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Characteristics of Nonfatal Occupational Injuries Among U.S. Workers With and Without Disabilities

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Background *Workers with disabilities have a higher risk of nonfatal occupational injuries than workers without disabilities. The characteristics of these injuries are not well described.*

Methods *Using 1997–2011 National Health Interview Survey (NHIS) data, we compared the nonfatal occupational injuries sustained by U.S. workers with and without disabilities.*

Results *Overexertion or strenuous movements and falls accounted for 56.7% of all occupational injuries in workers with disabilities, compared with 45.6% in workers without a disability. Workers with disabilities were more frequently injured in the lower extremity (32.3% vs. 26.6%) or torso (22.9% vs. 16.9%). Workers with disabilities sustained more unspecified injuries (13.5% vs. 7.9%) and fewer open wound injuries (15.7% vs. 24.2%) than their counterparts without a disability.*

Conclusions *U.S. workers with disabilities had a higher rate of occupational injuries and these injuries tended to be more severe and were more likely to be caused by overexertion/ strenuous movement or falls.* Am. J. Ind. Med. 58:168–177, 2015.
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KEY WORDS: disability; occupational injury; U.S. workers; nonfatal; injury severity

INTRODUCTION

Based on the 2012 American Community Survey (ACS), an estimated 10% of people (aged 18–64 years) in the United States, or approximately 19.6 million people, have disabilities [U.S. Census Bureau, 2012]. According to the U.S. Department of Labor, in January 2014, 4.5 million people with disabilities aged 16 years and above were employed [U.S. Department of Labor, 2014]. Due to the aging workforce and the increasing number of children with disabilities who will eventually enter the working population, the number of workers with disabilities will likely increase in the coming years [Institute of Medicine (IOM), 2007]. Recent reports from the World Health Organization and the U.S. Surgeon General have addressed disparities in the health of persons with disabilities [U.S. Department of Health and Human Services, 2005; World Health Organization, 2011]. Previous research has shown that persons with disabilities are more susceptible to injuries [Xiang et al., 2005, 2014; Brophy et al., 2008; Rasch et al., 2008] and have a greater risk of occupational injury [Moll van Charante and Mulder, 1990; Zwerling et al., 1997, 1998a,b; Lysaght et al., 2011]. Our previous study, using 10 years of National Health Interview Survey (NHIS) data, showed that the U.S. workers with disabilities have a 2.39 times higher odds of occupational injury than workers without disabilities [Price et al., 2012].

Previous studies have reported a higher prevalence of occupational injuries among workers with disability; however, to our knowledge no study has examined the characteristics of occupational injuries sustained by U.S. workers with

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disabilities. Prior research has defined disability in different ways; however this study and more recent studies have sought to measure those reporting activity limitations which may or may not be accommodated environmentally. Information on injury characteristics, such as demographics, causes of injury, places of injury, types of injury and the most vulnerable body regions, is necessary to develop evidence-based injury prevention programs [Holder et al., 2001; Centers for Disease Control and Prevention National Center for Injury Prevention and Control (NCIPC), 2013]. Previous injury research focusing on persons with disabilities has been limited by small sample sizes of individuals with disabilities [Xiang et al., 2005; Brophy et al., 2008; Price et al., 2012]. Therefore, these smaller sample studies were limited in their ability to conduct the detailed analyses needed to discover the unique mechanisms and environmental situations of injuries suffered by persons with disabilities.

This study aimed to compare the major occupational injury patterns among U.S. workers with and without disabilities, including the leading causes of injury, places of injury, activities at the time of injury, injury severity, injured body part, and types of injuries. Knowing patterns of injuries among U.S. workers with disabilities would provide crucial information that can aid in the creation of evidence-based injury prevention strategies for reducing work-related injuries among U.S. workers with disabilities.

MATERIALS AND METHODS

Data Source

We analyzed data from the 1997 to 2011 National Health Interview Survey (NHIS) [National Center for Health Statistics, 2011]. This survey data, maintained by the National Center for Health Statistics, provided cross-sectional health information on the civilian, non-institutionalized population in the U.S. The complex survey design allows for the calculation of national estimates. The NHIS used computer-assisted personal interviews to collect information about the prior 3 months for all members of selected households. The overall response rate for the survey years was approximately 86%. In our study, the Person file was used for extracting demographic information including disability information, and the Injury Episode file was used to obtain data on injury characteristics. Calculations of pooled estimates were performed as recommended in the NHIS Survey Description file to produce reliable and meaningful results about the U.S. civilian worker population over the defined time period.

Identification of Workers

Workers were those "working for pay at a job or business," "with a job or business but not at work," or "working, but not for pay, at a family-owned job or business" in the past week. For those respondents included in the Sample Adult survey, the responses on employment status were considered more accurate than the answers in the Person file, because in the Sample adult file, the respondent was answering for themselves, while in the Person file, the information might be collected from another person in the household. For the subset of workers with Sample adult data, occupation information was reported. Occupation was not known for those workers with Person file data only.

Definition of Disability

Disability questions in the NHIS survey were based upon the disability concepts of the World Health Organization's *International Classification of Functioning, Disability and Health* (ICF) [World Health Organization, 2011]. Respondents were asked whether they had activity limitations because of a physical, mental, or emotional problem. Activity limitations questions included personal care needs, routine needs, working, walking, remembering or any other activities. This classification of disability has been used in previous studies [Loeb and Chen, 2011; Price et al., 2012]. To ensure all disabilities were pre-existing to any reported occupational injuries in our study, respondents were categorized as having a disability if they answered "yes" to any of the disability questions and if the limitations were from a chronic condition. Conditions that are generally not cured once acquired or other conditions that have been present for 3 months or longer were considered chronic in NHIS. Persons without disabilities were defined as those "not limited in any way." Those reporting "limited, unknown if condition is chronic" and those "limited, not caused by chronic condition" were excluded from the analysis. The NHIS variables used to define limitations (disability) did not change between 1997 and 2011.

Definition of Occupational Injuries

The NHIS collected specific data about medically treated injuries that occurred during the 3 months prior to the interview. Interviews were conducted year-round, thereby eliminating seasonal influence. Details about the injury included diagnosis, cause of injury, location, and activity at the time of injury. Injury information was then verified and coded using the International Classification of Disease 9th revision, Clinical Modification (ICD-9-CM) codes for nature/diagnosis (N code) and external cause (E code). Each respondent was allowed to record up to 10 injury and poisoning episodes. Every injury occurrence reported by a respondent was counted as a separate injury episode. One injured person could have multiple injury episodes. Occupational injuries were defined by the response of "working at a

paid job" to the survey question "What activity were you involved in at the time of the injury?"

Sociodemographic Variables

We included sex, age, race/ethnicity, education, marital status, poverty status, and health insurance coverage as variables that could potentially affect the association between disability and injuries. Questions about demographic information were recorded in the NHIS Person file, and the responses were obtained from one member of the household for all members of the household.

Statistical Analysis

Data analyses were conducted using SAS 9.3 (SAS Institute, Cary, NC) and Stata release 13 (StataCorp LP, College Station, TX). Our analyses accounted for the complex survey design of the NHIS. The SAS procedure SURVEYFREQ was used. We translated the ICD-9-CM diagnosis code(s) into New Injury Severity Score (NISS) and entries of the Barell Diagnosis Injury Matrix using a Stata program ICDPIC [Clark et al., 2010]. The Abbreviated Injury Scale (AIS) scores each individual injury by body region according to its relative severity on a 6-point scale. The NISS is defined as the sum of the squares of the AIS scores of each of a patient's three most severe AIS injuries regardless of the body region in which they occur [Osler et al., 1997]. The entries of the Barell matrix are combinations of injury body regions and nature of injury [Barell et al., 2002]. From these entries, we further extracted body region and nature of injury. Following procedures described in the Survey Description file, we calculated national estimates, weighted proportions (%), and 95% confidence intervals for the proportions, by demographic and other injury characteristics for workers with and without disabilities. The Chi-square test was used to compare rates and proportions.

The data analyzed in this study were de-identified publicly accessible data. The Institutional Review Board of Nationwide Children's Hospital reviewed the study and approved the exempt status.

RESULTS

Using NHIS data from 1997 to 2011, our analysis included 633,710 workers $\geq$18 years who met the study's inclusion criteria. Of the 633,710 workers, 4,105 workers reported 4,203 occupational injuries during the survey reference period. Among the 604,134 workers without disabilities, 3,678 workers reported 3,757 medically treated occupational injuries, with a 3-month incidence of 0.62 injuries per 100 workers. Among the 29,576 workers with disabilities, 427 workers reported 446 occupational injuries, translating into a 3-month incidence of 1.51 injuries per 100 workers. The difference between these two rates was statistically significant ($P < 0.0001$). The prevalence for workers with disabilities decreased by 34% (the average in the period of 2007–2011 compared with the average in 1997–2001), while for workers without disabilities the prevalence decreased by 25%. Those workers with chronic bone/joint injury and those with back/neck problems had a higher prevalence of occupational injuries (Table I).

The characteristics of the workers with and without disabilities are shown in Table II. Females were a slightly larger proportion of the workers with disabilities (48.9%) when compared to the proportion of females among workers without disabilities (46.3%). Workers with disabilities were older than those without disabilities. Of the workers with disabilities, 31.5% were 55 years or older, as compared to workers without disabilities (15.3% were 55 years or older). There were a larger proportion of Non-Hispanic White persons among those with disabilities. A smaller proportion of those workers with disabilities had completed a 4-year degree. Among workers with disabilities, larger proportions were separated/divorced/widowed (26.2% vs. 14.0% of workers without disabilities). Workers with disabilities were more heavily represented in service occupations and had smaller proportions in managerial and professional occupations. Workers with disabilities were poorer, but similar proportions of workers with and without disabilities had health insurance.

Male workers sustained over half of all occupational injuries in both groups; however the gender distributions were different among workers with and without disabilities, with females accounting for a larger proportion of injuries among workers with disabilities (43.3%) compared with 31.4% among those without a disability (Table III). Workers with disabilities sustaining occupational injuries tended to be older and separated/divorced/widowed. There were no other striking differences in the distribution of occupational injuries between workers with and without disabilities with respect to race, education, poverty status, or medical insurance coverage.

Occupational injuries to workers with disabilities appeared to be slightly more severe than injuries to workers without disabilities (Table IV). Workers with a disability who sustained an occupational injury tended to miss more workdays and a higher proportion of their injuries were in a higher NISS group. The mean NISS was higher in workers with disabilities (2.24 ± 3.98) than in workers without disabilities (1.80 ± 1.61), $P = 0.0268$. Overall, however, the majority of injuries were minor, with only about 2% of injuries requiring hospitalization and over 90% of injuries with a NISS less than 5.

Table IV also shows the location and cause of injuries. Compared with injuries sustained by workers without a disability, a higher proportion of occupational injuries among workers with disabilities occurred at a shopping center,

TABLE I. The Prevalence of Occupational Injuries Among U.S. Workers With and Without Disabilities, NHIS 1997–2011

	Number of workers	Number of workers sustained occupational injuries	Number of occupational injuries	Proportion of injured workers (%)	Injury prevalence (%)
Workers without disabilities	604,134	3,678	3,757	0.61	0.62
1997–2001	219,126	1,572	1,605	0.72	0.73
2002–2006	199,723	1,109	1,129	0.56	0.57
2007–2011	185,285	997	1,023	0.54	0.55
Workers with disabilities	29,576	427	446	1.44	1.51
1997–2001	11,694	193	204	1.65	1.74
2002–2006	9,663	141	147	1.46	1.52
2007–2011	8,219	93	95	1.13	1.16
Chronic conditions reported by workers with activity limitations/disabilities[a]					
Back/neck problem	7,608	153	163	2.01	2.14
Arthritis/rheumatism	4,345	66	70	1.52	1.61
Fracture/bone/joint injury	3,317	70	72	2.11	2.17
Musculoskeletal problem	2,605	36	38	1.38	1.46
Heart problem	2,469	20	22	0.81	0.89
Depression/anxious/emotional problem	2,408	37	38	1.54	1.58
Lung/breath problem	2,249	31	33	1.38	1.47
Nervous system problem	2,223	29	29	1.30	1.30
Diabetes	2,040	28	29	1.37	1.42
Hypertension	1,876	22	23	1.17	1.23

[a]Workers reporting limitations, top 10 chronic conditions associated with disabilities/activity limitations. Workers may report more than one chronic condition.

restaurant, store, bank, gas station, or other place of business, or at a health care facility, and less likely occurred in industrial or construction areas. Overexertion/strenuous movements and falls were the two leading causes of work-related injuries for both U.S. workers with and without disabilities. However, among the injuries to workers with disabilities, these two types of injuries accounted for a higher share of the total: 56.7% for workers with disabilities versus 45.6% for workers without disabilities. The top three types of injuries (by body region injured and nature of injury) for workers with disabilities were sprains and strains of the back and buttock (9.9%), open wounds of the wrist/hand/fingers (8.8%), and unspecified injuries of the trunk (6.5%) (Table IV). The injury profile was different for workers without disabilities, with the top three injuries being open wounds to the wrist/hand/fingers (15.6%), sprains and strains of the back and buttock (9.5%), and lower leg or ankle sprains and strains (6.0%). Workers with disabilities had a higher percentage of unspecified injuries of the trunk (6.5% vs. 2.9%) and fewer open wound injuries of the wrist/hand/fingers (8.8% vs. 15.6%) compared with workers without disabilities. With respect to body region injured, a higher proportion of workers with disabilities were injured in the lower extremities (32.3% vs. 26.6%) and torso (22.9% vs. 16.9%) than workers without disabilities. Although the leading injury type for both groups was sprains and strains (37.4% and 38.6%, for workers with and without disabilities, respectively), workers with a disability had more unspecified injuries (13.5% vs. 7.9%) and fewer open wound injuries (15.7% vs. 24.2%).

DISCUSSION

Utilizing 15 years of NHIS data to produce one of the largest study samples of U.S. workers with occupational injuries, this study found differences in workplace injury patterns among workers with and without disabilities. Workers with disabilities sustained more work-related injuries, and these injuries appeared to be more severe compared with those sustained by workers without disabilities. For workers with disabilities, overexertion/strenuous movements and falls were the two most common mechanisms; sprains and strains were the most common type of injuries for both workers with and without disabilities.

Confirming the findings of our previous study [Price et al., 2012], this study found that workers with disabilities had greater than two times higher risk of being injured at one's place of work than workers without disabilities. Additionally, for the work-related injuries sustained by workers with disabilities

TABLE II. Demographic Distribution of U.S. Workers With and Without Disabilities, NHIS 1997–2011

	Without disabilities				With disabilities			
	Sample (n)	National estimate[a]	Weighted %[a]	95% CI	Sample (n)	National estimate[a]	Weighted %[a]	95% CI
Total	604,134	129,517,148			29,576	6,626,685		
Sex								
Male	320,890	69,565,170	53.7	(53.6–53.8)	14,799	3,382,927	51.1	(50.4–51.7)
Female	283,244	59,951,978	46.3	(46.2–46.4)	14,777	3,243,758	48.9	(48.3–49.6)
Age (years)								
18–34	218,909	46,842,027	36.2	(35.9–36.5)	5,731	1,314,679	19.8	(19.3–20.4)
35–54	296,566	62,869,529	48.5	(48.3–48.8)	14,694	3,225,645	48.7	(48.0–49.3)
55+	88,659	19,805,593	15.3	(15.1–15.5)	9,151	2,086,362	31.5	(30.8–32.2)
Race								
Hispanic	127,582	16,648,007	12.9	(12.5–13.2)	3,339	453,641	6.8	(6.5–7.2)
Non-Hispanic White	364,408	91,858,490	70.9	(70.5–71.4)	21,580	5,326,846	80.4	(79.7–81.0)
Non-Hispanic Black	78,009	14,369,706	11.1	(10.8–11.4)	3,664	640,735	9.7	(9.2–10.1)
Others	34,135	6,640,945	5.1	(5.0–5.3)	993	205,463	3.1	(2.9–3.3)
Education								
<12 years, no diploma	83,854	14,089,295	10.9	(10.7–11.1)	4,224	836,362	12.6	(12.2–13.1)
High school graduate or GED	168,820	36,000,710	27.8	(27.5–28.1)	9,179	2,068,051	31.2	(30.6–31.8)
Some college	175,024	38,538,649	29.8	(29.5–30.0)	9,540	2,163,599	32.6	(32.0–33.3)
Bachelor's degree or above	162,200	38,112,807	29.4	(29.0–29.8)	6,279	1,480,580	22.3	(21.7–23.0)
Marriage								
Married	364,373	78,070,169	60.3	(59.9–60.6)	15,240	3,416,955	51.6	(50.8–52.3)
Single/never married	148,448	32,284,370	24.9	(24.6–25.2)	6,311	1,440,828	21.7	(21.1–22.3)
Separated/divorced/widowed	86,235	18,111,251	14.0	(13.8–14.1)	7,877	1,734,819	26.2	(25.6–26.8)
Occupation[b]								
Management, business, and financial operations	34,660	8,023,438	14.8	(14.5–15.0)	1,817	416,703	11.8	(11.3–12.4)
Professional and related occupations	48,263	11,381,721	20.9	(20.6–21.2)	2,671	625,784	17.7	(17.0–18.5)
Service occupations	44,089	9,049,857	16.6	(16.4–16.9)	3,239	706,995	20.0	(19.4–20.7)
Sales and office occupations	60,696	13,440,350	24.7	(24.5–24.9)	4,065	935,328	26.5	(25.7–27.3)
Farming, forestry, and fishing	4,058	737,511	1.4	(1.3–1.4)	265	54,953	1.6	(1.4–1.8)
Construction, extraction, maintenance	24,058	5,194,326	9.6	(9.4–9.7)	1,340	306,745	8.7	(8.1–9.3)
Production, transportation, materials moving	31,844	6,561,602	12.1	(11.8–12.3)	2,129	479,890	13.6	(13.0–14.2)
Poverty								
Poor	37,998	6,968,232	5.4	(5.2–5.5)	2,708	575,156	8.7	(8.3–9.1)
Near poor	72,955	13,798,936	10.7	(10.5–10.8)	4,606	979,406	14.8	(14.3–15.3)
Not poor	359,091	81,499,773	62.9	(62.5–63.3)	16,892	3,918,222	59.1	(58.3–59.9)
Medical insurance coverage								
Not covered	108,008	20,432,613	16.8	(16.6–17.0)	4,591	999,784	16.2	(15.7–16.8)
Covered	446,791	100,129,425	82.4	(82.1–82.6)	22,341	5,137,432	83.4	(82.9–84.0)

[a]Due to missing values, the subtotals may not add up to total and percentages may not add up to 100% for each of the categories.
[b]Only those included in adult sample have occupation information.

there were higher percentages of female and older workers, and their injuries more commonly happened at shopping centers, restaurants, stores, banks, gas stations, other places of business, and health care facilities and less frequently occurred in industrial or construction areas. The higher percentage of injuries in specific subgroups, specifically in females and older workers, might be the result of higher percentages of employment in those groups compared with workers without disabilities. The NHIS data only contained industry or occupation information for respondents who were selected to enter the Sample adult survey and therefore does not contain employment information for all workers. In this study, we could

TABLE III. Demographic Distribution of Occupational Injuries Sustained by U.S. Workers With and Without Disabilities, NHIS 1997–2011

	Without disabilities				With disabilities				
	Sample (n)	National estimate[a]	Weighted %[a]	95% CI	Sample (n)	National estimate[a]	Weighted %[a]	95% CI	*P*-value[c]
Total	3,757	833,833			446	99,217			
Sex									<0.0001
Male	2,532	571,926	68.6	(67.0–70.2)	252	56,243	56.7	(51.1–62.3)	
Female	1,225	261,906	31.4	(29.8–33.0)	194	42,974	43.3	(37.7–48.9)	
Age (years)									<0.0001
18–34	1,555	359,170	43.1	(41.2–44.9)	116	26,902	27.1	(22.5–31.7)	
35–54	1,761	377,481	45.3	(43.5–47.0)	240	51,697	52.1	(47.3–56.9)	
55+	441	97,182	11.7	(10.5–12.8)	90	20,619	20.8	(16.7–24.8)	
Race									0.0658
Hispanic	648	86,528	10.4	(9.4–11.3)	57	8,219	8.3	(5.8–10.8)	
Non-Hispanic White	2,567	641,037	76.9	(75.5–78.2)	328	80,662	81.3	(77.6–85.0)	
Non-Hispanic Black	414	79,250	9.5	(8.5–10.5)	51	8,797	8.9	(6.3–11.4)	
Others	128	27,017	3.2	(2.6–3.9)	10	1,539	1.6	(0.5–2.6)	
Education									0.4792
<12 years, no diploma	588	110,631	13.3	(12.0–14.5)	58	11,089	11.2	(8.1–14.2)	
High school graduate or GED	1,274	285,678	34.3	(32.5–36.0)	154	36,209	36.5	(31.7–41.3)	
Some college	1,298	298,912	35.8	(34.2–37.5)	173	37,618	37.9	(32.9–42.9)	
Bachelor's degree or above	569	133,399	16.0	(14.6–17.4)	60	14,044	14.2	(10.4–17.9)	
Marriage									<0.0001
Married	2,129	459,235	55.1	(53.1–57.0)	211	46,404	46.8	(41.8–51.8)	0.0002
Single/never married	989	234,817	28.2	(26.4–29.9)	97	21,524	21.7	(17.7–25.6)	0.0369
Separated/divorced/widowed	629	137,324	16.5	(15.1–17.9)	136	31,001	31.2	(26.8–35.7)	<0.0001
Occupation[b]									0.1345
Management, business, and financial operations	143	30,136	7.4	(6.2–8.5)	26	5,584	10.1	(6.4–13.9)	
Professional and related occupations	225	49,345	12.0	(10.6–13.5)	37	9,026	16.4	(11.7–21.0)	
Service occupations	351	78,489	19.1	(17.4–20.9)	39	8,886	16.1	(11.1–21.1)	
Sales and office occupations	282	66,041	16.1	(14.4–17.8)	38	9,141	16.6	(11.2–22.0)	
Farming, forestry, and fishing	36	8,405	2.1	(1.4–2.7)	4	895	1.6	(0.0–3.2)	
Construction, extraction, maintenance	396	89,250	21.8	(19.7–23.8)	40	8,796	16.0	(11.0–20.9)	
Production, transportation, materials moving	402	88,295	21.5	(19.6–23.5)	58	12,782	23.2	(17.8–28.6)	
Poverty									0.0372
Poor	239	48,433	5.8	(4.9–6.7)	39	7,392	7.5	(4.9–10.0)	
Near poor	549	115,011	13.8	(12.6–15.0)	88	18,264	18.4	(14.6–22.2)	
Not poor	2,430	558,186	66.9	(65.3–68.6)	261	61,267	61.8	(56.9–66.6)	
Medical insurance coverage									0.2315
Not covered	663	141,825	18.7	(17.3–20.1)	87	20,038	22.0	(17.4–26.6)	
Covered	2,677	613,238	80.9	(79.5–82.3)	312	71,092	77.9	(73.3–82.5)	

[a]Due to missing values, the subtotals may not add up to total and percentages may not add up to 100% amongst categories.
[b]Only those included in adult sample have occupation information.
[c]Chi-square test.

not reliably compare the injury rate by occupation due to the small numbers of injury in each occupation. Further studies are needed to compare injury patterns by occupation.

Work-related injuries sustained by workers with disabilities appeared to be more severe (had a higher NISS) and resulted in more missed days of work. Workers with disabilities have reported experiencing more health care barriers [Drainoni et al., 2006] and thus might be less likely to pursue medical treatment for minor injuries. Because respondents in this study were only asked about medically

TABLE IV. Characteristics of the Occupational Injuries Sustained by U.S. Workers With and Without Disabilities, NHIS 1997–2011

	Without disabilities				With disabilities				
	Sample (n)	National estimate[a]	Weighted %[a]	95% CI	Sample (n)	National estimate[a]	Weighted %[a]	95% CI	*P*-value[b]
Total	3,757	833,833			446	99,217			
Hospitalized									0.9297
Yes	88	17,654	2.1	(1.6–2.6)	14	2,212	2.2	(1.0–3.5)	
No	3,663	814,678	97.7	(97.2–98.2)	431	96,751	97.5	(96.2–98.9)	
Days of work missed									<0.0001
None	1,588	362,794	43.9	(42.2–45.6)	137	29,458	30.0	(25.3–34.6)	
<1 day	431	98,287	11.9	(10.7–13.1)	51	10,386	10.6	(7.5–13.6)	
1–5 days	1,002	219,169	26.5	(24.9–28.1)	131	32,917	33.5	(28.2–38.8)	
6 or more days	698	144,177	17.4	(16.2–18.7)	121	25,172	25.6	(21.4–29.8)	
Injury severity									<0.0001
NISS 1	2,549	564,655	72.8	(71.2–74.4)	260	57,685	63.0	(58.1–67.9)	
NISS 2–4	812	178,308	23.0	(21.5–24.4)	119	26,750	29.2	(24.6–33.8)	
NISS 5–75	143	32,807	4.2	(3.5–5.0)	32	7,148	7.8	(5.5–10.1)	
Location where injured									<0.0001
Shopping center, restaurant, store, bank, gas station, or other place of business	571	127,143	15.2	(14.0–16.5)	93	21,902	22.1	(17.3–26.8)	0.0020
Industrial or construction area	1,015	226,989	27.2	(25.7–28.8)	92	18,883	19.0	(15.1–23.0)	0.0038
Health care facility (include hospital)	173	37,879	4.5	(3.9–5.2)	37	7,985	8.0	(5.6–10.5)	0.0007
Other public building	292	67,530	8.1	(7.1–9.1)	35	7,096	7.2	(4.5–9.8)	0.9552
Home (outside)	166	36,251	4.3	(3.7–5.0)	24	5,047	5.1	(3.1–7.0)	0.3548
Other locations[c]	1,540	338,041	40.5	(38.8–42.3)	165	38,304	38.6	(33.7–43.5)	
Cause of injury									0.0002
Overexertion/strenuous movements	932	206,180	24.7	(23.2–26.2)	132	29,382	29.6	(24.8–34.5)	0.0279
Fall	811	174,600	20.9	(19.4–22.4)	120	26,847	27.1	(22.5–31.6)	0.0105
Struck by object or person	485	106,818	12.8	(11.6–14.0)	61	13,824	13.9	(10.4–17.4)	0.6484
Cut/pierce	534	123,742	14.8	(13.6–16.0)	38	8,635	8.7	(5.9–11.5)	0.0009
Transportation	131	27,963	3.4	(2.7–4.0)	15	3,179	3.2	(1.7–4.7)	0.8928
Other causes[d]	864	194,529	23.3	(21.8–24.8)	80	17,350	17.5	(13.9–21.1)	
Body region and injury nature (Barell injury matrix)									0.0007
Back and buttock, sprains and strains	330	75,820	9.5	(8.5–10.6)	41	9,244	9.9	(6.8–12.9)	0.6701
Wrist, hand and fingers, open wound	541	124,288	15.6	(14.4–16.9)	35	8,192	8.8	(5.8–11.7)	0.0001
Trunk, unspecified injury	112	22,924	2.9	(2.3–3.5)	28	6,058	6.5	(4.0–9.0)	0.0002
Lower leg and ankle, sprains and strains	214	47,995	6.0	(5.2–6.8)	22	5,380	5.8	(3.2–8.3)	0.4166
Shoulder and upper arm, sprains and strains	166	35,670	4.5	(3.8–5.2)	22	4,905	5.2	(3.2–7.3)	0.6193
Other and unspecified lower extremities, sprains and strains	172	39,857	5.0	(4.2–5.8)	23	4,884	5.2	(2.5–7.9)	0.6010
Foot and toes, fracture	75	17,876	2.2	(1.7–2.8)	13	3,099	3.3	(1.3–5.3)	0.2163
Pelvis and urogenital, sprains and strains	47	9,833	1.2	(0.9–1.6)	11	2,688	2.9	(0.8–5.0)	0.0375
Other and unspecified lower extremities, unspecified injury	77	15,554	2.0	(1.5–2.4)	13	2,585	2.8	(1.3–4.2)	0.2864
Hand and fingers, contusion/superficial	66	15,524	2.0	(1.4–2.5)	8	2,494	2.7	(0.7–4.6)	0.9552
Others (all other body region and injury type combinations in Barell matrix)	1,759	390,138	49.0	(47.2–50.8)	204	43,903	47.0	(41.7–52.2)	
Body region									0.0007
Extremities, lower	931	211,444	26.6	(24.9–28.3)	130	30,162	32.3	(27.2–37.3)	0.0734
Extremities, upper	1,418	319,203	40.1	(38.3–42.0)	126	29,042	31.1	(26.1–36.0)	<0.0001

(*Continued*)

TABLE IV. (*Continued.*)

	Without disabilities				With disabilities				
	Sample (n)	National estimate[a]	Weighted %[a]	95% CI	Sample (n)	National estimate[a]	Weighted %[a]	95% CI	*P*-value[b]
Torso	597	134,392	16.9	(15.5–18.3)	98	21,392	22.9	(18.6–27.2)	0.0008
Other head, face and neck (excluding traumatic brain injuries)	315	68,004	8.5	(7.5–9.6)	28	5,960	6.4	(4.1–8.7)	0.1203
Vertebral column injury	196	40,469	5.1	(4.3–5.8)	28	4,930	5.3	(3.4–7.2)	0.3456
Other body regions[e]	102	21,967	2.8	(2.2–3.4)	10	1,944	2.1	(0.7–3.4)	
Injury nature									0.0001
Sprains and strains	1,365	306,854	38.6	(36.8–40.4)	156	34,922	37.4	(32.3–42.4)	0.5623
Open wound	849	192,228	24.2	(22.7–25.6)	65	14,658	15.7	(12.0–19.4)	<0.0001
Contusions/superficial	410	93,169	11.7	(10.5–12.9)	54	13,250	14.2	(10.4–18.0)	0.4788
Unspecified	308	62,601	7.9	(7.0–8.8)	60	12,632	13.5	(10.1–16.9)	0.0003
Fracture	320	72,345	9.1	(8.0–10.2)	41	9,786	10.5	(7.3–13.7)	0.7153
Other injury types[f]	307	68,282	8.6	(7.6–9.5)	44	8,182	8.8	(6.2–11.3)	

[a]Due to missing values, the subtotals may not add up to total and percentages may not add up to 100% amongst categories.
[b]Chi-square test.
[c]Other locations include street or highway, school, parking lot, home(inside), residential institution (exclude hospital), farm, sport facility, athletic field, playground, park or recreation area (include bike or jog path), sidewalk, child care center or preschool, river/lake/stream/ocean, other or unspecified.
[d]Other causes include machinery, fire/burn/scald related, animal or insect bite, poisoning, and other.
[e]Other body regions include traumatic brain injury, spinal cord injury, and other and unspecified body regions.
[f]Other injury nature include burns, internal injury, amputation, nerves injury, and blood vessels injury.

treated injuries, medical care seeking behavior was a potential source of bias. Medical care seeking behavior differences between workers with and without disabilities should be considered in future studies.

Falls represented a larger portion of injuries in workers with disabilities; this has also been shown by multiple other studies [Ramirez et al., 2004; Xiang et al., 2005; Gauchard et al., 2006; Brophy et al., 2008; Price et al., 2012]. The reasons behind the increased proportion of occupational injuries caused by overexertion or strenuous movement observed in our study are not clear. One possible explanation could be that workers with physical disabilities might have greater difficulty performing some physically demanding job tasks and thus were more likely to be injured by overexertion. Engineering improvements or modification of job assignment policies in particular work environments should focus on reducing overexertion and falls. A few studies showed that the accommodations provided to workers with disability typically cost little to nothing (moving the employee to another job or changing a work schedule), but generally are effective [Unger and Kregel, 2003; Hartnett et al., 2011; Job Accommodation Network (JAN), 2013]. The 1990 Americans with Disabilities Act requires employers to make reasonable accommodations for qualified workers with disabilities. Furthermore, we noted that overexertion/strenuous movements and falls were also the top two mechanisms of injury for workers without disabilities. So, improving the working environment for workers with disability has the potential to also reduce overexertion or fall related injuries for workers without disabilities.

The lower extremities, upper extremities and the torso were the three most commonly injured body regions for both U.S. workers with and without disabilities, but among workers with disabilities, the lower extremities and the torso were more commonly injured than among their non-disabled counterparts. While sprains and strains were the most common injury types among both groups, workers with disabilities were also more likely to sustain unspecified injuries and less likely to sustain fractures and open wound injuries. We hypothesize that due to activity limitations, workers with disabilities were less likely to engage in or be assigned to high-risk jobs that may potentially result in fractures or open wounds. In both group, over one-third of the injuries were sprains and strains. This should be a main target of injury prevention among U.S. workers with disabilities and also among workers without disabilities.

Limitations and Strengths

Using data from the NHIS, this study is the first to compare nationally representative estimates of the characteristics of non-fatal occupational injuries sustained by U.S. workers with and without disabilities; however, the NHIS did

not provide data on fatal injuries. As mentioned above, we only had occupational information for those workers in the Sample adult file. The survey relied on self-report of injuries that required medical attention over a 3-month time period and was subject to recall bias [Warner et al., 2005]. Occupational injury prevalence declined during the 15-year study time period among workers with and without disabilities. Evaluating the temporal trends in the characteristics of those injuries is beyond the scope of this study. Despite these limitations, the results of our study revealed valuable information about injury patterns among U.S. workers with disabilities. Results of this study could provide evidence for developing targeted work safety programs to reduce occupational injuries among U.S. workers with disabilities.

CONCLUSION

Although U.S. workers with and without disabilities shared some similarities in the characteristics of their occupational injuries, workers with disabilities had some unique work-related injury patterns. Those injuries in workers with disabilities appeared to be more severe and more likely to be the result of overexertion/strenuous movements and falls.

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