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## Occupational injury and psychological distress among U.S. workers: The National Health Interview Survey, 2004–2016

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## ABSTRACT

**Introduction:** Injuries at work may negatively influence mental health due to lost or reduced working hours and financial burden of treatment. Our objective was to investigate, in U.S. workers (a) the prevalence of serious psychological distress (SPD) by injury status (occupational, non-occupational, and no injury) and injury characteristics, and (b) the association between injury status and SPD. **Methods:** Self-reported injuries within the previous three months were collected annually for 225,331 U.S. workers in the National Health Interview Survey (2004–2016). Psychological distress during the past 30 days was assessed using the Kessler 6 (K6) questions with Likert-type scale (0–4, total score range: 0–24). SPD was defined as  $K6 \geq 13$ . Prevalence ratios (PR) from fitted logistic regression models were used to assess relationships between injury and SPD after controlling for covariates. **Results:** The prevalence of SPD was 4.74%, 3.58%, and 1.56% in workers reporting occupational injury (OI), non-occupational injury (NOI), and no injury, respectively. Workers with head and neck injury had the highest prevalence of SPD (Prevalence: OI = 7.71%, NOI = 6.17%), followed by workers with scrape/bruise/burn/bite (6.32% for those with OI). Workers reporting OI were two times more likely to have SPD compared to those without injury (PR = 2.19, 95%CI: 1.62–2.96). However, there was no significant difference in SPD between workers with OI and workers with NOI (PR = 0.98, 95%CI: 0.65–1.48). **Conclusion:** The prevalence of SPD varied by injury status with the highest being among workers reporting OI. We found that the workers reporting OI were significantly more likely to have SPD than those without injury, but not more than those with NOI. **Practical Applications:** Mental health management programs by employers are necessary for workers who are injured in the workplace.

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## 1. Introduction

According to the U.S. National Health Interview Survey (NHIS), 28.6% of employed adults experienced work-related injuries in 1997–1999 (Smith, Sorock, Wellman, Courtney, & Pransky, 2006). The U.S. Bureau of Labor Statistics in 2017 reported that approximately 2.8 million nonfatal workplace injuries and illnesses (2.8 cases per 100 full-time workers) occurred among private industry employees (BLS, 2018). Injury may affect a worker's standard of living and increase anxiety and insecurity about future income. Work-related injuries may result in disability, reduced earnings, financial burden for treatment, difficulty returning to work, and

lost employment due to the injury (Zwerling, Whitten, & Davis, 1997; Biddle & Keane, 2011; Young, 2010). Injured workers may also experience loss of status or contact with friends and coworkers, an important sources of social and professional support, stressors that may lead to mental health problems such as depression and anxiety (Asfaw & Souza, 2012). A study reported that about half of workers without a diagnosis of depression a year prior to a work-related injury may feel depressed at some point during the following year, and a quarter may feel depressed at the one-year mark (Carnide, 2016).

According to the Centers for Disease Control and Prevention (CDC), one out of every four adults in the United States had a mental illness in 2004. The economic cost of mental illness in the United States is substantial, approximately \$300 billion (CDC, 2011). The report also stated that the occurrence of mental illness was associated with risky behaviors (e.g., alcohol and drug abuse) and chronic conditions (e.g., disease and injuries). Data from the NHIS

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in 2000–2003 indicate that 5.8% of U.S. workers experienced serious psychological distress during the previous 30 days (Kim, 2008).

Researchers often encounter difficulty quantifying the relationship between occupational injuries and mental health. A number of cross-sectional epidemiologic studies have investigated the association between mental health and injuries and vice versa. Many studies have reported that mental disorders (e.g., depression symptoms, psychological distress) increased the risk for occupational injuries (Hilton & Whiteford, 2010; Kim, 2008; McAninch, Greene, Sorokin, Lavoie, & Smith, 2014; Jacobsen et al., 2013). A study using data from full-time Australian workers found that high psychological distress increased the odds of workplace accidents as well as work failure (Hilton & Whiteford, 2010). Jacobsen and colleagues found that mental distress in construction workers was associated with injury and illness. Studies investigating the effect of occupational injuries on psychological distress are limited. A recent study in police officers found that work-related injury was associated with psychological distress (West et al., 2017).

This study compared the difference in mental distress across three groups of workers: occupationally injured workers, non-occupationally injured workers (NOI), and uninjured workers. The aims of this study, which is based on a nationally representative sample of U.S. workers, were (a) to estimate the prevalence of serious psychological distress by the injury status (occupationally injured workers, non-occupationally injured workers, and non-injured workers), selected socio-demographics, and injury characteristics (injury site, injury type, external causes, treatment location, and the number of workdays missed) and (b) to investigate the association between injury status and serious psychological distress across injury characteristics.

## 2. Materials and methods

### 2.1. Data source

Psychological distress and injury were assessed using data from NHIS, a cross-sectional survey of the civilian U.S. household population conducted annually by the National Center for Health Statistics (NCHS), CDC. Data are collected through in-person household interviews and are based on a multistage clustered area probability sample. The NHIS oversamples Blacks, Hispanics, and Asians and adults aged  $\geq 65$  years to allow for the precise estimation of health in minority populations and elders. Extensive details about the questionnaire, methodology, data, and documentation are available on the NHIS website [NCHS, 2014]. Written informed consent was obtained from all subjects. All procedures in each NHIS were approved by the NCHS Research Ethics Review Board [NCHS, 2012].

### 2.2. Study sample

We first selected paid workers aged 18 years and older who were 'working at a job or business' or 'with a job or business but not at work' during the week prior to their interview. The total number of the combined 2004–2016 NHIS adults was 392,584 with average response rate of 79.8% (Supplement Table 1). From this population, our study included 225,331 working adults, after excluding those who were retired, unemployed, or did not answer the employment status or the psychological distress questions.

Data from the NHIS basic module (a Sample Adult Core questionnaire and a Family Core questionnaire) for 2004–2016 were analyzed for this study. The Sample Adult questionnaire in the NHIS elicited information from participants on socio-demographic characteristics (age, gender, race/ethnicity, marital status, education, income), lifestyle factors (sleep duration, smoking status, alcohol intake, leisure-time physical activity, body mass

index), and job characteristics (length of employment, employment status, second job, occupational group, industrial group). The Family Core questionnaire included injury and poisoning questions.

### 2.3. Injury

Information on injury, including site of injury, type of injury, external causes of injury, treatment location after injury, activity at time of injury, and the number of workdays missed due to injury was obtained from the Injury/Poisoning Episode files in the Family Core section. All injury episodes that reportedly occurred during the three months (91 days) prior to the date of the interview were collected to reduce the recall bias of less serious injury (NCHS, 2012). The NHIS Injury file contains information about the external causes and the nature of the injury episode, what the person was doing at the time of the injury, where the person received medical advice and treatment, whether the person was hospitalized, and whether the person missed any days from work due to the injury, with the 9th Revision of the International Classification of Diseases (ICD-9-CM) diagnostic codes and ICD-9-CM external cause codes. Injuries for each person have been classified according to the nature of injury codes 800–909.2, 909.4, 909.9, 910–994.9, 995.5–995.59, and 995.80–995.85 in ICD-9-CM and one external cause of injury code of E800–E848, E850–E869.9, E880–E929.9, or E950–E999 [NCHS, 2012].

Occupational injury was defined as injury that occurred while the worker was 'working at a paid job,' using the question "What activity were you involved in at the time of the injury?" Non-occupational injury was defined as injury that occurred while the worker was not 'working at a paid job,' (e.g., driving or riding in a motor vehicle (except when driving for work), house or yard work at home, attending school, unpaid work such as volunteer work, sports and exercise, leisure activity, sleeping, resting, eating, drinking, cooking, caring for others).

The sites of injuries were grouped as lower extremity (feet, legs, knees, thighs, hip), upper extremity (hands, arms, shoulders), back/buttocks, and head/neck. The nature of injuries (i.e., type of injuries) was categorized as fracture, sprain/strain/twist, cut, and scrape/bruise/burn/bite. The external causes of injuries were listed as fall, struck by object, overexertion/strenuous movement, burn/scald/poisoning/bite, cut/pierce, and transportation. For analysis purposes, a worker was considered injured if he/she had one or more injury episodes reported.

### 2.4. Serious psychological distress

Measurement of psychological distress included six screening questions for symptoms of anxiety and depression that were designed for the NHIS and referred to as Kessler 6 (K6) [21]. The six-question K6 asks about the six symptoms of mental or psychological distress; respondents were asked "During the past 30 days, how often did you feel ... (1) So sad that nothing could cheer you up? (2) Nervous? (3) Restless or fidgety? (4) Hopeless? (5) That everything was an effort? and (6) Worthless?" Response categories were "All of the time" (score = 4), "Most of the time" (score = 3), "Some of the time" (score = 2), "A little of the time" (score = 1), and "None of the time" (score = 0). The total psychological distress score (referred to as K6) is the sum of the six items with a range of 0–24. Only participants who answered all six questions were included in the study sample. Serious psychological distress was defined as the total psychological distress score equal to or greater than 13, i.e.  $K6 \geq 13$ .

## 2.5. Covariates

The Sample Adult Core Questionnaire collected demographic information including age ( $\geq 18$  years: 18–34, 35–54, 55+), gender, race/ethnicity (Non-Hispanic White, Non-Hispanic Black, Hispanic, Non-Hispanic all other race groups), marital status (single/never married, married, divorced/widowed/separated), and education (less than high school, junior college or incomplete college, college graduate or higher), and current income (<25 K, 25–45 K, 45 K+). Lifestyle information included daily sleep duration (<7 h, 7+ h), smoking status (never, former, current), alcohol status (never/former, current ( $\leq 3$  drinks/week), current (4+ drinks/week)), and leisure-time physical activity (inactive, insufficiently active, sufficiently active). To assess leisure-time physical activity, participants were asked to summarize their usual physical activity both in terms of frequency, intensity, and duration while engaging in aerobic physical activity. Employment information included length of employment (<1 year, 1–4 years, 5+ years), employment status (full-time, part-time), second job (yes, no), occupational groups (management/professional, services, sales/office administration, construction/production/transportation), and industrial groups (agriculture/mining/construction, manufacture/transportation/warehousing, trade, services, health/social services/education/public administration).

Identification of covariates as potential confounders was determined based on the significant association of these variables with both main exposure (injury) and outcome (psychological distress), and based on previous research. The potential confounders included in the analyses were age, gender, race/ethnicity, marital status, education level, smoking status, alcohol intake status, employment status, sleep duration, physical activity, and occupational groups.

## 2.6. Statistical analyses

Sample weights were used in calculating point estimates in all analyses since the NHIS data are obtained through a complex, multistage sample design that involves stratification, clustering, and oversampling of specific population subgroups. A weighting variable was divided by 13 to take into consideration the 13 survey years 2004–2016. The standard errors were estimated using Taylor series linearization with the sample weight and sample design.

Comparisons of selected demographic and lifestyle characteristics by injury status among all study participants and among those who reported serious psychological distress ( $K6 \geq 13$ ) were performed using Chi-square tests. The prevalence of serious psychological distress (per 10,000 workers) during the past three months was calculated by dividing the estimated number with serious psychological distress by the estimated population of selected characteristics in each injury status (no injury, non-occupational injury, occupational injury), and then multiplying by 10,000. If the prevalence values are indicated by the symbol ( $\dagger$ ) in the tables, they are unreliable since the relative standard error of the estimate is larger than 30% [Klein, Proctor, & Boudreault, 2004].

The prevalence ratios (PR) were obtained from average marginal predictions in the fitted logistic regression model (Bieler et al., 2010). The unadjusted PR of serious psychological distress (SPD) and the associated 95% CIs were compared by injury status across demographic and lifestyle characteristics; prevalence ratios (PRs) were then used to compare prevalence of SPD in those with occupational injury relative to uninjured workers, and to workers with non-occupational injury, across levels of selected characteristics (socio-demographic, lifestyle, job). The prevalence of SPD by injury status across categories of injury characteristics were computed; unadjusted and covariate adjusted comparisons of the

prevalence estimates (occupationally injured vs. uninjured, occupationally injured vs. non-occupationally injured) were made. Adjustments were made for the following potential confounders: gender, age, race/ethnicity, marital status, education level, smoking status, alcohol intake status, employment, sleep duration, physical activity, and occupation. All reported  $p$ -values were two-sided and a  $p$ -value of  $<0.05$  was considered statistically significant. Analyses were performed using SAS-callable SUDAAN software version 11.0.

## 3. Results

The distribution of selected demographic and lifestyle characteristics by injury status (no injury, non-occupational injury, and occupational injury) among all participants and among those with serious psychological distress is presented in Table 1. The overall prevalence of occupational injury and non-occupational injury were 0.8% and 1.9% per 10,000 workers, respectively. We observed a higher proportion of occupational injuries in male workers versus female workers (65.4% and 34.6%, respectively). Workers who had less education ( $\leq$ HS/GED) experienced a higher rate of occupational injuries relative to the highly educated ( $\geq 4$  years college) workers (44.5% and 20.7%, respectively), while workers who were highly educated experienced more non-occupational injuries than the less educated workers (42.4% and 26.5%, respectively). Workers in construction and transportation had a much higher proportion (43.4%) of occupational injury than other job groups.

In those who reported serious psychological distress, the occupationally injured workers were composed of higher proportion of men (56.8%), divorced workers (44.2%), workers with lower education ( $\leq$ HS/GED = 54.4%), lower annual income (<25 K = 61.6%), and higher proportion of workers in the construction and transportation occupational groups (43.4%) compared to non-occupationally injured or uninjured workers.

Over these years, the prevalence of injury and serious psychological distress (Supplement Table 1) did not change substantially (range of the prevalence: 0.72–0.90 for occupational injury, 1.69–2.17 for non-occupational injury, 1.37–1.98 for serious psychological distress).

Table 2 shows the prevalence of serious psychological distress by injury status across levels of selected characteristics, and the prevalence ratios of serious psychological distress (occupational injury vs. no injury and occupational injury vs. non-occupational injury). The prevalence of serious psychological distress by injury status was 4.74% among the occupationally injured workers, 3.58% among the non-occupationally injured workers, and 1.56% among the non-injured workers. The prevalence of serious psychological distress differed based on socioeconomic status and lifestyle behaviors. Women, the divorced, the less educated, those who had lower income, those who had shorter sleep duration, current smokers, those who were physically inactive, and the obese reported higher prevalence of serious psychological distress.

The highest prevalence of serious psychological distress in workers with occupational injury was among divorced workers (9.82%). Divorced workers with occupational injury had four times higher prevalence of serious psychological distress than married workers (9.82 and 2.13, respectively). Sufficiently physically active workers had a lower prevalence of serious psychological distress than insufficiently active or inactive workers (2.78, 6.32, and 6.46, respectively). We also observed that serious psychological distress was lowest in workers with occupational injury who were overweight ( $25 \leq \text{BMI} < 30 \text{ kg/m}^2$ ) compared to those with normal ( $\text{BMI} < 25$ ) and those with obesity ( $\text{BMI} \geq 30$ ) regardless of injury status. Among occupational groups, workers in sales and administrative office (7.77) had more serious psychological distress than those in service (4.16) or in construction or transportation (4.79).

**Table 1**  
Distribution of selected characteristics by injury status among all participants and among those who reported serious psychological distress (K6 ≥ 13).

Characteristics	Injury Status (all subjects)			p-value‡	Injury Status among those with Serious Psychological Distress (K6 ≥ 13)			p-value‡
	No Injury N (%)*	Non-occupational Injury N (%)*	Occupational Injury N (%)*		No Injury N (%)*	Non-occupational Injury N (%)*	Occupational Injury N (%)*	
All sample	218,841 (97.3)	4,626 (1.9)	1,864 (0.8)		3,878 (93.6)	185 (4.2)	103 (2.2)	
Socioeconomic Demographics								
Sex								
Men	108,217 (53.2)	2,214 (53.0)	1,088 (65.4)	<0.0001	1,388 (39.7)	70 (49.7)	47 (56.8)	0.0252
Women	110,624 (46.8)	2,412 (47.0)	776 (34.6)		2,490 (60.3)	115 (50.3)	56 (43.2)	
Race/ethnicity								
Non-Hispanic White	134,281 (67.8)	3,339 (77.7)	1,180 (69.5)	<0.0001	2,215 (63.8)	124 (72.4)	67 (73.9)	0.1819
Non-Hispanic Black	30,431 (11.3)	558 (9.6)	283 (12.4)		610 (13.2)	24 (9.3)	12 (7.3)	
Hispanic	39,659 (15.0)	487 (8.4)	320 (14.2)		861 (18.3)	28 (13.0)	17 (13.9)	
All other	14,470 (5.9)	242 (4.3)	81 (3.9)		192 (4.8)	9 (5.4)	7 (4.9)	
Age								
18–34	73,195 (34.9)	1,697 (37.3)	667 (38.8)	0.0016	1,322 (37.8)	78 (46.5)	46 (49.1)	0.0804
35–54	100,027 (46.2)	1,945 (43.8)	846 (44.9)		1,884 (46.6)	85 (44.4)	38 (39.9)	
55+	45,619 (18.9)	984 (18.9)	351 (16.3)		672 (15.7)	22 (9.1)	19 (10.9)	
Marital Status								
Single	65,745 (27.5)	1,642 (31.6)	651 (32.5)	<0.0001	1,325 (32.8)	68 (31.7)	37 (34.8)	0.0471
Married	104,160 (57.1)	1,745 (48.8)	703 (46.4)		1,206 (40.2)	38 (39.1)	17 (21.0)	
Divorced	48,200 (15.4)	1,233 (19.6)	507 (21.2)		1,337 (27.0)	79 (29.2)	48 (44.2)	
Education								
≤HS/GED	76,280 (34.7)	1,203 (26.5)	822 (44.5)	<0.0001	1,827 (48.2)	67 (43.3)	48 (54.4)	0.0038
<4 yrs college	59,498 (27.4)	1,430 (31.1)	643 (34.8)		1,237 (32.6)	61 (29.1)	44 (38.2)	
≥4 yrs college	81,355 (37.9)	1,980 (42.4)	385 (20.7)		780 (19.2)	55 (27.6)	10 (7.4)	
Income								
<25 K	61,668 (34.1)	1,388 (33.8)	618 (39.3)	<0.0001	1,849 (58.2)	80 (50.2)	52 (61.6)	0.0001
25–45 K	50,859 (28.6)	1,041 (25.7)	511 (32.0)		757 (24.2)	41 (30.5)	25 (35.4)	
45 K+	61,699 (37.3)	1,530 (40.5)	421 (28.7)		522 (17.6)	36 (19.3)	3 (3.0)	
Lifestyle Characteristics								
Sleep								
<7 h/day	68,453 (31.0)	1,695 (35.4)	805 (42.9)	<0.0001	2,180 (57.4)	90 (44.3)	58 (59.0)	0.1015
7+ h/day	148,504 (69.0)	2,894 (64.6)	1,046 (57.1)		1,649 (42.6)	91 (55.7)	44 (41.0)	
Smoke status								
Never	135,404 (62.1)	2,625 (57.3)	890 (47.7)	<0.0001	1,786 (46.2)	87 (44.6)	42 (40.5)	0.8426
Former	41,098 (19.1)	975 (20.6)	404 (21.9)		617 (15.7)	21 (12.9)	14 (16.2)	
Current	41,335 (18.8)	1,008 (22.1)	567 (30.4)		1,459 (38.1)	77 (42.4)	47 (43.3)	
Alcohol								
Never/Former	61,563 (27.7)	997 (21.3)	489 (26.1)	<0.0001	1,128 (29.0)	44 (20.3)	31 (26.0)	0.1913
Current (≤3 drks/wk)	103,509 (48.9)	2,212 (49.8)	858 (46.3)		1,781 (47.6)	86 (55.9)	40 (40.4)	
Current (4+ drks/wk)	49,614 (23.4)	1,347 (29.0)	487 (27.7)		884 (23.4)	53 (23.8)	30 (33.7)	

Table 1 (continued)

Characteristics	Injury Status (all subjects)				Injury Status among those with Serious Psychological Distress (K6 ≥ 13)			
	No Injury	Non-occupational Injury	Occupational Injury	p-value‡	No Injury	Non-occupational Injury	Occupational Injury	p-value‡
	N (%)*	N (%)*	N (%)*		N (%)*	N (%)*	N (%)*	
<b>Leisure-time physical activity</b>								
Inactive	63,067 (28.3)	996 (22.1)	563 (31.7)	<0.0001	1,592 (41.4)	61 (34.7)	47 (43.6)	0.1308
Insufficiently active	43,439 (20.5)	795 (17.5)	383 (21.2)		816 (21.7)	33 (15.5)	19 (28.5)	
Sufficiently active	108,430 (51.2)	2,750 (60.4)	885 (47.2)		1,400 (36.8)	88 (49.7)	33 (28.0)	
<b>BMI</b>								
Normal (18.5-<25)	77,271 (36.6)	1,603 (34.9)	552 (29.5)	<0.0001	1,272 (33.4)	64 (36.4)	34 (27.0)	0.2698
Overweight (25.0-<30)	76,250 (36.2)	1,545 (35.8)	649 (35.9)		1,120 (30.2)	43 (22.0)	26 (26.2)	
Obese (30 + )	58,314 (27.2)	1,350 (29.2)	633 (34.6)		1,380 (36.5)	72 (41.6)	43 (46.8)	
<b>Job Characteristics</b>								
<b>Length of work</b>								
<1 yr	35,073 (16.5)	842 (17.7)	426 (23.2)	<0.0001	1,054 (27.7)	60 (29.1)	30 (26.4)	0.1988
1–4 yrs	69,511 (32.2)	1,568 (34.6)	591 (33.2)		1,325 (34.0)	62 (29.3)	43 (48.2)	
5+ yrs	111,454 (51.2)	2,193 (47.7)	838 (43.6)		1,474 (38.3)	63 (41.6)	30 (25.3)	
<b>Employment status</b>								
Full-time (>=30 h/wk)	182,763 (85.5)	3,590 (83.3)	1,583 (86.6)	0.0037	2,826 (76.5)	114 (74.7)	82 (84.2)	0.2405
Part-time	30,760 (14.5)	765 (16.7)	257 (13.4)		886 (23.5)	44 (25.3)	17 (15.8)	
<b>2nd Job</b>								
Yes	18,980 (8.6)	544 (11.8)	181 (10.6)	<0.0001	359 (9.6)	19 (10.2)	6 (10.4)	0.9598
No	199,179 (91.4)	4,069 (88.2)	1,509 (89.4)		3,513 (90.4)	166 (89.6)	71 (89.6)	
<b>Occupational groups^</b>								
Management/professional	62,875 (30.1)	1,599 (35.8)	285 (14.9)	<0.0001	687 (18.8)	37 (19.1)	14 (9.2)	0.0718
Services	54,573 (24.2)	1,139 (23.3)	525 (27.1)		1,304 (32.8)	60 (29.2)	27 (23.6)	
Sales/office Adm.	49,866 (23.5)	1,055 (22.3)	267 (14.6)		993 (25.9)	54 (24.9)	22 (23.7)	
Construction/Prod./Trans.	46,009 (22.1)	762 (18.6)	765 (43.3)		846 (22.4)	33 (26.8)	40 (43.4)	
<b>Industrial groups</b>								
Agri/Forest/Mining/Util/Const	20,070 (9.7)	361 (8.3)	303 (17.8)	<0.0001	290 (8.1)	13 (9.0)	18 (16.6)	0.0094
Manuf/Transp/Warehousing	30,610 (14.9)	559 (13.5)	358 (19.9)		502 (13.4)	20 (15.3)	20 (21.4)	
Trade	27,219 (13.3)	526 (11.6)	220 (13.1)		604 (16.2)	21 (8.0)	18 (20.7)	
Services	72,801 (33.9)	1,652 (36.6)	468 (25.0)		1,402 (36.9)	74 (40.1)	31 (29.4)	
Health/Social/Educ/Public Adm.	62,968 (28.2)	1,464 (30.0)	498 (24.2)		1,043 (25.4)	56 (27.5)	16 (11.9)	
<b>Lifestyle Characteristics</b>								
<b>Psychological distress</b>								
None (K6 = 0)	110,163 (50.8)	1,589 (35.5)	656 (37.4)	<0.0001	N/A	N/A	N/A	N/A
Mild (K6: 1–4)	74,389 (34.2)	1,864 (41.9)	672 (36.1)					
Moderate (K6: 5–12)	30,411 (13.4)	988 (19.0)	433 (21.8)					
Serious (K6>=13)	3,878 (1.6)	185 (3.6)	103 (4.7)					
<b>Num. of injury episode</b>								
Single episode	N/A	4,455 (96.5)	1,765 (95.5)	0.1330	N/A	164 (86.5)	88 (88.2)	0.7896
Multiple episodes	N/A	171 (3.5)	99 (4.5)		N/A	21 (13.5)	15 (11.8)	

\*N: actual sample size (unweighted), %: weighted value of column percent. ‡ P-value from Chi-square test. The Bonferroni-adjusted level of significance is 0.05/16 = 0.00313 where a test is declared significant if the p-value is smaller than 0.00313.

**Table 2**  
Prevalence of serious psychological distress by injury status across worker's characteristics.

Characteristics	Prevalence of serious psychological distress			Prevalence Ratio§	
	No Injury Prev (95% CI)	Non-occupational Injury Prev (95% CI)	Occupational Injury Prev (95% CI)	Occupationally Injured vs. Uninjured PR (95% CI)§	Occupationally Injured vs. Non- Occupationally Injured PR (95% CI)§
All injury	1.56 (1.50, 1.63)	3.58 (2.86, 4.46)	4.74 (3.66, 6.11)	<b>3.03 (2.35, 3.91)</b>	1.32 (0.95, 1.85)
Sex					
Men	1.16 (1.07, 1.25)	3.35 (2.28, 4.90)	4.11 (2.79, 6.02)	<b>3.53 (2.40, 5.19)</b>	1.23 (0.72, 2.08)
Women	2.02 (1.91, 2.13)	3.83 (3.04, 4.82)	5.91 (4.34, 8.00)	<b>2.93 (2.16, 3.99)</b>	<b>1.54 (1.04, 2.28)</b>
Race/ethnicity					
Non-Hispanic White	1.47 (1.39, 1.55)	3.33 (2.51, 4.40)	5.04 (3.67, 6.88)	<b>3.42 (2.50, 4.69)</b>	1.51 (0.99, 2.30)
Non-Hispanic Black	1.81 (1.63, 2.02)	3.48 (2.02, 5.92)	†2.79 (1.35, 5.69)	1.54 (0.74, 3.17)	†0.80 (0.32, 1.99)
Hispanic	1.90 (1.75, 2.07)	5.53 (3.41, 8.86)	†4.63 (2.41, 8.72)	<b>2.43 (1.28, 4.65)</b>	†0.84 (0.38, 1.87)
All other	1.27 (1.03, 1.55)	†4.46 (2.12, 9.15)	†5.94 (2.21, 15.03)	†4.70 (1.77, 12.46)	†1.33 (0.40, 4.46)
Age					
18–34	1.69 (1.57, 1.82)	4.47 (3.08, 6.43)	5.99 (4.14, 8.60)	<b>3.55 (2.44, 5.15)</b>	1.34 (0.82, 2.20)
35–54	1.63 (1.54, 1.73)	3.62 (2.70, 4.84)	4.22 (2.69, 6.56)	<b>2.68 (1.71, 4.18)</b>	1.16 (0.68, 1.99)
55+	1.87 (1.73, 2.01)	3.59 (2.66, 4.84)	5.04 (3.32, 7.59)	<b>2.45 (1.38, 4.37)</b>	1.84 (0.85, 3.98)
Marital Status					
Single	1.87 (1.73, 2.01)	3.59 (2.66, 4.84)	5.04 (3.32, 7.59)	<b>2.70 (1.79, 4.08)</b>	1.40 (0.85, 2.32)
Married	1.10 (1.03, 1.17)	2.87 (1.79, 4.57)	2.13 (1.20, 3.77)	<b>1.94 (1.09, 3.45)</b>	0.74 (0.36, 1.52)
Divorced	2.73 (2.55, 2.93)	5.34 (4.07, 6.97)	9.82 (6.50, 14.56)	<b>3.59 (2.39, 5.40)</b>	<b>1.83 (1.11, 3.03)</b>
Education					
≤HS/GED	2.26 (2.12, 2.41)	5.78 (3.91, 8.45)	5.81 (4.08, 8.21)	<b>2.67 (1.87, 2.80)</b>	1.01 (0.59, 1.71)
<4 yrs college	1.86 (1.73, 2.00)	3.31 (2.28, 4.78)	5.24 (3.36, 8.06)	<b>2.81 (1.80, 4.39)</b>	1.58 (0.89, 2.80)
≥4 yrs college	0.79 (0.72, 0.87)	2.31 (1.63, 3.26)	1.70 (0.80, 3.58)	<b>2.15 (1.01, 4.56)</b>	0.74 (0.32, 1.71)
Income					
<25 K	2.68 (2.52, 2.85)	5.46 (4.05, 7.31)	7.07 (5.01, 9.87)	<b>2.63 (1.86, 3.72)</b>	1.29 (0.84, 2.00)
25–45 K	1.33 (1.22, 1.46)	4.37 (2.45, 7.70)	4.98 (2.91, 8.42)	<b>3.74 (2.18, 6.44)</b>	1.14 (0.52, 4.50)
45 K+	0.74 (0.66, 0.83)	1.75 (1.15, 2.65)	†0.47 (0.12, 1.83)	†0.63 (0.16, 2.49)	†0.27 (0.06, 1.13)
Sleep					
<7 h/day	2.88 (2.74, 3.04)	4.46 (3.41, 5.81)	6.57 (4.61, 9.29)	<b>2.28 (1.60, 3.25)</b>	1.47 (0.95, 2.29)
7+ h/day	0.96 (0.90, 1.03)	3.08 (2.19, 4.30)	3.43 (2.38, 4.92)	<b>3.57 (2.47, 5.16)</b>	1.12 (0.58, 1.84)
Smoke status					
Never	1.16 (1.09, 1.24)	2.79 (2.13, 3.65)	4.05 (2.70, 6.03)	<b>3.48 (2.32, 5.22)</b>	1.45 (0.90, 2.32)
Former	1.28 (1.17, 1.41)	2.26 (1.15, 4.40)	3.51 (1.54, 7.83)	<b>2.74 (1.20, 6.24)</b>	1.56 (0.84, 4.48)
Current	3.16 (2.95, 3.38)	6.90 (4.71, 10.00)	6.79 (4.70, 9.71)	<b>2.15 (1.49, 3.10)</b>	0.98 (0.58, 1.68)
Alcohol					
Never/Former	1.63 (1.51, 1.77)	3.44 (2.38, 4.96)	4.73 (3.11, 7.13)	<b>2.89 (1.89, 4.43)</b>	1.37 (0.78, 2.42)
Current (≤3 drks/wk)	1.52 (1.43, 1.61)	4.06 (2.87, 5.72)	4.14 (2.64, 6.42)	<b>2.72 (1.73, 4.28)</b>	1.02 (0.58, 1.79)
Current (4+ drks/wk)	1.56 (1.44, 1.70)	2.97 (2.11, 4.15)	5.77 (3.64, 9.02)	<b>3.69 (2.34, 5.84)</b>	<b>1.94 (1.09, 3.46)</b>
Leisure-time physical activity					
Inactive	2.28 (2.14, 2.44)	5.66 (3.96, 8.02)	6.46 (4.49, 9.22)	<b>2.83 (1.96, 4.07)</b>	1.14 (0.69, 1.89)
Insufficiently active	1.66 (1.51, 1.82)	3.20 (2.05, 4.96)	6.32 (3.52, 11.07)	<b>3.81 (2.14, 6.79)</b>	1.97 (0.96, 4.05)
Sufficiently active	1.12 (1.05, 1.20)	2.97 (2.08, 4.24)	2.78 (1.72, 4.47)	<b>2.48 (1.53, 4.03)</b>	0.94 (0.52, 1.69)

Table 2 (continued)

Characteristics	Prevalence of serious psychological distress			Prevalence Ratio§	
	No Injury Prev (95% CI)	Non-occupational Injury Prev (95% CI)	Occupational Injury Prev (95% CI)	Occupationally Injured vs. Uninjured PR (95% CI)§	Occupationally Injured vs. Non- Occupationally Injured PR (95% CI)§
<b>BMI</b>					
Normal (18.5–<25)	1.43 (1.33, 1.54)	3.72 (2.37, 5.80)	4.43 (2.93, 6.63)	<b>3.10 (2.06, 4.65)</b>	1.19 (0.65, 2.19)
Overweight (25.0–<30)	1.31 (1.21, 1.41)	2.26 (1.57, 3.25)	3.53 (2.06, 5.99)	<b>2.70 (1.58, 4.62)</b>	1.56 (0.81, 3.00)
Obese (30+)	2.11 (1.96, 2.26)	5.02 (3.60, 6.97)	6.55 (4.42, 9.60)	<b>3.11 (2.10, 4.61)</b>	1.30 (0.79, 2.15)
<b>Length of work</b>					
<1 yr	2.64 (2.43, 2.86)	5.92 (4.16, 8.35)	5.42 (3.38, 8.57)	<b>2.05 (1.27, 3.31)</b>	0.91 (0.51, 1.65)
1–4 yrs	1.66 (1.54, 1.78)	3.04 (2.22, 4.16)	6.92 (4.69, 10.10)	<b>4.18 (2.84, 6.15)</b>	<b>2.27 (1.38, 4.75)</b>
5+ yrs	1.18 (1.10, 1.26)	3.13 (2.06, 4.73)	2.77 (1.70, 4.47)	<b>2.35 (1.44, 3.85)</b>	0.88 (0.46, 1.68)
<b>Employment status</b>					
Full-time (>=30 hrs/wk)	1.38 (1.31, 1.44)	2.94 (2.19, 3.93)	4.41 (3.29, 5.91)	<b>3.20 (2.39, 4.30)</b>	1.50 (0.99, 2.27)
Part-time	2.50 (2.28, 2.74)	4.97 (3.37, 7.28)	5.38 (3.06, 9.29)	<b>2.15 (1.23, 3.76)</b>	1.08 (0.55, 2.14)
<b>2nd Job</b>					
Yes	1.75 (1.52, 2.01)	3.08 (1.90, 4.97)	†3.55 (1.41, 8.63)	†2.03 (0.81, 5.10)	†1.15 (0.41, 3.22)
No	1.55 (1.48, 1.62)	3.65 (2.88, 4.63)	3.63 (2.66, 4.94)	<b>2.35 (1.73, 3.19)</b>	0.99 (0.68, 1.46)
<b>Occupational groups^</b>					
Management/professional Services	0.99 (0.90, 1.09)	1.93 (1.32, 2.82)	†2.97 (1.50, 5.77)	†3.00 (1.52, 5.92)	†1.54 (0.71, 3.32)
Sales/office Adm.	2.14 (1.99, 2.31)	4.54 (3.34, 6.16)	4.16 (2.54, 6.76)	<b>1.94 (1.20, 3.16)</b>	0.92 (0.51, 1.65)
Construction/Prod./Trans.	1.74 (1.60, 1.90)	4.04 (2.81, 5.78)	7.77 (4.75, 12.45)	<b>4.45 (2.74, 7.25)</b>	<b>1.92 (1.05, 3.51)</b>
Industrial groups	1.60 (1.47, 1.74)	5.23 (2.83, 9.45)	4.79 (3.08, 7.40)	<b>2.99 (1.93, 4.63)</b>	0.92 (0.44, 1.93)
Agri/Forest/Mining/Util/Const	1.32 (1.12, 1.56)	3.93 (1.67, 9.00)	4.45 (2.25, 8.61)	<b>3.36 (1.67, 6.76)</b>	1.13 (0.37, 3.43)
Manuf/Transp/Warehousing	1.42 (1.27, 1.59)	†4.08 (1.64, 9.79)	†5.13 (2.64, 9.74)	†3.61 (1.90, 6.89)	†1.26 (0.42, 3.79)
Trade	1.93 (1.74, 2.14)	2.50 (1.42, 4.36)	7.53 (4.27, 12.94)	<b>3.91 (2.22, 6.90)</b>	<b>3.01 (1.35, 6.69)</b>
Services	1.79 (1.60, 1.86)	3.97 (2.97, 5.28)	5.62 (3.51, 8.90)	<b>3.26 (2.04, 5.22)</b>	1.42 (0.82, 2.45)
Health/Social/Educ/Public Adm.	1.43 (1.32, 1.54)	3.33 (2.34, 4.71)	†2.35 (1.30, 4.22)	†1.64 (0.91, 2.97)	†0.71 (0.36, 1.40)

§PR: Prevalence ratios with 95% confidence interval from unadjusted model (the values in bold are significant  $p < 0.05$ ).

^The estimate of the prevalence of injury is unreliable because the relative standard error of the estimate is larger than 30% [Klein et al., 2004].

Among industrial groups, workers in trade had the highest prevalence of serious psychological distress (7.53).

The prevalence of serious psychological distress in the occupationally injured workers was three times higher than that in the uninjured workers (PR = 3.03, CI = 2.35–2.91). The prevalence ratios of serious psychological distress between the occupationally injured workers and the uninjured workers vary by selected characteristics (PRs from 1.54 to 4.45), with most being statistically significant. However, the prevalence ratios of serious psychological distress between the occupationally injured workers and the non-occupationally injured workers were insignificant for most characteristics; some were significant: female (PR = 1.54, CI = 1.04–2.28), the divorced (PR = 1.83, CI = 1.11–3.03), those consuming 4 or more drinks per week (PR = 1.94, CI = 1.09, 3.46), those who were employed 1–4 years (PR = 2.27, CI = 1.38–4.75), those who worked in sales and office administration (PR = 1.92, CI = 1.05–3.51), and those who worked in trade (PR = 3.01, CI = 1.35, 6.69).

The sample size of the injury characteristics (body site of injury, type of injury, external causes, treatment location after injury, and

day of work missed) by injury status for all subjects and for those with serious psychological distress is shown in Supplement Table 2. The most frequent site of injury among the occupationally injured workers (N = 1,864) was in the upper extremities (N = 766), the most common type of injury was sprain/strain/twist (N = 792), and the most common external cause being overexertion/strenuous movement (N = 365). Approximately 41% of all injuries occurred in the upper extremities and the most common types of injuries were sprains/strains/twists (42.5% of all injuries).

Table 3, which is derived from Supplement Table 2, shows the prevalence of serious psychological distress of by injury status for each injury characteristic. Overall, the prevalence of serious psychological distress among the occupationally injured workers was higher than that among the non-occupationally injured workers and the uninjured workers for each injury characteristic. For example, the prevalence of serious psychological distress among workers injured in the lower extremity was 5.97/10,000 for those injured at a work site, 2.93 for those injured at a non-work-site, and 1.60 for those without injury. The prevalence of serious psychological distress caused by falls was 4.47 for those injured at a

**Table 3**  
Prevalence of the serious psychological distress (SPD, K6>=13) by injury status across injury characteristics.

Characteristics of Injury	Prevalence of serious psychological distress		
	Among uninjured workers Prev (95%CI)	Among non-occupationally injured workers Prev (95%CI)	Among occupationally injured workers Prev (95%CI)
All injury	1.56 (1.50, 1.63)	3.58 (2.86, 4.46)	4.74 (3.66, 6.11)
Body site of injury <sup>§</sup>			
Lower extremity	1.60 (1.54, 1.67)	2.93 (2.17, 3.95)	5.97 (3.77, 9.32)
Upper extremity	1.61 (1.54, 1.68)	3.29 (1.98, 5.44)	4.26 (2.78, 6.45)
Back/buttocks	1.61 (1.54, 1.68)	5.66 (3.74, 8.48)	6.79 (4.12, 10.00)
Head/neck	1.60 (1.54, 1.67)	6.17 (3.64, 10.26)	7.71 (4.40, 13.18)
Type of injury (how injured) <sup>§</sup>			
Fracture	1.62 (1.56, 1.70)	3.52 (2.29, 5.39)	†4.94 (2.41, 9.85)
Sprain/strain/twist	1.59 (1.53, 1.66)	4.16 (3.12, 5.51)	5.40 (3.62, 7.96)
Cut	1.62 (1.55, 1.69)	1.61 (0.89, 2.88)	†4.37 (2.37, 7.91)
Scrape/bruise/burn/bite	1.61 (1.54, 1.68)	4.31 (2.86, 6.44)	6.32 (3.40, 11.47)
External causes <sup>§</sup>			
Fall	1.62 (1.55, 1.69)	2.99 (1.94, 4.58)	4.47 (2.41, 8.13)
Overexertion/strenuous move	1.62 (1.55, 1.69)	3.31 (1.90, 5.68)	5.14 (2.97, 8.74)
Struck by object	1.62 (1.55, 1.69)	†2.14 (1.10, 4.13)	†3.39 (1.60, 7.01)
Cut/pierce	1.62 (1.56, 1.69)	†0.99 (0.31, 3.14)	†4.35 (1.78, 10.23)
Burn/scald/poisoning/bite	1.62 (1.56, 1.69)	†4.18 (2.07, 8.27)	†2.95 (0.82, 10.05)
Transportation	1.61 (1.55, 1.68)	†5.16 (2.50, 10.32)	†14.33 (4.00, 40.16)
Treatment location after injury <sup>§</sup>			
Emergency vehicle	1.61 (1.54, 1.68)	4.13 (2.81, 6.04)	5.75 (3.39, 9.58)
Emergency room	1.59 (1.53, 1.66)	3.79 (2.88, 4.96)	6.26 (4.35, 8.91)
Doctor's office/clinic	1.57 (1.51, 1.64)	3.86 (3.00, 4.95)	4.93 (3.70, 6.53)
Call to medical prof	1.60 (1.53, 1.67)	3.79 (2.75, 5.22)	6.28 (4.30, 9.08)
Days of work missed			
None or <1 day	1.62 (1.55, 1.69)	2.08 (1.54, 2.81)	2.57 (1.66, 3.95)
1–5 days	1.62 (1.53, 1.67)	5.48 (3.39, 8.74)	6.38 (3.97, 10.10)
6+ days	1.61 (1.54, 1.68)	4.73 (3.22, 6.90)	7.11 (4.34, 11.46)

<sup>§</sup>The frequencies of sub-level are not mutually exclusive.

<sup>†</sup>The estimate of the prevalence of injury is unreliable because the relative standard error of the estimate is larger than 30% [Klein et al., 2004].

work-site, 2.99 for those injured at a non-work-site, and 1.62 for those without injury. Serious psychological distress by body site of injury among the occupationally injured workers was highest in the head and neck area (Prev = 7.71), followed by the back or

buttocks (Prev = 6.79), lower extremity (Prev = 5.97), and was lowest in the upper extremity (Prev = 4.26). Workers injured occupationally with scrape/bruise/burn/bite had more serious psychological distress (Prev = 6.32) than other types of injury. Even though serious psychological distress was highest in the occupationally injured workers whose injuries were due to transportation (Prev = 14.33), the estimate is not reliable since the events of the injuries due to transportation were too small.

Table 4 shows that each injury characteristic was associated with serious psychological distress in the unadjusted as well as in models adjusted for age, gender, race/ethnicity, marital status, education, smoking status, alcohol intake, employment, sleep duration, leisure-time physical activity, and occupational group.

The occupationally injured workers were three times more likely to have serious psychological distress than the uninjured workers (PR = 3.03, CI = 2.35–3.91). The prevalence ratio attenuated in the adjusted model (PR = 2.19, CI = 1.62–2.96). The results were similar across each level of injury characteristics. For example, the occupationally injured workers with injuries in the head and neck were four times more likely to experience serious psychological distress than the non-injured workers in the adjusted model (PR = 3.99, CI = 2.01–7.90).

We did not see many significant differences in the prevalence of serious psychological distress between occupationally injured workers and the non-occupationally injured workers. The occupationally injured workers who reported that they visited emergency rooms had a 78% higher prevalence of serious psychological distress than the non-occupationally injured workers after adjustment for covariates (PR = 1.78, CI = 1.12–2.87).

#### 4. Discussion

*Prevalence of SPD and risk factors:* Using nationally representative data, this study sought to assess the prevalence of serious psychological distress by injury status and to investigate the association between injury status and serious psychological distress. Our findings were consistent with previous studies that examined risk of distress or depression following injury events. Results from population-based studies conducted in the United States and Australia showed that depression, anxiety, and stress disorders developed at 6 or 12 months after traumatic injury in hospitalized patients (Jenness, Witt, Quistberg, & Johnston, 2017; Wiseman, Curtis, Lam, & Foster, 2014; Zatzick et al., 2007). A Canadian study found that injured patients have mental health issues in the year following the event, compared to the non-injured (Cameron, Purdie, Kliever, & McClure, 2006).

Our study showed that psychological distress was high in workers who were divorced, less educated, had lower income, shorter sleep duration, currently smoked, were physically inactive, or were obese. These findings are similar to some previous reports (Mason, Turpin, Woods, Wardrope, & Rowlands, 2006; Wiseman et al., 2014). It is especially noteworthy that workers who were overweight ( $25 \leq \text{BMI} < 30 \text{ kg/m}^2$ ) had lower serious psychological distress after injury than the workers with normal weight ( $18.5 \leq \text{BMI} < 25 \text{ kg/m}^2$ ) and those who were obese ( $\text{BMI} \geq 30 \text{ kg/m}^2$ ). Some studies revealed that excessive fat would protect the risk of fracture when falling because of greater cushioning (Bouchard, Pickett, & Janssen, 2010; Dimitri, Bishop, Walsh, & Eastell, 2012).

*SPD in occupational or industrial group:* Workers employed in sales or office administration who had occupational injuries experienced more serious psychological distress than those who had non-occupational injuries. Since the main duties of workers in sales include moving and assembly of merchandise, they are some-

**Table 4**  
Association between injury status and serious psychological distress (SPD) stratified by injury characteristics.

Injury characteristics	Prevalence Ratio of SPD (Occupationally Injured vs. Uninjured)		Prevalence Ratio of SPD (Occupationally injured vs. Non-occupationally Injured)	
	Unadjusted PR (95% CI) <sup>§</sup>	Adjusted PR (95% CI) <sup>§</sup>	Unadjusted PR (95% CI) <sup>§</sup>	Adjusted PR (95% CI) <sup>§</sup>
All injury	<b>3.03 (2.35, 3.91)</b>	<b>2.19 (1.62, 2.96)</b>	1.32 (0.95, 1.85)	0.98 (0.65, 1.48)
Site of injury (grouped sites) <sup>§</sup>				
Lower extremity	<b>3.71 (2.36, 5.84)</b>	<b>2.83 (1.67, 4.78)</b>	<b>2.03 (1.18, 3.50)</b>	1.76 (0.99, 3.15)
Upper extremity	<b>2.65 (1.74, 4.03)</b>	<b>2.14 (1.33, 3.46)</b>	1.29 (0.67, 2.51)	0.95 (0.49, 1.87)
Back/buttocks	<b>4.22 (2.56, 6.91)</b>	<b>2.78 (1.49, 5.17)</b>	1.20 (0.63, 2.27)	0.75 (0.37, 1.52)
Head/neck	<b>4.80 (2.76, 8.33)</b>	<b>3.99 (2.01, 7.90)</b>	1.25 (0.59, 2.65)	0.95 (0.49, 1.83)
Type of injury (how injured) <sup>§</sup>				
Fracture	†3.05 (1.51, 6.19)	†1.36 (0.43, 4.27)	†1.40 (0.61, 3.21)	†0.74 (0.30, 1.82)
Sprain/strain/twist	<b>3.38 (2.28, 5.01)</b>	<b>2.07 (1.25, 3.44)</b>	1.30 (0.80, 2.10)	0.80 (0.44, 1.44)
Cut	<b>2.69 (1.47, 4.92)</b>	<b>2.49 (1.31, 4.76)</b>	<b>2.72 (1.18, 6.28)</b>	2.13 (0.99, 4.55)
Scrape/bruise/burn/bite	<b>3.93 (2.13, 7.22)</b>	<b>3.23 (1.69, 6.18)</b>	1.47 (0.70, 3.07)	1.37 (0.66, 2.85)
External causes <sup>§</sup>				
Fall	<b>2.76 (1.50, 5.07)</b>	2.07 (0.98, 4.33)	1.49 (0.72, 3.13)	1.72 (0.82, 3.62)
Overexertion/strenuous move	<b>3.18 (1.85, 5.45)</b>	<b>1.96 (1.09, 3.52)</b>	1.55 (0.71, 3.39)	0.65 (0.34, 1.24)
Struck by object	†2.09 (0.99, 4.36)	†0.96 (0.34, 2.70)	†1.58 (0.63, 3.99)	†0.92 (0.43, 1.97)
Cut/pierce	†2.68 (1.11, 6.46)	†2.99 (1.21, 7.39)	†4.41 (1.03, 18.98)	†1.32 (0.40, 4.33)
Burn/scald/poisoning/bite	†1.82 (0.51, 6.44)	†1.23 (0.25, 6.01)	†0.71 (0.17, 2.98)	†0.96 (0.20, 4.54)
Transportation	†8.87 (2.70, 29.12)	†7.90 (2.20, 28.36)	†2.78 (0.70, 11.07)	†2.36 (0.84, 6.61)
Treatment location after injury <sup>§</sup>				
Emergency vehicle	<b>3.56 (2.11, 6.02)</b>	<b>2.71 (1.50, 4.91)</b>	1.39 (0.78, 2.48)	1.11 (0.60, 2.07)
Emergency room	<b>3.92 (2.74, 5.61)</b>	<b>2.99 (2.04, 4.39)</b>	<b>1.65 (1.07, 2.56)</b>	<b>1.78 (1.12, 2.87)</b>
Doctor's office/clinic	<b>3.13 (2.36, 4.15)</b>	<b>2.60 (1.91, 3.54)</b>	1.28 (0.87, 1.87)	0.99 (0.64, 1.55)
Call to medical prof	<b>3.92 (2.69, 5.70)</b>	<b>2.95 (1.95, 4.46)</b>	1.65 (1.00, 2.73)	1.29 (0.76, 2.13)
Days of work missed				
None or <1 day	<b>1.59 (1.03, 2.45)</b>	1.42 (0.82, 2.12)	1.23 (0.73, 2.08)	1.03 (0.58, 1.83)
1–5 days	<b>3.98 (2.50, 6.35)</b>	<b>2.87 (1.70, 4.82)</b>	1.16 (0.60, 2.26)	0.91 (0.44, 1.87)
6+ days	<b>4.42 (2.72, 7.20)</b>	<b>3.94 (2.42, 6.39)</b>	1.50 (0.81, 2.80)	1.34 (0.75, 2.38)

<sup>§</sup>PR: prevalence ratios with 95% confidence interval are adjusted for gender, age, race/ethnicity, marital status, annual income, smoking status, alcohol intake status, sleep duration, physical activity, body mass index, and industry groups. Prevalence ratios are obtained from marginal predictions in the fitted logistic regression model. The values in bold are significant  $p < 0.05$ .

<sup>†</sup>The estimate of the prevalence ratio is unreliable because the relative standard error of the estimate of injury prevalence is larger than 30% [Klein et al., 2004].

what more likely to be exposed to injuries from pushing, pulling, contact with sharp objects, slipping, tripping, and falling items.

Although Wulsinand colleagues (2014) reported that the prevalence of clinical depression was highest in workers employed in healthcare and social assistance sector, our study found that workers in the trade sector (wholesale and retail trade) had the highest level of serious psychological distress. The difference in results could be partly attributed to differences in scales used for assessment of clinical depression versus SPD. Anderson and colleagues (2010) found that the trade sectors (beer/wine/liquor, building materials/supplies, and grocery-related products) had injury/illness rates well above the U.S. national average and that the leading causes of injury or illness were overexertion and contact with objects/equipment. Our study found that the prevalence of serious psychological distress among individuals whose injury was from overexertion/strenuous movement was higher among occupationally injured workers than among non-occupationally injured workers or uninjured workers (Prev = 5.14, 3.31, 1.62, respectively).

*Prevalence of SPD by injury characteristics:* Our results show that the prevalence of serious psychological distress was higher in the occupationally injured workers than in the non-occupationally injured workers, especially among those with injuries to the head/neck, back/buttocks, and in those workers whose injuries were obtained from scrape/bruise/burn/bite and due to overexertion/strenuous movement. Physical pain after injuries may result in mental suffering such as depression and mood swings. De Koning and colleagues reported that patients with brain injuries experience more mental distress than patients with other bodily injuries (De Koning et al., 2016). The pain after low back injury could induce psychological distress. An epidemiologic study reported that 59% of regular opioid users were having back pain (Hudson,

Edlund, Steffick, Tripathi, & Sullivan, 2008). Our study also shows that workers with injuries related to skin (i.e., scrape/bruise/burn/bite) had more serious psychological distress than the workers with injuries related to bones or muscles (i.e. fractures, sprain/strain/twist). Individuals who have burn injuries have high psychological distress (Wisely, 2013). In addition, the higher the number of work days missed (which may be indicative of the severity or frequency of injury), the higher the prevalence of serious psychological distress among occupationally injured workers. The uninjured workers had similar psychological distress regardless of the number of work days missed.

*Comparing SPD by injury status:* Compared with uninjured workers, the occupationally injured workers were significantly more likely to suffer serious psychological distress (PR = 2.19, CI: 1.62–2.96). Even though serious psychological distress was not statistically different between the occupationally injured workers and the non-occupational injured workers (PR = 1.32, CI: 0.95–1.85, unadjusted model), the prevalence of serious psychological distress among occupationally injured workers was 32% higher than that of the non-occupationally injured workers (4.74% and 3.58%, respectively). A study using the U.S. Medical Expenditure Panel Survey (2000–2006) found a result similar to ours that workers with occupational injuries were more likely to have depression than those with non-occupational injury, but the difference was not statistically significant (Kim, 2013). Carnide and colleagues showed that workers who had depression after a work-related injury were having difficulty returning to work (Carnide et al., 2016). The consequences of serious psychological distress due to occupational injury include lost productivity at work, difficulty returning to work, dependence on illegal drugs for relief, and the financial burden of treatment. Lower quality of life and a decreased

sense of well-being have a greater effect on worker's mental health during injury.

**Limitations and strengths:** In interpreting the results of our study, we should consider several limitations. Since our study is cross-sectional, we cannot infer a causal relationship between injury and serious psychological distress. The second limitation is that our analysis took into account only nonfatal injuries over the past 91 days due to the fact that NHIS collects data at home with person-to-person interviews, and did not account for those with fatal injuries or those who were hospitalized. This may have led to an underestimation of the number of injuries that would have affected calculation of the prevalence of serious psychological distress. Third, even though the dataset is large, a relatively small number of events (<30 events and relative standard error <30%) of serious psychological distress prevented us from estimating the prevalence and prevalence ratio in subgroups of workers' characteristics. Fourth, due to the large number of tests, the probability of observing at least one significant result due to chance may be higher than 5%. An additional limitation of this study is that we were unable to control for other factors (e.g., history of mental symptoms, job strain, and job demands), which are related to injuries and psychological distress. These variables were not available in the NHIS dataset. Lastly, serious psychological distress ( $K6 \geq 13$ ) was derived from self-report and not from professional or clinical diagnoses.

Even with such limitations, to our knowledge, this is one of the few studies investigating associations between injury and psychological distress among U.S. workers. Furthermore, the current study used nationally representative data of the working population with a high response rate (80%). Information was available in the dataset to provide estimates by socioeconomic demographics, lifestyle characteristics, job characteristics, specific injury characteristics (body sites of injury, types of injury, external causes of injury, treatment locations after injury, and missed days of work), and injury status.

**Conclusions:** This study found that occupationally injured workers were more likely to experience psychological distress than uninjured workers. Even though workers who are experiencing some mental distress symptoms do not necessarily require medical treatment, it is still important for them to make their health care providers aware of these symptoms so that appropriate support can be put in place. According to Carnide (2016), "being at work is important. Research has clearly shown that retuning to work after a work injury is good for both physical and mental health. It is a vicious circle; people who return to work are more likely to feel better mentally, and people who feel better mentally are more likely to be working." A mental health management program in the workplace is essential for injured workers and it makes for a healthy working environment.

The results of this study are not presented across specific occupational groups. The prevalence of depression is different by industries and gender (Wulsin et al., 2014), and each industry sector is likely to have different characteristics of injury. It may be worthwhile to investigate the prevalence of psychological distress by industry, occupational group, and gender. Additionally, the consequences of psychological distress after injury warrant future longitudinal investigation with workers injured in and outside the workplace.

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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of

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#### Declaration of competing interest

None of the authors have any conflicts of interest.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jsr.2020.06.002>.