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Work-Related Non-Fatal Injuries Among Foreign-Born and US-Born Workers: Findings From the U.S. National Health Interview Survey, 1997–2005

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Background *Millions of foreign-born workers are employed in the US. Population-based surveys have value in describing the non-fatal work-related injuries that these workers suffer.*

Methods *Using data from the 1997–2005 National Health Interview Survey, we compared the rates of non-fatal work-related injuries among foreign-born and US-born adult workers. Logistic regression was used to produce work-related injury odds ratios (ORs) and 95% confidence intervals (95% CI) by nativity and years of residence while controlling for sex, age, race/ethnicity, education, poverty, family size, insurance status, delayed medical care, and alcohol use. Industry-specific rates were also compared.*

Results *Foreign-born workers reported a lower rate of work-related injuries than US-born workers, 50 per 10,000 foreign-born workers versus 89 per 10,000 US-born workers ($P < 0.01$). After controlling for confounding variables, the OR of work-related injuries for foreign-born workers as compared to US-born workers was 0.50 (95% CI = 0.38–0.66). The construction, agriculture/forestry and fisheries, and manufacturing industries had the highest work-related injury rates for both groups of workers.*

Conclusions *Foreign-born workers had a lower overall rate of work-related injury when compared to US-born workers. Both US-born and foreign-born workers face significant injury risks, especially in certain industries. Interventions tailored with ethnic and cultural differences in mind are still warranted.* Am. J. Ind. Med. 52:25–36, 2009. © *2008 Wiley-Liss, Inc.*

KEY WORDS: non-fatal; injury; occupational; industry; foreign-born workers

BACKGROUND

Immigrant workers comprise a sizable proportion of the total US workforce, and their numbers are growing [Mosisa, 2002; McCauley, 2005]. It is important that occupational health professionals understand the needs of this population. Safety and injury prevention at work have been raised as an issue among the US immigrant population, in part, because of their frequent employment in dangerous industrial and agricultural occupations [Richardson et al., 2003; Brunette, 2004; McCauley, 2005]. Additionally, many immigrant families either are not adequately covered by medical

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insurance or lack health insurance [Lillie-Blanton and Hudman, 2001; Jacobs et al., 2002].

Azaroff et al. [2004] have reported on drops in rates of occupational injuries and illnesses seen in the 1990s Bureau of Labor Statistics (BLS) and workers compensation records. The authors argue that behind these trends are employees who are less likely to report occupational injuries and illnesses because of issues such as immigrant status, precarious employment, and declines in wages and opportunities. Still, in the US adult population as a whole, occupational injuries comprise a substantial portion of the total injury burden, with 38% of all medically treated injuries to employed adults [Smith et al., 2005]. It has been estimated that occupational injuries in the US in 1999 cost $40 billion in direct costs and $200 billion in indirect costs [National Institute for Occupational Health and Safety (NIOSH), 2003].

Studies specifically designed to evaluate data sources like the BLS [Azaroff et al., 2002; Smith et al., 2005; Rosenman et al., 2006] and workers compensation and hospital records [Azaroff et al., 2003] have reported that these data systems often fail to fully document the extent of immigrant work-related injuries. Community and occupational samples of immigrant workers have provided insight into this vulnerable group of workers [O'Connor and Easter, 2000; Pransky et al., 2002; Azaroff et al., 2003; Quandt et al., 2006; Grzywacz et al., 2007a,b]. Among immigrant Hispanics employed in non-agricultural occupations, the injury rate was found to be higher than the national averages [Pransky et al., 2002]. A recent national study using population data found that foreign-born persons were significantly more likely to be injured while working at a paid job (21.7%) when compared to US-born persons (14.9%) [Sinclair et al., 2006]. Also, when considering the location at the time of injury, foreign-born individuals were more likely to be injured at an industrial or construction area [Sinclair et al., 2006].

Data from the 1996–2001 Census of Fatal Occupational Injuries indicated that the occupational fatality relative risk for foreign-born workers was 1.11 when using all US workers as the comparison group, and the relative risk of fatality was 1.82 for Mexican-born workers [Loh and Richardson, 2004]. Although fatal occupational injuries among all US workers have declined, workplace fatalities among foreign-born workers have been increasing [Loh and Richardson, 2004].

We have not found any studies that directly compare the rates of non-fatal work-related injuries between foreign-born and US-born workers and focus on comparisons by industry. As well, no studies have attempted to compare external injury cause, injury type, and injured body part between foreign-born and US-born injured workers. The study reported here evaluated work-related injury risk and patterns of injuries among foreign-born workers in the United States. This information is needed in order to develop optimal occupational safety and health programs that target immigrant workers.

MATERIALS AND METHODS

Data Source and Sample Design

The data presented in this article were compiled from the 1997–2005 National Health Interview Survey (NHIS), which is a survey of the civilian, non-institutionalized population administered by the US Census Bureau for the National Center for Health Statistics (NCHS). The NHIS uses a complex survey design involving stratification, clustering, and oversampling of certain populations (e.g., racial/ethnic minorities) to ensure a sufficient sample size of underrepresented groups [National Center for Health Statistics (NCHS), 2004; National Center for Health Statistics (NCHS), 2005]. Sample weights provided by NCHS take into account the complex sampling design and non-response. The NHIS interviews are conducted year-round to eliminate seasonal influences on responses.

Trained interviewers conducted computer-assisted personal interviews in participants' homes. All adult household members who were present at the time of the interview were invited to participate. One adult family member was chosen to provide information for all children and for any adults not home at the time of the interview. Interviewers made a number of attempts to contact family members before excluding a household. In most cases, one or two attempts were sufficient to obtain an interview. The overall household response rates for the NHIS ranged from 86.5% to 90.0% between 1997 and 2005 [National Center for Health Statistics (NCHS), 2004; National Center for Health Statistics (NCHS), 2005].

The NHIS includes a personal file, an adult sample file, an injury file, and other data files. We used the personal file and the injury file for the majority of the statistical results presented in this article. In order to evaluate alcohol use and industry, the adult sample file data were used. Response rates for the adult sample files were 69.0% in 2005 and 80.4% in 1997.

Birthplace and Years of Residency

Birthplace was determined by responses to the question, ''Where were you born?'' A respondent was categorized as being foreign-born if birthplace was outside the US. The NHIS categorized respondents born in US territories as foreign-born because they were likely to have a culture different from mainstream US culture. Therefore in our analysis, US-born workers included only those individuals born in one of the 50 states or the District of Columbia.

Another variable included in our study was the number of years of residency in the US. Foreign-born respondents

were categorized into four groups: <5 years, 5–9 years, 10–14 years, and ≥15 years. These data were obtained from responses to the question, ''About how long have you been in the United States?''

Definition of Work-Related Injuries and Workers

The NHIS data included questions about medically consulted injuries that occurred for any member of the family within a 3-month reference period. A medically consulted injury episode refers to a traumatic event in which a person is injured from an external cause (e.g., fall, motor vehicle traffic accident) and seeks medical help (e.g., call to a poison control center, use of an emergency vehicle, visit to an emergency room, visit to a doctor's office or other health clinic, phone call to a doctor, nurse, or other health care professional). Respondents were asked to report the total number of injury/poisoning episodes that occurred during the 3-month reference period.

It is important to note that from 1997 to 1999, the Injury/Poisoning Episode file contained up to four injury episodes. Beginning in 2000, a person could record up to ten injury episodes in the Injury/Poisoning Episode file. In our study, injured ''workers'' were used in statistical comparisons between foreign-born and US-born workers (essentially, injury = yes or no). However, when characteristics of injuries were compared all ''work-related injuries'' were analyzed.

Detailed information about these injury episodes included the date/month/year of injury, medical treatment, and cause of injury. Injury cause was coded based on external cause of injury E-codes. Injury nature or type and injured body region were coded based on International Classification of Disease, Ninth Revision, Clinical Modification (ICD-9-CM) codes.

The Barell injury diagnosis matrix was applied to injury type and body region [Barell et al., 2002]. The matrix produces 12 nature of injury columns and 36 body region rows placing each ICD-9-CM code in the range from 800 to 995 in a unique cell location in the matrix. The matrix rows and columns can easily be collapsed to get broader groupings or expanded if more specific sites are required. In this analysis, we collapsed categories and used six categories for nature of injury and five categories for body region. Unspecified nature of injury denoted that the respondent provided an insufficient description of the injury to enable assignment of an ICD-9-CM code.

Respondents were asked the question, ''What were you doing when the injury happened?'' In this study, work-related injury episodes were defined by the response, ''Working at a paid job'' (variables ''WHAT_1'' and ''WHAT_2'' in the NHIS). There were separate questions about injuries and poisoning, and data were saved separately in two files (one for injuries and one for poisonings) from 1997 to 1999. After 1999, one question was asked about both injuries and poisonings, but injuries could be separated from poisonings by using a variable describing ''the cause of the person's injury/poisoning'' (''CAUSNEW''). We chose to focus on work-related injuries, and poisoning cases were excluded using this injury cause variable (''CAUSNEW'' = 4 for poisoning).

Employment status was defined using the survey question, ''What were you doing last week?'' in the personal file. In our analysis, workers were defined as those who gave one of the following three responses: ''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 job or business.'' We accounted for changes in the variable name and response categories for this question during the study period. According to the NHIS documents, those adults ''with a job or business but not at work'' made up <3% of the NHIS cohort. Our definition of employment status is consistent with the NCHS recommendation to use this question to identify employed adults [NCHS, 2004, 2005].

In order to describe injury patterns by injured workers' industry, we linked industry information from the adult sample file with the injury file. Sample adults who were employed during the week prior to their interview were asked a series of questions about their job and work status during the week prior to the interview.

During the course of the NHIS adult sample interview, verbatim responses were obtained from each eligible worker regarding his/her industry. This information was subsequently reviewed by US Census Bureau coding specialists, who assigned appropriate industry codes. For the years 1997–2003, there were 14 simplified industry codes based on the 1987 Standard Industrial Classification (SIC) and the 1995 revisions to the Standard Occupational Classification (SOC). For 2004–2005, there were 21 simplified industry codes based on 2002 North American Industrial Classification System (NAICS) and 2000 Standard Occupational Classification (2000 SOC). We used these 2-digit codes to group industry into seven categories: construction; agriculture, forestry, and fisheries; manufacturing; transportation and utilities; wholesale/retail trade; services; and others.

Statistical Analysis

Compilation of the NHIS data (1997–2005), variable recoding, and statistical analysis were done using SAS Institute [2004]. SUDAAN [2004] procedures were used to account for the complex sample design and weighting structure of the NHIS.

The weighted rates of work-related injuries per 10,000 workers among the foreign-born and US-born were calculated by sociodemographic characteristics (the personal file was linked with the injury file). The work-related injury rates

were calculated for each year and all years combined (1997–2005) for both foreign-born and US-born workers. Injury odds ratios (ORs) and 95% confidence intervals (95% CI) were also calculated in logistic regression models.

In univariate models, nativity, sex, age, race/ethnicity, level of education, poverty status, family size, insurance status, delayed medical care, alcohol use, and years in the US were all significant ($P < 0.05$) and used as covariates in the final logistic regression models. Out of the four final logistic regression models, two models were based only on the adult sample file of the NHIS. This allowed for inclusion of a variable describing alcohol use, which is often considered a significant injury risk factor. The adult sample files were approximately 1/3 the size of the person files of NHIS data, ranging from 34.9% in 1997 to 31.9% in 2005. Interactions between immigrant status and other covariates were examined. The interaction terms were not statistically significant and were not included in the final logistic regression models.

Using the adult sample file, injury rates by industry were calculated and ranked for both foreign-born and US-born workers. Injury patterns for all injuries (external cause, injury type, and body region injured) were examined using information from the injury datasets. The following measures of severity were included: overnight hospitalization, hospitalized nights, and days of work missed as the result of the work-related injury. Proportions of injuries and 95% CIs by external cause, injury type, injured body region, and injury severity were presented separately for foreign-born and US-born workers.

Human Participant Protection

The data were collected following procedures approved by the Institutional Review Board at the National Center for Health Statistics, which involved obtaining informed consent from all NHIS respondents. The Nationwide Children's Hospital Institutional Review Board approved secondary analysis of the data for our study.

RESULTS

A total of 402,667 adults employed in the week prior to the interview were studied. Of those, 19.3% were foreign-born workers. Forty-seven percent of foreign-born workers were Hispanic (Table I). There were differences in the distribution of characteristics between foreign-born and US-born workers. Statistically significant differences were seen for gender, age, race/ethnicity, education, poverty status, family size, insurance status, delayed medical care, and alcohol use (Table I). Foreign-born workers were slightly more likely to be male and more likely to be 25–44 years old. Foreign-born workers were more likely to have fewer years of education with only 21.2% having a high school education compared to 30.5% of US-born workers. Foreign-born workers were also more likely to live in poor or near poor households, to have a larger family size, to abstain from alcohol, and be uninsured.

Non-Fatal Work-Related Injuries

The time trends of foreign-born and US-born work-related injury rates for the years 1997–2005 are similar (Fig. 1). A total of 3,260 workers reported work-related injuries during the 3-month prior to the NHIS interview (Table II). Foreign-born workers reported a lower rate of work-related injuries than US-born workers, 50/10,000 (95% CI = 45–56) versus 89/10,000 (95% CI = 86–93). The injury rates among foreign-born workers did not differ significantly by years of residence in the US.

For both foreign-born and US-born workers, males had a higher rate of work-related injury than females. Among US-born workers, work-related injury rates were highest among the youngest workers, and the rates trended down with increasing age groups. For the foreign-born worker, injury rates were highest among the youngest and oldest age groups.

Across many of the sociodemographic categories, foreign-born workers had significantly lower rates of work-related injuries than their US-born counterparts. Only for workers 65 years and older was the foreign-born work-related injury rate higher than the US-born rate; however this difference was not statistically significant (Table II).

Odds Ratio of Injuries From Logistic Regression Models

Results from univariate and multivariate models are shown in Table III. Nativity, sex, age, education, race/ethnicity, poverty status, family size, insurance status, delayed medical care, and alcohol drinking status were significantly associated with work-related injuries in univariate models (Table III). Years of residence were also a significant variable in the univariate model. When nativity and years of residence were entered into multivariate models separately with the above-mentioned covariates minus alcohol use (multivariate models 1 and 3), both nativity and years of residence remained significant variables (for nativity: OR = 0.66, 95% CI = 0.55–0.80; for years of residence: ORs ranged from 0.56 to 0.71).

Alcohol drinking status was a significant variable for work-related injuries. In model 2, compared with non-drinkers, the ORs of work-related injuries were 1.51 (95% CI = 1.22–1.88) for current alcohol drinkers and 1.57 (95% CI = 1.19–2.06) for former alcohol drinkers. In model 4, the ORs were 1.51 (95% CI = 1.22–1.88) for current alcohol drinkers and 1.56 (95% CI = 1.18–2.05) for former alcohol drinkers. When alcohol use was entered into multivariate model, the injury odds ratio for nativity

TABLE I. Percentage Distribution of Selected Characteristics of US Workers by Nativity, NHIS, 1997–2005

	Foreign-born n = 77,844 proportion (95% CI)	US-born n = 324,823 proportion (95% CI)
Sex**		
Male	59.1 (58.6–59.5)	52.8 (52.7–53.0)
Female	40.9 (40.5–41.4)	47.2 (47.0–47.3)
Age (years)**		
18–24	11.4 (11.1–11.8)	13.3 (13.1–13.6)
25–44	56.5 (56.0–57.0)	48.9 (48.6–49.2)
45–64	29.8 (29.3–30.4)	34.5 (34.2–34.8)
65+	2.2 (2.1–2.4)	3.3 (3.3–3.4)
Race/ethnicity**		
Non-Hispanic White	22.0 (21.2–22.8)	81.8 (81.2–82.3)
Black	8.2 (7.6–8.8)	11.3 (10.8–11.9)
Hispanic	47.4 (46.2–48.7)	5.2 (4.9–5.5)
Asian	21.4 (20.4–22.4)	0.8 (0.7–0.9)
Other ethnic group	0.7 (0.6–0.9)	0.9 (0.7–1.0)
Not reported	0.3 (0.2–0.3)	0.1 (0.1–0.1)
Education**		
Less than high school diploma	28.2 (27.3–29.2)	8.6 (8.4–8.9)
High school diploma or GED	21.2 (20.7–21.7)	30.5 (30.1–30.9)
Some college	20.1 (19.6–20.6)	31.4 (31.2–31.7)
Bachelor's degree or higher	26.5 (25.7–27.3)	27.7 (27.2–28.2)
Not reported	4.0 (3.7–4.2)	1.8 (1.7–1.9)
Poverty status**		
Poor	8.9 (8.5–9.3)	4.3 (4.1–4.5)
Near poor	16.6 (16.1–17.1)	9.4 (9.2–9.6)
Not poor	45.3 (44.5–46.1)	61.6 (61.0–62.1)
Not reported	29.2 (28.5,29.9)	24.8 (24.3,25.3)
Family size**		
1–3	50.8 (50.1–51.5)	67.4 (67.0–67.8)
4–5	36.4 (35.8–37.0)	28.4 (28.0–28.7)
6+	12.8 (12.3–13.3)	4.3 (4.1–4.4)
Insurance status**		
Uninsured	29.2 (28.4–29.9)	12.0 (11.7–12.2)
Insured	60.9 (60.1–61.7)	76.6 (76.3–76.9)
Not reported	10.0 (9.6–10.3)	11.5 (11.3–11.7)
Delayed getting needed medical care**		
Yes	6.4 (6.2–6.7)	8.0 (7.9–8.2)
No	93.3 (93.0–93.6)	91.8 (91.6–91.9)
Not reported	0.3 (0.2–0.4)	0.2 (0.2–0.2)
Alcohol use**,[a]		
Lifetime abstainer	31.7 (31.0–32.5)	15.0 (14.5–15.4)
Former drinker	8.6 (8.3–9.0)	12.0 (11.7–12.2)
Current drinker	58.9 (58.2–59.7)	72.4 (71.9–72.9)
Not reported	0.7 (0.6–0.8)	0.7 (0.6–0.7)
Years in the US		
<5	12.5 (12.0–13.0)	
5–9	13.7 (13.3–14.1)	
10–14	13.5 (13.1–13.8)	
>15	44.1 (43.3–45.0)	
Not reported	16.2 (15.8–16.6)	

[a]Alcohol use was available in the NHIS adult file only (38% of the foreign-born sample and 46% of the US-born sample).
**$P < 0.001$ based on chi-square test comparing foreign-born to US-born.

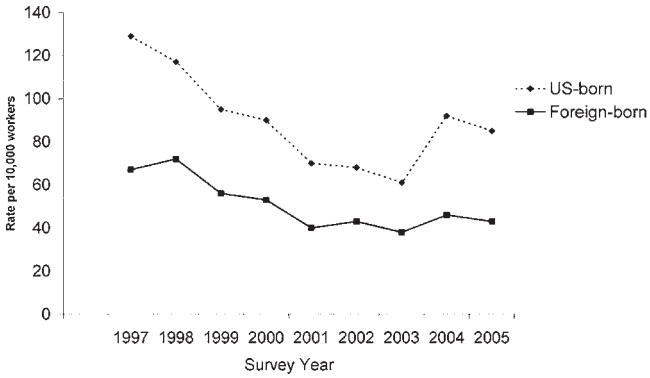

FIGURE 1. Time trends of work-related injury rates among US-born and foreign-born workers (1997–2005).

decreased (comparison between models 1 and 2). The same was true for years of residence, when alcohol drinking was added as a covariate, the ORs for years of residence slightly decreased (comparison between models 3 and 4). These findings indicate that alcohol use might have a confounding impact on the association between nativity and years of residence in the US and work-related injuries.

Hispanics had significantly lower odds of injury as compared to the reference group, Non-Hispanic Whites, in models 1 and 3; however, the ORs approached non-significance when alcohol use was considered in models 2 and 4 (Table III). When alcohol use was included in models 2 and 4, the odds of work-related injury for Asians and Non-Hispanic Whites were not different.

Work-Related Injuries by Industry

Because sample adults were a subset of the adult respondents in the personal file, we could only identify industry status for 142 injured foreign-born workers (35.1% of total injured foreign-born workers) and 1,338 injured US-born workers (46.9% of total injured US-born workers). In all industrial categories, foreign-born workers reported a significantly lower rate of work-related injuries than US-born workers (Table IV). Rankings by industry were similar for foreign-born and US-born workers. Those industries showing higher injury rates were construction (104/10,000 in foreign-born workers vs. 214/10,000 in US-born workers), agriculture/forestry and fisheries (80/10,000 in foreign-born workers vs. 170/10,000 in US-born workers), and manufacturing (80/10,000 in foreign-born workers vs. 133/10,000 in US-born workers).

Work-Related Injuries by External Cause

Overexertion/strenuous activities and falls were the two most common external causes of injury, followed by cut/pierced by object, struck by object or person, machinery, transportation, and fire/burn/scald (Table V). The patterns for these external causes were similar between foreign-born and US-born workers. Overexertion/strenuous activities ranked first among injuries of US-born workers. Falls ranked first among the injuries of foreign-born workers, but the proportion of injuries due to falls and overexertion/strenuous activity were similar between the two populations.

Injury Type and Body Region

For both foreign-born and US-born injured workers, sprains and strains were the most common type of injury, followed by open wound (Table V). Nature of injury was coded as ''unspecified'' for 18.4% of the injuries of foreign-born workers and 15.5% of injuries of US-born workers.

Injury patterns by affected body region were also similar for foreign-born and US-born workers. Injury to the extremities accounted for more than 84% of total work-related injuries, followed by injuries to the torso, head, and neck (Table V). Injured body region was coded as unclassified in 6.6% of the injuries for both injured foreign-born and US-born workers.

Table V also includes measures of injury severity, specifically hospitalization and missed work. Injuries suffered by foreign-born workers were more likely to result in hospitalization, and a larger proportion of those injuries to foreign-born workers resulted in more than 6 days or more of missed work. The two groups of workers did not differ in length of hospital stay after injury.

DISCUSSION

Statistical results from our study indicated that the non-fatal work-related injury rates were significantly lower for foreign-born workers than US-born workers. Injury severity measures suggested that foreign-born workers might have suffered more severe injuries than US-born workers. However, patterns of work-related injuries with regard to external cause of injury, nature of injury, and injured body region were similar between the two groups.

The lower work-related injury rates in foreign-born workers could not be explained by distribution of gender or age. Previous studies have found work-related injury rates to be higher among individuals <44 years of age and in males as compared to females [Jackson, 2001; Salminen, 2004; Smith et al., 2005]. With these assumptions in mind, it could be inferred that the injury rate should be higher in foreign-born workers because among the foreign born, males and 25–44 year olds were larger proportions of the workers. However, this was not supported by the findings of our study. The work-related injury rate for 25–44 year olds and the injury rate for males in the foreign-born group were lower than those in US-born group (Table II).

TABLE II. Work-Related Injury Rate per 10,000 With 95% CI for Foreign-Born and US-Born Workers, NHIS, 1997–2005

	Foreign-born			US-born			
	Observation (n)	Injured (n)	Rate (95% CI)	Observation (n)	Injured (n)	Rate (95% CI)	Rate ratio
Total	77,844	405	50 (45–56)	324,823	2,855	89 (86–93)	0.56**
Sex							
Male	45,992	291	59 (52–68)	167,431	1,927	116 (110–122)	0.51**
Female	31,852	114	36 (30–44)	157,392	928	59 (55–64)	0.61**
Age (years)							
18–24	9,110	58	62 (46–83)	40,432	421	116 (103–129)	0.53**
25–44	44,622	221	48 (41–55)	159,944	1,503	95 (89–100)	0.51**
45–64	22,566	115	48 (39–61)	113,475	882	77 (71–82)	0.62**
65+	1,546	11	63 (33–120)	10,972	49	45 (34–60)	1.40
Race/ethnicity							
Non-Hispanic White	11,548	67	60 (46–78)	244,239	2,214	92 (87–96)	0.65**
Black	5,605	22	39 (25–60)	44,232	329	76 (67–85)	0.51**
Hispanic	48,479	274	54 (48–62)	30,936	254	83 (72–97)	0.65**
Asian	11,536	37	32 (23–44)	2,473	11	40 (22–73)	0.80
Other ethnic group	390	4	113 (44–287)	2,684	43	145 (107–197)	0.78
Education							
Less than high school	28,077	171	58 (49–68)	30,555	416	144 (130–159)	0.40**
High school diploma	16,524	83	50 (39–64)	100,716	1,095	114 (107–122)	0.44**
Some college	14,277	88	66 (51–84)	102,243	972	97 (91–104)	0.68**
Bachelor's degree or not reported	15,704	52	32 (24–44)	85,468	349	40 (36–45)	0.80
Poverty status							
Poor	8,505	48	52 (38–72)	15,057	183	123 (104–145)	0.42**
Near poor	14,886	82	52 (41–65)	32,456	424	138 (125–153)	0.38**
Not poor	31,184	182	55 (47–65)	195,835	1,763	92 (88–98)	0.60**
Family size							
1–3	36,803	208	56 (48–65)	216,245	1,997	93 (89–98)	0.60**
4–5	29,309	129	41 (33–51)	92,994	741	82 (76–88)	0.50**
6+	11,732	68	52 (39–70)	15,584	117	77 (63–94)	0.68*
Insurance status							
Uninsured	26,144	129	47 (38–56)	40,531	446	116 (104–128)	0.41**
Insured	43,148	221	49 (42–57)	243,343	1,910	80 (76–84)	0.61**
Not reported	654	2	36 (7–194)	2,186	11	52 (27–98)	0.69
Delayed getting needed medical care							
Yes	5,194	38	71 (50–101)	26,061	427	166 (151–183)	0.43**
No	72,445	366	48 (43–54)	298,151	2,425	83 (79–87)	0.58**
Alcohol use							
Life time abstainer	9,797	32	30 (20–44)	23,208	156	68 (58–81)	0.44**
Former drinker	2,668	22	72 (47–112)	18,212	200	114 (99–131)	0.63*
Current drinker	16,925	101	53 (43–65)	105,694	1,115	107 (100–114)	0.50**
Years in the US							
<5	9,573	54	59 (43–80)				
5–9	10,519	56	50 (38–66)				
10–14	10,596	55	50 (37–67)				
>15	33,278	174	48 (41–58)				

*$P < 0.05$ based on chi-square test comparing foreign-born to US-born.
**$P < 0.01$ based on chi-square test comparing foreign-born to US-born.

TABLE III. Logistic Regression Among Workers With Work-Related Injury by Nativity and Years of US Residence, NHIS, 1997–2005

	Univariate model OR (95% CI)	Multivariate model 1[a] OR (95% CI)	Multivariate model 2[b] OR (95% CI)	Multivariate model 3[c] OR (95% CI)	Multivariate model 4[d] OR (95% CI)
Nativity	**	**	**		
US-born	Reference	Reference	Reference		
Foreign-born	0.56 (0.49–0.62)	0.66 (0.55–0.80)	0.50 (0.38–0.66)		
Sex	**	**	**	**	**
Male	1.91 (1.76–2.07)	2.08 (1.88–2.31)	1.96 (1.71–2.25)	2.09 (1.88–2.32)	1.97 (1.71–2.26)
Female	Reference	Reference	Reference	Reference	Reference
Age (years)	**	**	**	**	**
18–24	Reference	Reference	Reference	Reference	Reference
25–44	0.80 (0.71–0.90)	0.94 (0.81–1.09)	0.92 (0.76–1.13)	0.94 (0.81–1.09)	0.92 (0.76–1.13)
45–64	0.67 (0.59–0.76)	0.77 (0.65–0.90)	0.74 (0.60–0.92)	0.76 (0.65–0.90)	0.74 (0.60–0.92)
65+	0.43 (0.32–0.57)	0.41 (0.28–0.60)	0.41 (0.24–0.68)	0.40 (0.28–0.59)	0.41 (0.24–0.68)
Race/ethnicity	**	**	**	**	**
Non-Hispanic White	Reference	Reference	Reference	Reference	Reference
Black	0.79 (0.69–0.90)	0.73 (0.62–0.87)	0.76 (0.61–0.94)	0.73 (0.62–0.87)	0.76 (0.61–0.94)
Hispanic	0.73 (0.65–0.81)	0.71 (0.59–0.84)	0.77 (0.60–0.98)	0.72 (0.60–0.85)	0.77 (0.61–0.98)
Asian	0.37 (0.27–0.49)	0.60 (0.41–0.89)	0.53 (0.24–1.19)	0.62 (0.42–0.91)	0.54 (0.24–1.22)
Other ethnic group	1.57 (1.17–2.11)	1.49 (1.07–2.07)	1.75 (1.15–2.68)	1.49 (1.07–2.07)	1.76 (1.15–2.69)
Overall education	**	**	**	**	**
Less than high school	2.91 (2.53–3.34)	3.05 (2.55–3.63)	3.09 (2.39–4.01)	3.06 (2.56–3.65)	3.10 (2.39–4.01)
High school or GED	2.76 (2.43–3.13)	2.73 (2.35–3.17)	2.72 (2.19–3.38)	2.73 (2.35–3.18)	2.73 (2.20–3.39)
Some college	2.42 (2.13–2.75)	2.21 (1.89–2.58)	2.13 (1.73–2.63)	2.20 (1.88–2.58)	2.14 (1.73–2.64)
Bachelor's degree or higher	Reference	Reference	Reference	Reference	Reference
Poverty status	**	*		*	
Poor	1.19 (1.01–1.39)	0.96 (0.78–1.17)	0.95 (0.74–1.22)	0.96 (0.79–1.18)	0.95 (0.74–1.22)
Near poor	1.34 (1.21–1.49)	1.20 (1.06–1.36)	1.17 (0.97–1.40)	1.20 (1.06–1.36)	1.16 (0.97–1.40)
Not poor	Reference	Reference	Reference	Reference	Reference
Family size	**	**	*	**	*
1–3	1.30 (1.10–1.54)	1.53 (1.22–1.93)	1.33 (0.89–1.99)	1.54 (1.22–1.94)	1.32 (0.88–1.98)
4–5	1.09 (0.92–1.29)	1.15 (0.91–1.46)	1.12 (0.74–1.67)	1.16 (0.92–1.46)	1.11 (0.74–1.67)
6+	Reference	Reference	Reference	Reference	Reference
Insurance status	**				
Uninsured	1.25 (1.13, 1.38)	0.89 (0.78, 1.01)	1.04 (0.87, 1.24)	0.90 (0.79, 1.02)	1.04 (0.87, 1.24)
Insured	Reference	Reference	Reference	Reference	Reference
Delayed getting needed medical care	**	**	**	**	**
Yes	Reference	Reference	Reference	Reference	Reference
No	0.50 (0.45–0.55)	0.55 (0.48–0.63)	0.68 (0.56–0.82)	0.55 (0.48–0.63)	0.68 (0.56–0.82)
Alcohol use	**		**		**
Lifetime abstainer	Reference		Reference		Reference
Former drinker	1.87 (1.51–2.30)		1.57 (1.19–2.06)		1.56 (1.18–2.05)
Current drinker	1.72 (1.45–2.03)		1.51 (1.22–1.88)		1.51 (1.22–1.88)
Years in US	**			**	**
US-born	Reference			Reference	Reference
<5	0.65 (0.47–0.90)			0.67 (0.44–1.03)	0.49 (0.27–0.87)
5–9	0.56 (0.42–0.73)			0.56 (0.39–0.82)	0.55 (0.33–0.91)
10–14	0.55 (0.41–0.74)			0.62 (0.44–0.87)	0.53 (0.33–0.87)
15 or more	0.54 (0.45–0.65)			0.71 (0.56–0.90)	0.47 (0.32–0.69)

[a]Model 1 includes Nativity and all covariates except Alcohol use.
[b]Model 2 includes Nativity and all covariates including Alcohol use.
[c]Model 3 includes Years of US residence and all covariates except Alcohol use.
[d]Model 4 includes Years of US residence and all covariates including Alcohol use.
*$P < 0.05$.
**$P < 0.01$.

TABLE IV. Work-Related Injury Rate per 10,000 Workers With 95%CI by Industry[a] and Nativity, NHIS, 1997–2005

	Foreign-born			US-born			
	Rank order	Injured (n)	Rate (95% CI)	Rank Order	Injured (n)	Rate (95% CI)	PR (%)
Industry[a]		142			1338		
Construction	1	23	104 (67–163)	1	174	214 (183–251)	0.49**
Agriculture, forestry and fisheries	2	10	80 (40–160)	2	40	170 (119–242)	0.47*
Manufacturing	3	36	80 (56–114)	3	248	133 (118–150)	0.60**
Transportation and utilities	5	10	36 (18–69)	4	117	118 (98–143)	0.31**
Wholesale/retail trade	4	27	53 (34–84)	5	248	106 (92–122)	0.50**
Services	6	27	27 (18–41)	6	362	66 (59–73)	0.41**
Others		6	15 (6–35)		131	67 (55–81)	0.22**

[a]Industry information only available from the adult sample survey.
*$P < 0.05$ based on chi-square test comparing foreign-born to US-born.
**$P < 0.01$ based on chi-square test comparing foreign-born to US-born.

A previous study has reported that Hispanics had higher fatal and non-fatal work-related injury rates than any other ethnic groups in the US [Richardson et al., 2003]. This work by Richardson has suggested that Hispanic workers are more heavily represented in higher risk occupations than non-Hispanic Whites and other racial/ethnic groups, and this disproportionate representation explains their higher rates of fatality and non-fatal injury [Richardson et al., 2003]. Our results also showed that Hispanic workers had higher overall work-related injury rates than Blacks and Asians but lower rates than Non-Hispanic Whites. In the multivariate logistic regression models, which include alcohol use, the racial/ethnic differences in rates of work-related injuries are mitigated.

Work-related injuries ranked by industry had the same patterns among these two groups; however, the injury rate for each industry was lower among foreign-born workers than US-born workers. The BLS indicated that the highest non-fatal workplace injury and illness rates were in transportation and warehousing, followed by construction, then manufacturing, and then goods producing [Bureau of Labor Statistics, 2004a]. In 2003, private construction sector had the highest number of fatalities, but the highest fatality rates were in agriculture, forestry, fishing, and hunting, followed by mining, transportation and warehousing, and construction [Bureau of Labor Statistics, 2004b]. In our analysis, transportation and utilities ranked fifth. Transportation without utilities might have ranked higher.

The NHIS severity threshold for inclusion of injury episodes is medically attended injury episodes. Carangan et al. [2004] reported that there was no difference in the types and severity of injuries sustained by local and foreign workers in Singapore, but foreign workers were more often hospitalized. Our results were similar; workers did not differ in terms of cause and nature of injury, but injuries to foreign-born workers resulted in hospitalization more often and a greater proportion of those injuries resulted in 6 or more days of missed work.

Study Limitations

A number of limitations should be considered when interpreting the results of our study. First, only medically consulted injuries were reported in the NHIS. This limitation is important given that researchers have found that foreign-born workers may utilize fewer, or be more likely to delay, health services than US-born workers [Ciesielski et al., 1994]. In our study, a higher percentage of foreign-born workers lacked health insurance (Table I), and therefore, may not have sought medical attention for their injuries. Differences in health insurance coverage status could have biased injury reporting in our study. The apparent lower injury risk among foreign-born workers may simply be a consequence of a bias in medical care seeking behavior. However, in our study, a lower percentage of the foreign-born reported delays in getting needed medical care (6.4% vs. 8.0% of US-born workers). When comparing only insured workers, foreign-born workers still had a lower rate of injury than US-born workers (Table II). These findings suggest that observed lower work-related injury rates among foreign-born workers in our study were not simply due to bias in medical seeking behaviors or medical insurance coverage. It is possible that foreign-born workers are more likely to be employed in workplaces that discourage reporting or seeking of healthcare after work-related injuries. Foreign-born workers perhaps are less familiar with Occupational Safety and Health Administration (OSHA) rules about effective safety training. In a community sample of immigrant workers, only 31% of the respondents were offered job safety training [Pransky et al., 2002]. Pransky et al. also found that while 100% of injured immigrant employees reported their workplace injury to their employer, nearly 60%

TABLE V. Weighted Proportion (%) of Work-Related Injuries by Injury External Causes, Nature, Body Region, and Measures of Severity, NHIS, 1997–2005

	Foreign-born			US-born		
	Rank order	Injuries (n)	Proportion (95% CI)	Rank order	Injuries (n)	Proportion (95% CI)
Cause of injury based on E codes						
Overexertion/strenuous movements	2	93	23.3 (18.8–28.4)	1	821	28.2 (26.4–30.0)
Fall	1	102	23.6 (19.1–28.8)	2	637	21.4 (19.7–23.3)
Cut/pierce	3	57	15.9 (11.7–21.3)	3	365	12.8 (11.6–14.2)
Struck by object or person	4	50	10.3 (7.8–13.6)	4	372	12.5 (11.4–13.8)
Machinery	5	35	7.8 (5.5–10.9)	5	158	5.3 (4.5–6.3)
Transportation	6	23	6.0 (3.8–9.5)	6	114	3.6 (3.0–4.4)
Fire/burn/scald	7	10	2.5 (1.3–4.9)	7	73	2.5 (2.0–3.2)
Animal or insect bite	8	4	1.0 (0.3–3.3)	8	47	1.7 (1.2–2.3)
Other		40	9.8 (6.9–13.7)		350	12.0 (10.8–13.2)
Nature						
Sprain & strains	1	119	31.2 (26.6–36.3)	1	1021	35.1 (33.1–37.1)
Open wound	2	84	20.8 (16.3–26.1)	2	593	20.8 (19.3–22.4)
Contusion/superficial	4	44	10.2 (7.4–13.8)	3	296	9.9 (8.8–11.0)
Fracture	3	46	11.0 (8.1–14.9)	4	240	8.2 (7.2–9.3)
Others		37	8.3 (5.7–12.0)		319	10.7 (9.6–11.9)
Unspecified		81	18.4 (13.9–24.0)		463	15.5 (14.1–16.9)
Body region						
Extremities	1	339	84.0 (78.8–88.1)	1	2499	85.5 (84.1–86.8)
Torso	2	29	6.2 (3.7–10.1)	2	156	5.3 (4.5–6.3)
Head and neck	3	8	1.6 (0.8–3.3)	3	60	2.0 (1.5–2.6)
Spine and back	4	8	1.6 (0.8–3.1)	4	19	0.6 (0.4–1.0)
Unclassified		27	6.6 (4.3–10.0)		192	6.6 (5.7–7.6)
Hospitalized over night*						
Yes		24	5.4 (3.4–8.4)		90	2.8 (2.3–3.5)
No		385	94.6 (91.6–96.6)		2835	97.2 (96.5–97.7)
Hospitalized nights						
None		385	94.6 (91.6–96.6)		2835	97.2 (96.5–97.7)
1		10	2.2 (1.0–4.7)		33	1.0 (0.7–1.4)
2–3		6	1.5 (0.6–3.8)		30	1.0 (0.7–1.5)
4+		8	1.6 (0.7–3.7)		26	0.8 (0.6–1.2)
Work days missed**						
None		119	30.0 (25.2–35.3)		1063	36.6 (34.7–38.4)
<1		47	12.1 (8.8–16.5)		347	12.4 (11.1–13.8)
1–5		100	25.9 (21.1–31.4)		766	26.8 (25.0–28.7)
6+		144	32.0 (27.4–36.9)		732	24.3 (22.8–25.9)

*$P < 0.05$ based on chi-square test comparing foreign-born to US-born.
**$P < 0.01$ based on chi-square test comparing foreign-born to US-born.

of those same injured employees did not file workers' compensation claims.

Second, the self-report nature of injuries in the NHIS and its reliance on retrospective reporting from respondents may also introduce recall bias. It is not clear if the foreign-born would differ from the US-born in terms of recall. A third limitation may be that undocumented foreign-born people are underrepresented in the NHIS because of undocumented persons' fear of official reporting to a US government study. Language barriers may also prevent them from participation in a survey like the NHIS. Unfortunately, the extent of underreporting of the undocumented foreign-born population in the NHIS is unknown and has never been thoroughly investigated.

A fourth limitation is that the NHIS asked about employment during the week prior to the interview, but injury was assessed during the 3 months prior to the interview. It is possible that the injury happened while the

worker was in a different job (and possibly a different industry) than the reported industry.

A fifth limitation is that some changes were made to the Family Core Injury Section of the NHIS during the time period for our study. The total number of injury episodes allowed in the NHIS injury data files was different between 1997–1999 and 2000–2005. As pointed out by the National Center for Health Statistics [National Center for Health Statistics (NCHS), 2000], a key injury question was inadvertently reworded between 1999 and 2000, and as a result injury/poisoning episodes in the 2000 NHIS may have been underreported. We decided to use injured ''workers'' for the majority of our statistical analyses to eliminate the effect of different numbers of injury episodes. However, the impact of fewer allowed injury episodes in the injury files before 2000 on our comparison of characteristics of work-related injuries between foreign-born and US-born workers is unknown.

Finally, deaths from injuries are not captured by NHIS. The Census of Fatal Occupational Injuries does indicate that injuries sustained by foreign-born workers more often result in death [Loh and Richardson, 2004]. Loh and Richardson report that the higher fatality relative risks for those in sales occupations and handler, equipment cleaner, helper, and laborer occupations contribute to the overall higher fatality relative risk among the foreign-born.

Implications

Despite the limitations mentioned, our research was the first of its kind to compare the risk of work-related non-fatal injuries by industry between foreign-born and US-born workers using a large nationally representative population-based data source. As a household survey, the NHIS provides information about work-related injury regardless of workers' compensation coverage, current employment status, and willingness to report to their employer [Azaroff et al., 2003; Smith et al., 2006]. Our findings indicate that foreign-born workers had an overall lower risk of non-fatal work-related injury compared with the US-born population. However, both US-born and foreign-born workers in certain industries face significant injury risks. Construction, agriculture/forestry and fisheries, and manufacturing industries were the US economic sectors where significantly higher rates of work-related injuries are seen in this study. Although we found that foreign-born workers generally had a lower rate of non-fatal work-related injuries, interventions tailored with ethnic and cultural differences in mind are still warranted.

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