



HHS Public Access

Author manuscript

Am J Ind Med. Author manuscript; available in PMC 2015 September 03.

Published in final edited form as:

Am J Ind Med. 2013 June ; 56(6): 635–646. doi:10.1002/ajim.22089.

The Prevalence of Selected Potentially Hazardous Workplace Exposures in the US: Findings From the 2010 National Health Interview Survey

Geoffrey M. Calvert, MD, MPH^{1,*}, Sara E. Luckhaupt, MD, MPH¹, Aaron Sussell, PhD, MPH¹, James M. Dahlhamer, PhD², and Brian W. Ward, PhD²

¹Division of Surveillance, Hazard Evaluations and Field Studies, National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Cincinnati, Ohio

²Division of Health Interview Statistics, National Center for Health Statistics, Centers for Disease Control and Prevention, Hyattsville, Maryland

Abstract

Objective—Assess the national prevalence of current workplace exposure to potential skin hazards, secondhand smoke (SHS), and outdoor work among various industry and occupation groups. Also, assess the national prevalence of chronic workplace exposure to vapors, gas, dust, and fumes (VGDF) among these groups.

Methods—Data were obtained from the 2010 National Health Interview Survey (NHIS). NHIS is a multistage probability sample survey of the civilian non-institutionalized population of the US. Prevalence rates and their variances were calculated using SUDAAN to account for the complex NHIS sample design.

Results—The data for 2010 were available for 17,524 adults who worked in the 12 months that preceded interview. The highest prevalence rates of hazardous workplace exposures were typically in agriculture, mining, and construction. The prevalence rate of frequent handling of or skin contact with chemicals, and of non-smokers frequently exposed to SHS at work was highest in mining and construction. Outdoor work was most common in agriculture (85%), construction (73%), and mining (65%). Finally, frequent occupational exposure to VGDF was most common among mining (67%), agriculture (53%), and construction workers (51%).

Conclusion—We identified industries and occupations with the highest prevalence of potentially hazardous workplace exposures, and provided targets for investigation and intervention activities.

*Correspondence to: Geoffrey M. Calvert, MD, MPH, National Institute for Occupational Safety and Health, 4676 Columbia Parkway, R-17, Cincinnati, OH 45226. gcalvert@cdc.gov.

Publisher's Disclaimer: The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the National Institute for Occupational Safety and Health, or the National Center for Health Statistics.

Disclosure Statement: The authors report no conflicts of interests.

Keywords

occupational exposure; industry; occupations; dermatitis; tobacco smoke pollution; heat stress disorders

INTRODUCTION

Little nationally representative information on US workplace hazard exposures is available. Additional national prevalence estimates of workplace exposures are needed to characterize current workplace exposures so that exposure reduction interventions can be appropriately targeted, and to assess the impact of the many changes in materials, processes, equipment, work practices, and the workforce that have taken place in the past several decades [Shire et al., 2011].

This report provides findings from the 2010 National Health Interview Survey (NHIS)—Occupational Health Supplement (OHS) that focus on workplace exposures over the previous 12 months involving skin contact/handling of chemicals, regular exposure to secondhand smoke (SHS), and working outdoors at least twice weekly (a risk factor for heat-related illness). In addition, this report provides findings on exposure to airborne chemical substances and dusts at the job held longest by the respondent in their lifetime. Differences in prevalence of exposures by demographic characteristics, industry of employment, and occupation are examined.

METHODS**National Health Interview Survey (NHIS)**

NHIS is a cross-sectional in-person household survey conducted continuously since 1957 by the National Center for Health Statistics (NCHS), Centers for Disease Control and Prevention (CDC), and is used to monitor the health of the nation. Data are collected on the civilian non-institutionalized population of the US, and exclude persons in long-term care facilities (e.g., nursing homes) or correctional facilities, active-duty Armed Forces personnel (although civilian family members are included), and US nationals residing in foreign countries [Pleis et al., 2010; National Center for Health Statistics, 2011]. The survey uses a multi-stage clustered sample design, with an over-sampling of black, Hispanic, and Asian persons. Black, Hispanic, and Asian adults aged 65 or older are also over-sampled to complete the sample adult module, which, as described later, is one of the four main NHIS modules. NHIS produces nationally representative data on health insurance coverage, health care access and utilization, health status, health behaviors, and other health-related topics.

The NHIS questionnaire consists of a core set of questions that remain relatively unchanged from year to year, and supplemental questions that vary from year to year which collect additional data pertaining to current health issues of national importance. In 2010, the survey instrument had four main modules: household, family, sample child, and sample adult. The first two modules collected health and sociodemographic information on each member of each family residing within a sampled household. Within each family, additional information was collected from one randomly selected adult (the “sample adult”) aged 18

years or older. In rare instances when a sample adult was physically or mentally unable to respond, proxy responses were accepted (<1.5% of sample). Interviews were conducted in-person (some telephone follow-up is allowed) using computer assisted personal interviewing (CAPI). A total interview lasted on average about 1 hr. In 2010, NHIS interviews were conducted in 34,329 households, accounting for 89,976 persons in 35,177 families. The estimates presented in this paper are based on data collected from 27,157 sample adults. The household response rate was 79.5%, the conditional sample adult response rate (i.e., the response rate for those sample adults identified as eligible) was 77.3%, and the final sample adult response rate (i.e., the response rate that takes into account both the conditional sample adult response rate and the household/family response rate) was 60.8%.

Information regarding industry and occupation of employment, occupational exposures, and smoking were obtained from core and OHS questions included in the sample adult module. Demographic characteristics were obtained from questions asked in the household and family modules.

The 2010 National Health Interview Survey (NHIS) was approved by the Research Ethics Review Board of the National Center for Health Statistics (Protocol #2009-16) and the US Office of Management and Budget (Control #0920-0214). Written consent for participation in the 2010 NHIS was not received, but instead all 2010 NHIS respondents provided oral consent prior to participation.

Study Definitions

The questions on workplace exposures were only asked of sample adults who were currently employed or employed at some time in the 12 months prior to interview. In the questions that began “During the past 12 months,” the subject was asked about exposures during the past 12 months in the main job the respondent held in the week preceding interview. If the respondent was not working in the preceding week, these questions were addressed to the job held most recently. It did not matter if the main job or most recent job was full-time or part-time. Potential skin hazards were assessed with the question “During the past 12 months, did you regularly handle or were you in skin contact with chemical products or substances at work twice a week or more?” Those who answered “yes” were defined as having frequent occupational skin contact with chemicals during the past 12 months. Exposure to SHS was assessed with the question “During the past 12 months, were you regularly exposed to tobacco smoke from other people at work twice a week or more?” Those who answered “yes” were defined as having frequent workplace exposure to SHS during the past 12 months. Most analyses of exposure to SHS were limited to current non-smokers because it is possible that smokers were exposed in designated smoking areas. Working outdoors was assessed with the question “During the past 12 months, did you regularly work outdoors twice a week or more?” Those who answered “yes” were defined as frequently working outdoors during the past 12 months. Inhalational exposure to vapors, gas, dust, or fumes (VGDF), which is a measure of exposure to airborne chemical substances and dusts, was assessed with the question “Please tell me if you are/were regularly exposed to vapors, gas, dust, or fumes at work twice a week or more?” Those who answered “yes” were defined as having frequent occupational exposure to VGDF at their

longest-held job. The VGDF question was asked about the longest held job in the respondent's lifetime only, as the health effects associated with VGDF exposure are often not acute, but instead develop after many months and years of exposure.

Those who had worked in the 12 months that preceded the interview were also classified according to several demographic characteristics: sex, age group, race/ethnicity, marital status, education, current smoking status, place of residence, and geographic region. Analyses by educational status were limited to workers aged 25 years and over. Non-smokers were defined as those respondents who had never smoked a cigarette, smoked fewer than 100 cigarettes in their lifetime, or who had smoked 100 cigarettes or more in their lifetime but did not currently smoke [Schoenborn and Adams, 2010]. Geographic classification was based on the location of a respondent's home, and included region (Northeast, Midwest, South, and West) and place of residence. For place of residence, a metropolitan statistical area (MSA) is defined by the US Office of Management and Budget and is typically centered around a single large city that wields substantial influence over the region included in the MSA. Large MSAs have a population size of 1,000,000 or more, small MSAs have a population size of less than 1,000,000, and "not in MSA" consists of persons not living in a MSA.

Open-ended responses were obtained from each employed sample adult respondent regarding his/her industry (employer's type of business) and occupation (employee's type of work), both for the main job held in the 12 months preceding interview and for the longest held job. These responses were reviewed by US Census Bureau coding specialists who assigned 4-digit industry and occupation codes. The data were coded using US Census codes based on the 2007 North American Industrial Classification System (NAICS) and 2010 Standard Occupational Classification (SOC) system. To allow for sufficient sample size for more reliable estimates, we primarily used simple (i.e., less detailed) 2-digit industry and occupation (I&O) recodes. The industry recodes include 21 simple categories, and the occupation recodes include 23 simple categories. However, in a few instances we examined the detailed I&O recodes within a simple recode category. Detailed I&O recodes were used when the simple recode category met the following criteria: relatively substantial sample size (>900 sample adults); high observed prevalence rate for at least one exposure; and, anticipated to have a relatively wide spectrum of exposure prevalence across its detailed I&O recode categories.

Data Analyses—To account for the complex sampling design of the NHIS, analyses of the 2010 data were completed using SAS-callable SUDAAN software version 10.0 [RTI, 2008]. To represent the US civilian, non-institutionalized population age 18 years and over, all prevalence estimates were weighted using the NHIS individual sample adult record weight. Point estimates with relative standard error (RSE) >30% and >50% are noted with an asterisk symbol (*), and estimates with RSE >50% are not reported.

If the estimates of two independent prevalence rates have 95% confidence intervals that do not overlap, then the two prevalence rates are considered significantly different ($P < 0.05$). When there is overlap in the two confidence intervals, the two independent prevalence rates may or may not be significantly different. Therefore, two sample z -tests were used to

compare select prevalence rates, and the resulting statistically significant differences ($P < 0.05$) were reported in the Results section. Not all comparisons were evaluated nor are all statistically significant findings reported in the Results section. In addition to these statistically significant comparisons of independent prevalence rates, we also tested for statistically significant differences between I&O groups with the highest exposure prevalence rates compared to the prevalence rate for all current/recent workers combined. These significance tests were adjusted such that the estimated standard error of the difference between prevalence rates for I&O groups and all current/recent workers accounted for non-independence of I&O groups and all current/recent workers by incorporating their covariance [a method used in Cohen and Makuc, 2008]. All comparisons reported in the results section are significantly different at the $P < 0.05$ level.

RESULTS

Exposure data in the 2010 NHIS were available for 17,524 sample adults who worked in the 12 months preceding interview. This sample represented approximately 155.3 million non-institutionalized US adults.

Prevalence Rate of Frequent Occupational Skin Contact with Chemicals

The prevalence rate of frequent occupational skin contact with chemicals during the 12 months preceding the interview among sample adult workers was 20.6% (Table I). The prevalence rate was higher among workers who were male (23.4%) compared to females (17.4%); lowest among workers aged 65 years old (11.1%) compared to other ages; highest among workers who had a high school diploma (27.1%) or less education (27.3%) compared to those with higher education levels; and, highest among workers who did not reside in a MSA (26.1%) compared to residing in one.

Prevalence Rate of Frequently Working Outdoors

The prevalence rate of frequently working outdoors during the 12 months preceding the interview was 24.7% (Table I). The prevalence was higher among workers who were male (37.2%) compared to females (10.9%); highest among workers who were Hispanic (31.8%) compared to all other races/ethnicities; highest among workers who had less than a high school diploma (39.5%) compared to those with higher education levels; highest among workers who did not reside in a MSA (32.7%) compared to residing in one; and, highest among workers who resided in the Western (26.9%) or Southern US (26.5%) compared to other regions.

Prevalence Rate of Frequent Workplace Exposure to Secondhand Smoke (SHS)

The prevalence rate of frequent workplace exposure to SHS during the 12 months preceding the interview was 14.9% for all workers, and 10.0% for current non-smoking workers (Table I). Among current non-smokers, the prevalence rate was higher among workers who were male (13.1%) compared to females (6.7%); highest among workers who were aged 18–29 years old (13.6%) compared to other ages; higher among non-Hispanic blacks (14.5%) and Hispanics (12.2%) compared to non-Hispanic whites (8.9%) and Asians (6.8%); lowest among workers who had a Bachelor's degree or higher (4.7%) compared to those with lower

education levels; and highest among workers who resided in the Southern US (11.6%) compared to other regions.

Prevalence Rate of Frequent Occupational Exposure to VDGF at their Longest-Held Job

Among sample adult workers, the prevalence rate of frequent occupational exposure to VDGF at their longest-held job was 25% (Table I). The prevalence was higher among workers who were male (33.3%) compared to females (15.8%); highest among workers who were aged 30–64 years old (26.7%) compared to other ages; lowest among non-Hispanic Asians (12.3%) compared to other races/ethnicities; highest among workers who had a high school diploma (35.7%) or less education (38.1%) compared to those with higher education levels; highest among workers who did not reside in a MSA (34.0%) compared to those residing in one; and, highest among workers who resided in the Midwest (26.7%) or South (25.8%) compared to workers who resided in the Northeast (22.4%) or West (23.8%).

Workplace Exposures by Industry from the 2010 NHIS–OHS

For three of the four exposures that were investigated, mining was the industry category with the highest observed prevalence rate. Mining had the highest observed prevalence rate of frequent exposure to skin contact with chemicals (38.5%), non-smokers exposed to workplace SHS (28.4%), and chronic occupational exposure to VDGF (66.8%; Table II). The three industry categories that had the highest observed prevalence rate of workers who frequently worked outdoors were agriculture, forestry, fishing, and hunting (84.6%), construction (72.7%), and mining (65.4%). Construction also had a relatively high prevalence rate of workers exposed to the other three hazardous exposures [third highest observed prevalence rate of skin contact with chemicals (31.2%), second highest observed prevalence rate of non-smokers exposed to workplace SHS (23.8%), and third highest observed with VDGF exposure (51.1%)]. After mining and construction, the industry category with the highest observed prevalence rate of non-smoking workers exposed to workplace SHS were the arts, entertainment, and recreation industries (18.2%). Within manufacturing, workers employed in primary metal (e.g., steel mills and foundries) had high prevalence rates of skin contact with chemicals (48.1%) and VDGF exposure (65.5%) (Table III). Within other services, workers employed in repair and maintenance, and personal services (e.g., beauty and nail salons, dry cleaners, and funeral homes) had high prevalence rates of skin contact with chemicals (52.4% and 51.5%, respectively) and VDGF exposure (68.0% and 48.1%, respectively) (Table III). Industry categories that tended to have the lowest prevalence rate of workers exposed to these work-place hazards included several services subsectors: finance and insurance; professional, scientific, and technical services; and education services. When compared to all current/recent workers, all of the prevalence rates reported in this paragraph were statistically significant ($P < 0.05$).

Workplace Exposures by Occupation from the 2010 NHIS–OHS

Among occupation categories, construction and extraction workers had among the highest observed prevalence rates for the four workplace exposures (Table IV). For example, construction and extraction occupations accounted for the highest observed prevalence rate of non-smoking workers exposed to workplace SHS (28.5%), and the second highest rate for

exposures to VGDF (57.6%), and these findings were largely driven by construction trades workers (Table V). Those employed in installation, maintenance, and repair occupations had the highest observed prevalence rate exposed to VGDF (64.2%). Similarly, transportation and material moving occupations had high observed prevalence rates of workers exposed to three of the four exposures that were investigated (i.e., all but frequent skin contact with chemicals). The three occupational categories with the highest observed prevalence rate of workers who frequently worked outdoors were farming (90.1%), construction and extraction occupations (79.5%), and protective service occupations (i.e., police, firefighters, and guards, 59.3%). Protective service occupations also had one of the highest observed prevalence rates of non-smokers exposed to SHS (20.2%). Production occupations had a high prevalence rate of workers with VDGF exposure (53.2%), and skin contact with chemicals (35.9%), particularly printing workers (76.1% and 55.7%, respectively), and metal and plastic workers (69.7% and 49.2%, respectively) (Table V). The occupation category with the highest observed prevalence rate of workers with frequent skin contact with chemicals was building and grounds cleaning and maintenance occupations (55.4%). The prevalence rate of exposure to these hazards was lowest among many traditional white-collar occupation categories including: computer and mathematical occupations; and business and financial operations occupations. Education, training, and library occupations comprised the occupation category with the lowest prevalence rate of non-smoking workers frequently exposed to workplace SHS (2.3%). When compared to all current/recent workers, all of the prevalence rates reported in this paragraph were statistically significant ($P < 0.05$).

DISCUSSION

This is one of the first reports providing results from the 2010 NHIS–OHS, and focused on the prevalence of four potentially hazardous workplace exposures. Furthermore, for the first time in at least 22 years, estimates based on a representative national sample are provided on workplace skin contact with chemicals, and workplace exposure to SHS. To our knowledge, this is the first report to provide national estimates on the prevalence of outdoor work and workplace exposure to VGDF.

Other Sources of Prevalence Estimates of Workplace Hazards in the US

The National Institute for Occupational Safety and Health (NIOSH) conducted two facility-based national chemical exposure surveys; however, these surveys did not quantify chemical exposures and the last of these was completed in 1983—over 25 years ago [NIOSH, 1988]. Another source of exposure data is the National Health and Nutrition Examination Survey (NHANES) which provides national estimates of the body burden of many chemicals or their metabolites in the US population, and national estimates of a few self-reported exposures (e.g., noise) [CDC, 2009; Tak et al., 2009]. Finally, another national workplace exposure database is the Integrated Management Information System (IMIS), developed and maintained by the Occupational Safety and Health Administration (OSHA). IMIS consists of information collected during OSHA enforcement and consultation visits that were conducted between 1979 and the present, and contains over 1.6 million sampling measurements for 1,320 unique agents of exposure [Henn et al., 2011]. IMIS data have been used to characterize lead and noise exposures in US workplaces [Middendorf, 2004; Henn et

al., 2011]. However, since OSHA enforcement inspections and consultation visits rarely involve very small employers (<10 employees) and the self-employed, are not conducted using a random design, and often result from particular regulatory emphasis programs, it is unlikely that IMIS data are representative of all workers.

Information on dermal exposures and exposure to SHS are also available from the 1988 NHIS, which was the last year a version of the NHIS–OHS was administered before 2010 [Park et al., 1993]. However, the questions on potential skin hazards and SHS exposure were very different from those asked in 2010. In 1988, participants were asked about eight different skin exposures (e.g. solvents, pesticides, cutting oils). In addition, the frequency of exposure that was asked also differed between the two years. In 1988, each participant was asked whether “you got any of these things on your hands or arms at your job during the past 12 months” whereas in 2010 participants were asked “During the past 12 months, did you regularly handle or were you in skin contact with chemical products or substances at work twice a week or more?” SHS exposure was assessed in the 1988 NHIS–OHS with two questions: “Is smoking allowed in your place of work other than in designated areas?” and if the response was “yes,” the respondent was asked “Do you find that cigarette smoke in the work place causes you no discomfort, some discomfort, moderate discomfort, or great discomfort?” Due to the substantial differences in the questions asked in 1988 and 2010, a detailed comparison of findings between these two years was considered beyond the scope of this paper. The 1988 NHIS–OHS did not include questions on outdoor work or exposure to VGDF.

Workplace Skin Contact with Chemicals

The findings that males had a higher prevalence of workplace skin contact with chemicals is consistent with those from a study of New Zealand workers [Eng et al., 2011]. Eng et al. found that males were significantly more likely to report exposure to oils, solvents, acids, alkalis, and pesticides. Furthermore, they found that among males and females working in the same occupation, males were significantly more likely to be exposed to oils and solvents.

We identified the industry and occupation categories with the highest observed prevalence rates of workplace skin contact with chemicals during the 12 months preceding interview. These industries and occupations could be targeted with efforts to assess dermal exposures qualitatively (or quantitatively if appropriate). The findings from these in-depth exposure measurements could guide interventions to reduce exposures to causative agents for work-related dermatitis.

Secondhand Smoke

SHS is associated with an increased risk for lung cancer and coronary heart disease, and there is no known risk-free level of exposure [U.S. Department of Health and Human Services, 2006]. Our findings suggest that the prevalence rate of workplace SHS exposure among non-smoking workers is 10%. Although this prevalence is relatively low, this represents 12.5 million non-smoking workers who are exposed to SHS twice per week or more [U.S. Department of Health and Human Services, 2006].

Before 2002, there were no states that had comprehensive workplace smoke-free laws (i.e., laws that prohibited smoking in all indoor areas of these three venues: worksites, restaurants, and bars) [CDC, 2011]. By the end of 2010, there were 26 states with such laws. An additional 10 states prohibit smoking in up to two of the three venues. However, as of 2010, there were no states in the South that had comprehensive workplace smoke-free laws. This may contribute to the reason that in 2010 the South had the highest prevalence rate of non-smoking workers exposed to SHS (11.6%).

After the home, the workplace is the most common site where adults spend most of their time [Klepeis et al., 2001]. As such, the workplace can be a major contributor to SHS exposure. Our findings identified the industry and occupation categories with the highest observed prevalence rates of workplace SHS exposure among non-smokers (e.g., construction) and these could be targeted with interventions to reduce these exposures.

Outdoor Work

Working outdoors under hot and humid conditions is a risk factor for heat-related illness [Bonauto et al., 2010]. Few studies have been conducted to assess the magnitude of occupational heat-related illness [Jackson and Rosenberg, 2010]. In a study of heat-related illness in Washington State in the years 2000 through 2009, industries with the highest risk for heat-related illness were construction (especially roofers and highway, street, and bridge construction), public administration (especially firefighting), and agriculture [Bonauto et al., 2010], which is consistent with the findings of our study. The average maximum daytime temperature on the date of the heat-related illness in Washington State was 89F. Given the evidence that climate change is occurring [McMicheal et al., 2006], there is concern that the number of days with hot and humid temperatures will continue to increase. We also found other industries and occupations with a high prevalence rate of outdoor work (e.g., mining, utilities, and real estate rental and leasing) which were not reported to be at increased risk for heat-related illness in the Washington State study [Bonauto et al., 2010]. This difference could be a result of the small numbers of these workers in Washington State, or the fact that these industries have effective policies and procedures to prevent heat-related illness. Recommendations to prevent occupational heat-related illness are available and include: training management and workers on the prevention, recognition and management of heat-related illness; establishing a heat acclimatization program; providing adequate hydration; and, providing cooling measures such as frequent rest breaks, shaded areas to rest and cooling equipment to dissipate heat [CDC, 2008; Jackson and Rosenberg, 2010]. It should also be noted that some employees with outdoor work are exposed to cold environments, which may place them at risk for hypothermia and frostbite [Delaney and Goldfrank, 2007].

Workplace Exposure to VGDF

In contrast to the other exposure questions included in the 2010 NHIS–OHS, the question on exposure to VGDF asked about the respondent's longest held job. Other studies have used a similar question to assess VGDF exposures during an individual's longest held job [Blanc et al., 2005]. In addition, the VGDF question has been used to assess the work-relatedness of lung diseases such as asthma [Blanc et al., 2005]. Those who reported VGDF exposure at

their longest-held job had a significantly elevated risk for adult-onset asthma (odds ratio = 1.7, 95% confidence interval = 1.03–2.8) [Blanc et al., 2005].

Similar to our findings, Eng et al. [2011] also found that males had a higher prevalence of workplace exposure to dust, smoke, fume, and gas. Furthermore, they found that among males and females working in the same occupation, males were significantly more likely to be exposed to smoke, fume, and/or gas. We are not aware of studies that compared VGDF exposure across any other demographic characteristics.

In addition to asthma and chronic obstructive pulmonary disease (COPD), associations between VGDF and other health outcomes can be examined in future studies using 2010 NHIS–OHS data. These data may be useful in assessing the work-relatedness of chronic disease. However, investigators need to be familiar with the caveats of the VGDF question. To our knowledge, the VGDF has not been validated against actual industrial hygiene measurements; however, it has been compared to multi-exposure checklists and job-exposure matrices (JEMs) created by experts who assessed the likelihood of exposure in occupation/industry categories. Among studies of those without lung disease, the sensitivity of the VGDF question compared to checklists and JEMs has ranged from 42% to 64% and the specificity from 74% to 91% [Quinlan et al., 2009]. The sensitivity and specificity of the VGDF question is similar among those with lung disease (sensitivity = 48–65%; specificity = 80–83%) [Quinlan et al., 2009].

Workers employed in the mining, construction, and agriculture, forestry, fishing and hunting industries had the highest observed prevalence rates of VGDF exposures. The occupation with the highest observed VGDF exposure prevalence rate was installation, maintenance, and repair. Consideration should be made for targeting these industries and occupations with interventions to reduce VGDF exposures.

Limitations

This study is subject to several limitations. First, all exposure estimates are based on self-report, which are subject to recall and interviewer bias. Additionally self-reports may be inaccurate if the respondent was not fully informed about their workplace exposures [Schenker et al., 2010]. We are aware of no validation of the questions used to obtain these self-reported exposures; however, the VGDF question has been shown to have modest agreement with exposure checklists and JEMs [Quinlan et al., 2009]. Second, the questions regarding exposures to airborne chemicals and dusts, and skin exposures to chemicals do not provide any information about the toxicity of the substances or the intensity of the exposures. Self-reports are qualitative, and made by a non-experts, so it is not possible to infer whether or not the reported exposures would be deemed unacceptable if assessed by industrial hygienists. Using the question on outdoor work as a surrogate for exposure to heat and humidity has limitations, particularly since there may be some workers who frequently work outdoors only under cool or cold conditions. Additionally heat stress depends greatly on whether the workplace has effective policies and procedures to prevent heat-related illness. Finally, there are also limitations associated with the I&O groups used in these analyses. The simple I&O categories lumped together workers who likely had substantially different workplace exposures, and different intensities of exposure. Using more specific

I&O categories led to smaller cell sizes and less reliable estimates. Finally, the economic climate and high unemployment rates in the US during 2010 should also be considered when interpreting our findings as these conditions could have influenced the NHIS-OHS estimates.

CONCLUSIONS

We identified industry and occupation categories with the highest observed prevalence rates for potentially hazardous workplace exposures. These data provide some potential industry and occupation categories that could serve as potential targets both for further investigation and potential intervention activities. Among US adult workers, the prevalence rate of frequent occupational skin contact with chemicals during the 12 months preceding interview was 20.6%. The prevalence rate of frequent workplace exposure to SHS among non-smoking workers during the 12 months preceding interview was 10.0%. The prevalence rate of frequently working outdoors during the 12 months preceding interview was 24.7%. The prevalence rate of frequent occupational exposure to VDGF at one's longest-held job was 25.0%. Workers employed in construction, mining and installation, maintenance and repair were observed to have among the highest prevalence rates for the four workplace exposures, and were significantly elevated compared to the rates among all current/recent workers.

ACKNOWLEDGMENTS

The authors thank the following individuals for their review of earlier versions of this manuscript: Paul Blanc, Bill Halperin, John Sestito, and Marie Haring Sweeney. The authors also thank Jia Li for her invaluable statistical guidance. All authors are federal government employees, and the NHIS and preparation of this manuscript were completely funded by the US Government.

REFERENCES

- Blanc PD, Eisner MD, Balmes JR, Trupin L, Yelin EH, Katz PP. Exposure to vapors, gas, dust or fumes: Assessment by a single survey item compared to a detailed exposure battery and a job exposure matrix. *Am J Ind Med.* 2005; 48:110–117. [PubMed: 16032739]
- Bonauto, D.; Rauser, E.; Lim, L. Occupational heat illness in Washington State, 2000–2009. Washington State Department of Labor and Industries; Olympia, Washington: 2010. Technical Report Number 59-1-2010
- CDC. Heat-related deaths among crop workers—United States, 1992–2006. *MMWR.* 2008; 57:649–653. [PubMed: 18566563]
- CDC. Fourth national report on human exposure to environmental chemicals. Centers for Disease Control and Prevention, National Center for Environmental Health; Atlanta, GA: 2009. Available at: <http://www.cdc.gov/exposurereport/pdf/FourthReport.pdf> [Accessed July 6, 2011]
- CDC. State smoke-free laws for worksites, restaurants, and bars—United States, 2000–2010. *MMWR.* 2011; 60:472–475. [PubMed: 21508923]
- Cohen RA, Makuc DM. State, regional, and national estimates of health insurance coverage for people under 65 years of age: National Health Interview Survey, 2004–2006. *Natl Health Stat Rep.* 2008; 1:1–23.
- Delaney, KA.; Goldfrank, LR. Thermal extremes in the work environment. In: Rom, WN., editor. *Environmental and occupational medicine.* 4th edition. Lippincott Williams and Wilkins; Philadelphia: 2007. p. 1337-1350.
- Eng A, Mannetje A, McLean D, Ellison-Loschmann L, Cheng S, Pearce N. Gender differences in occupational exposure patterns. *Occup Environ Med.* 2011; 68:888–894. [PubMed: 21486991]

- Henn SA, Sussell AL, Li J, Shire JD, Alarcon WA, Tak S. Characterization of lead in US workplaces using data from OSHA's Integrated Management Information System. *Am J Ind Med.* 2011; 54:356–365. [PubMed: 21246587]
- Jackson LL, Rosenberg HR. Preventing heat-related illness among agricultural workers. *J Agromedicine.* 2010; 15:200–215. [PubMed: 20665306]
- Klepeis NE, Nelson WC, Ott WR, Robinson JP, Tsang AM, Switzer P, Behar JV, Hern SC, Engelmann WH. The National Human Activity Pattern Survey (NHAPS): A resource for assessing exposure to environmental pollutants. *J Expo Anal Environ Epidemiol.* 2001; 11:231–252. [PubMed: 11477521]
- McMicheal AJ, Woodruff RE, Hales S. Climate change and human health: Present and future risks. *Lancet.* 2006; 367:859–869. [PubMed: 16530580]
- Middendorf PJ. Surveillance of occupational noise exposures using OSHA's Integrated Management Information System. *Am J Ind Med.* 2004; 46:492–504. [PubMed: 15490475]
- National Center for Health Statistics. 2010 National Health Interview Survey (NHIS) public use data release. NHIS survey description. US Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Center for Health Statistics; Hyattsville, Maryland: 2011. Available at: ftp://ftp.cdc.gov/pub/Health_Statistics/NCHS/Dataset_Documentation/NHIS/2010/srvydesc.pdf [Accessed December 5, 2011]
- National Institute for Occupational Safety and Health. National Occupational Exposure Survey. Analysis of management interview responses. US Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. DHHS (NIOSH); Cincinnati, OH: 1988. p. 89-103. Publication No
- Park CH, Wagener DK, Winn DM, Pierce JP. Health conditions among the currently employed: United States, 1988. National Center for Health Statistics. *Vital Health Stat.* 1993; 10(186):1–67.
- Pleis JR, Ward BW, Lucas JW. Summary Health Statistics for US Adults: National Health Interview Survey, 2009. *Vital Health Stat.* 2010; 10(249):1–207.
- Quinlan PJ, Earnest G, Eisner MD, Yelin EH, Katz PP, Balmes JR, Blanc PD. Performance of self-reported occupational exposure compared to a job-exposure matrix approach in asthma and chronic rhinitis. *Occup Environ Med.* 2009; 66:154–160. [PubMed: 18805880]
- Research Triangle Institute (RTI). SUDAAN (Release 10.0) [computer software]. Research Triangle Institute (RTI); Research Triangle Park, NC: 2008.
- Schenker N, Raghunathan TE, Bondarenko I. Improving on analyses of self-reported data in a large-scale health survey by using information from an examination-based survey. *Stat Med.* 2010; 29:533–545. [PubMed: 20029804]
- Schoenborn CA, Adams PF. Health behaviors of adults: United States, 2005–2007. *Vital Health Stat.* 2010; 10(245):1–132.
- Shire JD, Marsh GM, Talbott EO, Sharma RK. Advances and current themes in occupational and environmental public health surveillance. *Annu Rev Public Health.* 2011; 32:109–132. [PubMed: 21219165]
- Tak S, Davis RR, Calvert GM. Exposure to hazardous workplace noise and use of hearing protection devices among US workers—NHANES, 1999–2004. *Am J Ind Med.* 2009; 52:358–371. [PubMed: 19267354]
- U.S. Department of Health and Human Services. The health consequences of involuntary exposure to tobacco smoke: A report of the Surgeon General. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Coordinating Center for Health Promotion, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; Atlanta, GA: 2006. Available: <http://www.surgeongeneral.gov/library/reports/secondhandsmoke/report-index.html> [Accessed June 26, 2012]

TABLE I

Prevalence of Exposure to Select Potentially Hazardous Workplace Exposures Among US Adults Who Worked in the Past 12 Months, by Demographic Characteristics

	Sample ^{a,c}	Est. population (in thousands)	Frequent occupational skin contact with chemicals ^d		Frequently work outdoors ^d		Non-smokers frequently exposed to SHS at work ^d		Currently non-smoker ^d		Frequent exposure to vapors, gas, dust, or fumes at work ^b	
			Cases ^c	% (95% CI)	Cases ^c	% (95% CI)	Cases ^c	% ^d (95% CI)	Cases ^c	% (95% CI)	Cases ^c	% (95% CI)
Sex												
Male	8,500	81,412	1,908	23.4 (22.3–24.6)	3,208	37.2 (35.9–38.5)	887	13.1 (12.2–14.2)	6,628	78.8 (77.7–79.8)	2,822	33.3 (32.1–34.5)
Female	9,024	73,850	1,538	17.4 (16.5–18.4)	989	10.9 (10.2–11.7)	528	6.7 (6.0–7.4)	7,373	82.0 (81.0–83.0)	1,479	15.8 (14.9–16.7)
Age group(yrs.)												
18–29	4,059	38,916	868	22.8 (21.2–24.6)	910	23.3 (21.6–25.0)	418	13.6 (12.1–15.3)	3,171	78.0 (76.3–79.6)	873	22.0 (20.5–23.7)
30–44	5,967	49,624	1,243	21.5 (20.3–22.8)	1,451	24.9 (23.6–26.3)	531	10.5 (9.5–11.5)	4,788	79.9 (78.6–81.2)	1,503	25.6 (24.3–27.0)
45–64	6,506	59,041	1,226	19.5 (18.3–20.7)	1,587	25.3 (24.0–26.7)	416	7.9 (7.1–8.9)	5,162	80.9 (79.7–82.0)	1,713	26.7 (25.3–28.1)
65	992	7,681	109	11.1 (9.0–13.7)	249	25.3 (22.0–28.9)	50	5.5 (4.0–7.5)	880	90.1 (87.8–91.9)	212	22.1 (19.2–25.2)
Race/ethnicity												
Non-Hispanic white	9,997	106,033	2,061	21.2 (20.3–22.2)	2,394	24.5 (23.5–25.6)	672	8.9 (8.2–9.7)	7,716	78.2 (77.2–79.2)	2,488	25.1 (24.1–26.1)
Non-Hispanic black	2,600	16,822	460	18.5 (16.6–20.5)	581	22.5 (20.4–24.7)	286	14.5 (12.6–16.5)	2,076	81.4 (79.5–83.1)	658	25.6 (23.5–27.7)
Non-Hispanic Asian	1,112	7,278	142	13.1 (10.8–15.8)	121	10.3 (8.3–12.6)	61	6.8 (4.9–9.4)	977	89.8 (87.5–91.6)	138	12.3 (10.2–14.8)
Non-Hispanic other race	351	2,856	72	20.3 (15.5–26.1)	77	25.3 (19.7–31.9)	30	11.8 (7.9–17.4)	255	75.2 (69.3–80.3)	102	27.6 (22.6–33.2)
Hispanic	3,464	22,273	711	21.5 (19.8–23.3)	1,024	31.8 (29.9–33.8)	366	12.2 (10.8–13.8)	2,977	87.0 (85.5–88.3)	915	27.6 (25.7–29.6)
Marital status												
Married	8,105	86,431	1,526	19.3 (18.3–20.4)	2,038	25.7 (24.5–26.9)	579	8.3 (7.6–9.0)	6,914	85.0 (84.1–86.0)	2,005	25.2 (24.1–26.3)
Widowed	514	2,902	77	15.9 (12.5–19.8)	99	19.5 (15.9–23.6)	25	5.8 (3.7–8.8)	408	77.6 (73.1–81.5)	120	21.7 (18.3–25.6)
Divorced or separated	2,983	17,626	592	21.5 (19.8–23.3)	707	24.6 (22.8–26.5)	270	12.8 (11.1–14.7)	2,219	73.4 (71.5–75.3)	795	27.1 (25.3–29.0)
Never married	4,661	35,565	951	22.0 (20.5–23.7)	1,029	22.5 (21.0–24.1)	444	13.2 (11.7–14.8)	3,623	78.3 (76.7–79.8)	1,013	21.7 (20.2–23.3)
Living with partner	1,232	12,564	296	24.8 (22.2–27.6)	319	25.3 (22.6–28.2)	95	11.6 (9.3–14.3)	814	63.9 (60.8–66.8)	360	30.1 (27.2–33.2)
Education ^e												
Less than HS diploma	1,812	13,049	463	27.3 (24.9–29.9)	675	39.5 (36.7–42.4)	169	13.5 (11.3–16.1)	1,350	71.7 (69.1–74.2)	639	38.1 (35.5–40.9)
HS/GED diploma	3,685	32,164	931	27.1 (25.4–28.9)	1,113	33.0 (31.1–34.9)	343	13.3 (11.8–14.9)	2,628	70.7 (68.7–72.5)	1,249	35.7 (33.8–37.6)
Some college	4,656	39,755	992	22.5 (21.0–24.1)	1,150	26.5 (24.9–28.1)	426	11.4 (10.2–12.7)	3,595	77.9 (76.4–79.4)	1,306	29.2 (27.6–30.9)

	Sample ^{a,c}	Est. population (in thousands)	Frequent occupational skin contact with chemicals ^a		Frequently work outdoors ^a		Non-smokers frequently exposed to SHS at work ^a		Currently non-smoker ^a		Frequent exposure to vapors, gas, dust, or fumes at work ^b	
			Cases ^c	%(95% CI)	Cases ^c	%(95% CI)	Cases ^c	%(95% CI)	Cases ^c	%(95% CI)	Cases ^c	%(95% CI)
BA/BS and higher	5,284	48,309	596	11.3 (10.3–12.4)	775	14.4 (13.3–15.6)	239	4.7 (4.0–5.4)	4,754	91.1 (90.2–92.0)	658	12.3 (11.3–13.4)
Place of residence												
Large MSA	9,796	84,107	1,684	17.9 (17.0–19.0)	2,096	21.8 (20.8–22.9)	770	9.3 (8.5–10.2)	8,045	82.4 (81.4–83.3)	2,129	21.8 (20.7–22.9)
Small MSA	5,266	48,741	1,154	22.5 (21.0–24.2)	1,315	26.0 (24.5–27.5)	422	10.5 (9.4–11.7)	4,123	79.7 (78.2–81.1)	1,366	26.2 (24.8–27.7)
Not in MSA	2,462	22,414	608	26.1 (24.1–28.2)	786	32.7 (30.0–35.5)	223	11.6 (10.2–13.2)	1,833	74.1 (71.8–76.2)	806	34.0 (31.9–36.1)
Region ^f												
Northeast	2,685	27,043	465	18.2 (16.5–20.1)	531	20.6 (18.7–22.7)	185	8.1 (6.9–9.6)	2,194	82.4 (80.5–84.1)	565	22.4 (20.5–24.5)
Midwest	3,948	36,932	862	23.1 (21.4–24.9)	848	22.8 (20.9–24.9)	289	9.8 (8.6–11.2)	3,019	77.8 (76.2–79.4)	1,041	26.7 (25.0–28.4)
South	6,421	54,415	1,289	21.0 (19.7–22.3)	1,641	26.5 (25.1–27.9)	580	11.6 (10.5–12.8)	5,048	78.5 (77.1–79.8)	1,623	25.8 (24.5–27.2)
West	4,470	36,873	830	19.1 (17.6–20.7)	1,177	26.9 (25.3–28.6)	361	9.3 (8.1–10.6)	3,740	84.0 (82.6–85.3)	1,072	23.8 (22.3–25.4)
Total	17,524	155,262	3,446	20.6 (19.8–21.3)	4,197	24.7 (23.9–25.6)	1,415	10.0 (9.4–10.6)	14,001	80.3 (79.5–81.1)	4,301	25.0 (24.2–25.8)

SHS, secondhand smoke; Est, estimated; CI, confidence interval; HS, high school; GED, general educational development; BA/BS, bachelor's; MSA, metropolitan statistical area. Data: National Health Interview Survey, 2010.

All estimates weighted unless otherwise noted. Data include only U.S. working adults who are part of the civilian non-institutionalized population.

^a Refers to most recently held job.

^b Refers to longest-held job.

^c Unweighted.

^d These proportions pertain only to non-smokers. To estimate the non-smoking population exposed to SHS, one first needs to multiply this proportion with the proportion of non-smokers and then multiply this product by the estimated population.

^e Education only shown for persons aged 25 years and over.

^f States were grouped into the following four regions used by the U.S. Census Bureau: Northeast: ME, VT, NH, MA, CT, RI, NY, NJ, PA; Midwest: OH, IL, IN, MI, WI, MN, IA, MO, ND, SD, KS, NE; South: DE, MD, DC, WV, VA, KY, TN, NC, SC, GA, FL, AL, MS, LA, OK, AR, TX; West: WA, OR, CA, NV, NM, AZ, ID, UT, CO, MT, WY, AK, HI.

TABLE II

Prevalence of Exposure to Select Potentially Hazardous Workplace Exposures Among US Adults Who Worked in the Past 12 Months, by Industry

	Sample ^{a,c}	Est. population (in thousands)	Frequent occupational skin contact with chemicals ^a		Frequently work outdoors ^a		Non-smokers frequently exposed to SHS at work ^a		Currently non-smoker ^a		Frequent exposure to vapors, gas, dust, or fumes at work ^b	
			Cases ^c	% (95% CI)	Cases ^c	% (95% CI)	Cases ^c	% ^d (95% CI)	Cases ^c	% (95% CI)	Cases ^c	% (95% CI)
Agriculture, forestry, fishing, and hunting	269	2,308	84	29.1 (22.4–36.9)	220	84.6 (78.6–89.2)	18	6.9 (3.6–12.9) ^e	225	82.4 (76.5–87.0)	148	52.9 (44.7–60.9)
Mining	75	721	30	38.5 (27.6–50.8)	49	65.4 (52.4–76.5)	16	28.4 (17.7–42.2)	56	73.2 (61.2–82.5)	45	66.8 (55.5–76.5)
Utilities	140	1,447	36	23.6 (16.5–32.6)	83	61.5 (52.0–70.3)	18	15.2 (8.5–25.7)	113	80.2 (72.2–86.3)	45	34.6 (26.0–44.4)
Construction	1,115	10,639	344	31.2 (28.1–34.6)	824	72.7 (69.5–75.7)	174	23.8 (20.3–27.7)	775	69.6 (66.3–72.6)	568	51.1 (47.6–54.5)
Manufacturing	1,590	14,555	398	26.2 (23.8–28.8)	238	15.1 (13.1–17.4)	144	11.2 (9.4–13.4)	1,255	78.1 (75.8–80.3)	797	42.8 (40.0–45.6)
Wholesale trade	396	3,780	50	12.6 (9.1–17.3)	113	30.6 (25.4–36.4)	40	13.7 (9.7–19.1)	308	76.5 (71.0–81.2)	85	21.2 (17.0–26.1)
Retail trade	1,795	17,214	329	20.6 (18.2–23.2)	278	15.5 (13.5–17.7)	126	8.8 (7.0–10.9)	1,375	77.2 (74.6–79.5)	380	21.5 (19.3–23.9)
Transportation and warehousing	714	6,192	88	12.1 (9.6–15.2)	369	51.6 (47.2–55.9)	81	13.6 (10.6–17.4)	557	78.6 (75.0–81.8)	293	41.7 (37.5–46.0)
Information	450	3,854	32	8.6 (5.6–12.9)	86	19.0 (15.0–23.8)	33	9.6 (6.5–14.1)	370	84.2 (80.1–87.6)	64	14.2 (10.7–18.5)
Finance and insurance	730	6,365	9	1.3 (0.6–2.7) ^e	36	4.9 (3.2–7.4)	14	1.4 (0.8–2.5)	607	84.1 (80.8–87.0)	38	5.1 (3.5–7.3)
Real estate and rental and leasing	344	2,896	55	19.1 (14.0–25.4)	152	45.6 (39.2–52.0)	31	14.8 (9.5–22.3)	263	77.0 (71.3–81.9)	59	21.0 (16.1–27.0)
Professional, scientific, and technical services	1,153	10,509	83	6.6 (5.1–8.5)	127	11.6 (9.4–14.2)	48	4.1 (3.0–5.6)	988	86.5 (84.1–88.5)	94	9.2 (7.4–11.5)
Management of companies and enterprises	10	95	0	<i>f</i>	0	<i>f</i>	0	<i>f</i>	9	94.7 (67.3–99.4)	2	<i>g</i>
Administrative and support and waste management and remediation services	848	6,895	222	28.7 (25.0–32.8)	314	41.0 (36.9–45.1)	83	14.6 (11.4–18.4)	628	75.0 (71.4–78.4)	215	34.1 (29.8–38.7)
Education services	1,694	15,330	211	12.3 (10.5–14.4)	277	16.4 (14.3–18.7)	58	3.2 (2.4–4.3)	1,519	91.4 (89.8–92.7)	192	12.5 (10.6–14.7)
Health care and social assistance	2,444	20,205	576	24.5 (22.6–26.6)	266	11.2 (9.8–12.8)	170	8.0 (6.7–9.6)	2,023	83.1 (81.0–84.9)	309	13.4 (11.8–15.2)
Arts, entertainment, and recreation	384	3,420	67	16.5 (12.4–21.7)	123	32.7 (27.1–38.8)	53	18.2 (13.4–24.1)	290	77.9 (72.0–82.9)	84	21.7 (16.8–27.6)
Accommodation and food services	1,223	10,744	360	30.7 (27.4–34.1)	133	11.7 (9.7–14.0)	132	16.4 (13.5–19.8)	858	69.6 (66.2–72.8)	245	15.6 (13.4–18.0)
Other services (except public administration)	919	7,791	328	38.3 (34.6–42.1)	193	22.1 (18.9–25.6)	62	8.5 (6.2–11.6)	746	81.7 (78.4–84.6)	301	39.2 (35.3–43.3)
Public administration	934	8,018	107	13.3 (10.9–16.1)	254	28.2 (25.0–31.7)	94	10.5 (8.3–13.3)	782	85.0 (82.1–87.5)	186	21.6 (18.5–24.9)

Am J Ind Med. Author manuscript; available in PMC 2015 September 03.

SHS, secondhand smoke; Est., estimated; CI, confidence interval.

Data: National Health Interview Survey, 2010.

All estimates weighted unless otherwise noted. Data include only U.S. working adults who are part of the civilian non-institutionalized population.

^a Refers to most recently held job.

^b Refers to longest-held job.

^c Unweighted.

^d These proportions pertain only to non-smokers. To estimate the non-smoking population exposed to SHS, one first needs to multiply this proportion with the proportion of non-smokers and then multiply this product by the estimated population.

^e These estimates have a relative standard error >30% and <50% and should be used with caution as they do not meet standards of reliability/precision.

^f Quantity zero.

^g Estimates with a relative standard error >50% are not shown as they do not meet standards of reliability/precision.

Prevalence of Exposure to Select Potentially Hazardous Workplace Exposures Among US Adults Who Worked in the Past 12 Months, by Detailed Industry Codes for Those in Manufacturing and Other Services (except public administration)

TABLE III

Sample ^{a, c}	Est. population (in thousands)	Frequent occupational skin contact with chemicals ^d		Frequently work outdoors ^d		Non-smokers frequently exposed to SHS at work ^d		Currently non-smoker ^d		Frequent exposure to vapors, gas, dust, or fumes at work ^b	
		Cases ^e	% (95% CI)	Cases ^e	% (95% CI)	Cases ^e	% ^d (95% CI)	Cases ^e	% (95% CI)	Cases ^e	% (95% CI)
Manufacturing	14,555	398	26.2 (23.8–28.8)	238	15.1 (13.1–17.4)	144	11.2 (9.4–13.4)	1,255	78.1 (75.8–80.3)	797	42.8 (40.0–45.6)
Food	1,940	42	18.7 (13.8–24.9)	44	19.7 (14.0–26.9)	25	14.5 (9.5–21.4)	188	75.2 (67.6–81.5)	75	31.8 (25.2–39.2)
Beverage and tobacco product	23	4	24.8 (8.6–53.8) ^e	9	32.9 (15.7–56.5) ^e	1	8	17	86.0 (66.1–95.1)	9	36.1 (17.5–60.1) ^e
Textile mills	16	2	8	1	8	1	8	11	66.5 (39.7–85.7)	13	51.7 (28.4–74.2)
Textile product mills	25	3	8	1	8	1	8	23	96.5 (86.2–99.2)	9	24.6 (11.8–44.3) ^e
Apparel	31	2	8	2	8	0	f	25	75.8 (54.1–89.3)	12	17.5 (9.6–29.8)
Leather and allied product	1	0	f	0	f	0	f	1	8	0	f
Wood product	45	11	28.8 (16.5–45.2)	15	31.5 (17.2–50.4)	5	13.4 (5.6–28.7) ^e	35	76.4 (58.0–88.4)	35	68.2 (51.2–81.4)
Paper	43	10	22.5 (10.8–41.0) ^e	3	8	4	8	39	92.3 (76.8–97.8)	26	47.0 (30.1–64.6)
Printing and related support activities	88	27	33.3 (22.6–46.1)	9	11.7 (5.5–23.0) ^e	3	8	66	73.6 (61.4–83.0)	67	56.5 (45.0–67.3)
Petroleum and coal products	20	8	38.7 (18.0–64.4) ^e	10	56.2 (29.2–80.0)	0	—	17	90.4 (72.7–97.1)	6	36.2 (12.8–68.5) ^e
Chemical	126	46	37.5 (28.9–47.1)	21	15.6 (9.9–23.7)	8	9.7 (4.6–19.2) ^e	101	80.1 (70.3–87.3)	54	35.8 (27.3–45.3)
Plastics and rubber products	58	16	30.0 (17.9–45.9)	2	8	4	8	41	65.6 (49.7–78.7)	27	48.5 (34.0–63.3)
Nonmetallic mineral product	40	10	23.5 (12.2–40.3) ^e	12	38.4 (22.4–57.4)	3	8	28	68.6 (50.0–82.7)	27	50.8 (35.2–66.3)
Primary metal	57	23	48.1 (34.1–62.5)	18	30.8 (18.4–46.7)	11	20.6 (10.0–37.7) ^e	42	72.6 (57.2–84.1)	39	65.5 (50.7–77.7)
Fabricated metal product	120	42	37.5 (27.9–48.2)	21	17.9 (11.2–27.3)	14	17.4 (9.8–29.1)	80	64.6 (54.0–74.0)	67	51.0 (41.3–60.7)
Machinery	107	31	27.1 (19.1–37.0)	9	7.2 (3.6–14.2) ^e	17	18.0 (10.7–28.7)	85	83.2 (75.0–89.1)	59	41.3 (31.3–52.0)
Computer and electronic product	128	20	18.4 (11.6–27.8)	5	3.9 (1.5–9.6) ^e	8	5.8 (2.7–11.9) ^e	112	87.6 (80.0–92.6)	38	20.3 (14.5–27.8)
Electrical equipment, appliance, and component	41	14	33.3 (19.7–50.5)	3	8	2	8	38	93.4 (80.9–97.9)	27	51.4 (36.2–66.4)

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

	Sample ^{a, c}	Est. population (in thousands)	Frequent occupational skin contact with chemicals ^d		Frequently work outdoors ^d		Non-smokers frequently exposed to SHS at work ^d		Currently non-smoker ^d		Frequent exposure to vapors, gas, dust, or fumes at work ^b	
			Cases ^e	% (95% CI)	Cases ^e	% (95% CI)	Cases ^e	% ^d (95% CI)	Cases ^e	% (95% CI)	Cases ^e	% (95% CI)
Transportation equipment	206	2,022	51	23.0 (17.1–30.2)	31	13.9 (9.0–20.7)	21	12.7 (7.8–20.2)	161	77.8 (69.9–84.0)	115	47.3 (39.7–55.1)
Furniture and related product	57	519	11	19.7 (10.5–33.9) ^e	9	15.5 (7.6–29.0) ^e	4	8	47	83.8 (71.7–91.3)	35	60.3 (45.6–73.4)
Miscellaneous	122	1,096	25	19.0 (11.7–29.5)	13	8.6 (4.3–16.2) ^e	12	12.3 (6.5–22.0) ^e	98	78.4 (66.7–86.7)	57	40.0 (30.8–50.1)
Other services (except public administration)	919	7,791	328	38.3 (34.6–42.1)	193	22.1 (18.9–25.6)	62	8.5 (6.2–11.6)	746	81.7 (78.4–84.6)	301	39.2 (35.3–43.3)
Repair and maintenance	218	2,051	103	52.4 (44.8–59.9)	92	42.7 (35.4–50.5)	30	19.5 (12.9–28.5)	159	71.7 (63.9–78.4)	138	68.0 (60.1–75.0)
Personal services	296	2,549	143	51.5 (44.7–58.1)	40	14.1 (9.9–19.7)	23	10.7 (6.6–17.0)	227	78.4 (72.1–83.6)	126	48.1 (41.3–55.0)
Religious, grantmaking, civic, labor, professional, and similar organizations	250	2,145	23	8.5 (5.3–13.4)	37	14.7 (10.3–20.5)	3	8	224	92.6 (89.0–95.1)	13	6.4 (3.2–12.4) ^e
Private households	155	1,046	59	39.2 (29.3–50.2)	24	16.3 (10.2–25.0)	6	3.0 (1.2–7.5) ^e	136	87.0 (78.8–92.3)	24	17.6 (10.1–29.1)

SHS, secondhand smoke; Est., estimated; CI, confidence interval.

Data: National Health Interview Survey, 2010.

All estimates weighted unless otherwise noted. Data include only U.S. working adults who are part of the civilian non-institutionalized population.

a, b, c, d, e, f, g Please see Table II for definition of footnotes.

TABLE IV

Prevalence of Exposure to Select Potentially Hazardous Workplace Exposures Among US Adults Who Worked in the Past 12 Months, by Occupation

Occupation	Sample ^{a, c}	Est. population (in thousands)	Frequent occupational skin contact with chemicals ^a		Frequently work outdoors ^a		Non-smokers frequently exposed to SHS at work ^a		Currently non-smoker ^a		Frequent exposure to vapors, gas, dust, or fumes at work ^b	
			Cases ^c	% (95% CI)	Cases ^c	% (95% CI)	Cases ^c	% ^d (95% CI)	Cases ^c	% (95% CI)	Cases ^c	% (95% CI)
Management	1,497	14,409	203	13.9 (12.0–16.1)	356	24.1 (21.4–27.1)	94	7.0 (5.5–8.9)	1,290	86.9 (84.8–88.7)	277	18.5 (16.2–21.0)
Business and financial operations	821	7,029	31	3.3 (2.2–4.9)	74	9.6 (7.3–12.4)	32	4.1 (2.8–6.0)	694	85.2 (82.1–87.8)	53	7.1 (5.2–9.5)
Computer and mathematical	471	4,256	5	1.9 (0.7–5.0) ^e	16	3.3 (1.9–5.6)	18	4.2 (2.4–7.2)	407	87.5 (83.6–90.6)	18	4.7 (2.7–8.0)
Architecture and engineering	305	3,020	53	16.1 (11.8–21.5)	65	20.6 (15.7–26.5)	20	6.0 (3.6–9.8)	264	86.9 (81.9–90.7)	53	16.7 (12.2–22.6)
Life, physical, and social science	180	1,691	55	30.1 (23.3–38.0)	30	14.9 (10.0–21.5)	6	3.0 (1.2–7.0) ^e	170	94.8 (89.4–97.5)	45	25.0 (18.3–33.0)
Community and social services	333	2,782	31	8.7 (5.8–13.0)	74	19.7 (15.4–24.7)	28	10.0 (6.4–15.2)	295	90.3 (86.5–93.1)	11	3.7 (1.7–8.0) ^e
Legal	195	1,809	2	8	6	2.9 (1.1–7.0) ^e	7	3.9 (1.7–8.6) ^e	165	87.9 (82.1–92.0)	5	8
Education, training, and library	1,125	10,415	123	10.2 (8.3–12.4)	208	18.2 (15.7–21.1)	27	2.3 (1.4–3.6)	1,011	91.5 (89.4–93.2)	105	9.8 (7.8–12.2)
Arts, design, entertainment, sports and media	379	3,251	25	5.5 (3.6–8.4)	64	16.3 (12.5–20.9)	26	8.0 (5.2–12.1)	322	86.9 (82.7–90.2)	45	10.7 (7.9–14.4)
Healthcare practitioners and technical	855	7,285	269	32.9 (29.3–36.8)	44	4.4 (3.2–6.1)	50	6.3 (4.7–8.5)	748	89.6 (87.1–91.7)	123	14.2 (11.7–17.1)
Healthcare support	485	3,824	127	27.0 (22.7–31.9)	29	7.1 (4.6–10.9)	38	11.0 (7.6–15.7)	356	69.8 (64.0–75.1)	68	15.0 (11.4–19.5)
Protective service	358	3,022	51	17.3 (12.8–23.0)	207	59.3 (53.2–65.1)	61	20.2 (15.2–26.3)	296	83.1 (78.2–87.1)	99	32.1 (26.5–38.2)
Food preparation and serving related	997	8,802	301	32.2 (28.6–36.0)	71	7.0 (5.3–9.2)	93	15.4 (12.2–19.3)	686	68.0 (64.2–71.5)	189	16.5 (13.9–19.6)
Building and grounds cleaning and maintenance	767	6,023	400	55.4 (50.9–59.9)	317	46.7 (42.3–51.0)	90	15.8 (12.4–20.0)	600	78.3 (74.5–81.7)	313	47.4 (42.5–52.3)
Personal care and service	672	5,734	215	35.6 (31.0–40.5)	129	22.6 (18.6–27.1)	48	9.6 (6.8–13.5)	534	81.4 (77.6–84.7)	147	27.2 (23.0–31.9)
Sales and related	1,743	16,176	222	14.5 (12.4–17.0)	328	19.2 (17.1–21.6)	114	8.6 (6.8–10.9)	1,354	78.2 (75.6–80.6)	277	16.1 (14.1–18.3)
Office and administrative support	2,400	20,497	131	6.0 (4.9–7.3)	221	10.1 (8.7–11.8)	137	5.9 (4.8–7.2)	1,918	80.5 (78.5–82.4)	319	13.5 (12.0–15.3)
Farming, fishing, and forestry	135	1,048	41	29.2 (21.1–38.8)	116	90.1 (85.1–93.5)	17	13.7 (7.3–24.2) ^e	117	84.3 (74.5–90.7)	82	50.8 (39.8–61.7)
Construction and extraction	906	8,707	305	33.3 (29.8–36.9)	730	79.5 (76.1–82.6)	173	28.5 (24.4–33.0)	632	69.2 (65.7–72.5)	526	57.6 (53.7–61.4)

Sample ^{a, c}	Est. population (in thousands)	Frequent occupational skin contact with chemicals ^a		Frequently work outdoors ^a		Non-smokers frequently exposed to SHS at work ^a		Currently non-smoker ^a		Frequent exposure to vapors, gas, dust, or fumes at work ^{b, c}	
		Cases ^c	% (95% CI)	Cases ^c	% (95% CI)	Cases ^c	% ^d (95% CI)	Cases ^c	% (95% CI)	Cases ^c	% (95% CI)
Installation, maintenance, and repair	564	261	50.1 (45.3–55.0)	315	56.4 (51.4–61.3)	86	21.1 (16.9–26.0)	402	71.3 (66.6–75.7)	333	64.2 (59.4–68.8)
Production	1,053	354	35.9 (32.5–39.5)	163	15.5 (13.2–18.2)	106	14.5 (11.7–17.9)	785	73.3 (70.3–76.2)	615	53.2 (49.9–56.5)
Transportation and material moving	978	197	20.9 (18.1–24.1)	573	58.1 (54.2–61.9)	123	16.9 (13.7–20.6)	695	70.9 (67.3–74.2)	442	46.9 (43.0–50.9)

SHS, secondhand smoke; Est., estimated; CI, confidence interval.

Data: National Health Interview Survey, 2010.

All estimates weighted unless otherwise noted. Data include only U.S. working adults who are part of the civilian non-institutionalized population.

^{a, b, c, d, e, f, g}Please see Table II for definition of footnotes.

Prevalence of Exposure to Select Potentially Hazardous Workplace Exposures Among US Adults Who Worked in the Past 12 Months, by Detailed Occupation for Those in Construction and Extraction, Production, and Transportation and Materials Moving

TABLE V

	Sample ^{a,c}	Est. population (in thousands)	Frequent occupational skin contact with chemicals ^a		Frequently work outdoors ^a		Non-smokers frequently exposed to SHS at work ^a		Currently non-smoker ^a		Frequent exposure to vapors, gas, dust, or fumes at work ^a	
			Cases ^c	% (95% CI)	Cases ^c	% (95% CI)	Cases ^c	% ^d (95% CI)	Cases ^c	% (95% CI)	Cases ^c	% (95% CI)
Construction and extraction	906	8,707	305	33.3 (29.8–36.9)	730	79.5 (76.1–82.6)	173	28.5 (24.4–33.0)	632	69.2 (65.7–72.5)	526	57.6 (53.7–61.4)
Supervisors	62	692	21	31.0 (19.7–45.1)	52	82.4 (68.2–91.1)	10	28.4 (14.8–47.6) ^e	41	69.9 (56.3–80.8)	36	49.4 (37.1–61.8)
Construction trades workers	766	7,181	261	33.8 (30.0–37.9)	613	78.8 (75.0–82.2)	148	28.9 (24.4–33.8)	534	68.6 (64.6–72.3)	443	58.5 (54.2–62.7)
Helpers, construction trades	5	35	2	^g	4	^g	1	72.8 (18.1–97.0) ^e	3	63.9 (18.8–93.1) ^e	6	91.8 (56.0–99.0)
Other construction and related workers	48	550	10	25.1 (13.3–42.4)	42	89.1 (76.2–95.4)	7	21.1 (9.7–40.1) ^e	33	71.1 (53.9–83.8)	20	41.6 (26.3–58.6)
Extraction workers	25	249	11	43.7 (24.7–64.8)	19	74.5 (50.0–89.6)	7	27.9 (13.5–48.8) ^e	21	80.3 (56.5–92.8)	21	83.1 (60.1–94.1)
Production	1,053	9,136	354	35.9 (32.5–39.5)	163	15.5 (13.2–18.2)	106	14.5 (11.7–17.9)	785	73.3 (70.3–76.2)	615	53.2 (49.9–56.5)
Supervisors	88	879	24	27.5 (18.4–38.9)	19	20.2 (12.7–30.6)	6	9.0 (3.9–19.5) ^e	68	75.8 (64.6–84.3)	64	58.1 (47.8–67.8)
Assemblers and fabricators	141	1,258	39	24.2 (17.0–33.2)	10	6.5 (3.5–11.9) ^e	14	9.2 (5.2–15.9)	108	79.9 (72.5–85.8)	75	44.3 (35.3–53.8)
Food processing workers	100	793	26	29.7 (19.8–42.0)	11	8.6 (4.4–16.1) ^e	9	12.4 (6.3–23.0) ^e	77	71.0 (56.9–82.0)	23	26.1 (16.2–39.3)
Metal workers and plastic workers	161	1,431	71	49.2 (40.1–58.3)	27	17.2 (11.6–24.8)	26	28.2 (19.2–39.3)	104	65.2 (56.0–73.3)	141	69.7 (62.1–76.4)
Printing workers	44	372	24	55.7 (39.5–70.7)	5	14.3 (5.5–32.0) ^e	3	^g	31	69.1 (51.5–82.4)	37	76.1 (58.1–88.0)
Textile, apparel, and furnishings workers	106	735	29	28.2 (19.2–39.5)	7	5.8 (2.6–12.5) ^e	7	7.9 (3.3–17.9) ^e	88	82.3 (71.8–89.4)	43	31.2 (22.3–41.7)
Woodworkers	16	150	6	34.3 (14.6–61.3) ^e	4	27.5 (10.3–55.4) ^e	1	^g	9	52.9 (30.1–74.5)	12	87.5 (58.5–97.2)
Plant and system operators	29	316	15	56.3 (34.9–75.6)	21	71.1 (50.1–85.8)	4	20.4 (7.6–44.4) ^e	24	80.0 (57.4–92.2)	16	52.9 (32.6–72.2)
Other production occupations	368	3,201	120	36.1 (30.3–42.3)	59	15.1 (11.2–20.1)	36	14.6 (10.2–20.5)	276	73.0 (67.1–78.2)	204	53.6 (47.6–59.5)
Transportation and materials moving	978	8,684	197	20.9 (18.1–24.1)	573	58.1 (54.2–61.9)	123	16.9 (13.7–20.6)	695	70.9 (67.3–74.2)	442	46.9 (43.0–50.9)
Supervisors	19	166	4	38.2 (15.6–67.3) ^e	6	41.5 (18.4–69.1) ^e	0	—	9	45.8 (22.6–71.0)	15	62.5 (41.8–79.5)
Air transportation workers	31	275	2	^g	5	18.4 (7.1–40.0) ^e	1	^g	28	95.7 (86.0–98.8)	15	37.1 (18.2–60.9) ^e
Motor vehicle operators	458	4,022	71	17.2 (13.5–21.7)	364	78.9 (74.0–83.1)	64	17.5 (13.2–22.8)	337	72.8 (67.6–77.5)	177	42.4 (36.7–48.3)

Sample ^{a,c}	Est. population (in thousands)	Frequent occupational skin contact with chemicals ^a		Frequently work outdoors ^a		Non-smokers frequently exposed to SHS at work ^a		Currently non-smoker ^a		Frequent exposure to vapors, gas, dust, or fumes at work ^a	
		Cases ^c	% (95% CI)	Cases ^c	% (95% CI)	Cases ^c	% ^d (95% CI)	Cases ^c	% (95% CI)	Cases ^c	% (95% CI)
Rail transportation workers	10	2	8	9	92.2 (59.5–98.9)	2	8	9	85.3 (42.1–97.9)	12	84.3 (56.2–95.8)
Water transportation workers	4	0	f	3	66.4 (15.6–95.5) ^e	0	f	2	g	3	91.9 (53.6–99.1)
Other transportation workers	37	11	23.8 (12.6–40.5) ^e	23	56.1 (36.7–73.8)	8	26.8 (12.5–48.3) ^e	26	74.4 (56.7–86.6)	21	57.7 (38.6–74.6)
Material moving workers	419	107	25.6 (20.9–30.8)	163	38.6 (33.0–44.5)	48	17.5 (12.5–23.9)	284	67.7 (62.0–72.9)	199	47.7 (41.9–53.6)

SHS, secondhand smoke; Est., estimated; CI, confidence interval.

Data: National Health Interview Survey, 2010.

All estimates weighted unless otherwise noted. Data include only U.S. working adults who are part of the civilian non-institutionalized population.

a, b, c, d, e, f, g Please see Table II for definition of footnotes.