Occupational Factors and Smoking Cessation Among Unionized Building Trades Workers

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RESEARCH ABSTRACT

The purpose of this study was to estimate the contribution of occupational factors to smoking cessation among building trades workers. Longitudinal data came from the MassBUILT smoking cessation intervention study for unionized building trades workers. Multivariable logistic regression analyses were applied to identify the significant predictors of smoking cessation, which was defined as abstinence from smoking during the previous 7 days at the 1-month monitoring and prolonged abstinence for at least 6 months at the 6-month monitoring. Greater concern about exposure to occupational hazards was significantly associated with increased likelihood of smoking cessation at 1 month (odds ratio = 1.06; 95% confidence interval = 1.01–1.11). Additionally, smokers who had a more positive view of their unions had at least marginally increased likelihood of smoking cessation at 1 month. Furthermore, older age, higher levels of educational attainment and household income, and fewer cigarettes smoked per day were important covariates that predicted smoking cessation. Concerns about exposures to work hazards should be incorporated into comprehensive intervention approaches for building trades workers. Additionally, the findings emphasize that blue-collar workers with lower income and education levels and heavy smokers should be considered target groups for implementing cessation interventions.

Smoking cessation has immediate as well as long-term benefits, reducing the risk for diseases caused by smoking and improving health in general (U.S. Department of Health and Human Services, 2004). According to the National Health Interview Survey (NHIS), the quit ratio (i.e., ratio of former smokers to ever smokers for each survey year) has been stable and ranged from 49% in 1998 to 51% in 2008 among U.S. adults (Centers for Disease Control and Prevention, 2009). Despite health risks of smoking and benefits of quitting being well-known, blue-collar workers have lower quit rates compared to white-collar workers (37% vs. 51%) (Giovino, Pederson, & Trosclair, 2000). In addition to the slow declines in blue-collar workers' smoking prevalence over time, the difference in quit rate may lead to a widening of the persistent occupational disparity in smoking behavior (Barbeau, Krieger, & Soobader, 2004; Covey, Zang, & Wynder, 1992; Giovino et al., 2000; Sorensen, 2001).

The occupational disparities in smoking behavior may be explained by occupational factors in the work environment. Stressful work conditions, including high job demand, high workload (Albertsen, Borg, & Oldenburg,

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Applying Research to Practice

Appropriate interventions should be targeted at lower income and education groups among building trades workers. Given the strong relationship between number of cigarettes smoked per day and smoking cessation, interventions that focus on reducing the number of cigarettes smoked may direct smokers toward future successful smoking cessation techniques. Additionally, it is important to address workers' concerns about exposures to hazards at work and incorporate them into smoking cessation strategies.

2006; Kouvonen, Kivimaki, Virtanen, Pentti, & Vahtera, 2005; Kouvonen et al., 2009; Otten, Bosma, & Swinkels, 1999; Steptoe et al., 1998), and exposures to occupational hazards (Albertsen, Hannerz, Borg, & Burr, 2004; Sorensen et al., 1996; Sterling & Weinkam, 1990), may contribute to increased smoking or to difficulties with cessation. For example, Sorensen et al. (2002) found that smoking quit rates among blue-collar workers in a smoking cessation intervention integrated with occupational health and safety (e.g., reduction of workplace hazards) more than doubled relative to quit rates in a smoking cessation-only intervention.

The purpose of this study was to identify significant baseline occupational and individual factors that may influence smoking cessation among unionized building trades workers. Although some studies have advocated reducing smoking rates by considering factors in the work environment, little is known about the impact of occupational factors on smoking cessation among blue-collar workers. Also, whether these occupational factors are more significant predictors of smoking cessation than individual factors has not been examined. Numerous studies have identified several individual factors that contribute to smoking cessation, including a number of sociodemographic characteristics, such as older age, male gender, White race, higher income level, and higher educational attainment (Centers for Disease Control and Prevention, 2009; Fagan, Shavers, Lawrence, Gibson, & O'Connell, 2007; Lee & Kahende, 2007; U.S. Department of Health and Human Services, 1998). In their previous studies, the authors reported the cross-sectional relationships between several factors, including individual and occupational factors, and current smoking or heavy smoking (Chin, Hong, Gillen, Bates, & Okechukwu, 2012; Chin et al., in press).

METHODS

This study used longitudinal data from the Mass-BUILT study, a multipronged, randomized, controlled trial conducted in Massachusetts between 2004 and 2007 to test a smoking cessation intervention for apprentices in the building trades. Details of the research design and procedures and results of the intervention have been previously reported elsewhere (Okechukwu, Krieger, Sorensen, Li, & Barbeau, 2009, 2011; Okechukwu, Nguyen, & Hickman, 2010). Briefly, 10 union sites met the eligibility criteria for the study and agreed to participate. The union sites were size-matched and randomly assigned to four intervention sites (n = 1,044 apprentices) and six control sites (n = 897 apprentices). The apprentices in the intervention sites received a multipronged smoking cessation intervention conducted during 4 months. The multipronged intervention strategy included (1) toxics and tobacco curriculum; (2) group-based behavioral counseling; (3) nicotine replacement therapy; (4) a do-it-yourself quit kit that contained a smoking cessation guide; and (5) environmental cues for smoking cessation, including posters and written materials. Both the intervention and the control sites participated in a baseline survey and monitoring surveys at 1 and 6 months after the intervention to assess changes in smoking behaviors. The apprentices at the control sites did not receive any intervention components until after all study data collection was completed (Okechukwu et al., 2009).

All enrolled apprentices 18 years or older were eligible to complete the surveys. Baseline and monitoring data were collected from apprentices using self-administered questionnaires. The baseline survey was completed by 1,817 apprentices (93.6% response rate); approximately 43% of the participants (n = 763) were classified as current smokers who had smoked at least 100 cigarettes during their lifetime and had smoked a cigarette in the past 30 days (National Center for Health Statistics, 2009). A total of 621 smokers (81.4% response rate) among baseline smokers completed both the baseline and the 1-month monitoring survey and 490 smokers (64.2% response rate) completed the baseline and the 1-month and 6-month monitoring surveys after the intervention. The Dana-Farber Cancer Institute Institutional Review Board approved all methods and materials used in the original study. All procedures for the current study received approval from the University of California San Francisco (UCSF) Committee on Human Subjects.

Measures

Dependent Variable

Smoking Cessation. Smoking cessation was assessed by (1) 7-day point prevalence abstinence (defined as a self-report that the smoker had not smoked any cigarettes in the past 7 days) at the 1-month monitoring; and (2) prolonged abstinence from smoking for at least 6 months at the 6-month monitoring.

Independent Variables

The independent variables included individual and occupational factors.

Individual Factors. Individual factors included sociodemographic characteristics and smoking intensity.

Sociodemographic Characteristics. Sociodemographic characteristics included age, gender, and racial or ethnic

group (Hispanic, Non-Hispanic African American, Non-Hispanic White, and other). Educational level had three classifications: high school diploma/general equivalency diploma or less, some college or 2-year degree, and 4 years or more of college. Three household income levels—less than $50,000, $50,000 to $74,999, and $75,000 or more—were used.

Smoking Intensity. Smoking intensity was defined by the question "During the past 30 days, on the days that you smoked, about how many cigarettes did you usually smoke that day?" and was dichotomized as 1 to 20 cigarettes and more than 20 cigarettes per day.

Occupational Factors. Occupational factors included union commitment, exposure to occupational hazards, and concern about exposure to occupational hazards.

Union Commitment. Union commitment was assessed by participants' attitudes toward their unions on five statements, such as "I am proud to tell others that I am a union apprentice" (Barbeau et al., 2005; Lambert & Hopkins, 1995). A 4-point Likert scale, ranging from 1 (completely disagree) to 4 (completely agree), was used. The scale scores obtained by summing the five items ranged from 5 to 20, with a higher score indicating a more positive view toward the union. Cronbach's alpha in this study was 0.70.

Exposure to Occupational Hazards. Exposure to occupational hazards, including work-related musculoskeletal hazards, chemicals, dust, injuries, and secondhand smoke at work, was also collected via self-reported questionnaire. *Work-related musculoskeletal hazards,* modified from the Washington State Ergonomics Rule (Washington State, 2000), were determined by asking the number of hours per full shift requiring awkward postures of the shoulders, neck, back, or knees, repetitive hand motions, and hand force to pinch or grip an object. Response options were almost never, less than 1, 1 to 4, and more than 4 hours. Most of the questions used to assess the following exposures asked about exposure frequency during the past 12 months. *Dust, chemicals, secondhand smoke, and injury exposures* were evaluated by asking about the frequency of each exposure at work. Response options were never, rarely, and a lot. Exposure to occupational hazards was classified as the highest exposure category (Okechukwu, Krieger, et al., 2010; Quinn et al., 2007): exposed more than 4 hours per work shift to awkward postures of the shoulders, neck, back, and knees, repetitive hand motions, or hand force; and exposed a lot to dust, chemicals, secondhand smoke, and injury. Based on these criteria, participants were classified as either exposed or unexposed to each occupational hazard.

Concern About Exposure to Occupational Hazards. Concern about exposure to occupational hazards was assessed with six items by determining the level of concern about exposure to dust, chemicals, secondhand smoke, and injuries at work. A four-point Likert scale, ranging from 1 (not at all) to 4 (very concerned), was used. The scale scores obtained by summing the six items ranged from 6 to 24, with a higher score indicating more concern about exposure to hazards at work. Cronbach's alpha in this study was 0.82.

Data Analysis

Statistical analyses were performed with SPSS version 19 (SPSS Inc., Chicago, IL) for descriptive analyses and Stata/SE version 12 (Stata Corporation, College Station, TX) for multiple imputations and multivariable analyses. The dependent variables in the analyses were 7-day point prevalence abstinence at the 1-month monitoring and 6-month prolonged abstinence, comparing "quitters" to "non-quitters." Descriptive statistics were analyzed for each potential predictor. Values for continuous variables were presented as means and standard deviations. Categorical variables were summarized by frequencies and percentages.

The work site was the unit of randomization and location of the intervention in the original study. Thus, control for potential clustering by site was needed. Generalized linear mixed models were used for multivariable analyses to control for the random effect of sites. As an initial step in the multivariable analysis, multicollinearity was assessed to determine whether high intercorrelations existed among predictors. Significant correlations between exposure to occupational hazards (e.g., dust, chemicals, injuries, secondhand smoke, and work-related musculoskeletal hazards; $r < 0.20$) were found. However, these correlations were well below the level indicating multicollinearity ($r > 0.80$) (Glantz & Slinker, 2001). Thus, all these variables were included in the multivariable models. Multivariable analyses assessed the predictive relationship of each variable separately with dichotomous outcomes (quitter = 1 vs. non-quitter = 0) at 1- and 6-month post-intervention monitoring, after controlling for the potential cluster effect. Due to the small sample size, the Hispanic, African American, and other categories were collapsed into the "non-White" category for the logistic regression model.

In the case of most variables, data were missing from 5% or less of the respondents, although information on household income level was missing from 13.4% (83 of 621). Data were analyzed by imputing missing values. The current study used the multiple imputation method to create 10 complete data sets, each with different imputed values for the missing data (Allison, 2002; Rubin, 1996; Schafer, 1999). All variables that were included in the logistic model were part of the imputation model used to predict missing data. The multivariable analyses presented here were based on the combined results from the 10 imputed data sets. For each variable, the estimates were used to report the odds ratios (ORs) and 95% confidence intervals (95% CI), along with a corresponding p value. The level of statistical significance was set at less than .05.

RESULTS

Characteristics of the Study Participants

The baseline characteristics of smokers ($N = 763$), prior to imputing missing covariates, are presented in Table 1. The mean age of smokers was 27.7 years, 91.7% were male, 81.1% were non-Hispanic White, 51.4% had a high school education or less, and 39.4% reported a household income of less than $50,000 annually. Approximately 20% of smokers reported smoking more than

Table 1

Baseline Characteristics of Building Trades Smokers (*N* = 763)

Individual factors	
Age (year)	
Mean ± SD	27.7 ± 5.9
Range	18 to 49
Gender	
Male	700 (91.7)
Female	44 (5.8)
Missing	19 (2.5)
Race/ethnicity	
Hispanic	18 (2.4)
African American, non-Hispanic	40 (5.2)
Other, non-Hispanic	44 (5.8)
White, non-Hispanic	619 (81.1)
Missing	42 (5.5)
Education	
High school diploma/GED or less	392 (51.4)
Some college or 2-year degree	287 (37.6)
4 years or more of college	48 (6.3)
Missing	36 (4.7)
Income	
< $50,000	301 (39.5)
$50,000 to $74,999	172 (22.5)
⩾ $75,000	181 (23.7)
Missing	109 (14.3)
Smoking intensity (cigarettes/day)	
⩽ 20	599 (78.5)
> 20	156 (20.4)
Missing	8 (1.1)
Intervention condition	
Intervention group	390 (51.1)
Control group (no intervention)	373 (48.9)
Occupational factors	
Union commitment[a]	
Mean ± SD	17.8 ± 2.0
Range	9 to 20
Exposure to occupational hazards	
Work-related musculoskeletal hazards	
Exposed	456 (59.8)
Unexposed	305 (40.0)
Missing	2 (0.2)
Dust	
Exposed	611 (80.1)
Unexposed	143 (18.7)
Missing	9 (1.2)
Chemicals	
Exposed	238 (31.2)
Unexposed	516 (67.6)
Missing	9 (1.2)
Secondhand smoke	
Exposed	339 (44.4)
Unexposed	421 (55.2)
Missing	3 (0.4)
Injuries	
Exposed	227 (29.8)
Unexposed	530 (69.5)
Missing	6 (0.8)
Concern about exposure to occupational hazards[b]	
Mean ± SD	14.9 ± 4.3
Range	6 to 24

Note. *Values are number (%) unless otherwise indicated. All values were calculated prior to imputing missing covariates. GED = general equivalency diploma.* [a]*A high score indicates a more positive view toward the union.* [b]*A high score indicates more concern about exposure to occupational hazards.*

20 cigarettes per day during the past 30 days. The mean union commitment score was 17.8, ranging from 9 to 20. The most commonly reported hazardous occupational exposure was dust (80.1%), followed by work-related musculoskeletal hazards (59.8%), secondhand smoke (44.4%), chemicals (31.2%), and injuries (29.8%). The mean score for *concern about exposure to occupational hazards* was 14.9, ranging from 6 to 24. A total of 390 (51%) smokers were assigned to the intervention group and 373 (49%) to the control group.

Smoking Cessation

Of the 621 smokers at baseline who completed the 1-month monitoring survey, 21% reported they had not smoked in the past 7 days. However, the 6-month prolonged abstinence rate dropped to 8% among 490 baseline smokers who completed the 1- and 6-month monitoring surveys.

Predictors of Smoking Cessation

Table 2 presents the baseline variables that predicted smoking cessation at the 1- and 6-month monitoring, after controlling for the potential random effect of site.

Table 2

Predictors of Smoking Cessation at 1- and 6-Month Post-intervention Monitoring

	1-Month Monitoring (n = 621)		*6-Month Prolonged Abstinence (n = 490)*	
Baseline Variable	***OR***	***(95% CI)***	***OR***	***(95% CI)***
Individual factors				
Intervention vs. control	1.34	(0.87–2.07)	1.10	(0.51–2.41)
Age (continuous)	1.01	(0.97–1.04)	1.06	(1.00–1.12)*
Gender				
Male	2.19	(0.61–7.89)	1.20	(0.24–6.06)
Female	reference			
Race				
Non-White	0.97	(0.51–1.81)	0.61	(0.19–1.95)
White	reference			
Income				
< $50,000	0.50	(0.30–0.84)**	0.39	(0.16–0.93)*
$50,000 to $74,999	0.65	(0.37–1.15)	0.52	(0.21–1.24)
⩾ $75,000	reference			
Education				
High school diploma/GED or less	0.33	(0.15–0.71)**	0.35	(0.12–1.03)†
Some college or 2-year degree	0.45	(0.20–0.98)*	0.41	(0.14–1.22)
4 years or more of college	reference			
Smoking intensity (cigarettes/day)				
⩽ 20	2.08	(1.14–3.81)*	1.46	(0.56–3.81)
> 20	reference			
Occupational factors				
Union commitment (continuous)	1.11	(0.99–1.25)†	0.99	(0.81–1.21)
Exposure to occupational hazards[a]				
Work-related musculoskeletal hazards	0.95	(0.62–1.43)	1.16	(0.57–2.36)
Dust	0.86	(0.50–1.48)	0.61	(0.24–1.51)
Chemicals	0.84	(0.52–1.38)	0.56	(0.23–1.34)
Secondhand smoke	0.77	(0.50–1.20)	1.58	(0.77–3.25)
Injuries	1.21	(0.75–1.93)	0.59	(0.25–1.39)
Concern about exposure to occupational hazards (continuous)	1.06	(1.01–1.11)*	1.06	(0.98–1.15)

Note. *GED = general equivalency diploma; OR = odds ratio, controlling for the cluster effect; CI = confidence interval.* [a]*Reference = workers who are unexposed to each occupational hazard.*
*p < .05. **p < .01. †p < .1.

Regarding sociodemographic characteristics, an annual household income less than $50,000 (OR = 0.50; 95% CI = 0.30–0.84), a high school education or less (OR = 0.33; 95% CI = 0.15–0.71), or some or a 2-year college degree (OR = 0.45; 95% CI = 0.20–0.98) were significantly associated with lower likelihood of smoking cessation at 1 month. Furthermore, lower smoking intensity (⩽ 20 cigarettes per day) had a strong effect on the increased likelihood of smoking cessation at 1 month (OR = 2.08; 95% CI = 1.14–3.81). Of the occupational

factors, greater concern about exposure to occupational hazards was significantly associated with an increased likelihood of smoking cessation at 1 month (OR = 1.06; 95% CI = 1.01–1.11). Smokers who had a more positive view of their unions had at least marginally significant increased likelihood of smoking cessation at 1 month (OR = 1.11; 95% CI = 0.99–1.25; $p = .086$).

Regarding maintaining abstinence for at least 6 months, older age was significantly associated with an increased likelihood of smoking cessation (OR = 1.06; 95% CI = 1.00–1.12). An annual household income of less than $50,000 was significantly associated with lower odds of prolonged smoking cessation at the 6-month monitoring (OR = 0.39; 95% CI = 0.16–0.93). No significant occupational predictors of prolonged smoking cessation for at least 6 months existed.

DISCUSSION

Main Findings

This is the first study, to the authors' knowledge, to evaluate blue-collar workers' smoking cessation while taking into account both individual and occupational factors. The disparities in smoking cessation by sociodemographic characteristics among U.S. adults are well-known (Centers for Disease Control and Prevention, 2009; Fagan et al., 2007; Lee & Kahende, 2007; U.S. Department of Health and Human Services, 1998). Consistent with prior intervention studies, the current study also found that of the sociodemographic characteristics, higher educational attainment and annual household income and older age independently predicted short- or long-term smoking cessation after controlling for intervention effect (Bjornson et al., 1995; Dale et al., 2001; Murray et al., 2000; Nides et al., 1995; Nollen et al., 2006). Appropriate interventions should be targeted to the lower socioeconomic groups among blue-collar workers.

Another finding of the current study that is supported by prior studies was the impact of baseline smoking intensity (e.g., number of cigarettes smoked per day) on smoking cessation, even after adjustment for the intervention effect. Smokers who smoked fewer than 20 cigarettes per day were twice as likely to report smoking cessation at the 1-month monitoring compared to those who smoked more than 20 cigarettes per day. Previous intervention studies have identified a lower number of cigarettes smoked per day as a significant predictor of smoking cessation (Dale et al., 2001; Ferguson et al., 2003; Hymowitz, Sexton, Ockene, & Grandits, 1991). Reducing the number of cigarettes smoked per day could lower the risk for smoking-related diseases (e.g., lung cancer) (Godtfredsen, Prescott, & Osler, 2005). Therefore, reduced smoking intensity may represent an important step toward successful smoking cessation in heavy smokers. More intensive or tailored pharmacological and behavioral interventions may be needed to assist smokers who smoke more cigarettes per day to quit smoking.

Smoking behaviors seem to have a complex association with concerns about hazards on the job and actual exposure to hazards on the job. Greater concern about exposure to occupational hazards at baseline was significantly associated with increased odds of short-term smoking cessation. Smokers' concerns about hazardous exposures such as dust and chemicals on the job could prove to be a significant influence in quitting smoking. This finding is supported by a study of craftspersons and laborers at 22 work sites, which showed that concern about exposure to job hazards was significantly associated with an increased intention to quit (Sorensen et al., 1996). The current study shows that concern about occupational hazards is associated with actual smoking cessation among construction workers. This finding is of note because construction workers remain the occupational group with the highest smoking prevalence (Centers for Disease Control and Prevention, 2011; Lee et al., 2007). Smoking cessation strategies that address workers' concerns about exposures to occupational hazards may promote smoking cessation.

The current study did not find any relationship between self-reported exposure to occupational hazards and smoking cessation. This is surprising given that several studies have found that workers exposed to occupational hazards also have higher smoking rates than workers without such exposures (Sorensen et al., 1996; Sterling & Weinkam, 1990). Exposure to these occupational hazards may be a significant barrier to smoking cessation among blue-collar workers. However, the current study shows that although concern about these exposures is associated with cessation, the actual exposures are not related to smoking cessation.

Only one smoking cessation intervention study of blue-collar workers tested the effectiveness of an intervention integrating smoking cessation *plus* an occupational health and safety program. It reported that this intervention led to a doubling of 6-month smoking cessation quit rates, compared to blue-collar workers exposed only to the smoking cessation program (Sorensen et al., 2002). The results demonstrated that workplace changes that reduced workers' exposure to hazardous substances used in work processes were associated with improved smoking cessation rates among blue-collar workers (Sorensen et al., 2002). Therefore, although an association between exposure to occupational hazards and smoking cessation was not found in the current study, a potential relationship is still important when addressing the contribution of occupational hazards to smoking behaviors among blue-collar workers (Sorensen et al., 2002). An in-depth examination of the relationship between exposure to occupational hazards and smoking behavior is needed to further explicate this relationship.

Having a more positive view of the union was marginally but not significantly related to smoking cessation. Unions may play a role in providing resources and support in the work environment for quitting. Examples of this are the development and implementation of work site smoking policies (e.g., smoking restrictions, smoking bans) (Sorensen et al., 2000) and health insurance coverage for smoking cessation (Barbeau, 2001; Barbeau et al., 2001; Curry, Grothaus, McAfee, & Pabiniak, 1998).

Strengths and Limitations

The current study adjusted for multiple covariates, including individual factors and occupational factors, thereby limiting confounding. Multiple imputation methods, which preserved information on variables with missing data for estimating the regression model, minimized validity bias and had more statistical power than the often used listwise method of deleting all observations with missing values on any covariate (Allison, 2002; Little & Rubin, 2002; Patrician, 2002; Rubin, 1987).

Several limitations to the current study must also be noted. First, because the sample included only unionized workers at construction work sites, generalizability of the findings is limited. In addition, generalizability is further limited because the participants in this study were predominantly younger, male, non-Hispanic White smokers. Second, although no evidence indicates that the likelihood of leaving the study was related to any smoking characteristic, more females than males left the study and participants who left the study had lower union commitment. These findings might have reduced or limited the associations between predictors and smoking cessation.

Finally, information about exposures and outcomes was based on self-report and might have lead to misclassification. Self-report of exposure to occupational hazards may result in an underestimation or overestimation of the actual hazardous exposures (Birdsong, Lash, Thayer, Kumekawa, & Becker, 1992; Brower & Attfield, 1998; Spielholz, Silverstein, Morgan, Checkoway, & Kaufman, 2001; Van Eerd et al., 2009). Further, smoking status was not validated by any biochemical test. However, earlier studies have demonstrated that self-reported smoking status is valid and reliable (Caraballo, Giovino, Pechacek, & Mowery, 2001; Patrick et al., 1994).

IMPLICATIONS FOR PRACTICE

This study described the various factors that might relate to smoking cessation and extended the understanding of the process of smoking cessation among building trades workers. To more effectively guide smokers in this group, the underlying dynamics of the quitting process with respect to not only smokers' individual characteristics but also their working environments should be better understood. The findings emphasize that lower income and educational level are the more important blue-collar worker target groups. The current findings also suggest that tailored and more intensive interventions focused on reducing smoking intensity should be developed for these groups. More importantly, addressing concerns about exposures to occupational hazards might be helpful in developing comprehensive smoking cessation intervention programs for building trades workers. Interventions involving unions, such as restrictive smoking policies, might also provide work environment support for positive changes.

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