7-2017

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Funding: Research reported in this publication was supported by a research grant (R21CA161169) from the National Cancer Institute of the National Institutes of Health (NIH) and by the Washington University Institute of Clinical and Translational Sciences grant UL1 TR000448 & TL1 TR000449 from the National Center for Advancing Translational Sciences (NCATS) of the NIH. The content is solely the responsibility of the authors and does not necessarily represent the official view of the NIH.

Conflicts of Interest: None Declared

Acknowledgements: We would like to thank the St. Louis-Kansas City Carpenters Regional Council for facilitating access to and recruitment of union members.

Running Title: Construction worker health behaviors and concerns

Keywords: Construction, health behavior, risk perception, health disparity

ABSTRACT:

Objective: This study aimed to evaluate construction workers' health behaviors, attitudes, and perceptions of health risks from work related and non-work related hazards.

Methods: Construction workers completed a survey that assessed hazardous health behaviors (such as alcohol and tobacco use), attitudes toward health, and health risk perceptions. We compared construction workers' health behaviors to general population data from the Behavioral Risk Factor Surveillance System.

Results: Construction workers reported greater smoking and drinking compared to their age-adjusted white male counterparts in Missouri. While there was a high awareness of work-related health and safety risks, concerns about general health risks did not correspond with risks from relevant health behaviors.

Conclusion: Educational efforts have created awareness of work-related safety and health issues in this population; similar efforts are needed to address disparities of general health behaviors.

INTRODUCTION:

Construction continues to be one of the most dangerous industries in the in United States. While the number of fatalities related to construction have decreased over time, the rate of non-fatal and fatal injury are still high, with 9.4 deaths per 100,000 full time equivalent workers reported in 2010 (1). The estimated direct and indirect cost of fatal and nonfatal construction injuries totaled $13 billion (2002 dollars), and the medical expenses of nonfatal injuries alone totaled $1.36 billion per year (1). For these reasons, many efforts to decrease workplace injuries and work-related disease risks have been implemented among construction workers (2). Less attention has been paid to other disparities in health behaviors that put construction workers at higher risk of chronic diseases (3-5).

A number of studies have documented high rates of smoking, alcohol, and other substance use in the construction trades (6-8). While overall smoking rates have declined in recent years, there continues to be a substantial disparity among different occupational groups (9, 10). National data show that smoking rates among blue collar workers are more than twice those of white collar workers (10, 11). Specifically, construction is consistently among the highest smoking industries, with recent reports showing it just behind mining/extraction (38.5% vs. 39.9%, respectively) (10, 12, 13). A strong association between occupation and alcohol use has also been noted, with workers in physically demanding occupations reporting drinking more frequently, drinking in larger quantity, and more frequently binge drinking (14). These reported behaviors are associated with workplace injuries, as well as excess smoking and alcohol related deaths among construction workers (15, 16).

Obesity, seatbelt use, and sunscreen use are other important risk factors for chronic conditions and injuries in construction workers given the nature of their work (e.g. manual labor, outdoor work, long commutes to work and motor vehicle operation as part of work). Recent reports cite obesity prevalence in construction workers around 28% (17, 18) and studies in construction workers show that workplace injuries increase as body mass index (BMI) increases (19, 20). A report examining self-

reported seatbelt use by occupation in 21 states showed that construction workers had the highest rate of not wearing seatbelts (14%) in states with primary seatbelt laws, and the second highest rate (32%) in states with secondary seatbelt laws (21). Several studies in Europe and Australia have reported low rates of sunscreen use in construction workers, while studies in the US have focused on outdoor workers in industries other than construction (22). In the 2005 National Health Interview Survey, about half of participants reported infrequently using sunscreen and this was associated with being male, less educated, smoking, and engaging in risky drinking (23).

Risk perception is at the center of many health and safety behavior theories, though the relationship between perceived risk and behavior varies across behaviors (24). Much effort has been devoted to studying risk perception as it relates to workplace safety behavior and safety climate (25, 26), and it is common practice to address risk perceptions through workplace safety training (27). Construction workers' perceptions of health risk factors has not been explored, and thus less attention has been given to educating workers on the risks of lifestyle behaviors (e.g. smoking and sunscreen use) and the additional implications of their health behaviors due to the nature of their work (e.g. respirable dust interacting with smoking and greater sun exposure than indoor workers). The goal of this study was to examine health behaviors and risk perceptions among construction workers in two trades, carpentry and floor-laying. We compared carpenters' and floor layers' reported health behaviors to those reported by other white males in Missouri. We assessed construction workers' concerns about work related and non-work related health risks, and examined worker attitudes toward workplace smoking.

METHODS:

Study Design and Participants

We conducted a health survey of union construction workers to assess health behaviors and attitudes; the main function of the survey was to identify current smokers for recruitment into a smoking cessation intervention. Study eligibility requirements included being at least 18 years of age

and eligible for union health benefits. Union construction workers from two trades, carpentry and floor-laying, were recruited at training classes and union meetings from April 2012 through January 2013. The research team distributed consent forms and surveys to all workers in attendance, explained the purpose of the study, and invited those who met eligibility criteria to participate. After providing consent, subjects completed a self-administered questionnaire including items on demographics, multiple health behaviors, and attitudes toward health. Surveys were collected on the same day, and participants were given a $5 gas card. Survey items were selected based on their relevance to smoking cessation and attitudes regarding workplace smoking policies, since the primary purpose of the survey was to identify smokers to participate in a union-based smoking cessation intervention. We also queried other behaviors, attitudes, and health issues that could be used to develop targeted messaging related to smoking cessation in this population. Questions were adapted from several relevant questionnaires. Questions on smoking behaviors were obtained from the Fagerstrom Test for Nicotine Dependence (28), and the Smoking Adult Stage of Change Short Form (29). Questions on frequency and quantity of alcohol use were obtained from the Health at Work Survey administered by the World Health Organization (30), and questions about health attitudes and concerns were created for this study based in part on Prochaska's theory of stages of change (31).

We compared responses to those from a similar sample from the Behavioral Risk Factor Surveillance System (BRFSS), a nationally administered study conducted by the Center for Disease Control (CDC). The BRFSS surveys more than 400,000 adults annually in the US, and collects data on multiple health related risk behaviors, chronic health conditions, and preventative practices related to leading causes of morbidity and mortality. We used publically available 2013 BRFSS data on smoking and drinking rates, as well as seatbelt use and weight trends. To ensure appropriate comparison of our predominately white male sample to the general population, we restricted each dataset to white males living in Missouri. In addition, we performed direct age standardization of the BRFSS data using 5 year

age strata to calculate comparable age-matched population rates to our construction worker sample (32). The 2013 BRFSS in total interviewed 491,773 adults, of which 1915 were white males from Missouri. This study was approved by the Institutional Review Board of Washington University in St. Louis.

Definitions

Tobacco use

Participants who reported smoking within the last 30 days were defined as current smokers in our survey. The BRFSS defined current smokers as those who had smoked at least 100 cigarettes in their lifetime and reported that they currently smoked some days or every day.

Alcohol use

Our survey assessed the frequency of alcohol use and quantity consumed among the construction workers. Frequency of alcohol use was assessed by the question "In the past 30 days, how often did you drink any type of alcoholic beverage?" Potential responses included "I did not drink in the past 30 days," "once a month," "2-3 days/month," "once a week," "2-3 days/week," "nearly every day (4+ a week)," and "every day." In the BRFSS, study participants were asked how many days per week or per month they had at least one drink during the past 30 days. The continuous variable from the BRFSS was coded to match the response categories of our questionnaire. For purposes of data presentation, we condensed these categories into four categories: did not drink, drank a few times a month, a few times a week, and every day/nearly every day.

We assessed quantity of alcohol consumed by asking subjects how many drinks on average they had per week in the past 30 days. Response options were: I did not drink in the past 30 days; 1-4 drinks per week; 5-9 drinks per week; 10-19 drinks per week; 20-29 drinks per week; or 30+ drinks per week. The BRFSS used a continuous scale to ask participants how many drinks they had, on average, on days that they drank in the past 30 days. We calculated drinks per week from the BRFSS frequency and

quantity questions, and coded these BRFSS values into the categories of our survey. For purposes of data presentation these categories were collapsed to "did not drink in the past 30 days," "less than 5 drinks per week," "5 – 19 drinks per week," and "20 or more drinks per week."

Using the definitions from the Substance Abuse and Mental Health Services Administration, we defined *heavy drinking* as having 5 or more alcoholic drinks in one day, on 5 or more days in the past 30 days (33). In both our construction sample and the BRFSS, heavy drinking was assessed by asking participants how many days in the past 30 they had 5 or more drinks on a single occasion. We coded responses into three categories: none, 1 to 5 times in the past 30 days, or 5 or more times in the past 30 days.

Seatbelts

We asked participants if they consistently used seatbelts in the car; possible responses were "Yes, I have been for more than 6 months," "Yes, I have been but for less than 6 months," "No, but I intend to in the next 30 days," "No, but I intend to in the next 6 months," and "No and I do not intend to in the next 6 months." These responses were collapsed to "Yes" or "No" for current seatbelt use in the analysis. The BRFSS responses for seatbelt use were "always," "nearly always," "sometimes," "seldom," and "never;" these responses were collapsed to "Yes" or "No," with "always," "nearly always," and "sometimes" coded as Yes.

Body Mass Index (BMI)

We calculated BMI from self-reported height and weight, using the formula ((weight in pounds/ height in inches ^{2})*703). We segmented our group based on the definitions of normal/underweight (BMI<25), overweight (BMI≥25), obese (BMI ≥30) and morbidly obese (BMI≥40). The BRFSS provided individually calculated BMI that we coded into the above categories.

Health concerns

We asked construction workers to rate their level of concern for several health issues resulting from specific diseases (heart disease, diabetes, cancer), health behaviors (smoking, drinking alcohol, obesity), occupation related concerns (dust/fume inhalation, falls and injuries), and motor vehicle accidents using a six point scale from 1 (not at all concerned) to 6 (very concerned). We divided our responses into either concerned or not concerned based on a response of 1-3 as not concerned and a response of 4-6 as concerned.

Worksite Smoking effects on Safety and Productivity

We assessed construction workers' attitudes toward smoking at work by asking if they thought smoking should be allowed at the worksite, and if they would prefer to work at a non-smoking site. We also asked to what extent the subjects believed that smoking by crew members hurt job performance or reduced worksite safety; response options were "Not at all," "A little," "Some," and "A lot."

Data Analysis

We conducted descriptive analyses to report the prevalence of health behaviors and attitudes among construction workers in our sample. To compare our study population to the BRFSS data of white males in Missouri, we used robust Poisson regression to calculate prevalence ratios with 95% confidence intervals. The age standardization of the BRFSS group was done through 5-year age categorical groups in order to standardize the BRFSS population age distribution to that of the construction workers.

We stratified the health concern results by median age, health conditions (obese versus not obese), and presence/absence of health behaviors (smoking, heavy drinking, seatbelt use, and sunscreen use) to determine if concerns about health were appropriately different based on relevant risk factors. We also compared attitudes about workplace smoking by smokers and non-smokers. All data analysis was done using SPSS v.22 and R v. 3.2.0 (34, 35).

RESULTS

A total of 1937 eligible construction workers were invited to complete the survey, and 1636 participated (response rate 84.5 %). In our sample, the median age was 38 years, with 1611 male and 21 female participants. The majority, identified themselves as white (90.9%), with the second highest being African-Americans (6.6%). More than half of the sample was married (56.2%), 30.2% were single, 13.6% were divorced/separated/widowed. Most workers had children (70.1%); most had at least a high school diploma or GED (98.3%), with 34.9% reporting some college and 5.5% having a college degree. More than one third of construction workers reported current smoking (34.3%), 20% reported drinking nearly every day to everyday, 13.2% workers reported drinking 20 or more drinks per week, and 29.5% reported binge drinking 5 or more times in the past 30 days. Seatbelt use was common, but 15.6% participants did not regularly wear seatbelts in the car. Only 42.0% reported regular sunscreen use; 41.6% said they do not use sunscreen and have no intention to use it in the next six months. Based on calculated BMI from self-reported weight and height, 45.6% of workers were overweight, 25.2% were classified as obese, and 1.7% were morbidly obese. Finally, on average our construction workers drove 284.8 miles to work each week.

Comparison to BRFSS data

Of the 1636 trade workers who completed the survey, 1464 (89.4%) identified as white males, and were selected for comparison to the BRFSS data. Table 1 compares white male construction workers to their age standardized white male counterparts in Missouri. Compared to the BRFSS sample, the construction workers had higher rates of current smoking (PR=1.43), reported a higher frequency of alcohol use (PR=1.79 for drinking nearly every day to every day), a higher quantity of alcohol consumption (PR= 2.56 for drinking $\geq$20 drinks per week), and a markedly higher frequency of binge drinking (PR=5.58 for binge drinking on 5 or more occasions in the past 30 days). Construction workers were also more likely to report that they did not consistently use seatbelts (PR=1.08). Construction

workers were more likely to be overweight compared to the general population (46.2% vs. 39.2%), but less likely to be obese (24.6% vs. 27.2%) or morbidly obese (1.9% vs. 3.1%).

Construction Workers' Concerns for Pertinent Health Issues

We compared the proportions of construction workers who expressed health concerns about different injuries, diseases, and exposures. Overall, construction workers had similar levels of concern for work-related injuries and workplace dust/fume exposure as they did for cancer and heart disease (Table 2), but they demonstrated less concern for diabetes, obesity, smoking, drinking, and car accidents. Compared to older workers, younger workers were less concerned about health conditions, but had similar concerns about work-related conditions, accidents, smoking, and drinking.

We examined health concerns related to smoking, alcohol use, and to obesity. Only half of smokers reported being concerned about smoking, and their concern for other health conditions, including heart disease, cancer, and dust/fumes exposure, was similar to non-smokers. Only 13.1% of heavy drinkers were concerned about their drinking. Overall, heavy drinkers showed less concern for all other diseases, injuries, and behaviors compared to non-heavy drinkers. Obese workers reported concern for heart disease (49.9%), diabetes (38.2%), and obesity (41.5%) more frequently than non-obese workers, but concern for job injury was similar in both groups. Additionally, obese workers reported greater concern for dust/fume inhalation than for obesity-related diseases.

We examined seatbelt and sunscreen use for related conditions. Few workers who did not wear seatbelts reported concern for car accidents (19.7%) or job injuries (38.4%), a lower prevalence than among those who regularly wore seatbelts (21.1% and 51%, respectively). Finally, concern for cancer and job injury was higher among workers who reported wearing sunscreen compared to those who did not (52.4% vs. 43.8% for cancer; and 52.6% vs. 46.4 % for job injuries).

Worksite Smoking effects on Safety and Productivity

We assessed construction workers' opinions about smoking and its impact at the worksite (Table 3). The majority of non-smokers thought that smoking should not be allowed on worksites; in contrast, only 17.5% of current smokers thought smoking should not be allowed. Similarly, 65.7% of non-smoking construction workers preferred to work on sites without smoking, compared to 11.5% of smokers. When exploring the links between smoking, work productivity, and work safety, 55.5% of non-smokers reported that smoking by other crew members hurt job performance "Some / A lot" compared to only 19.8% of smokers. Thirty-nine percent of non-smokers reported that smoking reduced workplace safety "Some/A lot" compared to only 14.4% of current smokers.

DISCUSSION

Our results highlight several important trends in health behaviors and health concerns among construction workers, a large and growing segment of the working population with recognized health disparities. Consistent with previous literature, we found that construction workers were more likely to smoke, to drink alcohol more frequently and heavily, and to report less seatbelt use when compared to the general population. Construction workers' concerns about specific health conditions were often incongruent with health and injury risks posed by their behaviors. We also observed a sharp contrast between current smokers and non-smokers with regard to perceptions of the effects of smoking on safety and productivity, and on whether smoking should be allowed on worksites.

Among our study group of construction workers, we observed a high prevalence of smoking, with more than a third (34.3%) reporting current smoking. This value was almost twice the percentage (17.8%) of current smokers nationally (36). Our findings agreed with other studies that reported smoking rates among blue collar workers are almost twice of those among white collar workers (10). In addition, construction workers drank alcohol more frequently, consumed more alcohol, and reported a strikingly high rate of binge drinking. These findings are congruent with previous studies showing higher levels of alcohol use among manual workers (14).

Our study showed discordance between health concerns and health risks among our construction worker population. Among all workers, there was less concern for drinking and smoking compared to concern about work related hazards like dust/fume inhalation and onsite job injury, even among smokers and heavy drinkers. While work injury and dust inhalation represented significant risks of injury and chronic illness to construction workers, these risks are likely smaller for most workers than the very high attributable mortality for smoking (37). Almost the same proportion of smokers as non-smokers expressed concern for heart disease, cancer, and dust and fume inhalation at work, despite the well-known increased risks of heart disease (38) and lung cancer (39) associated with smoking, and the additive or synergistic effects of smoking on pulmonary disorders associated with workplace dust and fume inhalation (40). There was remarkably little concern over alcohol use in this group, despite the high levels of reported drinking, and known increased mortality from drinking associated disorders among construction workers.

Construction workers also reported less frequent seatbelt use (15.6% did not consistently wear seatbelts when driving), despite being at higher risk for motor vehicle fatalities. Construction workers often drive as part of their job duties, so are at risk from motor vehicle fatalities at work. A less appreciated risk is the long distances that construction workers routinely drive in commuting to geographically dispersed worksites. As reported by the U.S. Bureau of Transportation, the average American worker drives 153 miles a week to work and back (41), while our construction workers reported an average weekly commute of 285 miles per week. Lengthy commutes, coupled with lack of seatbelt use, results in construction workers exposing themselves to more risk when driving compared to other workers. Our data also found that those who did not wear seatbelts were also less concerned about car accidents or job injury. Workers also reported infrequent sunscreen use and few intended to use sunscreen despite working outdoors. As suggested by Hakes et al. (42), these findings may be due to a propensity to take risks among those who do not wear seatbelts. Failure to use seatbelts and

sunscreen is likely connected to workers' perceptions of risk, which has been shown to influence use of personal protective equipment for hearing protection and other disorders (43); perception of risk sufficient to alter current behavior is particularly difficult to encourage for disorders such as hearing loss or skin cancer, where the health effect is not manifest for many years after the exposure.

Our study showed that construction workers are more likely to be overweight than the general population (though less likely to be obese). Though being moderately overweight may not be associated with increased mortality in construction workers (44), being overweight may result in greater morbidity from cardiovascular disease, diabetes, or disability related to osteoarthritis (45). When compared to non-obese workers, obese workers were more likely to be concerned about heart disease, diabetes, and obesity, an example of an appropriately concordant health concern. However, obese workers were less concerned about job injuries, although some literature suggests that obesity increases the risk of work related acute injuries (16). Among populations with heavy physical work demands, both work and obesity also increase the risk of chronic musculoskeletal disorders of the low back, lower extremity, and upper extremity (46-48).

Non-smokers and smokers differed in their perceptions of the effects of smoking on safety and productivity, and on whether smoking should be allowed on worksites. A large fraction of non-smokers reported that smoking hurts job performance and safety; the majority of them preferred to work on a non-smoking worksite and preferred that smoking not be allowed at worksites. These links between smoking and perceived productivity and safety have been little explored, and provide additional justification for worksite policies banning smoking. Non-smoking policies at construction sites are more often established by the owner rather than the general contractor, and construction has been slower than other industries to adopt non-smoking policies, with only 67.8% of construction workers reporting a restriction on worksite smoking compared to 90.7% of white collar workers in the 2006-2007 Current Population Survey-Tobacco Use Supplement data (10).

Recent literature has described relationships between workplace safety climate, risk perception, and individual behaviors, including use of personal protective equipment and smoking (49, 50). Higher smoking rates and lower rates of PPE use were seen among workers who reported lower levels of belief that safety was valued in their workplace (49). Previous studies have described links between smoking and work-related hazards, and have attempted to simultaneously address workplace safety to improve smoking cessation among construction workers (50). To our knowledge, our data are the first to show large differences in belief among smoking and non-smoking construction workers about the effects of smoking on workplace safety and work productivity, and to show that many workers would prefer non-smoking sites.

There were several limitations to our study. Our survey question formats were somewhat different than the BRFSS format, resulting in the need to re-code data for comparison as described in the Methods section. While question format may account for some of the differences seen between construction workers and our reference population, it seems unlikely that the large differences in health behaviors seen between construction workers and the general male population can be attributed to question format alone. Our data come from self-reported behaviors, which may cause inaccuracy in reporting – most likely in the direction of reporting better health behaviors than actual, making our results all the more striking. The respondents of our survey were all unionized carpenters and floor layers in the St. Louis metropolitan region; however, the demographic of construction workers across the country includes many non-unionized workers, including many Hispanic workers, who may have different health behaviors and concerns. Additionally, workers in other construction trades may have different workplace exposures and policies that influence their health and attitudes. Finally, this study looked at health concern in a very broad scope, and it is likely that a more detailed examination of individual concerns would yield a clearer picture as to why perception of non-work related health concerns were different from work related.

Strengths of our study include its large sample size, its assessment of both health behaviors and concerns, and our questions on the perceived effects of health behaviors on safety and productivity.

In conclusion, our findings showed that there was a large difference in health behaviors between construction workers and their white male counterparts in Missouri. The construction workers generally showed a high concern for work-related health and safety risks, but concerns about their non-work related health behaviors did not correspond with the related health risks. Perceived health risks including cardiovascular disease, smoking, alcohol related illnesses, and automobile accidents did not correspond appropriately to reported behaviors. This discordance creates a public health opportunity in this large worker group. Educational efforts to improve construction safety have been successful in creating awareness of work-related safety and health issues and in changing safety behaviors in this population (51). A variety of national and local programs have addressed workplace safety and health and have created channels for influencing the construction industry. Similar efforts are needed to address observed disparities in important health behaviors among this high risk worker population.

Statement of Clinical Significance

This study highlights disparities in personal health behaviors among construction workers, and demonstrates a misalignment between their health behaviors and health risk perceptions. Education efforts are needed to create awareness of the health and safety risks associated with personal behaviors, especially for risks that may be amplified by construction work.

References

1. CPWR - The Center for Construction Research and Training, ed. *The Construction Chartbook*. Silver Spring, MD; 2013.

2. National Research Council. *Construction Research at NIOSH: Reviews of Research Programs of the National Institute for Occupational Safety and Health*. Washington, DC: The National Academies Press; 2009.

3. Dong XWS, Wang XW, Daw C, Ringen K. Chronic Diseases and Functional Limitations Among Older Construction Workers in the United States: A 10-Year Follow-up Study. *J Occup Environ Med*. 2011;53:372-380.

4. Barbeau E, McLellan D, Levenstein C, DeLaurier G, Kelder G, Sorensen G. Reducing occupation-based disparities related to tobacco: roles for occupational health and organized labor. *Am J Ind Med*. 2004;46:170-179.

5. Arias OE, Caban-Martinez AJ, Umukoro PE, Okechukwu CA, Dennerlein JT. Physical Activity Levels at Work and Outside of Work Among Commercial Construction Workers. *J Occup Environ Med*. 2015;57:73-78.

6. Lipscomb HJ, Dement JM, Li LM. Health care utilization of carpenters with substance abuse-related diagnoses. *Am J Ind Med*. 2003;43:120-131.

7. Armour BS, Woollery T, Malarcher A, Pechacek TF, Husten C. Annual smoking-attributable mortality, years of potential life lost, and productivity losses - United States, 1997-2001 (Reprinted from MMWR, vol 54, pg 625-628, 2005). *JAMA-J Am Med Assoc*. 2005;294:788-789.

8. Smith D. Tobacco smoking by occupation in Australia and the United States: a review of national surveys conducted between 1970 and 2005. *Ind Health*. 2008;46:77-89.

9. Giovino GA, Pederson LL, Trosclair A. The prevalence of selected cigarette smoking behaviors by occupational class in the United States. *Work, Smoking, and Health: A NIOSH Scientific Workshop*. Washington, DC: Centers for Disease Control and Prevention; 2000:22-31.

10. Ham DC, Przybeck T, Strickland JR, Luke DA, Bierut LJ, Evanoff BA. Occupation and Workplace Policies Predict Smoking Behaviors: Analysis of National Data From the Current Population Survey. *J Occup Environ Med*. 2011;53:1337-1345.

11. Barbeau E, Krieger N, Soobader M. Working class matters: socioeconomic disadvantage, race/ethnicity, gender, and smoking in NHIS 2000. *Am J Public Health*. 2004;94:269-278.

12. Lee D, Fleming L, Arheart K, et al. Smoking rate trends in U.S. occupational groups: the 1987 to 2004 National Health Interview Survey. *J Occup Environ Med*. 2007;49:75-81.

13. Graber JM, Delnevo CD, Manderski MT, et al. Cigarettes, Smokeless Tobacco, and Poly-Tobacco Among Workers in Three Dusty Industries. *J Occup Environ Med*. 2016;58:477-484.

14. Barnes AJ, Zimmerman FJ. Associations of occupational attributes and excessive drinking. *Soc Sci Med*. 2013;92:35-42.

15. Robinson C, Stern F, Halperin W, et al. Assessment of mortality in the construction industry in the United States, 1984-1986. *Am J Ind Med*. 1995;28:49-70.

16. Gu JK, Charles LE, Fekedulegn D, Ma CC, Andrew ME, Burchfiel CM. Prevalence of Injury in Occupation and Industry: Role of Obesity in the National Health Interview Survey 2004 to 2013. *J Occup Environ Med*. 2016;58:335-343.

17. Luckhaupt SE, Cohen MA, Li J, Calvert GM. Prevalence of obesity among U.S. workers and associations with occupational factors. *Am J Prev Med*. 2014;46:237-248.

18. Gu JK, Charles LE, Bang KM, et al. Prevalence of Obesity by Occupation Among US Workers The National Health Interview Survey 2004–2011. *J Occup Environ Med*. 2014;56:516-528.

19. Claessen H, Arndt V, Drath C, Brenner H. Overweight, obesity and risk of work disability: a cohort study of construction workers in Germany. *Occup Environ Med*. 2009;66:402-409.

20. Dong XS, Wang X, Largay JA. Occupational and non-occupational factors associated with work-related injuries among construction workers in the USA. *Int J Occup Environ Health*. 2015;21:142-150.

21. Boal WL, Li J, Rodriguez-Acosta RL. Seat Belt Use Among Adult Workers - 21 States, 2013. *MMWR Morb Mortal Wkly Rep*. 2016;65:593-597.

22. Reinau D, Weiss M, Meier CR, Diepgen TL, Surber C. Outdoor workers' sun-related knowledge, attitudes and protective behaviours: a systematic review of cross-sectional and interventional studies. *Br J Dermatol*. 2013;168:928-940.

23. Coups EJ, Manne SL, Heckman CJ. Multiple skin cancer risk behaviors in the U.S. population. *Am J Prev Med*. 2008;34:87-93.

24. Brewer NT, Chapman GB, Gibbons FX, Gerrard M, McCaul KD, Weinstein ND. Meta-analysis of the relationship between risk perception and health behavior: the example of vaccination. *Health Psychol*. 2007;26:136-145.

25. Geller ES. *Working safe: How to help people actively care for health and safety*: CRC Press; 2001.

26. Hallowell M. Safety risk perception in construction companies in the Pacific Northwest of the USA. *Construction Management and Economics*. 2010;28:403-413.

27. Rodríguez-Garzón I, Lucas-Ruiz V, Martínez-Fiestas M, Delgado-Padial A. Association between Perceived Risk and Training in the Construction Industry. *Journal of Construction Engineering and Management*. 2015;141.

28. Heatherton TF, Kozlowski LT, Frecker RC, Fagerstrom KO. The Fagerstrom Test for Nicotine Dependence: a revision of the Fagerstrom Tolerance Questionnaire. *Br J Addict*. 1991;86:1119-1127.

29. Cancer Prevention Resource Center. 2016. Smoking: Adult stage of change (short form). University of Rhode Island. [Accessed on: August 23, 2016]. http://web.uri.edu/cprc/smoking-adult-stage-of-change-short-form/

30. World Health Organization. 2001. Health at Work Survey. [Accessed on: 2015]. http://www.hcp.med.harvard.edu/hpq/ftpdir/HPQ%20Employee%20Version%2081810.pdf

31. Nigg CR, Burbank PM, Padula C, et al. Stages of change across ten health risk behaviors for older adults. *Gerontologist*. 1999;39:473-482.

32. Rothman K, Greenland S. *Modern epidemiology*. Philadelphia: Lippincott-Raven; 1998.

33. Substance Abuse and Mental Health Services Administration, Office of Applied Studies. Substance Use Disorders. [Accessed on: September 1, 2016]. http://www.samhsa.gov/disorders/substance-use

34. IBM Corp. IBM SPSS Statistics for Windows. Armonk, NY: IBM Corp.; 2013.

35. R Core Team. R: A Language and Environment for Statistical Computing. Vienna, Austria: R Foundation for Statistical Computing; 2015.

36. Centers for Disease Control and Prevention. Smoking and Tobacco Use: Fact Sheet. [Accessed on: July 20, 2015]. http://www.cdc.gov/tobacco/data_statistics/fact_sheets/fast_facts/

37. Carter BD, Abnet CC, Feskanich D, et al. Smoking and mortality--beyond established causes. *N Engl J Med*. 2015;372:631-640.

38. Hjermann I, Holme I, Byre KV, Leren P. Effect of diet and smoking intervention on the incidence of coronary heart disease. Report from the Oslo Study Group of a randomised trial in healthy men. *Lancet*. 1981;2:1303-1310.

39. Hecht SS. Tobacco smoke carcinogens and lung cancer. *J Natl Cancer Inst*. 1999;91:1194-1210.

40. Dement J, Welch L, Ringen K, Quinn P, Chen A, Haas S. A case-control study of airways obstruction among construction workers. *Am J Ind Med*. 2015.

41. Bureau of Transportation Statistics, US Department of Transportation. 2003. [Accessed on: January 13, 2017]. https://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/omnistats/volume_03_issue_04/pdf/entire.pdf

42. Hakes JK, Viscusi WK. Automobile seatbelt usage and the value of statistical life. *Southern Economic Journal*. 2007;73:659-676.

43. Arezes PM, Miguel AS. Hearing protection use in industry: The role of risk perception. *Safety science*. 2005;43:253-267.

44. Arndt V, Rothenbacher D, Zschenderlein B, Schuberth S, Brenner H. Body mass index and premature mortality in physically heavily working men - a ten-year follow-up of 20,000 construction workers. *J Occup Environ Med*. 2007;49:913-921.

45. Field AE, Coakley EH, Must A, et al. Impact of overweight on the risk of developing common chronic diseases during a 10-year period. *Arch Intern Med*. 2001;161:1581-1586.

46. Knutsson B, Sandén B, Sjödén G, Järvholm B, Michaëlsson K. Body mass index and risk for clinical lumbar spinal stenosis: A cohort study. *Spine*. 2015;40:1451-1456.

47. Fan ZJ, Harris-Adamson C, Eisen EA, et al. Associations between Workplace Factors and Carpal Tunnel Syndrome: A Multi-site Cross Sectional Study. *Am J Ind Med*. 2015;58:509-518.

48. Evanoff A, Sabbath EL, Carton M, et al. Does obesity modify the relationship between exposure to occupational factors and musculoskeletal pain in men? Results from the GAZEL cohort study. *PLoS One*. 2014;9:e109633.

49. Dutra LM, Kim SS, Williams DR, Kawachi I, Okechukwu CA. Worksite safety climate, smoking, and the use of protective equipment by blue-collar building workers enrolled in the MassBUILT smoking cessation trial. *J Occup Environ Med*. 2014;56:1082-1087.

50. Okechukwu CA, Krieger N, Sorensen G, Li Y, Barbeau EM. MassBuilt: Effectiveness of an apprenticeship site-based smoking cessation intervention for unionized building trades workers. *Cancer Causes Control*. 2009;20:887-894.

51. Kaskutas V, Buckner-Petty S, Dale AM, Gaal J, Evanoff BA. Foremen's intervention to prevent falls and increase safety communication at residential construction sites. *Am J Ind Med*. 2016;59:823-831.

Table 1: Construction Workers' Health Behaviors Compared to Age Adjusted White Males in Missouri

	White Male Construction Workers n = 1464	BRFSS - White Males in MO n=1908	Prevalence Ratio (95% CI)
Current Smoker, yes	35.1%	24.5%	1.43 (1.29 - 1.59)
Alcohol use - frequency			
Did not drink in the past 30 days	16.6%	41.7%	0.40 (0.35 - 0.45)
Few times a month	36.8%	32.3%	1.41 (1.04 - 1.25)
Few times a week	25.2%	14.0%	1.80 (1.56 - 2.07)
Nearly every day / Everyday	21.4%	11.9%	1.79 (1.53 -2.20)
Alcohol use - quantity			
Did not drink in the past 30 days	20.7%	41.7%	0.50 (0.44 - 0.56)
Less than 5 drink per week	31.2%	31.4%	0.99 (0.90 - 1.10)
Less than 20 drinks per week	34.1%	21.4%	1.59 (1.42 - 1.78)
20 or more drinks per week	14.1%	5.5%	2.56 (2.04 - 3.22)
5+ alcoholic drinks/day (last 30 days)			
None	39.5%	72.9%	0.54 (0.50 - 0.58)
Less than 5 days	29.1%	21.4%	1.36 (1.21 - 1.53)
More than 5 days	31.4%	5.6%	5.58 (4.56 - 6.83)
Seatbelt Use, yes	84.4%	91.4%	0.92 (0.90 - 0.95)
Body Mass Index (BMI)			
Normal/ Underweight	27.4%	30.4%	0.90 (0.81 - 1.00)
Overweight	46.2%	39.2%	1.18 (1.09 - 1.27)
Obese	24.6%	27.2%	0.90 (0.80 - 1.01)
Morbidly Obese	1.9%	3.1%	0.59 (0.38 - 0.92)

Table 2. Proportion of construction workers concerned for health, related to different injuries, diseases, exposures

	Overall	Median Age		Current Smoker		Heavy Alcohol Drinker		Obesity Status	
		≤ 38	> 38	No	Yes	No	Yes	Not Obese	Obese
Heart Disease	41.8%	34.9%	49.8%	42.7%	39.7%	44.3%	35.7%	38.6%	49.9%
Diabetes	29.3%	25.2	33.6	30.5%	26.3%	32.4%	21.6%	25.8%	38.2%
Obesity	20.3%	16.2%	25.2%	22.5%	15.6%	23.0%	13.7%	12.2%	41.5%
Cancer	47.4%	41.0%	54.8%	47.4%	47.4%	48.3%	45.3%	47.5%	48.2%
Drinking Alcohol	11.1%	11.1%	11.2%	11.0%	10.4%	10.1%	13.1%	10.1%	13.4%
Smoking	25.6%	26.0%	25.3%	12.8%	49.3%	25.7%	25.4%	26.2%	22.8%
Dust/Fumes	52.2%	52.1%	52.7%	52.1%	52.2%	52.9%	49.8%	52.4%	51.1%
Job Injury	48.9%	51.4%	46.5%	49.1%	48.2%	48.8%	47.8%	49.7%	46.2%
Car Accident	30.0%	29.5%	30.3%	32.1%	25.1%	31.1%	26.9%	31.0%	26.6%

Table 3. Construction Workers Opinions on Smoking

	Construction Workers	Smokers (n=553)	Non-Smokers (n=1059)	Ratio of Preferences between Smokers & Non-Smokers
Should Smoking be allowed				
Yes	557 (34.5%)	325 (59.2%)	226 (21.5%)	2.75
No	710 (44%)	96 (17.5%)	604 (57.6%)	0.30
It Depends	348 (21.5%)	128 (23.3%)	219 (20.9%)	1.11
Rather work on non-smoking site				
Yes	767 (47.3%)	63 (11.5%)	692 (65.7%)	0.18
No	340 (21%)	289 (52.6%)	51 (4.8%)	10.96
No Preference	513 (31.7%)	197 (35.9%)	311 (29.5%)	1.22
Smoking Hurt Job Performance				
Not at all/A little	906(56.6%)	438 (80.2%)	463 (44.5%)	1.80
Some / A lot	696 (43.4%)	108 (19.8%)	578 (55.5%)	0.36
Smoking Reduces Safety				
Not at all/ A little	1115 (69.3%)	469 (85.6%)	638 (61%)	1.40
Some / A lot	494 (30.7%)	79 (14.4%)	408 (39%)	0.37