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Original Article

A Tobacco Cessation Intervention with Rural, Medically Underserved, Blue-collar Employees: A Quasiexperimental Study

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ABSTRACT

Background: The aim of this study was to increase knowledge regarding the dangers associated with tobacco use, and decrease secondhand smoke exposure and tobacco use behaviors with an antitobacco messaging campaign among rural, medically underserved, blue-collar workers.
Methods: A quasiexperimental study was conducted with employees at two worksites. One worksite received the intervention, which consisted of nine different antitobacco messages. Baseline and follow-up surveys were conducted at each worksite to assess change in knowledge and behavior; the data were compared across the two worksites.
Results: Two hundred twenty-two and 243 participants completed baseline and follow-up surveys at the intervention and comparison sites, respectively. A statistically significant difference was seen over time between the worksites on knowledge of the dangers of tobacco ($p < 0.0001$); the mean knowledge score increased at the intervention site, but remained unchanged at the comparison site. In general, non-smokers at both worksites appeared to try to decrease exposure to secondhand smoke over the follow-up period. Repeated measures analysis indicated that there were no differences in motivation to quit ($p = 0.81$), interest in quitting ($p = 0.40$), thinking about quitting ($p = 0.53$), or several tobacco-use behaviors over time among smokers at the intervention and comparison worksites. There were slight increases over time in the proportion of smokers who do not allow smoking in their homes/vehicles at the intervention worksite, although not statistically significant.
Conclusion: Participants at the intervention worksite increased their knowledge regarding the dangers of tobacco use and secondhand smoke exposure. Among current tobacco users, the intervention appeared to increase family rules regarding secondhand smoke exposure in their homes and vehicles.

1. Introduction

Tobacco use remains one of the greatest public health concerns and is a leading cause of preventable death in the United States [1]. Research has established that low socioeconomic status (SES), which includes income, occupational status, and/or level of education, is associated with tobacco use [2]. In the United States, the decline in smoking rates among people living below the poverty line and who have low levels of education has stalled over the past 5 years [3].

Rural underserved low-SES communities have a major barrier to decreasing tobacco use because they lack resources (e.g., financial

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resources and access to services) to support tobacco education, prevention, cessation, and treatment [4,5]. Research suggests that the prevalence of smoking and smokeless tobacco use in rural underserved areas reflects delayed access to media resources, lower educational attainment, low SES, and poor access to medical care [4]. People who reside in rural (defined as all areas outside census tracks with 50,000 or less people), medically underserved areas (MUAs) are less likely to receive and comply with recommended prevention protocols [4]. MUAs are areas or populations designated by the U.S. Department of Health and Human Services as having too "few primary care providers, high infant mortality, high poverty and/or high elderly population" [6]. In addition, the prevalence rates of tobacco use (cigarettes and smokeless tobacco) and secondhand smoke exposure are higher in rural populations (25%) compared with those in metropolitan areas (18% for large metro areas and 22% for small metro areas) [4,7,8].

Over the past 40 years, Americans working in blue-collar occupations have had higher rates of smoking than their white-collar counterparts, and this trend continues today [9–11]. A 2000 report based on the National Health Interview Survey found that the smoking rate of blue-collar workers was more than twice that of their white-collar counterparts. In addition, blue-collar workers were more likely to be smokers at a younger age and were less likely to quit than white-collar workers [12]. However, to date, interventions have not addressed tobacco cessation specifically in blue-collar workers employed in rural areas.

Worksites provide a special opportunity to promote tobacco cessation because of the physical work environment and the opportunity to continuously expose workers to health messages. Worksites can help promote and support smoking cessation efforts because they can offer multiple types of interventions repeatedly over time. These repeated contacts with smokers at varying stages may motivate quitting and increase the likelihood of successful cessation [13–15]. In addition, worksites can provide access to many rural community residents who may not be reached through other means [16–18]. Therefore, worksite interventions can be leveraged to serve as a portal to the community by disseminating tobacco cessation interventions to employees.

Currently, tobacco-related death rates are 272.4 per 100,000 for New Hampshire (NH) [19] and 247.5 per 100,000 for Vermont (VT) [20]. Overall, the percentages of adults aged 18 years and older who smoke every day or some days are 16.9% in NH and 15.4% in VT [21]. Tobacco use in NH and VT may reflect a unique combination of geographic and climate isolation, low SES, rurality, and uneven distribution of health providers [4,7]. In both states, more than 37% of people live below 125% of the poverty line [19,20]. In addition, approximately 39.7% of NH residents and 61.1% of VT residents live in rural areas [22]. The purpose of this research is to examine the effectiveness of a novel, culturally sensitive messaging worksite intervention tailored to rural blue-collar workers in NH and VT and designed to increase knowledge about the dangers of tobacco and to decrease exposure to tobacco.

2. Materials and methods

2.1. Pilot programs

Two pilot programs were conducted to, first, test the feasibility of partnering with rural blue-collar employers and, second, test the antitobacco intervention materials to ensure that the messages were culturally sensitive and literacy appropriate. The first pilot was conducted with four worksites selected based on interest in the program, a high percentage of employees with low SES, and location in a rural community. The pilot tested the feasibility of using these worksites to disseminate information and to capture baseline and follow-up intervention data. The pilot revealed that worksites were a viable portal for disseminating a tobacco intervention and that they had the infrastructure necessary to support data collection for outcome assessments. Specifically, the employers were able to consistently display intervention messages to their employees and had the infrastructure necessary to support an antitobacco intervention over time.

The second pilot study was conducted with the same four employers and sought to develop culturally sensitive material designed to increase knowledge and change behavior regarding tobacco. The pilot study included two focus groups that reviewed the pairing of the health messages with the associated images. The messages and images were identified by the focus groups as being culturally appropriate. The campaign materials consisted of nine sequential antitobacco messages.

It was determined that the worksite-based tobacco campaign could be an effective impetus for positive behavioral change in the employees and could increase their knowledge of the harms of tobacco. The data from this pilot, electronic surveys at baseline and follow-up, revealed that 73% of employees reported learning something new, 50% shared the information with a significant other, and 13% reported a positive change in their behavior (avoiding smoking in their vehicle or home).

2.2. Methods

This study was approved by the Committee for the Protection of Human Subjects at Dartmouth College and the Institutional Review Board at Upstate Medical University.

2.2.1. Design

In 2012, a quasiexperimental study was conducted with two new rural blue-collar employers; one was randomly selected to serve as the intervention worksite and the other as the comparison worksite. Criteria for selection of worksites included the following:

Table 1
Intervention themes and messages

Theme	Message overview	Image description
Nicotine impact on the brain	Tobacco addition affecting the brain	Neurological image of the brain
Chemicals in cigarette	Number of chemicals in a cigarette	Barn lined with old gas cans, propane cans, and oil cans
Harms of secondhand smoke	Cigarette toxins stay in your home and car even after the smoke leaves	Cigarette butt
Harms of chewing tobacco	Health effects of chewing tobacco	Cow chewing cud
Steps to quit	Set a goal—keep your eye on the ball	Baseball image
Benefits of quitting	Minute, hour, year benefits of quitting	Chicken with a clock
Trigger and craving	Hold on—there is support	Motorcycle biker
Teamwork can increase success	Nontobacco users can help support users	Group of ants working as a team
Reasons to quit	List of health issues related to secondhand, smokeless, cigar, and cigarettes	Jean pockets with different reasons to quit smoking

being manufacturing plants, rural location in an MUA, sufficient distance between physical plant locations to minimize cross-contamination across the two sites (> 45 minutes apart), more than 1,000 employees, similarity of employee demographics, and employer's willingness to participate in a tobacco intervention. The two largest potential employers were contacted first, next the two second largest employers were contacted, and this process continued until two employers of approximately the same size agreed to participate. Geospatial mapping confirmed that the intervention and comparison worksites were in rural and medically underserved communities.

2.2.2. Intervention materials

The pilot data, described above, were used to inform a revised version of the nine antitobacco intervention messages (Table 1). The intervention materials contained eye-catching photographic images, and were culturally and literacy sensitive to the SES and culture of the population. Materials included paycheck stuffers, email blasts, posters (both paper and electronic), flyers (both paper and electronic), and flat-screen TV ads displayed at the worksite.

Intervention materials were delivered to the intervention worksite prior to the start of the intervention. The materials were packaged according to calendar date and for ease of distribution. The intervention worksite received a binder that contained step-by-step instructions for disseminating materials. The binder listed key facility personnel with their specific roles in the health communication framework, and outlined the dates for distribution and retraction of the materials. Employees at each worksite were trained by the principal investigator on how and when to disseminate the messages.

2.2.3. Questionnaires and outcome measures

Approximately 1,500 employees at the intervention worksite and 1,000 at the comparison worksite were invited to participate in the baseline survey. Employees self-selected and self-administered baseline and follow-up paper-and-pencil surveys. Surveys were attached to hourly employee paychecks and were collected within 24 hours of distribution. Respondents received $5 cash for completing a survey. Three hundred fifty-three and 323 employees completed the baseline survey at the intervention and comparison sites, respectively. Among those who completed a baseline survey, 222 respondents (63%) completed the follow-up survey at the intervention worksite and 243 (75%) completed the follow-up survey at the comparison worksite.

The baseline and follow-up surveys contained five sections: demographics, knowledge, secondhand smoke exposure, desire to quit, and tobacco use behavior. The demographic sections included eight questions that inquired about the employees' age, gender, race, household income, height, and weight. The knowledge section was measured with a series of 10 questions that asked about the difficulty of quitting tobacco, safety of tobacco use, addiction, harmful substances in tobacco, and the dangers of secondhand smoke exposure. These questions were evaluated individually and as an overall knowledge score. For the overall knowledge score, the 10 questions were weighted equally and the participants received 1 point for each correct response, for a total score ranging from 0 to 10, with higher scores indicating more knowledge. Information on secondhand smoke exposure was obtained from a set of questions on a participant's exposure to secondhand smoke and attempts to avoid secondhand smoke exposure, including rules regarding smoking at home or in vehicle. Three questions assessed the desire to quit smoking on a scale ranging from 1 to 10. Tobacco use

Table 2
Baseline characteristics of participants by worksite

Characteristic	Intervention worksite ($n = 222$)		Comparison worksite ($n = 243$)		p
	Mean	SD	Mean	SD	
Age (y)	45.4	13.5	45.2	12.0	0.86
Gender					
Male	151	68.0	153	63.0	0.25
Female	71	32.0	90	37.0	
Race					
White	216	97.3	217	89.3	0.0007
Other	6	2.7	26	10.7	
Education					
Less than high school	10	4.5	16	6.6	0.08
High school graduate or equivalent	143	64.4	132	54.3	
At least some college	69	31.1	95	39.1	
Income ($)					
30,000	25	11.4	46	18.9	0.007
30,000–49,000	87	39.7	114	46.9	
50,000–69,000	64	29.2	54	22.2	
≥ 60,000	43	19.6	29	11.9	
Smoking status					
Current	55	24.8	66	27.2	0.53
Former	79	35.6	93	38.3	
Never	88	39.6	84	34.6	
BMI (kg/m^2)					
< 25.0	53	24.2	51	21.3	0.75
25.0–29.9	69	31.5	78	32.5	
≥ 30.0	97	44.3	111	46.3	
General health					
Poor/fair	23	10.4	32	13.2	0.54
Good	104	46.9	104	42.8	
Very good/excellent	95	42.8	107	44.0	

Data are presented as n (%) or mean ± SD.
The p values for age are for pooled t tests; all others are for chi-square statistics.
BMI, body mass index; SD, standard deviation.

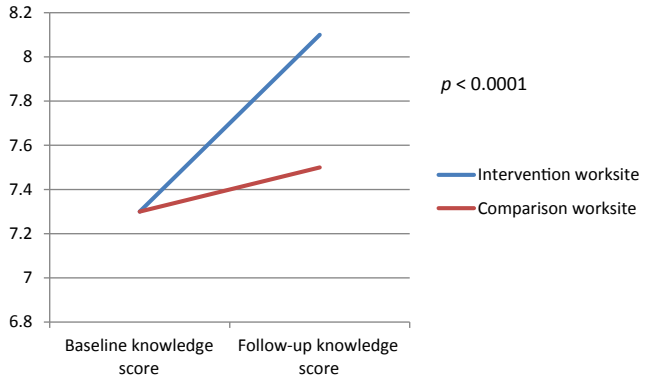

Fig. 1. Mean knowledge scores by worksite at baseline and follow-up. The *p* value is for worksite by time interaction term in a generalized linear model with repeated measures and adjusted for education and income.

behavior was assessed with five questions that explored current tobacco use, stages of change to quit using tobacco, number of cigarettes smoked per day ($\leq$ 10, 11–20, 21–30, $\geq$ 31), time from waking to first cigarette in minutes ($>$ 60 minutes, 31–60 minutes, 6–30 minutes, $\leq$ 5 minutes), and dollars spent per week on tobacco ($\leq$ \$10, \$11–20, \$21–30, \$31–40, \$41–50, \$51–60, \$61–70, \$71–80, \$81–90, $\geq$ \$91). The follow-up survey for participants at the intervention worksite also included program evaluation questions.

2.2.4. Statistical analysis

Descriptive statistics were used to compare the characteristics of participants at baseline between the two worksites, using chi-square statistics or *t* tests, where appropriate. Generalized estimating equations with repeated measures and adjusted for covariates were used to assess the intervention on the basis of the individual knowledge questions among all participants, secondhand smoke exposure questions among nonsmokers, and rules regarding smoking at home and in vehicle among smokers. Generalized linear models with repeated measures and adjusted for covariates were used to estimate the difference between the worksites in terms of mean knowledge scores among all participants, and desire to quit and tobacco use behavior among smokers. All analyses were conducted using SAS Version 9.3 (SAS Institute Inc., Cary, NC, USA).

3. Results

Table 2 displays the characteristics of participants at baseline by worksite. The intervention and comparison worksites were similar with respect to age, gender, body mass index, smoking status, and general health. Participants from the intervention worksite were more likely to report being white (97.3% vs. 89.3%, $p = 0.0007$) and having a higher income ($>$ \$60,000: 19.6% vs. 11.9%, $p = 0.007$) than participants from the comparison worksite. In addition, participants from the intervention worksite were less likely to report completing at least some college (31.1%) than participants from the comparison worksite (39.1%), although this difference was not statistically significant ($p = 0.08$).

Fig. 1 illustrates the difference in mean knowledge scores among all participants at baseline and follow-up between the intervention and comparison worksites after adjustment for education and income. Mean knowledge scores were equal at baseline at the two worksites (7.3), but differed at follow-up, with scores of 8.1 and 7.5 at the intervention and comparison worksites, respectively. The difference in the gain in knowledge over time between the worksites was statistically significant ($p < 0.0001$).

Table 3
Percentage of participants who answered the individual knowledge questions correctly at baseline and follow-up at the intervention ($N = 222$) and comparison ($N = 243$) worksites

Knowledge question	% Correct		*p*
	Baseline	Follow-up	
Hard to quit			
Intervention site	54.3	58.9	0.50
Comparison site	49.4	53.1	
Benefits of quitting			
Intervention site	52.5	72.4	0.0001
Comparison site	56.8	59.7	
Safety of tobacco			
Intervention site	79.7	80.6	0.17
Comparison site	72.0	73.3	
Causes cancer of mouth			
Intervention site	99.6	99.6	0.42
Comparison site	98.8	98.8	
Causes mouth sores			
Intervention site	98.6	98.6	0.93
Comparison site	98.8	98.8	
Causes gum disease			
Intervention site	99.6	99.6	0.63
Comparison site	99.6	99.2	
Causes tooth loss			
Intervention site	98.2	97.7	0.59
Comparison site	98.8	98.4	
Number of harmful substances			
Intervention site	24.0	62.9	< 0.0001
Comparison site	31.8	36.8	
Can harm babies			
Intervention site	30.8	46.2	0.04
Comparison site	30.5	38.3	
Secondhand smoke causes lung cancer			
Intervention site	94.6	96.9	0.34
Comparison site	93.8	94.7	

The *p* values are for the difference in worksites at follow-up after adjusting for education and income, and accounting for repeated measures.

Percentages of correct responses to the individual knowledge questions at baseline and follow-up among all participants are described in Table 3. Knowledge of illnesses caused by tobacco use and secondhand smoke exposure was generally high for both the intervention and the comparison worksites, with no statistically significant differences. After adjustment for education and income, knowledge increased from baseline to follow-up in the intervention group, but not in the comparison group with respect to two specific questions regarding the benefits of quitting tobacco ($p = 0.0001$) and the number of harmful substances present in tobacco ($p < 0.0001$). The percent of participants at the intervention

Table 4
Percentage of nonsmokers who tried to minimize secondhand smoke exposure at baseline and follow-up at the intervention ($N = 165$) and comparison ($N = 175$) worksites

Secondhand smoke exposure	Percentage		*p*
	Baseline	Follow-up	
Never or rarely exposed			
Intervention site	64.9	68.5	0.69
Comparison site	65.7	67.4	
Try to avoid exposure			
Intervention site	87.9	91.5	0.86
Comparison site	83.4	87.4	
Never allow smoking at home			
Intervention site	87.9	89.7	0.93
Comparison site	81.7	84.6	
Never allow smoking in vehicle			
Intervention site	90.9	91.5	0.42
Comparison site	85.1	89.1	

The *p* values are for the difference in worksites at follow-up after adjusting for education and income, and accounting for repeated measures.

worksite who correctly answered the question on the benefits of quitting smoking increased from 52.5% at baseline to 72.4% at follow-up, while 56.8% and 59.7% of participants at the comparison worksite answered the question correctly at baseline and follow-up, respectively. For the question on the number of harmful substances in tobacco, correct responses from participants at the intervention worksite increased from 24.0% at baseline to 62.9% at follow-up, while the increase from baseline to follow-up at the comparison worksite was only from 31.8% to 36.8%. A statistically significant difference was also found between the worksites for the question on the harm of secondhand tobacco smoke to babies and children ($p = 0.04$).

Table 4 displays behaviors of the nonsmoking participants with respect to secondhand smoke exposure. In general, nonsmokers at both worksites appeared to try to decrease exposure to secondhand smoke over the follow-up period, although none of the changes were substantial and comparisons between the worksites were not statistically significant. For example, after adjustment for education and income, the proportion of nonsmokers who reported trying to avoid secondhand smoke exposure increased from 87.9% to 91.5% at the intervention site; it also increased from 83.4% to 87.4% at the comparison worksite ($p = 0.86$).

Desire to quit smoking and tobacco use behaviors among smokers at baseline and follow-up are displayed in Table 5. After adjustment for education and income, repeated measures analysis indicated that there were no differences in motivation to quit ($p = 0.81$), interest in quitting ($p = 0.40$), or thinking about quitting ($p = 0.53$) over time between the intervention and comparison worksites. In addition, no statistically significant differences were seen over time between the worksites on tobacco use behaviors, such as money spent on tobacco per week ($p = 0.99$). While the proportion of smokers at the comparison worksite who do not allow smoking in their homes or vehicles did not increase over time, there were slight increases at the intervention worksite, although not statistically significant.

Table 5
Desire to quit smoking and tobacco use behaviors among current smokers at baseline and follow-up at the intervention ($N = 48$) and comparison ($N = 58$) worksites

	Mean (SE)		p^*
	Baseline	Follow-up	
Desire to quit smoking			
Motivation to quit			
Intervention site	6.2 (0.4)	6.0 (0.4)	0.81
Comparison site	5.3 (0.4)	5.2 (0.4)	
Interest in quitting			
Intervention site	6.8 (0.4)	6.5 (0.4)	0.40
Comparison site	5.8 (0.4)	5.7 (0.4)	
Thinking about quitting			
Intervention site	7.0 (0.5)	6.8 (0.4)	0.53
Comparison site	6.4 (0.4)	6.4 (0.4)	
Tobacco use behavior			
Stages of change			
Intervention site	2.2 (0.2)	2.3 (0.1)	0.07
Comparison site	2.2 (0.2)	1.9 (0.1)	
Money spent per week			
Intervention site	2.8 (0.3)	3.1 (0.3)	0.99
Comparison site	2.6 (0.2)	2.9 (0.3)	
Number of cigarettes smoked per week			
Intervention site	0.8 (0.1)	0.7 (0.1)	0.30
Comparison site	0.6 (0.1)	0.6 (0.1)	
Time to first cigarette at waking			
Intervention site	1.5 (0.2)	1.4 (0.1)	0.65
Comparison site	1.2 (0.1)	1.2 (0.1)	
	Percentage		$p^\dagger$
	Baseline	Follow-up	
Never allow smoking at home			
Intervention site	52.1	54.2	0.88
Comparison site	60.3	60.3	
Never allow smoking in vehicle			
Intervention site	27.1	29.2	0.12
Comparison site	24.1	17.2	

* The p values are for worksite by time interaction term in a generalized linear model with repeated measures and adjusted for education and income.
† The p values are for the difference in worksites at follow-up after adjusting for education and income, and accounting for repeated measures.
SE, standard error.

4. Discussion

This intervention offered a novel approach to addressing tobacco prevention and cessation among persons who may be at high risk for smoking—blue-collar employees working in rural areas. We developed a tailored, culturally sensitive intervention designed to be delivered by designated employers at a worksite. We found that participants at the intervention worksite increased their knowledge regarding the dangers of tobacco use and secondhand smoke exposure. Specifically, they were more aware of the number of harmful substances, the health benefits of quitting tobacco, and the harm to babies and children. The intervention, however, did not reduce exposure to secondhand smoke or tobacco use overall, nor did it positively impact desire to quit or tobacco use behaviors among smokers.

There are several plausible reasons why we may not have seen notable changes in tobacco use behavior as a result of the tobacco cessation messaging. First, the time between the baseline and follow-up surveys may not have been long enough to motivate major behavior change. Therefore, future studies should incorporate a longer follow-up period. In addition, information on the frequency and duration of exposure to the intervention was not obtainable, thereby missing any dose–response effect of the messaging. We also acknowledge the possibility of cross-contamination between the worksites; however, the facilities were located 55 miles apart (a 2-hour drive), thus minimizing this possibility. In addition, we did not collect information on some factors that are known to influence smoking behaviors, such as alcohol consumption and stress [23,24]. Our results could potentially be affected by uncontrolled confounding if these factors differed across the worksites. Finally, future studies should incorporate the role of tobacco policies at a worksite. In this case, the intervention worksite did not have a policy regarding tobacco use outdoors on the facility property, whereas the comparison worksite had a smoke-free campus. Therefore, the comparison using this particular worksite may have underestimated the potential impact of the intervention.

The effectiveness of antitobacco messaging alone as an impetus for change in tobacco use behavior has been inconsistent [25]; therefore, one of the primary purposes of the intervention was to increase knowledge of the dangers of tobacco use. This study was able to demonstrate that the intervention effectively increased knowledge. The results could have been biased by the low overall response rate at each worksite, and because the participants were self-selected and possibly more eager to learn about the dangers of tobacco use. However, baseline knowledge at the worksites was similar, and results were adjusted for demographic characteristics that differed between the worksites and were likely to impact knowledge. Therefore, while the sample of participants may have impacted the generalizability of the findings, it is unlikely to have biased the results of the success of the intervention.

While we did not see a reduction in tobacco use among smokers at follow-up, some smokers at baseline quit tobacco during the follow-up period. Among current smokers at baseline, 9.6% quit at the intervention worksite, while 7.6% quit at the comparison worksite, yielding a 2% higher incidence of quitting for those in the intervention group. The annual expense to the employer for

tobacco use is approximately $3,283 per year per tobacco user in terms of medical costs [26]. Therefore, based on our results, a worksite with approximately 1,000 employees receiving the intervention could expect approximately 20 employees to quit using tobacco due to this intervention, resulting in an annual savings of $65,660 in medical costs.

Overall, the tobacco intervention was well received by both the employers and the employees. All respondents in the intervention group reported seeing the tobacco messages. The majority of respondents reported that they learned something new (96%) and noticed their colleagues talking about the messages at least sometimes (58%). In addition, almost half (48%) shared the information with someone at home.

We found that rural blue-collar employers are interested in collaborating with public health initiatives to help improve health outcomes for their staff.

Conflicts of interest

The authors have no conflicts of interest to declare.

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