AMERICAN JOURNAL OF INDUSTRIAL MEDICINE 58:528–540 (2015)

Disparities in Occupational Injury Hospitalization Rates in Five States (2003–2009)

Jeanne M. Sears, PhD, MS, RN,[1]* Stephen M. Bowman, PhD, MHA,[2,3] and Sheilah Hogg-Johnson, PhD, MMath[4,5]

Background *Achievement of health equity and elimination of disparities are overarching goals of Healthy People 2020, yet there is a paucity of population-based data regarding race/ethnicity-based disparities in occupational injuries.*

Methods *Hospital discharge data for five states (Arizona, California, Florida, New Jersey, and New York) were obtained from the Healthcare Cost & Utilization Project (HCUP) for 2003–2009. Age-adjusted rates and trends for work-related injury hospitalizations were calculated using negative binomial regression (reference category: non-Latino white).*

Results *Latinos were significantly more likely to have a work-related traumatic injury hospitalization. The disparity for Latinos was greatest for machinery-related hospitalizations. Latinos were also more likely to have a fall-related hospitalization. African-Americans were more likely to have an occupational assault-related hospitalization, but less likely to have a fall-related hospitalization.*

Conclusions *We found evidence of substantial multistate disparities in occupational injury-related hospitalizations. Enhanced surveillance and further research are needed to identify and address underlying causes.* Am. J. Ind. Med. 58:528–540, 2015.

KEY WORDS: occupational injuries; injury surveillance; traumatic injuries; hospital discharge data; disparities; Latino; Hispanic; ethnicity; injury severity

INTRODUCTION

Achievement of health equity and elimination of disparities are among the overarching goals of Healthy People 2020 [U.S. Department of Health and Human Services, 2014]. Occupational injury surveillance is one of the primary tools for assessing progress regarding disparities related to the Healthy People 2020 Occupational Safety and Health objectives. Occupational injury surveillance involves efforts to accurately characterize trends in the extent and burden of work-related injuries, and is critical to monitoring our state and national progress toward prevention of occupational injuries. Identifying disparities in occupational injury rates can guide planning efforts related to prevention activities. However, workers' compensation (WC) databases generally do not include information on race and ethnicity. In addition, the national employer-based Survey of Occupational Injuries and Illnesses (SOII) includes race/ethnicity as optional data elements, resulting in high levels of missing data (upwards of 30% of cases) [Bureau of Labor Statistics (BLS), 2009; Steege et al., 2014]. These data gaps severely hamper surveillance efforts related to capturing racial/ethnic disparities.

In contrast, hospital discharge databases often do have available statewide data on race/ethnicity and have been used for disparity-related occupational injury surveillance and

[1]Department of Health Services, School of Public Health, University of Washington [Institution where the work was performed], Seattle, Washington
[2]Department of Health Policy and Management, Fay W. Boozman College of Public Health, University of Arkansas for Medical Sciences, Little Rock, Arkansas
[3]Center for Injury Research and Policy, Department of Health Policy and Management, Bloomberg School of Public Health, Johns Hopkins University, Baltimore, Maryland
[4]Institute for Work and Health, Toronto, Ontario, Canada
[5]Dalla Lana School of Public Health, University of Toronto, Ontario, Canada
*Correspondence to: Jeanne M. Sears, PhD, MS, RN, Department of Health Services, University of Washington, Box 357660, Seattle, WA 98195. E-mail: jeannes@uw.edu

Accepted 19 December 2014
DOI 10.1002/ajim.22427. Published online 4 March 2015 in Wiley Online Library (wileyonlinelibrary.com).

research [Hunt et al., 2005; McGreevy et al., 2010]. However, these efforts have been sporadic and have not been implemented on a multistate or national basis. The Council of State and Territorial Epidemiologists (CSTE) has developed a set of Occupational Health Indicators (OHIs) that are used to measure the baseline health of working populations at the state level [Council of State and Territorial Epidemiologists (CSTE), 2014]. The guidance for OHI #2 (Work-Related Hospitalizations) contains instructions for calculating race/ethnicity-specific rates. However, race/ethnicity-specific rates for this indicator are not reported on the CSTE website because hospital discharge data on race/ethnicity are not collected in some states, and are incomplete or have unverified validity in others.

Notwithstanding these data challenges, racial and ethnic disparities in occupational injuries have been observed in numerous studies. In particular, many studies have reported disproportionate numbers of occupational injuries among Latinos and African Americans, which may be due to both higher employment prevalence in more risky industries and occupations, as well as higher rates of injuries even within specific industries and occupations [Richardson et al., 2003; Dong and Platner, 2004; Orrenius and Zavodny, 2009; Buchanan et al., 2010; Baron et al., 2013; Marsh et al., 2013; Steege et al., 2014]. A number of studies based on hospital discharge data or trauma registry reports have found higher rates of work-related injuries among Latinos in several states, including Illinois [Friedman and Forst, 2008], Massachusetts [Hunt et al., 2005], New Jersey [McGreevy et al., 2010], and Washington [Sears et al., 2011], as well as for the U.S. as a whole [Richardson et al., 2003; Dong and Platner, 2004; Centers for Disease Control and Prevention, 2008]. There is also some evidence suggesting that the relative burden of occupational injuries is increasingly falling on Latinos and foreign-born workers [Loh and Richardson, 2004; Richardson et al., 2004; Sears et al., 2011, 2012a]. In an earlier study in Washington State, we found not only a disparity in the burden of work-related traumatic injuries sustained by Latinos relative to non-Latinos, but also a 5% mean annual increase in the odds that a comparable work-related traumatic injury was sustained by a Latino, after controlling for Latino representation in the labor force [Sears et al., 2012a]. In contrast, the unadjusted magnitude and trend in non-work injuries among Latinos appeared to more closely follow overall population trends.

Despite high levels of interest in the critical topic of race/ethnicity-based disparities in occupational injuries among the public health community, there is a paucity of information regarding population-based rates and trends due to the data constraints described earlier. To partially address this gap, we used population-based hospital discharge data for five states to address the following three study objectives: (1) to describe characteristics and rates of occupational injury hospitalizations by race/ethnicity; (2) to assess whether rates of occupational injury hospitalizations differ by race/ethnicity, overall and for several high-priority causes of injury; and (3) to assess whether any disparity in occupational injuries has changed over time. We hypothesized that Latinos have shouldered a disproportionate burden of traumatic occupational injuries, and, in addition, that the degree of that burden relative to non-Latinos has increased over time.

MATERIALS AND METHODS

Data Sources and Study Population

Population-based community hospital discharge data for five states were obtained from the following Data Partners of the Healthcare Cost & Utilization Project (HCUP), Agency for Healthcare Research and Quality [HCUP State Inpatient Databases (SID), 2003–2009]: Arizona (AZ) Department of Health Services, California (CA) Office of Statewide Health Planning and Development, Florida (FL) Agency for Health Care Administration, New Jersey (NJ) Department of Health, and New York (NY) State Department of Health. These five states satisfied several selection criteria, including state reporting of WC as a distinct payer category (unlike the uniform SID payer field that does not maintain WC as a distinct payer category); state reporting of race/ethnicity data from 2003 through 2009, affordably-priced data available via HCUP/SID, and availability of adequate employed population denominator data (reported cell counts for each age and race/ethnicity stratum of interest).

In order to construct comparable samples across all states, we restricted the age range to ages 20 through 64 years because of small cell sizes at the age margins for some states and categories. Because this study was dependent on using WC as payer to identify occupational injuries, this also served to minimize potential observation bias related to cost-shifting from WC to parental health insurance or Medicare.

Occupational traumatic injury hospitalizations were included if hospital discharge occurred from 2003 through 2009, if WC was listed as the primary payer, and if the first-listed diagnosis was a traumatic injury. CSTE recommends the use of WC as primary payer to identify work-related hospitalizations [Council of State and Territorial Epidemiologists (CSTE), 2014]. Traumatic injuries were defined using the ICD-9-CM diagnostic codes specified by the National Trauma Data Bank [National Trauma Data Bank, 2011]. The definition required a first-listed injury diagnostic code in the range 800–959.9, excluding the following injuries: 905–909.9 (late effects of injury), 910–924.9 (superficial injuries, including blisters, contusions, abrasions, insect bites), and 930–939.9 (foreign bodies). Burns (940–949.9) were excluded because the injury severity scoring system we used does not reliably classify burns due

to the importance of inhalation injuries (see the severity measurement section below). By convention, the first-listed diagnosis in HCUP SID data is the principal diagnosis, which is defined in the Uniform Hospital Discharge Data Set (UHDDS) as "that condition established after study to be chiefly responsible for occasioning the admission of the patient to the hospital for care" [Senathirajah et al., 2011]. HCUP considers inpatient principal diagnosis coding to be rigorous and well-scrutinized [Senathirajah et al., 2011]. Inclusion was based only on the first-listed diagnosis, an approach that: (1) avoids temporal bias in trend estimation due to the increasing number of available diagnosis fields over time in some states; (2) avoids including injuries that occurred incidental or subsequent to hospital admission; and (3) for the most part, captures the most severe injury [STIPDA: Injury Surveillance Workgroup 6, 2008]. This comports with injury surveillance recommendations promulgated by the Safe States Alliance (formerly STIPDA) and the Centers for Disease Control and Prevention (CDC) [STIPDA: Injury Surveillance Workgroup 5, 2007; STIPDA: Injury Surveillance Workgroup 6, 2008; Thomas and Johnson, 2012].

Rates of work-related traumatic injuries were based on employed population denominators obtained from the Bureau of Labor Statistics' Current Population Survey (CPS), as recommended by the CSTE [Council of State and Territorial Epidemiologists (CSTE), 2014]. People residing outside the hospitalization state were excluded, as they would not be included in state-based denominators. The Washington State Institutional Review Board approved this study.

Measures

Race/ethnicity was based on the HCUP uniform data element, which contains mutually exclusive race and ethnicity categories in one data element (RACE). When constructing the uniform data element from separate race and ethnicity data fields in state source data, HCUP gave ethnicity precedence over race. Due to small numbers in some cells (for HCUP data and/or CPS data), most analyses in this study focused on three race/ethnicity categories; non-Latino white, Latino/Hispanic, and Black/African-American. Analyses in AZ were limited to the non-Latino white and Latino/Hispanic categories due to insufficient numbers of injury hospitalizations among African-Americans.

First-listed valid external cause of injury codes (E-codes) were used to identify three injury causes of special interest to occupational injury surveillance for trend analysis: (1) fall-related hospitalizations; (2) machinery-related hospitalizations; and (3) motor vehicle traffic hospitalizations. Definitions for falls and motor vehicle traffic-related injuries were derived from the definitions described in the 2010 CDC instructions for state injury indicators [Thomas and Johnson, 2012]. An E-code in the range E880.X-E888.X, excluding E887.X, was used to identify fall-related hospitalizations (modeled on the CDC instructions for Fall Indicator 2). An E-code in the range E919.X was used to identify machinery-related hospitalizations. There is no related state injury indicator, but the machinery category is defined in the STIPDA Consensus Recommendations [STIPDA: Injury Surveillance Workgroup 5, 2007]. An E-code in the range E81X was used to identify motor vehicle traffic hospitalizations (modeled on the CDC instructions for Motor Vehicle Indicator 2, which specifically excludes injuries from collisions occurring off a public roadway). E-codes were also used to classify manner/intent of injury; specifically a first-listed valid E-code of E960.X-E969, E979.X, or E999.1 was used to identify assault/homicide-related injuries (modeled on the CDC instructions for Homicide/Assault Indicator 2). Manner/intent categories overlap with cause categories. "Unspecified" and "undetermined" categories are based on specific E-codes and do not technically constitute missing data. However, the unspecified and undetermined categories are conceptually equivalent to missing data for some comparative purposes, and thus were treated as missing and excluded from some analyses where indicated by table footnotes.

Place of injury (E849.X) was constructed from all available E-codes (up to seven per record, which varied by state/year). Place of injury data were collapsed into four categories: (1) industrial/mine/quarry (E849.2, E849.3); (2) street/highway (E849.5); (3) other specified (E849.0, E849.1, E849.4, E849.6, E849.7, E849.8); and (4) unspecified (E849.9).

The Abbreviated Injury Scale (AIS) was used to measure injury severity for this study [Association for the Advancement of Automotive Medicine, 1990]. AIS is an anatomically-based consensus-driven scoring system that rates injury severity based on threat to life and does not take comorbidity or complications into account. This type of severity score provides a reliable estimate of initial injury severity, independent of patient-specific factors that may influence hospitalization. In particular, AIS provides more face validity and empirical support as a measure of initial injury severity than do hospital admission or length of stay, both of which can be related to co-existing conditions, health status, and trends in insurance coverage and standards of care [National Center for Health Statistics (NCHS) Expert Group on Injury Severity Measurement, 2004; Stephenson et al., 2005; Cryer and Langley, 2008; Cryer et al., 2010; Sears et al., 2014]. AIS-based injury severity scores have been validated for prediction of mortality [Baker et al., 1974; Osler et al., 1997; Meredith et al., 2002; Kilgo et al., 2003; Harwood et al., 2006], and recent studies have established their association with occupational injury outcomes such as work disability and medical costs [Ruestow and Friedman, 2013; Sears et al., 2013a].

AIS was estimated from the first-listed ICD-9-CM diagnosis code using -icdpic-, a Stata user-written program developed using National Trauma Data Bank (NTDB) data [Clark et al., 2010]. The most serious injury, usually listed first if the primary reason for admission, has been found to predict mortality as well or better than using all injuries [Kilgo et al., 2003]. The -icdpic- program contains a crosswalk from ICD-9-CM diagnosis codes to AIS severity. Burns were excluded from this study because -icdpic- does not score burns and because inhalation injuries are strong contributors to burn severity, but are not scored by AIS. The AIS ordinal scale ranges from 1 (minor) to 6 (maximal). As in previous related studies, we defined severe injury as an AIS of 3 (serious) or above; these injuries carry a high probability of hospital admission and thus the hypothesized effect of systematic reductions over time in hospitalized injury ascertainment due to secular trends in hospital admission practices should be minimized for this subset [Cryer and Langley, 2008]. To illustrate the severity threshold we used, the ICD-9-CM code 821.0 (closed femur shaft fracture) maps to an AIS of 3 (classified as severe for this study), while 824.0 (closed medial malleolus/ankle fracture) maps to an AIS of 2 (classified as minor for this study). As another example, 887.0 (uncomplicated below-elbow amputation of arm/hand) maps to an AIS of 3, while 885.0 (uncomplicated thumb amputation) maps to an AIS of 2. Due to previously observed downward bias in estimated occupational injury trends when severity restriction is not employed [Sears et al., 2014], we calculated annual rates separately for: (1) all traumatic injury-related hospitalizations, and (2) the subset of severe traumatic injury-related hospitalizations.

Data Analysis

Crude and age-adjusted rates for the period from 2003 through 2009 were calculated for work-related injury hospitalizations overall and for each of the race/ethnicity categories. Age adjustment was performed using direct standardization based on the U.S. 2000 Standard Population (ages 16–64) [Klein and Schoenborn, 2001] and gamma confidence intervals were calculated [Fay and Feuer, 1997]. In the age-restricted samples used for this study, there were only slight and unremarkable differences between the crude and age-adjusted rates; therefore only age-adjusted rates were presented in the tables. Trends were calculated for the period from 2003 through 2009 using negative binomial regression models that included a continuous variable for discharge year and that adjusted for employed population denominators. These models were run once for all traumatic injuries and again for severe traumatic injuries only. For each state, we also assessed whether there was increasing disparity for Latinos or African-Americans compared with the non-Latino white reference group by adding interaction terms (year by race/ethnicity) to the models. Negative binomial regression models were also used to estimate all-year incidence rate ratios by race/ethnicity (using non-Latino white as the reference group), overall and stratified by injury cause. Negative binomial regression was used in preference to Poisson models because the Vuong test often indicated overdispersion [Vuong, 1989; Liu and Cela, 2008]. All statistical tests were two-tailed, with statistical significance defined as $P \leq 0.05$. All analyses were conducted using Stata/SE 11.2 for Windows (StataCorp LP, College Station, TX).

RESULTS

Table I presents data on cases missing data in key data fields by state, which were omitted from the column percentages for each variable presented in Table II. There were no missing data for age or first-listed diagnoses due to the inclusion criteria. In all five states, place of injury was often not coded. Notably, although CA had the highest amount of missing data for gender (20.2%), it had the lowest for place of injury (8.9%). The distribution of key characteristics of work-related injury hospitalizations for each of the five states is shown in Table II. Males accounted for more than 80% of these injury hospitalizations in all five states. About 20% to 25% qualified as severe traumatic injuries using AIS. The percentage of Latinos ranged from 10% in NJ to 42% in CA, and the percentage of African-Americans ranged from 2.2% in AZ to 25.7% in NJ.

Distributions of key characteristics of work-related injury hospitalizations for each of the five states are shown in Table III, stratified by race/ethnicity. There was no significant variation in inpatient death by race/ethnicity for any state (data not shown). Though not always statistically significant, a lower percentage of injury hospitalizations among Latinos and African-Americans were severe, compared with the non-Latino white category. In all five states, a higher percentage of injury hospitalizations among Latinos involved amputations. Place of injury was not included in Table III due to high levels of missing data.

Annual occupational injury hospitalization rates are presented in Tables IV and V. Table IV shows rates for all occupational injury hospitalizations, regardless of severity, and Table V is restricted to severe injury hospitalizations (estimated AIS of 3 to 6). In both tables, rates for non-Latino whites and Black/African-Americans were roughly similar in general, while rates for Latinos were significantly higher in most years for most states (this pattern was less consistent for severe injuries in FL and NY). Temporal trends in injury hospitalizations were clearly nonlinear, tracking economic cycles, and trend estimates are thus highly sensitive to

TABLE I. Amount of Missing Data in Key Variables (Occupational Injury Hospitalizations, 2003–2009)

	Arizona N = 7,233		California N = 31,416		Florida N = 20,276		New Jersey N = 10,389		New York N = 20,778	
Variable	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Gender	2	<0.1	2,988	9.5	1	<0.1	0	0	1	<0.1
Age[a]	0	0	0	0	0	0	0	0	0	0
Race/ethnicity	145	2.0	6,331	20.2	274	1.4	249	2.4	478	2.3
Injury severity (AIS)	69	1.0	256	0.8	208	1.0	65	0.6	123	0.6
Amputation injury[b]	0	0	0	0	0	0	0	0	0	0
Traumatic brain injury[b]	0	0	0	0	0	0	0	0	0	0
Inpatient death	2	<0.1	3	<0.1	0	0	0	0	0	0
Manner/intent of injury[c]	957	13.2	1,719	5.5	1,374	6.8	294	2.8	140	0.7
External cause of injury[c]	957	13.2	1,720	5.5	1,374	6.8	294	2.8	140	0.7
Place of injury[d]	2,412	33.4	2,803	8.9	12,800	63.1	9,888	95.2	3,370	16.2

[a]No missing data by definition, since the inclusion criteria required a specific age range.
[b]These variables were constructed to represent the presence/absence of particular ICD-9-CM diagnosis codes using all diagnosis fields; all WC cases in all states had at least one diagnosis code available.
[c]Constructed using primary valid external cause of injury code (E-code).
[d]Constructed using all available E-codes.

specification of start and end years. With these caveats, the estimated linear trends from 2003 to 2009 were either downward or statistically flat in all cases (data not shown), with the sole exception of a 5.2% average annual increase in severe traumatic injury hospitalizations among Latinos in NY.

Using the models designed to assess whether there was increasing disparity for Latinos or African-Americans compared with the non-Latino white reference group (by using interaction terms), we found no evidence of increasing divergence in linear trends for four of the five states. However, for NY, we did find evidence of increasing disparity for Latinos over time, in both the all-injury and severe-injury models. The disparity between the trend line for Latinos relative to the trend line for non-Latino whites increased by an average of 4.8% per year (95% CI: 1.2%, 8.5%; $P = 0.009$) for all traumatic injuries, and by an average of 7.2% per year (95% CI: 1.8%, 12.9%; $P = 0.008$) for severe traumatic injuries.

Table VI presents all-year incidence rate ratios for Latinos and for African-Americans, each compared with non-Latino whites, modeled separately for each state and for specified injury causes. These models accounted for employed population denominators and provided population-based estimates of the relative probability of occupational injury-related hospitalization for each group. Overall, Latinos were significantly more likely to have a work-related traumatic injury hospitalization compared with non-Latino whites, with estimates ranging from 1.42 times more likely in FL to 2.29 times more likely in NJ. In contrast, we did not find evidence for a disparity in overall occupational injury hospitalizations among African-Americans compared with non-Latino whites. Of the injury causes assessed, the disparity for Latinos was greatest for machinery-related occupational injury hospitalizations, with estimates ranging from 2.37 times more likely in FL to 5.70 times more likely in NJ. Across all five states, Latinos were also consistently more likely than non-Latino whites to have a fall-related hospitalization. In all four states tested, African-Americans were significantly more likely to have an assault-related occupational injury hospitalization compared with non-Latino whites, but significantly less likely to have a fall-related injury hospitalization.

DISCUSSION

Our primary hypothesis, that Latinos have shouldered a disproportionate burden of traumatic occupational injuries compared with the non-Latino white reference group, was supported by evidence from all five states. After adjusting for employed population denominators, Latinos were significantly more likely to have a work-related traumatic injury hospitalization, ranging from 1.42 times more likely in FL to 2.29 times more likely in NJ (Table VI). Of the injury causes assessed, the disparity for Latinos was greatest for machinery-related occupational injury hospitalizations. Latinos were also consistently more likely to have a fall-related hospitalization. Although there was no evidence of an elevated risk of occupational injury hospitalization among African-Americans overall, African-Americans were significantly more likely to have an assault-related occupational injury hospitalization in all four states tested.

Our secondary hypothesis, that the degree of disparity in injury burden for Latinos has increased over time, was borne

TABLE II. Characteristics of Occupational Injury Hospitalizations for Five States, 2003–2009

	Arizona N = 7,233		California N = 31,416		Florida N = 20,276		New Jersey N = 10,389		New York N = 20,778	
Characteristic	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Gender										
Male	6,125	84.7	23,603	83.0	16,711	82.4	8,565	82.4	17,082	82.2
Female	1,106	15.3	4,825	17.0	3,564	17.6	1,824	17.6	3,695	17.8
Age										
20–24	804	11.1	3,089	9.8	1,885	9.3	908	8.7	1,766	8.5
25–34	1,705	23.6	7,223	23.0	4,106	20.3	2,246	21.6	4,372	21.0
35–44	1,773	24.5	7,419	23.6	5,165	25.5	2,710	26.1	5,554	26.7
45–54	1,794	24.8	8,616	27.4	5,334	26.3	2,656	25.6	5,513	26.5
55–64	1,157	16.0	5,069	16.1	3,786	18.7	1,869	18.0	3,573	17.2
Race/ethnicity										
Non-Latino White	3,876	54.7	12,286	49.0	12,389	61.9	5,620	55.4	11,815	58.2
Latino/Hispanic (any race)	2,743	38.7	10,623	42.4	4,492	22.5	2,602	10.0	3,387	16.7
Black/African-American	159	2.2	884	3.5	2,298	11.5	1,016	25.7	2,232	11.0
Asian/Pacific Islander	65	0.9	710	2.8	105	0.5	165	1.6	563	2.8
Native American	191	2.7	NR	<0.1	32	0.2	32	0.3	116	0.6
Other/multiple	54	0.8	573	2.3	686	3.4	705	7.0	2,187	10.8
Injury severity (AIS)										
Minor/moderate (1–2)	5,355	74.8	23,507	75.4	14,817	73.8	8,236	79.8	16,419	79.5
Serious/severe/critical (3–6)	1,809	25.3	7,653	24.6	5,251	26.2	2,088	20.2	4,236	20.5
Amputation injury	303	4.2	1,631	5.2	853	4.2	543	5.2	941	4.5
Traumatic brain injury	1,175	16.2	4,827	15.4	2,865	14.1	1,627	15.7	3,242	15.6
Inpatient death	39	0.5	249	0.8	179	0.9	57	0.6	125	0.6
Manner/intent of injury										
Assault/homicide	128	2.0	728	2.5	356	1.9	175	1.7	518	2.5
Unintentional/other	6,144	97.9	28,941	97.5	18,518	98.0	9,889	98.0	20,079	97.3
Undetermined	NR	0.1	28	0.1	28	0.2	31	0.3	41	0.2
External cause of injury										
Fall	2,718	43.3	11,851	39.9	8,097	42.8	3,988	39.5	8,892	43.1
Machinery	722	11.5	3,924	13.2	1,937	10.3	1,298	12.9	1,969	9.5
Motor vehicle traffic	777	12.4	3,343	11.3	2,372	12.6	1,243	12.3	2,974	14.4
Other specified	1,907	30.4	9,497	32.0	5,748	30.4	3,028	30.0	5,913	28.7
Unspecified	152	2.4	1,081	3.6	748	4.0	538	5.3	890	4.3
Place of injury										
Industrial/mine/quarry	3,082	63.9	14,564	50.9	3,464	46.3	243	48.5	6,556	37.7
Street/highway	423	8.8	2,103	7.4	721	9.6	42	8.4	974	5.6
Other specified	1,096	22.7	7,883	27.6	2,311	30.9	148	29.5	6,875	39.5
Unspecified	220	4.6	4,063	14.2	980	13.1	68	13.6	3,003	17.3

AIS, abbreviated injury scale; NR, not reported due to small cell size, in accordance with HCUP guidance.
Categories for some characteristics do not sum to total N due to missing data. The undetermined and unspecified categories shown in this table were based on the presence of particular E-codes and do not represent missing data.

out only in NY. In NY, we found a mean annual increase of 4.8% in the disparity for Latinos in traumatic injury hospitalizations, and a mean annual increase of 7.2% in disparity when restricted to severe traumatic injury hospitalizations. There was not significant divergence between the trend lines for Latinos and non-Latino whites in the other four states tested. In previous research using the Washington State Trauma Registry, we found that Latinos in Washington State bore an increasingly disproportionate burden of severe work-related traumatic injuries, on the order of a 5% annual increase in disparity [Sears et al., 2012a]. Trends in disproportionate burden may truly vary by state, or trend

TABLE III. Characteristics of Occupational Injury Hospitalizations by Race/Ethnicity for Five States, 2003–2009

Characteristic	Non-Latino White	Latino/Hispanic	*P*-Value*	Black/African-American	*P*-Value[a]
Severe injury (AIS 3–6)					
Arizona	27.2	23.0	<0.001	n/a	n/a
California	26.4	25.9	NS	23.8	NS
Florida	27.7	23.9	<0.001	22.7	<0.001
New Jersey	20.9	19.2	NS	18.4	NS
New York	22.9	15.8	<0.001	14.5	<0.001
Amputation injury					
Arizona	3.3	5.5	<0.001	n/a	n/a
California	3.9	6.8	<0.001	2.8	NS
Florida	3.4	5.4	<0.001	6.0	<0.001
New Jersey	3.5	9.1	<0.001	4.1	NS
New York	3.1	6.7	<0.001	5.0	<0.001
Traumatic brain injury					
Arizona	15.7	16.9	NS	n/a	n/a
California	15.4	17.7	<0.001	13.0	NS
Florida	13.9	15.2	0.04	12.5	NS
New Jersey	16.1	14.6	NS	15.7	NS
New York	15.2	13.9	0.05	15.8	NS
Injury intent = assault/ homicide					
Arizona	2.6	1.1	<0.001	n/a	n/a
California	2.5	1.8	0.002	5.3	<0.001
Florida	1.8	1.4	NS	3.2	<0.001
New Jersey	1.4	1.2	NS	3.8	<0.001
New York	1.9	1.8	NS	5.5	<0.001
External cause of injury					
Arizona			<0.001		n/a
Fall	44.3	45.8		n/a	
Machinery	8.7	16.0		n/a	
Motor vehicle traffic	16.4	7.5		n/a	
Other specified	30.7	30.7		n/a	
California			<0.001		<0.001
Fall	44.9	39.0		36.5	
Machinery	10.0	18.3		10.1	
Motor vehicle traffic	14.4	9.8		19.2	
Other specified	30.7	32.9		34.1	
Florida			<0.001		<0.001
Fall	47.1	45.1		31.0	
Machinery	8.5	13.9		15.6	
Motor vehicle traffic	14.1	8.9		16.7	
Other specified	30.3	32.1		36.7	
New Jersey			<0.001		<0.001
Fall	47.1	34.2		33.7	
Machinery	8.9	22.2		13.4	
Motor vehicle traffic	14.6	8.1		18.4	
Other specified	29.5	35.5		34.6	

(*Continued*)

TABLE III. (*Continued.*)

Characteristic	Non-Latino White	Latino/Hispanic	*P*-Value*	Black/African-American	*P*-Value[a]
New York			<0.001		<0.001
Fall	48.2	41.5		36.6	
Machinery	8.6	14.1		9.9	
Motor vehicle traffic	15.8	9.6		18.9	
Other specified	27.4	34.9		34.6	

AIS, Abbreviated Injury Scale.
[a]*P*-value for two-group Chi-squared test of independence using the non-Latino white category as the comparator.
Unspecified/undetermined categories were excluded from testing by ethnicity and from this table.

TABLE IV. Annual Rates of All Occupational Injury Hospitalizations by Race/Ethnicity for Five States (Age-Adjusted Incidence Rates per 100,000 Employed Workers)

Characteristic	2003 (CI)	2004 (CI)	2005 (CI)	2006 (CI)	2007 (CI)	2008 (CI)	2009 (CI)
Arizona							
Non-Latino White	20.3	24.1	27.3	29.3	25.9	23.8	17.1
	(18.4–22.3)	(22.1–26.3)	(25.2–29.6)	(27.1–31.6)	(23.9–28.0)	(21.9–25.8)	(16.0–19.5)
Latino/Hispanic	45.9	57.4	73.9	66.4	58.7	46.7	31.4
	(40.6–51.8)	(51.5–64.0)	(67.3–81.2)	(60.5–72.8)	(53.2–64.7)	(41.7–52.1)	(27.4–35.9)
California							
Non-Latino White	16.9	16.1	16.2	14.8	14.4	12.7	10.9
	(16.1–17.6)	(15.4–16.9)	(15.5–17.0)	(14.1–15.5)	(13.7–15.1)	(12.1–13.4)	(10.3–11.5)
Latino/Hispanic	36.7	35.8	35.0	32.7	31.2	26.6	24.7
	(34.7–38.8)	(33.9–37.8)	(33.3–36.9)	(31.0–34.4)	(29.5–32.8)	(25.2–28.1)	(23.2–26.2)
Black/African-American	12.9	17.7	15.8	15.8	13.2	12.2	12.7
	(10.6–15.6)	(15.0–20.8)	(13.2–18.7)	(13.3–18.7)	(10.9–15.9)	(10.0–14.7)	(10.4–15.3)
Florida							
Non-Latino White	31.4	30.8	31.7	28.0	25.9	24.2	21.9
	(30.0–32.9)	(29.5–32.3)	(30.3–33.1)	(26.8–29.3)	(24.7–27.1)	(23.1–25.5)	(20.7–23.1)
Latino/Hispanic	47.1	43.9	55.5	42.9	35.9	30.6	25.5
	(43.5–51.0)	(40–5-47.5)	(51.8–59.5)	(39.9–46.2)	(33.1–38.8)	(28.0–33.4)	(23.0–28.1)
Black/African-American	32.6	35.3	36.2	33.1	29.6	25.5	19.5
	(29.1–36.4)	(31.7–39.1)	(32.6–40.0)	(29.7–36.7)	(26.5–33.1)	(22.6–28.6)	(16.9–22.3)
New Jersey							
Non-Latino White	30.2	35.2	26.5	23.3	23.2	23.3	19.3
	(28.3–32.3)	(33.1–37.3)	(24.7–28.4)	(21.6–25.1)	(21.5–24.9)	(21.6–25.1)	(17.8–21.0)
Latino/Hispanic	73.8	88.8	56.4	68.1	59.8	44.8	43.2
	(66.0–82.4)	(80.7–97.6)	(50.4–63.0)	(61.3–75.5)	(53.6–66.7)	(39.7–50.4)	(38.2–48.7)
Black/African-American	29.8	44.4	26.8	28.8	27.9	26.0	22.8
	(25.2–35.1)	(38.7–50.6)	(22.5–31.8)	(24.3–33.9)	(23.4–33.0)	(21.5–31.3)	(18.6–27.6)
New York							
Non-Latino White	28.4	29.5	28.6	26.9	25.0	24.9	22.2
	(27.1–29.8)	(28.2–30.9)	(27.3–30.0)	(25.6–28.2)	(23.8–26.3)	(23.7–26.2)	(21.1–23.4)
Latino/Hispanic	34.9	40.2	41.9	40.3	48.6	37.9	35.6
	(31.4–38.8)	(36.6–44.2)	(38.1–46.0)	(36.8–44.1)	(44.7–52.8)	(34.5–41.6)	(32.3–39.1)
Black/African-American	26.0	26.7	27.0	27.4	25.3	24.4	20.0
	(23.2–29.1)	(23.9–29.7)	(24.2–30.0)	(24.6–30.5)	(22.6–28.2)	(21.8–27.2)	(17.5–22.7)

CI, confidence interval.
Denominators based on Community Population Survey (CPS) estimates of employed population/subpopulations. Age-adjusted rates using year 2000 U.S. standard working population weights; 95% gamma confidence intervals.

TABLE V. Annual Rates of Severe[a] Occupational Injury Hospitalizations by Race/Ethnicity for Five States (Age-Adjusted Incidence Rates per 100,000 Employed Workers)

Characteristic	2003 (CI)	2004 (CI)	2005 (CI)	2006 (CI)	2007 (CI)	2008 (CI)	2009 (CI)
Arizona							
Non-Latino White	6.0	6.9	7.3	7.6	6.7	6.9	4.0
	(5.0–7.1)	(5.9–8.1)	(6.2–8.6)	(6.5–8.9)	(5.7–7.8)	(5.9–8.1)	(3.2–4.9)
Latino/Hispanic	9.6	13.3	16.6	17.4	12.2	10.8	7.3
	(7.3–12.6)	(10.5–16.9)	(13.5–20.4)	(14.5–21.0)	(9.7–15.2)	(8.5–13.5)	(5.4–9.6)
California							
Non-Latino White	4.0	4.0	4.2	4.2	3.6	3.5	3.2
	(3.6–4.4)	(3.6–4.4)	(3.9–4.6)	(3.9–4.6)	(3.3–4.0)	(3.2–3.8)	(2.9–3.5)
Latino/Hispanic	8.4	8.9	9.6	8.7	8.3	7.2	6.9
	(7.5–9.4)	(7.9–10.0)	(8.7–10.6)	(7.9–9.7)	(7.5–9.2)	(6.4–8.0)	(6.1–7.7)
Black/African-American	2.3	5.3	2.7	4.1	3.3	3.3	2.6
	(1.4–3.6)	(3.8–7.1)	(1.7–4.0)	(2.8–5.7)	(2.2–4.8)	(2.3–4.8)	(1.6–3.9)
Florida							
Non-Latino White	8.9	8.0	8.6	8.0	6.9	6.7	5.5
	(8.2–9.7)	(7.3–8.7)	(7.9–9.4)	(7.4–8.7)	(6.3–7.6)	(6.1–7.4)	(4.9–6.1)
Latino/Hispanic	11.2	8.3	12.3	11.4	9.4	7.7	5.7
	(9.5–13.1)	(6.9–10.0)	(10.6–14.3)	(9.9–13.1)	(8.1–11.0)	(6.4–9.1)	(4.6–7.1)
Black/African-American	7.3	8.3	8.0	8.1	6.8	5.4	4.0
	(5.7–9.2)	(6.6–10.3)	(6.4–10.0)	(6.5–10.0)	(5.3–8.5)	(4.1–6.9)	(2.9–5.5)
New Jersey							
Non-Latino White	5.7	5.2	5.9	5.0	5.6	5.3	4.4
	(4.9–6.6)	(4.4–6.1)	(5.1–6.9)	(4.2–5.8)	(4.8–6.5)	(4.5–6.2)	(3.6–5.2)
Latino/Hispanic	13.5	10.8	12.0	12.6	12.3	10.1	9.6
	(10.2–17.6)	(8.1–14.3)	(9.3–15.3)	(9.9–16.1)	(9.6–15.7)	(7.8–13.1)	(7.3–12.4)
Black/African-American	6.1	3.8	5.3	6.2	5.9	6.1	4.8
	(4.1–8.8)	(2.3–6.0)	(3.5–7.8)	(4.2–8.8)	(4.0–8.6)	(4.0–9.1)	(3.0–7.4)
New York							
Non-Latino White	5.9	6.0	7.0	6.2	5.8	5.8	5.3
	(5.3–6.5)	(5.4–6.6)	(6.4–7.7)	(5.6–6.9)	(5.2–6.4)	(5.3–6.5)	(4.8–5.9)
Latino/Hispanic	5.5	5.0	6.6	6.3	8.3	6.7	6.9
	(4.2–7.3)	(3.8–6.5)	(5.1–8.4)	(5.0–8.0)	(6.6–10.2)	(5.3–8.4)	(5.5–8.6)
Black/African-American	3.8	4.1	4.1	4.3	3.5	3.9	2.1
	(2.7–5.0)	(3.0–5.4)	(3.1–5.4)	(3.2–5.6)	(2.5–4.7)	(2.9–5.1)	(1.4–3.1)

CI, confidence interval.

[a]Restricted to injuries with Abbreviated Injury Scale ≥ 3 (based on first listed diagnosis).

Denominators based on Community Population Survey (CPS) estimates of employed population/subpopulations. Age-adjusted rates using year 2000 U.S. standard working population weights; 95% gamma confidence intervals.

estimates may be differentially affected by state-level differences in race/ethnicity reporting that may also change over time. In future studies, it will be important to investigate sources of the rising disparity in injury burden that we have observed for Latinos in NY and WA, as well as to investigate how widespread this rising disparity may be. Most states have not yet been assessed with respect to this issue.

Our findings do not account for differences in hazardous work exposures across states or across subpopulations within states. Higher rates of employment in more hazardous settings such as construction, agriculture, or late-night retail, for example, may in part account for the observed differences [Baron et al., 2013; Marsh et al., 2013; Steege et al., 2014]. Hospital discharge data typically lack information on occupation, industry, and work status (e.g., whether self-employed, full-time, temporary, etc.). A number of occupational injury researchers have called for the addition of occupation, industry, and other work-related information to hospital databases used for surveillance activities [Forst et al., 1999; Lowry et al., 2010; Sears et al., 2011]. Hospital

TABLE VI. Incidence Rate Ratios by Injury Cause and Race/Ethnicity for Five States, 2003–2009

	Arizona		California		Florida		New Jersey		New York	
Type of Injury	**IRR**	**95% CI**	**IRR**	**95% CI**	**IRR**	**95% CI**	**IRR**	**95% CI**	**IRR**	**95% CI**
All occupational injuries										
Non-Latino White	1.00	ref	1.00	ref	1.00	ref	1.00	ref	1.00	ref
Latino/Hispanic	**2.28**	1.83–2.85	**2.08**	1.82–2.37	**1.42**	1.16–1.73	**2.29**	1.85–2.85	**1.48**	1.34–1.63
Black/African-American	n/a	n/a	0.97	0.84–1.12	1.05	0.86–1.29	1.11	0.89–1.39	0.94	0.85–1.04
Fall										
Non-Latino White	1.00	ref	1.00	ref	1.00	ref	1.00	ref	1.00	ref
Latino/Hispanic	**2.44**	1.93–3.08	**1.86**	1.64–2.11	**1.39**	1.17–1.65	**1.66**	1.41–1.97	**1.27**	1.15–1.39
Black/African-American	n/a	n/a	**0.77**	0.65–0.91	**0.70**	0.58–0.83	**0.78**	0.65–0.95	**0.70**	0.63–0.77
Machinery										
Non-Latino White	1.00	ref	1.00	ref	1.00	ref	1.00	ref	1.00	ref
Latino/Hispanic	**4.38**	3.38–5.68	**3.90**	3.11–4.90	**2.37**	1.91–2.94	**5.70**	4.79–6.77	**2.42**	2.12–2.76
Black/African-American	n/a	n/a	0.96	0.70–1.31	**1.92**	1.53–2.42	**1.64**	1.30–2.07	1.06	0.90–1.26
Motor vehicle traffic										
Non-Latino White	1.00	ref	1.00	ref	1.00	ref	1.00	ref	1.00	ref
Latino/Hispanic	**3.30**	2.82–3.86	**1.45**	1.25–1.70	0.91	0.74–1.12	**1.28**	1.00–1.64	0.89	0.77–1.05
Black/African-American	n/a	n/a	**1.27**	1.03–1.57	**1.26**	1.02–1.55	**1.38**	1.07–1.77	1.09	0.94–1.27
Assault/homicide										
Non-Latino White	1.00	ref	1.00	ref	1.00	ref	1.00	ref	1.00	ref
Latino/Hispanic	0.97	0.62–1.51	**1.57**	1.30–1.89	1.16	0.82–1.66	**2.03**	1.33–3.09	**1.39**	1.04–1.86
Black/African-American	n/a	n/a	**2.10**	1.53–2.89	**1.89**	1.34–2.67	**3.07**	2.07–4.56	**2.76**	2.21–3.44

CI, confidence interval; ref, reference category; n/a, not available.

discharge databases also do not contain data on nativity and immigration status, characteristics which are differentially prevalent across race/ethnicity strata. Immigrant workers are more likely to be employed in high-risk jobs, and may be at higher risk of injury even after accounting for occupation and industry [Loh and Richardson, 2004; Orrenius and Zavodny, 2009; Steege et al., 2014].

In the absence of occupation and industry, E-codes provide some minimal information about settings and mechanisms of injury. In general, E-codes are prevalent in hospital discharge records; for example, 91% of injury-related hospital discharge records provided to HCUP for 2010 did contain an injury E-code [Barrett and Steiner, 2013]. Many states encourage E-code reporting through the use of mandates, enforcement, or other strategies [Barrett and Steiner, 2010]. However, expectations for use of the place of injury E-codes (E849.X) vary across states. According to injury surveillance guidance that prioritizes mechanism over place of injury, place of injury is not considered a valid primary E-code; hence, place of injury cannot be captured when only one E-code field is available [Injury Surveillance Workgroup, 2003]. Although at least one valid primary E-code was present for the vast majority of records in every state, place of injury was much more often missing (Table I). Notably, although place of injury data was missing for 95% of NJ cases, the distribution of place of injury for NJ, was similar to that for the other states having markedly less missing data for place of injury. Improving the capture of place of injury information would provide more robust data regarding workplace characteristics leading to occupational injuries.

Strengths and Limitations

For this study, we used five population-based hospital discharge data sets to extend our earlier findings of an elevated and increasingly disproportionate burden of traumatic occupational injuries among Latinos in Washington State [Sears et al., 2012a]. We included states from diverse geographic areas with structurally-differing WC systems. Although hospital discharge databases are population-based and avoid some recognized reporting filters, such as whether a particular injury is recognized and reported as work-related by employers and whether a WC claim is filed and accepted [Azaroff et al., 2002], they do carry limitations. They do not have a work-relatedness field independent of payer, nor do they include occupation or industry information. Although shown to be highly specific, use of WC as payer is known to undercount work-related injuries [Sorock

et al., 1993; Sears et al., 2012b]. In addition, the expected payer on hospital discharge records may not be accurate and may not reflect the actual payer. Basing the identification of work-related hospitalizations on the primary payer field alone may undercount some occupational injuries (for this study, three of the five included states had only one payer field available, and the other two states had few WC cases indicated in the second and third payer fields). Our use of only the first-listed diagnosis was intended to reduce temporal bias and inclusion of incidental injuries, but may also have resulted in undercounting. Although the first-listed diagnosis is intended to represent the principal reason for admission, billing practices intended to maximize reimbursement can result in some reshuffling of diagnosis fields. Patients hospitalized outside their state of residence and pre-admission fatalities were not captured. Hospitalization counts may have included readmissions for the same injury. Hospital discharge records are only available for non-federal, acute care hospitals. Burns were excluded from this study due to the use of AIS-based severity scoring (which does not reliably classify burns); burns accounted for roughly 5% of otherwise eligible injuries, with variation by state and year. The CDC Motor Vehicle Traffic Indicator used for this study does not include injuries from collisions occurring off a public roadway, many of which may be relevant to occupational injury surveillance and research (e.g., work-related injuries from collisions involving snow vehicles or off-road vehicles, or occurring in parking lots, ramps, airfields, farms, industrial premises, mines, quarries, private driveways/grounds, etc.). This is an area that may warrant further study.

Previous studies in Illinois and Washington State have found that a higher proportion of Latinos had WC listed as an expected payer for work-related injuries, which could bias disparity estimates based on expected payer [Friedman and Forst, 2008; Sears et al., 2012a]. This observation may seem counter-intuitive, given higher barriers to claim-filing among more vulnerable populations that might be expected to more heavily impact Latino workers [Azaroff et al., 2004; Scherzer et al., 2005]. However, Latinos may more often have WC listed as an expected payer due to their disproportionate lack of other insurance coverage [Sears et al., 2012a; Sears et al., 2013b].

All five of the included states are represented in the HCUP SID disparities analysis file, based on meeting criteria for acceptable reporting of race and ethnicity. However, California in particular had a high level of missing data for race/ethnicity (20.2% of WC cases, with a monotonic decrease from 22.8% in 2003 to 16.3% in 2009). Missing race/ethnicity data will affect rates via undercounting, and changes in the amount of missing race/ethnicity data over time could affect estimated trends. In addition to documented differences in data completeness, there may be differences in the way race and ethnicity information is collected and recorded, both across states and across time within states. Race/ethnicity information may rely on hospital staff observation rather than self-report, and there may be misclassification. There were discrepancies in the measurement of the numerator and denominator for the estimated rates. The HCUP databases used for the numerators each contain a single race/ethnicity data field with mutually exclusive categories. In contrast, the CPS data used for the denominators treat race and ethnicity as separate variables. Although this would affect the rate estimates, we believe the impact would be minor.

Conclusions

In conclusion, we found evidence of substantial multistate disparities in occupational injury-related hospitalizations. Further research is needed to identify and address the underlying causes of these disparities. The ability to identify populations at increased risk is crucial for guiding prevention planning. However, hospital discharge databases do not contain information about occupation or industry, restricting their value for identifying specific prevention opportunities. This study highlights the potential utility of including occupation, industry, and other work-related information in hospital discharge databases, in order to enhance surveillance and prevention efforts.

ACKNOWLEDGMENTS

This study was funded by the National Institute for Occupational Safety and Health (NIOSH), grant number 1R21OH010307. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of NIOSH.

REFERENCES

Association for the Advancement of Automotive Medicine. 1990. The abbreviated injury scale, 1990 revision. Des Plaines, IL: AAAM.

Azaroff LS, Lax MB, Levenstein C, Wegman DH. 2004. Wounding the messenger: the new economy makes occupational health indicators too good to be true. Int J Health Serv 34:271–303.

Azaroff LS, Levenstein C, Wegman DH. 2002. Occupational injury and illness surveillance: Conceptual filters explain underreporting. Am J Public Health 92:1421–1429.

Baker SP, O'Neill B, Haddon W, Jr., Long WB. 1974. The injury severity score: A method for describing patients with multiple injuries and evaluating emergency care. J Trauma 14:187–196.

Baron SL, Steege AL, Marsh SM, Menendez CC, Myers JR. 2013. Nonfatal work-related injuries and illnesses—United States, 2010. MMWR Surveill Summ 62(Suppl 3):35–40.

Barrett M, Steiner C. 2010. Addendum to healthcare cost and utilization project (HCUP) E code evaluation report. HCUP Methods Series Report #2004–06. U.S. Agency for Healthcare Research and Quality.

Barrett M, Steiner C. 2013. Healthcare cost and utilization project (HCUP) E code evaluation report, 2001–2010. HCUP Methods Series Report #2013–02. U.S. Agency for Healthcare Research and Quality.

Buchanan S, Vossenas P, Krause N, Moriarty J, Frumin E, Shimek JA, Mirer F, Orris P, Punnett L. 2010. Occupational injury disparities in the US hotel industry. Am J Ind Med 53:116–125.

Bureau of Labor Statistics (BLS). 2009. Occupational safety and health statistics. BLS Handbook of Methods [Chapter 9]. http://www.bls.gov/opub/hom/pdf/homch9.pdf (Accessed July 26, 2014).

Centers for Disease Control and Prevention. 2008. Work-related injury deaths among hispanics—United States, 1992–2006. MMWR Morb Mortal Wkly Rep 57:597–600.

Clark DE, Osler TM, Hahn DR. 2010. ICDPIC: Stata module to provide methods for translating International Classification of Diseases (Ninth Revision) diagnosis codes into standard injury categories and/or scores. http://ideas.repec.org/c/boc/bocode/s457028.html (Accessed March 2, 2012).

Council of State and Territorial Epidemiologists (CSTE). 2014. Occupational health indicators: A guide for tracking occupational health conditions and their determinants. March 2014; www.cste.org/resource/resmgr/OHIndicators/2014EditionOHIGuidanceManual.pdf. (Accessed March 24, 2014).

Cryer C, Gulliver P, Langley JD, Davie G. 2010. Is length of stay in hospital a stable proxy for injury severity? Inj Prev 16:254–260.

Cryer C, Langley J. 2008. Developing indicators of injury incidence that can be used to monitor global, regional and local trends. http://ipru3.otago.ac.nz/ipru/ReportsPDFs/OR070.pdf (Accessed May 2, 2014).

Dong X, Platner JW. 2004. Occupational fatalities of Hispanic construction workers from 1992–2000. Am J Ind Med 45:45–54.

Fay MP, Feuer EJ. 1997. Confidence intervals for directly standardized rates: A method based on the gamma distribution. Stat Med 16:791–801.

Forst LS, Hryhorczuk D, Jaros M. 1999. A state trauma registry as a tool for occupational injury surveillance. J Occup Environ Med 41:514–520.

Friedman LS, Forst L. 2008. Ethnic disparities in traumatic occupational injury. J Occup Environ Med 50:350–358.

Harwood PJ, Giannoudis PV, Probst C, Van Griensven M, Krettek C, Pape HC. 2006. Which AIS based scoring system is the best predictor of outcome in orthopaedic blunt trauma patients. J Trauma 60:334–340.

HCUP State Inpatient Databases (SID). Healthcare cost and utilization project (HCUP). 2003–2009. Rockville, MD: Agency for Healthcare Research and Quality (AHRQ). www.hcup-us.ahrq.gov/sidoverview.jsp. (Accessed June 30, 2014).

Hunt P, Won J, Dembe AE, Davis L. 2005. Work-related hospitalizations in Massachusetts: Racial/ethnic differences. Mon Labor Rev 128:56–62.

Injury Surveillance Workgroup. 2003. consensus recommendations for using hospital discharge data for injury surveillance. Marietta, GA: State and Territorial Injury Prevention Directors Association.

Kilgo PD, Osler TM, Meredith W. 2003. The worst injury predicts mortality outcome the best: Rethinking the role of multiple injuries in trauma outcome scoring. J Trauma 55:599–606, discussion 606–597.

Klein RJ, Schoenborn CA. 2001. Age adjustment using the 2000 projected U.S. population. Healthy People Statistical Notes, no. 20. Hyattsville, MD: National Center for Health Statistics.

Liu W, Cela J. 2008. Count Data Models in SAS, Paper 371–2008. SAS Global Forum 2008, Statistics and Data Analysis, San Antonio, TX.

Loh K, Richardson S. 2004. Foreign-born workers: Trends in fatal occupational injuries, 1996–2001. Mon Labor Rev 127:42–53.

Lowry SJ, Blecker H, Camp J, De Castro B, Hecker S, Arbabi S, Traven N, Seixas NS. 2010. Possibilities and challenges in occupational injury surveillance of day laborers. Am J Ind Med 53:126–134.

Marsh SM, Menendez CC, Baron SL, Steege AL, Myers JR. 2013. Fatal work-related injuries—United States, 2005–2009. MMWR Surveill Summ 62(Suppl 3):41–45.

McGreevy K, Lefkowitz D, Valiante D, Lipsitz S. 2010. Utilizing hospital discharge data (HD) to compare fatal and non-fatal work-related injuries among Hispanic workers in New Jersey. Am J Ind Med 53:146–152.

Meredith JW, Evans G, Kilgo PD, MacKenzie E, Osler T, McGwin G, Cohn S, Esposito T, Gennarelli T, Hawkins M, et al. 2002. A comparison of the abilities of nine scoring algorithms in predicting mortality. J Trauma 53:621–628, discussion 628–629.

National Center for Health Statistics (NCHS) Expert Group on Injury Severity Measurement. 2004. Discussion document on injury severity measurement in administrative datasets. http://www.cdc.gov/nchs/data/injury/DicussionDocu.pdf.

National Trauma Data Bank. 2011. National Trauma Data Standard: Data Dictionary. 2012 Admissions. http://www.ntdsdictionary.org/dataElements/documents/NTDS2012_xsd.PDF. (Accessed August 27, 2012).

Orrenius PM, Zavodny M. 2009. Do immigrants work in riskier jobs. Demography 46:535–551.

Osler T, Baker SP, Long W. 1997. A modification of the injury severity score that both improves accuracy and simplifies scoring. J Trauma 43:922–925, discussion 925–926.

Richardson DB, Loomis D, Bena J, Bailer AJ. 2004. Fatal occupational injury rates in southern and non-southern States, by race and Hispanic ethnicity. Am J Public Health 94:1756–1761.

Richardson S, Ruser J, Suarez P. 2003. Appendix D. Hispanic workers in the United States: An analysis of employment distributions, fatal occupational injuries, and non-fatal occupational injuries and illnesses. Committee on Communicating Occupational Safety and Health Information to Spanish-speaking Workers; National Research Council editor. Safety is Seguridad: A Workshop Summary Washington, DC: The National Academies Press.

Ruestow PS, Friedman LS. 2013. Characterizing the relationship between in-hospital measures and workers' compensation outcomes among severely injured construction workers using a data linkage strategy. Am J Ind Med 56:1149–1156.

Scherzer T, Rugulies R, Krause N. 2005. Work-related pain and injury and barriers to workers' compensation among Las Vegas hotel room cleaners. Am J Public Health 95:483–488.

Sears JM, Bowman SM, Adams D, Silverstein BA. 2011. Occupational injury surveillance using the Washington State Trauma Registry. J Occup Environ Med 53:1243–1250.

Sears JM, Bowman SM, Silverstein BA. 2012a. Trends in the disproportionate burden of work-related traumatic injuries sustained by Latinos. J Occup Environ Med 54:1239–1245.

Sears JM, Bowman SM, Silverstein BA, Adams D. 2012b. Identification of work-related injuries in a state trauma registry. J Occup Environ Med 54:356–362.

Sears JM, Blanar L, Bowman SM, Adams D, Silverstein BA. 2013a. Predicting work-related disability and medical cost outcomes:

Estimating injury severity scores from workers' compensation data. J Occup Rehabil 23:19–31.

Sears JM, Bowman SM, Adams D, Silverstein BA. 2013b. Who pays for work-related traumatic injuries? Payer distribution in Washington State by ethnicity injury severity, and year (1998–2008). Am J Ind Med 56:742–754.

Sears JM, Bowman SM, Hogg-Johnson S. 2014. Using injury severity to improve occupational injury trend estimates. Am J Ind Med 57:928–939.

Senathirajah M, Owens P, Mutter R, Nagamine M. 2011. Special study on the meaning of the first-listed diagnosis on emergency department and ambulatory surgery records. HCUP methods series report #2011–03. Rockville, MD: U.S. Agency for Healthcare Research and Quality.

Sorock GS, Smith E, Hall N. 1993. An evaluation of New Jersey's hospital discharge database for surveillance of severe occupational injuries. Am J Ind Med 23:427–437.

Steege AL, Baron SL, Marsh SM, Menendez CC, Myers JR. 2014. Examining occupational health and safety disparities using national data: A cause for continuing concern. Am J Ind Med 57:527–538.

Stephenson S, Langley J, Cryer C. 2005. Effects of service delivery versus changes in incidence on trends in injury: A demonstration using hospitalised traumatic brain injury. Accid Anal Prev 37:825–832.

STIPDA: Injury Surveillance Workgroup 5. 2007. Consensus recommendations for injury surveillance in state health departments. Atlanta, GA: State and Territorial Injury Prevention Directors Association.

STIPDA: Injury Surveillance Workgroup 6. 2008. Assessing an expanded definition for injuries in hospital discharge data systems. Atlanta, GA: State and Territorial Injury Prevention Directors Association.

Thomas KE, Johnson RL. 2012. State injury indicators report: Instructions for preparing 2010 data. Atlanta, GA: Centers for Disease Control and Prevention, National Center for Injury Prevention and Control.

U.S. Department of Health and Human Services. 2014. Healthy People 2020: About Healthy People/Foundation Health Measures/Disparities. http://healthypeople.gov/2020/about/DisparitiesAbout.aspx (Accessed July 26, 2014).

Vuong QH. 1989. Likelihood ratio tests for model selection and non-nested hypotheses. Econometrica 57:307–333.

Disclosure Statement: The authors report no conflicts of interests.