longhaul truck drivers (67%) and lowest among clerks (44%). Smoking rates among workers with other job titles were similar.

Conclusions— Our results will be used to adjust for the differences in smoking among job-related exposure groups when assessing the association between particulate matter exposure and lung cancer mortality. Our study also suggests that an assessment of methods to control for smoking should be considered in the design of retrospective occupational health studies.

Keywords

smoking; occupational health; industry

Introduction

In retrospective occupational cohort studies, the degree of confounding by smoking depends on variation in smoking behavior among exposure groups [Axelson, 1980, Blair et al., 1988, Steenland et al., 1984]. Usually, this information is not available in studies relying on work records. Since smoking behavior is expected to be similar among workers in a single occupational cohort, researchers commonly use an internal comparison group and assume that there is little variation in smoking behavior among exposure groups. There are few studies specifically assessing differences in smoking habits among workers within a single occupational cohort to test this assumption.

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We have been collecting exposure and work history information in a large retrospective cohort study of unionized U.S. trucking industry workers to determine the association of exposure to diesel exhaust and other mobile source related particulate matter (PM) with lung cancer. Job title is closely linked to trucking industry exposures since job duties are well defined and have remained similar over time. Because cigarette smoking is one of the strongest known risk factors for lung cancer, we performed a survey on smoking habits in a sample of currently working and recently retired workers. The objective of our study was to assess determinants of smoking behavior in these workers.

Materials and Methods

Population

The base population consisted of 57,852 unionized trucking industry employees working at three U.S. companies in 2002 or retired from these companies between 1997 and 2002. The three companies were members of the Motor Freight Carriers Association, and employees are members of the International Brotherhood of Teamsters. A questionnaire designed to obtain smoking history was first mailed in the summer of 2003 to a stratified sample of 11,986 workers, including all clerks and 9,730 workers randomly selected to represent the distribution of the remaining job titles. The study protocol was approved by the Brigham and Women's Hospital and VA Boston Institutional Review Boards.

Smoking Questionnaire

The questionnaire used for our study was modeled after the American Thoracic Society (ATS) questionnaire [Ferris, 1978]. It contains questions on history of current and past cigarette smoking, age of first cigarette use, average number of cigarettes smoked per day, and age stopped smoking. Questions about occupational history prior to working at the current (or for retirees, last) company, year of joining the trucking industry, and educational status were also included. People not responding after two mailings were subsequently mailed a post-card with only three questions on ever and current smoking, and age of smoking cessation if a former smoker.

Company Records

Information on employee job title, region of residence (based on mailing address), date of birth, sex, race, and location and size of the most recent truck terminal was extracted from company records and merged with the data from the questionnaire and postcard. Age was calculated as of December 31, 2003.

Definition of Variables

Smoking Characteristics—Current smokers reported smoking within one month of answering the questionnaire. Never smokers were defined as those who smoked less than 20 packs of cigarettes in a lifetime or less than 1 cigarette a day for one year. Cumulative lifetime smoking (pack-years) was calculated.

Job Titles—Job categories and duties are similar across the unionized trucking industry, with only minor differences in job titles between companies. Long-haul drivers operate heavy-duty tractor-trailer trucks between cities. Pick-up and Delivery (P&D) truck drivers operate tractors and smaller trucks within cities or rural areas and deliver cargo between terminal docks and consumers. Dock workers load/unload cargo and operate forklifts. Combination workers perform duties of both P&D drivers and dock-workers and are more frequently employed at smaller terminals. Mechanics repair, maintain, and fuel tractors. Hostlers drive a small,

specialized tractor unit to move trailers within the terminal yard. Clerks include cashiers, dispatchers, customer service representatives, and other workers in the terminal office.

Statistical Analysis

We used descriptive statistics (frequencies, proportions, and means) to examine response rates and smoking habits by job titles, race, sex, and other characteristics. Smoking characteristics of white men were described by direct standardization to the age distribution of the analysis cohort. We used logistic regression to determine the adjusted and unadjusted association between smoking behavior and characteristics of trucking industry workers. A linear regression model was used to assess the association of various characteristics with pack-years. Since we did not have information on education level of those responding only to the postcards, an indicator variable was used for missing values of education in the regression models. Intercooled STATA for UNIX (version 9.0), Stata Corporation, (College Station, TX) was used for all analyses.

Results

The mailing sample included 3,000 longhaul drivers, 1,104 P&D drivers, 2,638 combination workers, 400 hostlers, 2,258 dock workers, 299 mechanics, 2,256 clerks, 21 janitors, and 10 managers. The overall response rate among workers in the remaining sample was 40.5%, omitting the 632 questionnaires returned either due to an incorrect mailing address or because the employee was deceased. The distribution of job titles, gender, region of residence, and terminal size and location among responders and non-responders was similar (Table I). However, the response rate among Whites (44%) was higher than among Blacks (25%) and Hispanics (28%). Also, responders (mean age=53.0 years) were older than the non-responders (mean age=49.9 years).

Due to small numbers of females and non-white employees, we restricted this analysis to white males. We further excluded 36 responders with missing information on smoking and 3 janitors and 1 manager. Therefore, there were a total of 3,362 individuals available for analysis.

Characteristics by job title are presented in Table II. Longhaul drivers and clerks were older than other workers. Combination workers and P&D drivers worked in smaller terminals. Education status was similar across groups.

Age-standardized smoking rates and pack-years smoked were determined by job titles, education, region of residence, terminal size, and terminal location (Table III). Longhaul drivers had the highest prevalence of smoking (18% current smokers and 49% ex-smokers), followed by hostlers (16% current smokers and 49% ex-smokers) and P&D drivers (8% current smokers and 55% ex-smokers). There was only minor variation in never smoking rates between non-clerk job titles. Similarly, although smoking rates were higher among workers in the Midwest, the variation by region of residence was relatively small. Smoking rates were also higher in workers with less than high school education, and varied little by terminal location and size.

After adjusting for age, education, region of residence, terminal size, and terminal location, the long-haul drivers were more likely to smoke than the workers in other job categories (Table IV). However, these differences were small, with the exception of comparison to the clerks. The likelihood of ever smoking increased statistically significantly with increasing age. Workers in the South and West were significantly less likely to be ever smokers as compared with those in the Midwest. Among ever smokers, P&D drivers were significantly more likely to have quit smoking as compared with long-haul drivers, but there were only minor differences among other job titles (Table V). The likelihood of quitting smoking also increased with

increasing age. When pack-years was used as the outcome in linear regression models, employment as a longhaul truck driver, increasing age, and terminal location in urban areas were significantly associated with greater lifetime smoking (pack-years) (data not shown).

Similar results were obtained when regression analyses were conducted after excluding people who responded to the shorter personal history questionnaire on postcards (data not shown). Results were also similar if educational status (which had missing values) was dropped from the regression models.

Discussion

We examined smoking behavior of unionized trucking industry workers, primarily a blue-collar occupational group, based on job titles, age, education, region of residence, terminal size, and terminal location. Among white male workers, a greater likelihood of ever smoking was associated with employment as a longhaul truck driver, increasing age, residence in the Midwest, and educational attainment below high school. Clerks had the lowest prevalence of ever smoking; the other job titles were similar. Hence, there was minor variation in smoking behavior within trucking industry workers after adjusting for potential confounders.

Information on smoking is valuable to accurately associate the etiology of certain diseases with occupational exposures [Axelson, 1980, Blair, et al., 1988, Steenland, et al., 1984]. However, occupational cohort studies based on work or company records often lack information on smoking. The degree of confounding that can be attributed to smoking in such studies has been a matter of debate, and may be related to the variation in smoking behavior within a cohort. Some studies have reported that smoking only minimally confounds the risk estimates for the association between disease and occupational/environmental exposure [Siemiatycki et al., 1988]. Others have recommended a quantitative estimation of the impact of smoking on risk estimates [Axelson and Steenland, 1988]. Several direct and indirect methods to control for smoking in occupational health studies have also been discussed [Steenland, et al., 1984].

Smoking rates among adults have declined over the past decades in the United States (Table VI). Although rates are consistently higher than those in the general U.S. population, smoking rates have also steadily declined among blue-collar workers over the past decades. In our study, 15% of white male unionized trucking industry workers reported to be currently smoking, whereas 62% and 38% were ever and never smokers, respectively. Although recent estimates for unionized trucking industry workers are not available, the proportion of current smokers in our study was lower than historical rates reported in other blue-collar populations. This is unlikely to be due to the restriction to white males, since ever-smoking rates were lower in the females and non-whites who responded to the survey. However, these proportions may be attributed to a response bias by smoking status in our cohort. Our response rate was only 40.5%. Although this is low, it is not unexpected in an occupational cohort [Sorensen and Barbeau, 2004, Fortmann et al., 1984, Petitti et al., 1981]. The response was consistent across job title, but current smokers may have been less likely to respond than former and never smokers. The increased likelihood of non-responders being smokers [Winkleby et al., 1995], as well as the underreporting of smoking [Pechacek et al., 1984] in surveys has been previously described. However, many other studies have reported valid responses from smoking surveys [Fortmann, et al., 1984, Petitti, et al., 1981]. Although our study may underestimate current smoking rates in the trucking industry, a recent decline in smoking may be expected since the rate of strict smoking policies and smoking bans in workplaces has increased over the last decade [2000, Shopland et al., 2001, Sweeney et al., 2000]. Smoke-free workplaces are shown to encourage employees to quit smoking [Farkas et al., 1999, Fichtenberg and Glantz, 2002, Glasgow et al., 1997].

The likelihood of ever smoking as well as quitting smoking increased with increasing age in our cohort. This is likely due to a birth cohort effect, where older workers started smoking when smoking rates in the U.S. were higher and quit later in life. A lower educational attainment has also been associated with higher smoking rates in the general population [2004, 2005], as was seen in our cohort. In addition, smoking rates varied significantly by geographic location of the trucking industry workers. Workers in the Midwest had higher smoking rates than those in other regions of the country. This is consistent with other reports in the general population and in blue-collar workers [2004, Shopland et al., 1996].

In a national study, data from 1992–93 showed that male blue-collar workers in the Midwest and South had higher rates of current smoking (38.8% and 40%, respectively) than those in the Northeast and West (34.5% and 32.4%) [Shopland, et al., 1996].

In our retrospective lung cancer mortality study we identified approximately 55,000 unionized trucking industry workers employed in 1985, and are assessing mortality through 2000. Job titles, which indirectly determine amount of PM exposure will be used to assign exposure groups. The results from the current study will be used to estimate and adjust for the confounding caused by smoking in the exposed and unexposed group. This indirect method of adjustment has been described previously to account for the interaction between smoking and occupational exposure in various other cohorts [Axelson and Steenland, 1988, Larkin et al., 2000, Siemiatycki et al., 1988]. Due to the small variation in smoking rates across job title, we expect that we will not likely see large effects of confounding by smoking in this population.

In summary, we assessed smoking behavior by various characteristics of trucking industry workers, primarily a blue-collar occupational group. We found that employment as a longhaul truck driver, increasing age, living in the Midwest, and an educational attainment below high school, were associated with a higher likelihood of ever smoking. Clerks had the lowest likelihood of ever smoking. These results will help in indirect adjustment for the effect of smoking on the relation between diesel exhaust and lung cancer. Our study also suggests that a careful assessment of the need and methods to control for smoking should be considered in the design of occupational health studies, even if for reassurance that confounding is minimal.

Acknowledgements

We would like to acknowledge Tim Lynch and Bill Rogers of the Motor Freight Carriers Association, LaMont Byrd and Scott Madar of the International Brotherhood of Teamsters Health and Safety Office, and all of the responders to our survey for their support of this study.

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Table I**Characteristics of Responders and Non-Responders to a Smoking Survey in Trucking Industry Workers**

Characteristics	Responders (%) (N=4,594)	Non-responders (%) (N=6,760)
Age (years)		
Mean [Standard Deviation]	53.0 [9.6]	49.9 [10.3]
Race		
White	4026 (88%)	5200 (77%)
Black	316 (7%)	953 (14%)
Hispanic	201 (4%)	522 (8%)
Asian	19 (0.4%)	37 (0.6%)
Native Americans	13 (0.3%)	30 (0.4%)
Other	19 (0.4%)	18 (0.3%)
Sex		
Male	3879 (84%)	5706 (84%)
Job Title		
Longhaul Driver	1290 (28%)	1544 (23%)
Pick-Up and Delivery Driver	430 (9%)	622 (9%)
Pick-Up and Delivery Driver, and Dock Worker	1073 (23%)	1462 (22%)
Hostler	152 (3%)	232 (3%)
Dock Worker	691 (15%)	1472 (22%)
Mechanic	108 (2%)	180 (3%)
Clerk	843 (18%)	1225 (18%)
Janitor	6 (0.1%)	14 (0.2%)
Manager	1 (0.02%)	9 (0.1%)
Region		
Northeast	780 (17%)	939 (14%)
Midwest	1582 (34%)	2171 (32%)
South	1473 (32%)	2440 (36%)
West	759 (17%)	1210 (18%)
Terminal Size		
≥500	1732 (38%)	2825 (42%)
Terminal Location[‡]		
Urban	3099 (67%)	4638 (69%)

[‡] as defined by the United States Census

Table II

Characteristics of White Men in the Trucking Industry by Job Categories

	Job Categories						
	Longhaul Driver	Pick-Up and Delivery Driver	Dock Worker	Pick-Up and Delivery Driver, and Dock Worker	Hostler	Mechanic	Clerk
N	1130	362	570	940	137	91	132
Age (years)							
Mean [Standard Deviation]	56.3 [8.5]	53.0 [9.0]	49.4 [10.1]	53.0 [8.5]	51.4 [9.1]	53.1 [9.5]	56.1 [9.1]
Education							
Less than High School	99 (9%)	25 (7%)	37 (6%)	66 (7%)	7 (5%)	8 (9%)	1 (1%)
High School or more, or Trade School	827 (73%)	277 (77%)	424 (74%)	713 (76%)	101 (74%)	67 (74%)	104 (79%)
Missing	204 (18%)	60 (17%)	109 (19%)	161 (17%)	29 (21%)	16 (18%)	27 (20%)
Region							
Midwest	466 (41%)	112 (31%)	195 (34%)	300 (32%)	50 (37%)	32 (35%)	58 (44%)
Northeast	138 (12%)	80 (22%)	151 (26%)	210 (22%)	29 (21%)	16 (18%)	12 (9%)
South	391 (35%)	93 (26%)	147 (26%)	291 (31%)	39 (28%)	33 (36%)	50 (38%)
West	135 (12%)	77 (21%)	77 (14%)	139 (15%)	19 (14%)	10 (11%)	12 (9%)
Terminal Size							
<500	399 (35%)	258 (71%)	261 (46%)	904 (96%)	52 (38%)	53 (58%)	87 (66%)
>500	731 (65%)	104 (29%)	309 (54%)	36 (4%)	85 (62%)	38 (42%)	45 (34%)
Location[‡]							
Rural	403 (36%)	81 (22%)	199 (35%)	351 (37%)	38 (28%)	23 (25%)	46 (35%)
Urban	727 (64%)	281 (78%)	371 (65%)	589 (63%)	99 (72%)	68 (75%)	86 (65%)

[‡] as defined by the United States Census

Table III

Age-Standardized * Smoking Characteristics of White Men in the Trucking Industry
Number of Responders

Characteristics	Number of Responders	Smoking Status			Mean Pack-Years ^{***}
		Current Smoker	Ex-Smoker	Never Smoker	
Job Title					
Longhaul Driver	1130	18%	49%	33%	26
Pick-Up and Delivery Driver	362	8%	55%	36%	23
Pick-Up and Delivery Driver, and Dock Worker	940	14%	46%	40%	26
Hostler	137	16%	49%	35%	22
Dock Worker	570	20%	39%	41%	23
Mechanic	91	14%	39%	47%	20
Clerk	132	9%	35%	56%	16
Education					
Less than High School	243	25%	56%	20%	28
High School or more, or Trade School	2513	15%	46%	39%	25
Missing	606	-	-	-	-
Region					
Midwest	1213	17%	49%	34%	27
Northeast	636	14%	48%	38%	24
South	1044	15%	44%	41%	26
West	469	14%	43%	43%	22
Terminal Size					
<500	2014	14%	46%	40%	25
≥500	1348	18%	47%	35%	26
Terminal Location					
Rural	1141	14%	46%	40%	27
Urban	2221	16%	47%	37%	23
Total	3362	15%	47%	38%	25

* Age-standardized to the analysis cohort using 5 year categories between ages 35 and 65 years

*** Only for smokers. N=1,174 since some variables needed to calculate pack-years were missing

Total of current, ex, and never smokers may not equal 100% for some variables since there were no persons within one or more of the age strata when performing direct standardization.

Table IV

Unadjusted and Adjusted Likelihood of Smoking among 3,362 White Men in the Trucking Industry

Characteristics	Number of Responders	Number of Ever Smokers	Ever Smoker	
			Unadjusted Odds Ratios	Adjusted Odds Ratios
Job Title				
Longhaul Driver	1130	784	1.0	1.0
Pick-Up and Delivery Driver	362	228	0.8 (0.6–1.0)	0.9 (0.7–1.2)
Pick-Up and Delivery Driver, and Dock Worker	940	561	0.7 (0.5–0.8)	0.8 (0.6–1.0)
Hostler	137	84	0.7 (0.5–1.0)	0.9 (0.6–1.3)
Dock Worker	570	314	0.5 (0.4–0.7)	0.7 (0.6–0.9)
Mechanic	91	48	0.5 (0.3–0.8)	0.6 (0.4–0.9)
Clerk	132	64	0.4 (0.3–0.6)	0.4 (0.3–0.6)
Age	3362	2083	1.05 (1.04–1.05)	1.04 (1.03–1.05)
Education				
Less than High School	243	191	1.0	1.0
High School or more, or Trade School	2513	1513	0.4 (0.3–0.6)	0.5 (0.4–0.7)
Missing	606	379	-	-
Region				
Midwest	1213	800	1.0	1.0
Northeast	636	390	0.8 (0.7–1.0)	0.9 (0.7–1.1)
South	1044	627	0.8 (0.7–0.9)	0.7 (0.6–0.9)
West	469	266	0.7 (0.5–0.8)	0.7 (0.6–0.9)
Terminal Size				
<500	2014	1201	1.0	1.0
≥500	1348	882	1.3 (1.1–1.5)	1.1 (0.9–1.3)
Terminal Location				
Rural	1141	683	1.0	1.0
Urban	2221	1400	1.1 (1.0–1.3)	1.1 (0.9–1.3)

Table V
Unadjusted and Adjusted Likelihood of Quitting Smoking (among Ever Smokers) for 2,083 White Men in the Trucking Industry

Characteristics	Ever Smokers (n)	Quit Smoking (n)	Quit Smoking	
			Unadjusted Odds Ratios	Adjusted Odds Ratios
Job Title				
Longhaul	784	588	1.0	1.0
Pick-Up and Delivery	228	198	2.2 (1.5–3.3)	2.4 (1.5–3.7)
Hostler, and Dock				
Hostler	561	430	1.1 (0.8–1.4)	1.1 (0.8–1.4)
Dock	84	62	0.9 (0.6–1.6)	1.1 (0.7–1.9)
Mechanic	314	205	0.6 (0.5–0.8)	0.7 (0.6–1.0)
Clerk	48	35	0.9 (0.5–1.7)	0.9 (0.5–1.8)
Age	64	52	1.4 (0.8–2.8)	1.3 (0.7–2.5)
Education	2083	1570	1.04 (1.03–1.05)	1.04 (1.03–1.06)
Less than High School	191	144	1.0	1.0
High School or more, or Trade School	1513	1133	0.97 (0.7–1.4)	1.2 (0.8–1.7)
Missing	379	-	-	-
Region				
Midwest	800	594	1.0	1.0
Northeast	390	301	1.2 (0.9–1.6)	1.2 (0.9–1.6)
South	627	477	1.1 (0.9–1.4)	1.0 (0.8–1.3)
West	266	198	1.0 (0.7–1.4)	0.9 (0.6–1.3)
Terminal Size				
<500	1201	929	1.0	1.0
≥500	882	641	0.8 (0.6–1.0)	0.8 (0.6–1.1)
Terminal Location				
Rural	683	523	1.0	1.0
Urban	1400	1047	0.9 (0.7–1.1)	0.9 (0.7–1.1)

Table VI

Current and Former Smoking Rates from Selected Population and Occupational Surveys

Study	Year of Survey	Current Smoking	Former Smoking	Population	Data Source
[Weinkam and Sterling, 1987]	1979	53.1%	24%	blue-collar male workers	National Health Interview Surveys
[Nelson et al., 1994]	1978-1980	45%		blue collar male workers	
[Weinkam and Sterling, 1987]	1979-1980	45.4%	25.4%	blue-collar male workers	National Health Interview Surveys
[Winkelby, et. Al, 1995]	1979-1990	92.5%		low-educated white males	
[Stellman et al., 1988]	1982	27% 6% pipe or cigar smokers	44%	persons occupationally exposed to gasoline or diesel exhaust	American Cancer Society's Cancer Prevention Study
[Nelson, et al., 1994]	1987-1990	40%		blue collar male workers	
[Lee et al., 2004]	1987, 1988, 1990-94	43% 41%		truck drivers industrial truck and tractor equipment operators	National Health Interview Surveys
		36%		bus, truck and stationary engine mechanics	
[Bang and Kim, 2001]	1988-1994	37%		trucking service industry	NHANES III
[National Institute for Occupational Safety and Health, 2003]	2000	33%	19%	Trucking service and warehouse industry	National Health Interview Surveys
		35%	21%	Motor vehicle operators	
		32%	2.3%	Mechanics and repairers	
[Centers for Disease Control and Prevention, 2005]	2003	24.3%		White males	General US population