

**Within-Occupation and Industry Sex, Race, and Educational Differences in Exposures to  
Workplace Hazards**

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**Abstract**

In 2008, there were more than 5,000 work-related fatalities and 1.4 million nonfatal work-related illnesses and injuries (BLS 2011). Exposure to workplace conditions like handling hazardous chemicals and breathing toxic vapors and second-hand smoke in the workplace is significantly associated with a higher risk of occupationally-related illnesses. A small body of research examines whether there are group differences in the risk of exposure to workplace hazards. Group differences in exposure to hazardous workplace conditions have been ascribed to working in different occupations. However, previous research provides little insight into whether group differences would persist if we compared workers employed in the same types of workplaces. In this study, we use the occupational health supplement to the 2010 National Health Interview Surveys to investigate whether observed, sex, race, and educational differences in exposures to workplace hazards remain between workers employed within the same occupation-industry pairings.

The U.S. Bureau of Labor Statistics estimates that, in 2008, there were more than 5,000 work-related fatalities and 1.4 million nonfatal work-related illnesses and injuries (BLS 2011). Exposure to workplace conditions like handling hazardous chemicals and breathing toxic vapors and second-hand smoke in the workplace is significantly associated with a higher risk of occupationally-related illnesses. For example, approximately 9% of all adult asthma cases in the U.S. are attributable to occupational exposures (Blanc and Toren 1999) totaling \$1.6 billion in direct and indirect costs from health care and lost earnings (Leigh et al. 2002). Apart from deaths occurring on the job, others have estimated that approximately 55,000 additional deaths per year result from occupational disease or injury (Steenland et al. 2003).

A small body of research examines whether there are group differences in the risk of exposure to workplace hazards. Calvert and colleagues (2013) found statistically significant differences by sex, race/ethnicity, and education in self-reports of frequent exposure at work to hazards such as skin contact with chemicals in a sample of U.S. adults. For example, 33% of working men report frequent exposure to vapors, gas, dust, or fumes at work, compared to 16% of working women. Using a sample of workers in New Zealand, Eng et al. (2011) also found substantial sex differences in exposures to workplace hazards, where men were significantly more likely to be exposed to toxic chemicals and vapors than women, although women were more likely to be exposed to other types of workplace hazards.

In general, group differences in exposure to hazardous workplace conditions have been ascribed to working in different occupations. However, previous research provides little insight into whether group differences would persist if we compared workers employed in the same types of workplaces. In the only study we could locate that examined within-occupation differences in exposure to workplace hazards, Eng and colleagues (2011) found that sex

differences were reduced by comparing men and women employed within the same occupations, but remained statistically significant. They did not consider whether the remaining difference was attributable to working in different industries despite identical occupational titles. We have no information on whether other group differences disappear if we compare only those working within the same occupations.

With this study, we address gaps in the literatures on health disparities and occupational health by investigating whether sex, race, and educational differences in exposures to workplace hazards persist within occupation and industry. Specifically, we examine group differences in 1) regular skin contact with chemicals in the workplace; 2) frequent (twice a week or more) exposure to vapor, gas, dust, or fumes on the job; and 3) regular exposure to second-hand smoke in the workplace. In the current paper, we begin by examining bivariate relationships between group characteristics and exposure to selected workplace hazards for workers employed in the four most numerous occupational groupings: 1) management; 2) business and financial operations; 3) sales; and 4) office and administrative support. We then consider whether any observed group-level differences remain after adjusting for other individual-level characteristics. Future versions of this paper will use fixed effects modeling to investigate whether group-level differences in workplace exposures remain when comparing only workers employed in the same occupation-industry pairings.

## **Methods**

### *Data and Sample*

Data are from the 2010 Integrated Health Interview Series (IHIS), which was created from National Health Interview Survey (NHIS) data to facilitate analysis of the health of the U.S.

population (Minnesota Population Center and State Health Access Data Assistance Center, 2012). Although the NHIS is conducted annually, we use the 2010 data because it included an Occupational Health Supplement (OHS), focused on occupational conditions and exposures. The OHS was asked of sample adults aged 18 and older who were currently employed or had been employed at some time during the previous 12 months (n=17,524). Respondents with missing information on occupational exposures or any covariates were excluded from analyses, resulting in an analytic sample size of 16,352. In order to understand within-occupation differences, analyses were further restricted to members of four occupational classifications, for the purposes of case studies, resulting in a final sample size of 6,073. The four occupational categories, management, business and financial operations, sales, and office and administrative support, were chosen because they each had ample sample size to investigate differences by sex, race, and education (n>250 for each cell). Survey weights were employed to provide nationally representative estimates.

### *Analysis*

Bivariate analyses with chi-squared tests of significance were used to compare differences in occupational exposures by sex, race, and educational attainment overall and within four occupational sub-categories: management, business and financial operations, sales, and office and administrative support. We then ran logistic regressions separately for each of the four occupational categories, adjusting for sex, race, and education, as well as for age, citizenship, family income, marital status, and region. Results are presented as odds ratios of experiencing each of three types of occupational exposure.

### *Dependent Variables*

We look at three potentially harmful occupational exposures: 1. Regular skin contact with chemical substances on the job during the past 12 months; 2. Frequent (twice a week or more) exposure to vapor, gas, dust, or fumes (VGDF) on the job during the past 12 months; and 3. Regular exposure to second-hand tobacco smoke on the job during the past 12 months.

### *Independent Variables*

Our key independent variables were sex (male vs. female), race (white vs. non-white), and education (less than a four-year college degree vs. a college degree or more). We collapsed race and education into dichotomous categories because of sample size considerations. In future analyses, we will use the expanded, multiple-category versions shown in Table 1. Occupation is measured with 23 categories in the NHIS, based on the SOC codes. For the purposes of examining within-occupation differences, we further limited analyses to four occupational categories: management, business and financial operations, sales, and office and administrative support. These were chosen because they each had ample sample size to investigate differences by sex, race, and education ( $n > 250$  for each cell). Covariates included age (18 and older), citizenship (U.S. citizen vs. not), family income, marital status (currently married or cohabiting, separated/divorced/widowed, and never married) and region (Northeast, Midwest, South, and West).

## **Preliminary Findings**

### *Bivariate Results*

Table 1 presents the distribution of sample characteristics for the entire employed population and for workers employed in each of the four occupational case-studies. The table presents unweighted sample sizes for each cell and weighted population percentages or means.

Overall, the distribution of sample characteristics varies considerably, both across the four case-study occupations and between the case-study occupations and the overall employed population. For example, workers employed in management and business occupations are less likely to be Hispanic or black than the overall population (6.7% and 7.3% vs. 12.3%, and 7.3% and 10.7% vs. 12.2%, respectively), and more likely to have graduated from college (55.1% and 62.3% vs. 34.0%, respectively). The difference in the distribution of sample characteristics across our case study occupations will allow us to develop preliminary hypotheses related to occupational composition for later analyses.

Figures 1 and 2 present bivariate differences in the prevalence (in percentage terms) of on-the-job exposures to chemicals, VGDF, and second-hand smoke. On average, incumbents of the four case-study occupations experience less (and in some cases, substantially less) exposure to any of the three workplace hazards considered here (refer to Figure 1). Overall, 20% of workers report regular skin contact with chemicals at work, 25% of workers report frequent exposure to VGDF at work, and 15% of workers report regular exposure to second-hand smoke at work. Fourteen percent of workers employed in management occupations report exposure to chemicals, 18% report exposure to VGDF, and 10% report exposure to second-hand smoke. Three percent of workers employed in business and financial occupations report exposure to chemicals, 9% report exposure to VGDF, and 6% to second-hand smoke. Fourteen percent of workers in sales and related occupations report exposure to chemicals, 18% to VGDF, and 14% to second-hand smoke. Six percent of office and administrative support workers report exposure to chemicals, 16% to VGDF, and 11% to second-hand smoke.

**Table 1: Sample Characteristics, Overall and by Occupational Grouping**

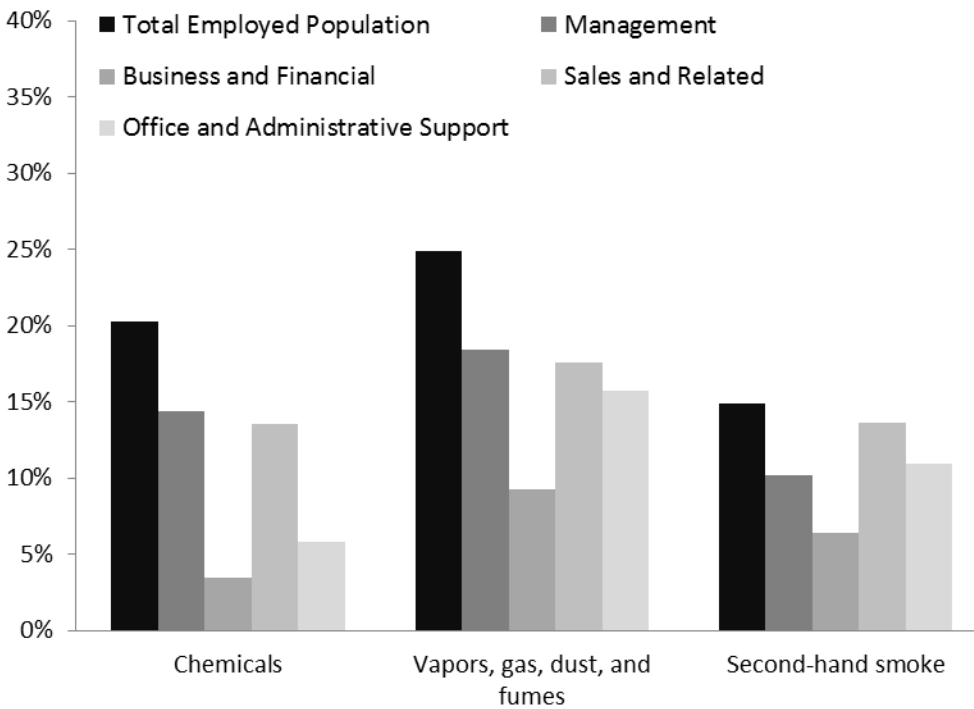
	All		Management		Business & Financial		Sales and Related		Office & Admin.	
	n	%/ Mean	n	%/ Mean	n	%/ Mean	n	%/ Mean	n	%/ Mean
<b>Sex</b>										
Men	7,914	49.5	828	60.4	342	45.4	734	47.2	540	24.8
Women	8,438	50.5	580	39.6	418	54.6	899	52.8	1,732	75.2
<b>Age</b>	16,352	41.8	1,408	45.5	760	43.1	1,633	39.8	2,272	42.6
<b>Racial group</b>										
Hispanic	3,255	12.3	150	6.7	87	7.3	299	11.0	404	11.2
White	12,288	81.2	1,160	87.4	550	80.5	1,273	83.4	1,637	78.2
Black	2,548	12.2	136	7.3	108	10.7	214	10.3	452	15.8
Asian	1,079	4.2	86	3.8	82	6.5	103	4.0	114	3.1
Other	437	2.4	26	1.5	20	2.4	43	2.3	69	2.9
<b>US citizen</b>	14,509	92.5	1,340	96.5	729	97.5	1,503	94.7	2,163	96.7
<b>Family Income</b>	16,352	62,282	1,408	91,757	760	85,785	1,633	57,862	2,272	56,823
<b>Education</b>										
<HS	1,662	7.7	48	2.8	4	0.5	138	6.8	94	3.5
HS grad	4,216	25.3	214	15.2	82	10.5	462	27.6	691	30.2
Some college	5,249	33.0	378	26.9	206	26.6	607	36.9	1,077	47.8
College grad	5,225	34.0	768	55.1	468	62.3	426	28.7	410	18.5
<b>Marital status</b>										
Married /Cohab	7,536	45.9	806	57.1	374	48.0	657	40.3	979	43.1
Sep/ widow/ divorced	3,281	20.2	268	19.4	145	19.6	309	19.5	540	25.1
Never married	4,368	26.8	270	19.0	197	26.4	519	30.8	613	26.0
<b>Region</b>										
NE	2,439	16.3	194	14.9	115	16.6	240	16.1	367	16.9
Midwest	3,704	24.9	332	24.9	157	22.1	356	24.0	516	24.8
South	6,025	36.1	468	32.6	291	38.0	627	28.1	855	37.2
West	4,184	22.8	414	27.7	197	23.3	410	21.8	534	21.1
<b>N</b>	16,352		1,408		760		1,633		2,272	

*Note: Percentages are calculated using survey weights.*



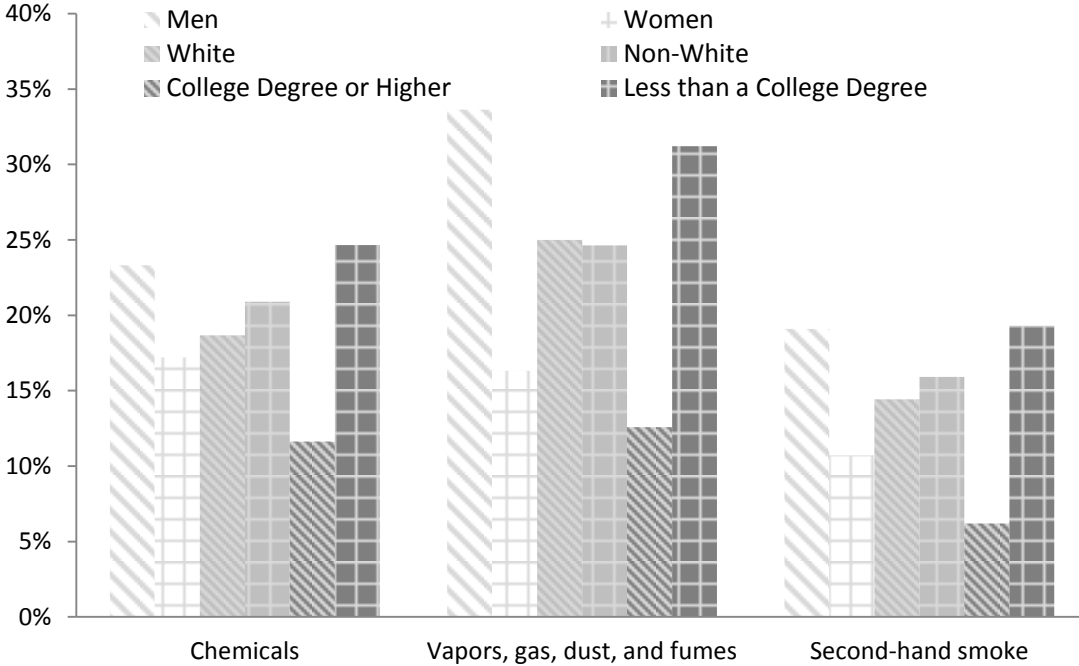
There is also substantial variation by sex and education, though not race, in self-reports of workplace exposures to hazardous conditions (refer to Figure 2). Men are more likely to report on-the-job exposures relative to women for all three of the conditions we consider here (23% vs. 17% for chemicals, 34% vs. 16% for VGDF, and 19 vs. 11% for second-hand smoke). College graduates are less likely to report regular skin contact with chemicals than are those with less than a college degree (12% vs. 25%), and less likely to report exposure to VGDF (13% vs. 31%) or second-hand smoke (6% vs. 19%).

**Figure 1. Prevalence of Exposures by Occupational Group**



*Note: All percentages are population-weighted.*

**Figure 2. Prevalence of Exposure by Demographic Characteristic**



*Note: All percentages are population-weighted.*

*Multivariate Results*

Table 2 displays the results of multivariate logistic regression models predicting self-reported exposure to each of the three substances we consider in the current study, separately by each of the four case-study occupational groupings. Multivariate results indicate that, even when considering workers employed within the same occupations, and adjusting for other individual-level factors, most sex and education differences in hazardous exposures persist. Among those employed in management occupations, women are 41% less likely to experience regular skin contact with chemical substances, 69% less likely to be frequently exposed to VGDF, and 59% less likely to have regular exposure to second-hand smoke. In business and financial occupations, they are 70% less likely to experience regular chemical contact or frequent exposure to VGDF; in sales and related occupations, female employees are 32% less likely to

experience frequent exposure to VGDF and 29% less likely to experience regular second-hand smoke exposure; and in office and administrative support positions, they are 41% less likely to regularly handle chemicals, 50% less likely to be exposed frequently to VGDF, and 49% less likely to experience regular second-hand smoke exposure.

**Table 2: Odds of occupational exposure by subgroup**

	Chemical Substances		Vapors		Smoke exposure	
	OR	P>t	OR	P>t	OR	P>t
Management (n=1,408)						
Female (n=580)	0.586	0.003	0.306	0.000	0.405	0.000
Non-White (n=388)	0.555	0.010	0.531	0.003	0.827	0.411
Less than a College Degree (n=640)	2.383	0.000	3.385	0.000	2.110	0.000
Business and Financial (n=760)						
Female (n=418)	0.293	0.002	0.304	0.000	0.861	0.651
Non-White (n=282)	1.891	0.130	1.590	0.122	1.465	0.195
Less than a College Degree (n=292)	3.133	0.007	2.978	0.000	1.189	0.630
Sales and Related (n=1,633)						
Female (n=899)	0.742	0.073	0.676	0.009	0.712	0.043
Non-White (n=636)	0.784	0.180	1.226	0.201	0.853	0.372
Less than a College Degree (n=1,207)	2.756	0.000	2.288	0.000	2.469	0.000
Office and Administrative Support (n=2,272)						
Female (n=1,732)	0.588	0.014	0.497	0.000	0.512	0.000
Non-White (n=987)	0.656	0.048	0.871	0.308	0.876	0.398
Less than a College Degree (n=1,862)	1.458	0.175	1.700	0.005	2.278	0.000

*All models adjust for age, citizenship, family income, marital status, and region.*

In all case-study occupations, except for office and administrative support, having less than a college degree has a large and statistically significant association with each of the hazardous workplace exposures we examined. Those with less than a college degree in management occupations were 2.4 times more likely to handle chemicals, 3.4 times more likely to be exposed to VGDF, and 2.1 times more likely to be regularly exposed to second-hand smoke. In business and financial occupations, those holding less than a college degree were

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approximately three times as likely to have regular skin contact with chemicals and frequent exposure to VGDF, and 20% more likely to be routinely exposed to second-hand smoke. Within sales and related occupations, they were 2.8 times more likely to handle chemical substances, 2.3 times more likely to be frequently exposed to VGDF, and 2.5 times more likely than college graduates to experience regular second-hand smoke exposure. Last, in office and administrative support, they were 1.7 times as likely to be exposed to VGDF and 2.3 times as likely to be exposed to second-hand smoke.

Results for racial differences in hazardous workplace exposures are mixed. Within business and financial occupations, and sales and related occupations, there were no differences in self-reported exposures to hazardous workplace conditions. Within management occupations, non-whites were 44% less likely to have regular skin contact with chemicals and 47% less likely than whites to have frequent exposure to VGDF. Among those holding office and administrative support positions, non-whites were 44% less likely to experience frequent skin contact with chemicals relative to whites.

### **Next steps**

For the 2014 PAA meetings, we will explore whether the preliminary results for our four case study occupations hold when we include workers from all of the occupational groupings included in the IHIS and control for industry as well as occupation. We will also estimate models with finer-grained racial/ethnic and educational categories, so that we can examine whether there are important differences within the non-white category and/or the less than college education category.

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