Occupational Fatalities of Hispanic Construction Workers From 1992 to 2000

Xiuwen Dong, MS and James W. Platner, PhD*

Background *Hispanic construction employment has dramatically increased, yet published data on occupational risk is lacking.*
Methods *Data from the Census of Fatal Occupational Injuries (CFOI) and current population survey (CPS) were examined from 1992 to 2000. Fatality rate, relative risk (RR), and risk index were calculated using CFOI fatality data and CPS data on hours worked, adjusted to full-time-equivalents (FTE). Data between 1996 and 2000 were combined to allow reliable comparisons of age and occupational groups. RR and 95% confidence intervals were calculated.*
Results *In 2000, Hispanics constituted less than 16% of the construction workforce yet suffered 23.5% of fatal injuries. RRs were: helpers, construction trades, 2.31 (95% CI: 1.41–3.80); roofers 1.77 (95% CI: 1.38–2.28); carpenters 1.39 (95% CI: 1.08–1.79); and construction laborers 1.31 (95% CI: 1.17–1.46).*
Conclusions *Hispanic construction workers consistently faced higher RRs, for every year from 1992 to 2000 and for every age group. In 2000, Hispanic construction workers were nearly twice (1.84, 95% CI: 1.60–2.10) as likely to be killed by occupational injuries as their non-Hispanic counterparts.* Am. J. Ind. Med. 45:45–54, 2004. © *2003 Wiley-Liss, Inc.*

KEY WORDS: construction; occupation; safety; fatality; fatal injury; Hispanic; worker; risk; workplace; immigrant; age

INTRODUCTION

Construction workers suffer the largest number of fatal occupational injuries of any industry sector (1,182 deaths in 2000) and face a higher risk of fatal injury (12.4 fatalities per 100,000 full-time-equivalents (FTE) in 2000) than workers employed in manufacturing or service industries [Buskin and Paulozzi, 1984; Sorock et al., 1993; Bureau of Labor Statistics (BLS), 1995; Ringen et al., 1995]. Fatality rates in construction have been essentially constant between 1992 and 2000, while the workforce has grown. The complex, dynamic, and continually changing nature of construction work has been recognized as an important contributor to the high rates of injuries and fatalities in the industry [Ringen et al., 1995; Pollack et al., 1996; Pollack and Chowdhury, 2001].

In recent years, the Hispanic population has dramatically increased in the US from 5% of the total population in 1990 to 12.5% in 2000 [Census, 2000]. At the same time, construction has become the sector of the workforce with the highest percentage of Hispanic workers outside of agriculture [CPWR, 2002]. In 2000, 1.4 million workers self-identified as Hispanics were employed in construction, accounting for more than 15% of the total construction workforce, a sharp increase from 8.5% in 1990. Meanwhile, fatal occupational injuries increased from 108 in 1992 to 278 in 2000 among Hispanic construction workers [Bureau of Labor Statistics (BLS), 1995]. The proportion of Hispanics among the total construction deaths jumped from 11.2% in 1992 to 23.5% in 2000. Previous construction injury and fatality analyses

The Center to Protect Workers' Rights, 8484 Georgia Ave., Suite 1000, Silver Spring, Maryland 20910

The contents are solely the responsibility of the authors and do not necessarily represent the official views of NIOSH.
Contract grant sponsor: The National Institute of Occupational Safety and Health (NIOSH); Contract grant number: CCU310982.

*Correspondence to: James W. Platner, The Center to Protect Workers' Rights, 8484 Georgia Ave., Suite 1000, Silver Spring, MD 20910. E-mail: jplatner@cpwr.com

Accepted 11 September 2003
DOI 10.1002/ajim.10322. Published online in Wiley InterScience (www.interscience.wiley.com)

[Pollack et al., 1996] have failed to discriminate the high risks faced by Hispanic workers in construction occupations.

In 2000, 26.7 million American residents (5 years and older) spoke Spanish at home, and about half of them (46.6%) said they speak English less than ''very well'' [Census, 2000]. In the same year, 452,840, or nearly one-third of Hispanic construction workers speak only Spanish [CPWR, 2002]. This reflects profound changes in typical construction work-site communication, work-site culture, organization of work, and ultimately safety on the work site [Pransky et al., 2002]. Previous analyses of occupational fatalities among immigrants in all industries [Windau, 1997] noted that almost half of all foreign born immigrant occupational fatalities were Hispanic, but looked at only 1994 data, which provided minimal detail on Hispanics in particular or the construction industry. Published studies of Hispanic workers [Moure-Eraso et al., 1997; Mora and Davila, 1998; Takaro et al., 1999] illustrate the importance of organization of work, social, and economic factors, but provide little insight about Hispanics employed in construction. A lack of surveys designed for these workers, difficulties accessing the population, informal work arrangements and transient employment, concerns about confidentiality, and absence of ethnicity data in workers' compensation records have limited the assessment of occupational risk factors [Pransky et al., 2002].

National data sets are used to characterize Hispanic construction workers, and compare fatal injury rates (FIRs) suffered by Hispanic and non-Hispanic construction workers, for the purpose of directing future public health interventions.

MATERIALS AND METHODS

We examined all work-related fatalities occurring in the US construction industry during the years of 1992–2000 based on the Census of Fatal Occupational Injuries (CFOI). To calculate rates, denominators were obtained according to Hispanic origin and occupation from the Current Population Survey (CPS) during the same period, and adjusted to person-years, or full-time-equivalent workers (FTE, 2,000 hr per year per worker).

Hispanic origin or ethnicity, as defined in these two data sources, includes a diverse population of all races and includes both foreign born and US born individuals. Hispanic origin or ethnicity can be viewed as ancestry, nationality, lineage, or country in which a person or his or her ancestors where born before their arrival in the US. Hispanic includes those with origins such as Mexican-American, Chicano, Mexican, Puerto Rican, Cuban, Spanish-speaking countries in Central or South America, Spanish, or other Hispanic. In the CPS, individuals identify themselves or household members as Hispanic. In CFOI, data sources, such as news accounts and death certificates, are evaluated for indications of Hispanic or non-Hispanic ethnicity.

Fatal Occupational Injury Data

The CFOI is administered by the Bureau of Labor Statistics (BLS). It compiles comprehensive and timely information on fatal work injuries occurring in the 50 states and the District of Columbia. Key information about each workplace fatality, occupation, and other worker characteristics including age, race, and ethnicity, is obtained by cross-referring six source records, including death certificates, workers' compensation and medical examiners reports, and federal and state agency administrative records. Confirmation from at least two of these sources, or one source verified by a survey of the employer, are required before a death is considered to be work-related. Data compiled by the CFOI program are issued annually, with a lag from data collection to public release of 1–2 years. Hispanic or non-Hispanic ethnicity is determined, based on references to country of origin, language, or other indications from the same six sources. Records with no ethnicity reported (10% in 2000) are excluded from calculations.

The BLS first published a complete occupational fatality data set in 1992; 2000 was the latest year for which the CFOI data were available when we conducted the study. From CFOI microdata, we selected all of the deaths occurring in the construction industry (Standard Industrial Classification (SIC) between 1,500 and 1,799), and included all of the fatalities among employees of federal, state, and local governments in construction. Thus, our calculations may differ from some BLS publications, which only include those deaths in the private sector of the construction industry. It is likely that there are some occupational fatalities that are not included in CFOI, although this is presumably a relatively small number.

We are limited to relatively few data fields (like industry code, occupation, age, race, ethnicity) where CPS and CFOI can be linked directly with common variables. Some expected indicators of fatality risk such as work experience, education, and union status, cannot be assessed directly because they are not present in the CFOI data set. While CFOI does include time with current employer, this is of limited value in an industry sector where time in the occupation is more relevant as workers may commonly have several different employers in a month.

CFOI also provides information on the event (e.g., fall from height, struck by vehicle, etc.) and nature of fatal injuries (intracranial injuries, etc.), which can be used to prioritize risks.

Population Data

The CPS provide the best characterization of worker ethnicity. CPS is a national monthly household survey conducted for the BLS by the Bureau of the Census. Estimates from the CPS are based upon a probability sample

of about 60,000 housing units. Interviewers contact the sampled units to obtain basic demographic information about all persons residing at the address and detailed labor force information for all persons aged 16 and older. Each household in the sample is asked to provide information on current employment, including occupation, industry, and number of hours worked in the previous week. Where appropriate, the CPS is administered in Spanish. Occupation and industry are coded according to the 1990 Bureau of Census classification schemes, where the construction industry is coded as 060, corresponding with the Standard Industrial Classification (SIC) 1,500–1,799 in the CFOI data. The demographic and socioeconomic information provided by CPS includes age, gender, race, Hispanic ethnicity, geographic distribution, educational attainment, union membership, earnings, etc. These variables were used to segment the survey datasets for our analyses. Since 1977, CPS has collected information on Hispanic ethnicity, based on the respondent's self-characterization as ''Hispanic or non-Hispanic'' [Office of Management and Budget (OMB), 1977; Tucker and Kojetin, 1996]. This is independent of responses to questions related to country of origin, language, or race.

MEASUREMENT

To quantify risk, we measured the occupational fatalities by worker exposures to risk in terms of hours worked [Ruser, 1995]. We adopted the FTE used by the BLS for calculation of non-FIRs rather than using total employment, since construction workers may spend variable hours on the job in a given time period, and have different lengths of exposure to workplace hazards. To obtain population estimates, we averaged these FTE values for selected occupations and all of construction within each ethnic group over the 12 months during each survey year by the formula FTE = 52HW/2000 (40×50), where H stands for hours worked per week, and W refers to the weighted value in CPS. This assumes a full-time worker works 40 hr per week and 50 weeks per year, or 2,000 hr per year. Respondents for whom hours worked were not reported were excluded from the calculation. Using the FTE obtained from the CPS as denominators and number of deaths from CFOI as numerators, we calculated FIR per 100,000 full-time-equivalent workers.

We also measured relative risk (RR) between Hispanic and non-Hispanic construction workers using the FIR. To compare risk between age groups, we used an index of RR for each age group as the ratio of the rate for that group and the rate for all construction workers: index of RR = fatality rate for a given group/fatality rate for all construction workers. This second statistic measures how much the fatality risk of the group differs from that of all construction workers in order to identify those at greatest risk [Ruser, 1995].

In addition, we combined CPS data and CFOI data from1996 to 2000 by industrial and occupational group to make the size of occupational groups larger in order to provide reliable fatality rates. The 5-year pooled data were weighted to reflect nationally representative population estimates. Moreover, we calculated 95% confidence intervals for RR for the construction industry overall between 1992 and 2000, and a 5-year average for the top ten occupations with the largest number of deaths. All statistical analyses were performed with the statistical software package SAS version 8.1 [SAS Institute, 2000].

RESULTS

Characteristics of Hispanic Construction Workers

Hispanic construction workers reported diverse geographic origins including Mexico, Puerto Rico, Cuba, Central or South America, and others. The combination of Mexican nationals and Mexican-Americans constitutes almost three-quarters of all Hispanic construction workers in the United States. Hispanic construction workers are geographically more concentrated than their non-Hispanic counterparts. They are more likely to reside in the West and less likely to live in the Northeast or the Midwest BLS regions.

Immigrant status may be a factor in occupational fatalities [Corvalan et al., 1994]. Most (74%) of the Hispanic construction workers were born abroad rather than in the US. More than 900,000 (61%) of them were not US citizens in 2000. Among the non-citizen Hispanic workers, 231,809, or 26% entered the US within the 2 years prior to the survey (see after 1998 in Table I). Although socioeconomic, education, and occupation differences between recent immigrants and other Hispanics are significant, CFOI does not include date of entry or other immigration data required for assessing the impact of these differences on fatality rates.

TABLE I. Origin and Citizenship of Hispanic Workers in Construction, CPS 2000

Characteristics	Number	Percent (%)
Origin/citizenship		
Born in the US	379,271	35.58
Born in Puerto Rico	20,182	1.36
Born abroad (American parent)	13,525	0.91
Naturalization	166,746	11.25
Non-citizen	903,031	60.9
Date of entry in the US (non-citizen only)		
Before 1980	93,934	10.40
1980–1989	251,222	28.82
1990–1997	326,066	36.11
After 1998	231,810	25.7
Total non-citizen	903,030	100.0

TABLE II. Age Distribution, Hispanic vs. Non-Hispanic Construction Workers, CPS 2000

Characteristics	Hispanics (%)	Non-Hispanics (%)	Total construction (%)
Gender			
Male	95.3	89.1	90.1
Female	4.7	10.9	9.9
Age			
16–19	4.1	3.0	3.2
20–29	33.5	20.2	22.2
30–39	31.7	27.2	27.9
40–49	21.7	28.9	27.7
50–59	6.6	15.4	14.0
60 and up	2.6	5.4	5.0
Total	100 (1.4 m)	100 (8.0 m)	100 (9.4 m)

Less than 5% of Hispanic construction workers are female, which is lower than the percentage of female workers (10%) in the industry (Table II). Hispanic workers are younger on average than their non-Hispanic counterparts [Del Pinal, 1996]. More than one-third of Hispanic construction workers are under 30 years old, while only 23% of the non-Hispanic construction workers are in this age group (Table II). The average age of Hispanic workers is 5 years younger than that of the non-Hispanic construction workers, and the difference between median ages is even wider, with a median age of 33 for Hispanic workers, and 39 for non-Hispanic workers. Young workers [Jackson, 2001], and workers over 65 [Richardson and Schulman, 1994] have the highest rates of work-related injuries and fatalities.

Education, Employment, and Unionization

Hispanic workers and non-Hispanic workers have different occupational distributions. Although Hispanics are an increasingly important minority in the licensed building trades, most Hispanic construction workers are employed as unskilled or semi-skilled workers, with few positioned in the managerial occupations. Construction occupations with a high proportion of Hispanic workers include construction laborers, helpers, roofers, concrete, tile workers, drywall, and painters (Table III). Regardless of their ethnicity, construction laborers, helpers, and roofers face more hazardous conditions than the average in the industry. Likewise, these dangerous occupations typically offer fewer opportunities for worker control of the work process, less on-the-job training, less job security, and lower average wages.

Table IV shows that Hispanic construction workers are less likely to be union members. The lower union density might be due to their new immigrant status, precarious employment (e.g., day laborers), residence concentrated in states with low union densities, work in residential construction or other segments of the construction sector with low union densities, and limited abilities with English.

TABLE III. Occupational Distribution, Hispanic vs. Non-Hispanic Construction Workers, CPS 2000

Selected occupations	% of Hispanic	% of non-Hispanic	% of all construction
Laborer +helpers	22.6	9.1	11.2
Carpenter	14.6	13.4	13.6
Painter	11.7	5.3	6.3
Manager	4.8	18.2	16.1
Roofer	4.7	1.8	2.2
Drywall	4.5	1.5	1.9
Bricklayer	3.9	2.4	2.6
Plumber	3.8	4.6	4.5
Electric	3.8	7.0	6.5
Support	3.5	7.3	6.7
Concrete	3.1	1.0	1.3
Oper. engineer	2.1	4.1	3.8
Tile	1.6	0.8	0.9
HVAC mech.	1.3	2.4	2.3
Truck driver	1.3	1.9	1.8
Repair	1.1	2.1	1.9
Others[a]	—	—	—
Total	100 (1.4 m)	100 (8.0 m)	100 (9.4 m)

[a]Note: other includes the occupations welders, carpet, insulation, ironworkers, glazier, sheetmetal, boilermaker, and elevator, which are less than 1% of the Hispanic workers, and those Hispanic construction workers who cannot be classified into any of the above occupations. Does not add to 100% because of rounding.

Hispanic construction workers are more likely to have lower educational attainment. More than 31% of Hispanic construction workers have less than a ninth-grade education, compared with only 2.3% of their non-Hispanic counterparts. The proportion with post-secondary school education is much lower for Hispanics than for non-Hispanic construction

TABLE IV. Education and Union Membership, CPS 2000

	Hispanic (%)	Non-Hispanic (%)	Total construction (%)
Union membership	10.9	21.3	19.4
Education			
Less than 9 grade	31.1	2.3	6.8
Some HS	23.0	12.2	13.9
HS Grad	28.8	45.3	42.8
More than HS	16.0	40.3	36.5

workers, with 16 and 36% for Hispanics and non-Hispanics, respectively (Table IV).

The proportion of construction workers covered by health insurance is relatively low, whether the insurance is provided by employers or any other sources. Hispanics are less likely to have health insurance coverage than their non-Hispanic counterparts—33% of Hispanics and 57% of non-Hispanic construction workers have some health insurance contribution through their employer or union [Fronstin et al., 1997; CPWR, 2002].

Fatal Occupational Injuries

Between 1992 and 2000, 9,957 construction workers died of occupational injuries in the US, among whom 1,501 were identified as of Hispanic origin. Hispanic deaths constituted 16.7% of the deaths having ethnic identification, while about 10% of all death records failed to include ethnicity information. Nearly half (47.8%) of the Hispanic deaths occurred in the most recent 3 years studied (1998–2000). In 2000, Hispanic deaths were 23.5% of deaths in construction, which was disproportionately high, considering that Hispanic workers were less than 16% of the construction workforce in the same year.

Table V shows that occupational fatality rates for Hispanic workers are significantly higher (range 16.2–20.6 per 100,000 FTEs) than for the non-Hispanic workers (range 10.6–12.6 per 100,000 FTEs) in every one of the 9 years for which fatality data is available. Both groups have experienced essentially static fatality rates from 1992 to 2000. Thus, in 2000, Hispanic construction workers continued to be nearly twice (1.84, 95% CI: 1.60–2.10) as likely to be killed by occupational injuries compared with their non-Hispanic counterparts.

Table VI provides a risk index for each age group by Hispanic origin, where a risk index equal to 1.0 corresponds to a fatality rate equal to the construction industry average from 1996 to 2000 and larger than one indicates higher than construction average fatality rates. Overall, Hispanic workers faced higher risks, with an index of 1.39 for Hispanic workers and 0.87 for non-Hispanic workers. A higher risk index for Hispanics than non-Hispanics is observed in every age group. Death distribution by age is different between the two ethnic groups. About 55.3% of deaths occurred among Hispanic workers who were under age 35, while 33.5% of deaths for non-Hispanic workers were in this age group. Hispanic workers over 65 years of age have a high fatal risk index of 5.6 times the construction average risk (Table VI). However, since less than 2% of the construction workforce is over 65, the reliability of the fatality rate measurements is limited.

The risk of fatal injuries varies among construction occupations. For example, ironworkers have high fatal occupational injury rate for both Hispanics (83.75 per 100,000 FTEs) and non-Hispanics (73.40 per 100,000 FTEs), while drywall installers have lower risk for both ethnic groups, with 6.89 and 3.93 per 100,000 FTEs respectively. For most construction occupations listed in Table VII, Hispanic workers had higher fatality rates. The differences between Hispanics and non-Hispanics are statistically significant for the large occupational groups. The data indicates that Hispanic workers who work as carpenters, roofers, helpers, and construction laborers are at a higher risk of fatal injury than their non-Hispanic counterparts in the same

TABLE V. Fatal Occupational Injuries, Hispanic Versus Non-Hispanic Construction Workers, 1992–2000

	All construction industry		Hispanics		Non-Hispanics[a]		
Years	Deaths	Rate[b]	Deaths	Rate[b]	Deaths	Rate[b]	RR (95% CI)
1992	963	14.47	108	20.60	758	11.99	1.72 (1.40–2.10)
1993	971	13.76	109	18.48	697	11.59	1.60 (1.30–1.95)
1994	1,077	14.76	116	16.19	765	11.17	1.45 (1.19–1.76)
1995	1,098	14.67	146	20.07	799	11.83	1.70 (1.42–2.02)
1996	1,095	14.02	137	17.59	835	11.88	1.48 (1.24–1.77)
1997	1,136	13.78	167	18.07	920	12.57	1.44 (1.22–1.70)
1998	1,207	14.19	215	19.73	937	12.64	1.82 (1.57–2.12)
1999	1,228	13.72	225	19.13	916	11.78	1.62 (1.40–1.88)
2000	1,182	12.43	278	19.52	857	10.60	1.84 (1.60–2.10)

Source: Census of Fatal Occupational Injuries (CFOI) and Current Population Survey (CPS), Bureau of Labor Statistics.
[a]Those whose ethnic status was unreported are excluded from the calculation.
[b]Rate: death numbers per 100,000 full-time-equivalent workers.

TABLE VI. Rate and Number of Occupational Fatalities by Age Group, Hispanics and Non-Hispanics, Average of 1996–2000

	Hispanics 1996–2000			Non-Hispanics 1996–2000		
Age groups	Deaths	% of Hispanic deaths	Risk index[a]	Deaths	% of non-Hispanic deaths	Risk index[a]
15–				—	—	
16–19	50	4.9	1.83	144	3.2	1.12
20–24	168	16.4	1.55	345	7.7	0.77
25–34	347	34.0	1.32	1,003	22.5	0.78
35–44	239	23.4	1.16	1,288	28.8	0.77
45–54	141	13.8	1.52	904	20.2	0.86
55–64	55	5.4	1.73	572	12.8	1.29
65+	19	1.9	5.59	205	4.6	2.72
N/A[b]	—	—				
Total	1,022	100	1.39	4,465	100	0.87

Source: Census of Fatal Occupational Injuries (CFOI) and Current Population Survey (CPS), Bureau of Labor Statistics.
[a]Risk index = fatal injury rate (fatalities per 100,000 FTE) in each age group divided by average rate for all construction industry 1996–2000, average risk index for all construction = 1.0.
[b]N/A = age not reported.

occupation, which indicates a worker's ethnic status is a predictor of the risk he/she faces at the workplace.

Events Leading to Fatal Occupational Injuries and Types of Injuries

For all construction workers, the five leading events tied to fatal occupational injuries in construction are, in order of frequency: fall to a lower level, highway collision, contact with electric current, struck-by an object, and pedestrian, non-passenger struck-by a vehicle. This distribution of fatal events differs between Hispanic and non-Hispanic workers, suggesting different risk exposures. Hispanic deaths were more likely to be caused by a fall to a lower level than non-Hispanic deaths: death caused by a fall to a lower level killed 376 Hispanic workers, accounting for 36.8% of Hispanic

TABLE VII. Fatal Injury Rates and Relative Risk by Selected Occupations, Hispanics and Non-Hispanics, Average of 1996–2000

	Hispanics 1996–2000		Non-Hispanics[a] 1996–2000		
Occupations	Deaths	Rate[b]	Deaths	Rate[b]	Relative risk (95% CI)
Helpers, construction trades	29	22.14	34	9.56	2.31 (1.41–3.80)
Roofers	92	44.64	177	25.18	1.77 (1.38–2.28)
Drywall installers	18	6.89	23	3.93	1.75 (0.95–3.25)
Carpenters and apprentices	72	9.57	333	6.90	1.39 (1.08–1.79)
Construction laborers	427	45.67	1,024	34.93	1.31 (1.17–1.46)
Welders and cutters	22	45.03	116	35.20	1.28 (0.81–2.02)
Structural metal workers	23	87.75	189	73.40	1.20 (0.78–1.84)
Electricians and apprentices	32	13.47	287	11.74	1.15 (0.80–1.65)
Truck drivers	20	20.78	225	27.35	0.76 (0.48–1.20)
Painters, construction, and maintenance	31	5.90	153	9.44	0.62 (0.42–0.92)
All construction industry	1,022	18.95	4,465	11.87	1.60 (1.49–1.71)

Source: Census of Fatal Occupational Injuries (CFOI) and Current Population Survey (CPS), Bureau of Labor Statistics.
[a]Those whose ethnic status was unreported are excluded from the calculation.
[b]Rate: annual deaths per 100,000 full-time-equivalent workers.

TABLE VIII. Percentage of Fatalities Caused by Fatal Falls: Hispanic and Non-Hispanic Construction Workers, 1996–2000

	1996 (%)	1997 (%)	1998 (%)	1999 (%)	2000 (%)	1996–2000 (average) (%)
Falls to lower level						
Hispanic	35.0	34.1	38.6	35.6	38.9	36.8
Non-Hispanic	28.4	33.6	28.9	30.0	28.8	29.8
Falls (other)						
Hispanic	0.7	1.2	0.5	0	0.7	0.7
Non-Hispanic	0.7	0.4	0.9	0.7	0.4	0.6

Source: Census of Fatal Occupational Injuries (CFOI), Bureau of Labor Statistics.

deaths from occupational injuries between 1996 and 2000 (see Table VIII). For non-Hispanic workers, although fall to a lower level was still the leading event associated with fatal occupational injuries, the percentage (29.8%) of the total deaths was lower than that of Hispanic workers.

The leading nature of fatal injuries differs for Hispanic and non-Hispanic workers, with nearly one-third (336) of 1,022 Hispanic deaths, resulting from intracranial injuries (i.e., head injuries) between 1996 and 2000 compared to a quarter (1,147) of 4,465 non-Hispanic construction fatalities. This is consistent with the higher rate of fatal falls among Hispanic construction workers, and suggests a priority area for prevention interventions. For non-Hispanic workers, the leading nature of injury is the far more diverse designation of other traumatic injuries and disorders associated with 1,539 fatal occupational injuries, 34.5% of non-Hispanic deaths; while intracranial injuries is third.

DISCUSSION

Limitations

Hispanic fatalities may be more likely to be missed to the extent that they are engaged in informal sector work where no recognized employer is responsible for reporting, newspapers might be less likely to report on the deaths of transient low income workers, death certificates might be uncoded or fail to indicate work relatedness since informal sector workers are unlikely to be eligible for workers' compensation to pay the medical expenses, and to the extent that workers survive more than 48 hr in the hospital there would be no medical examiners report in most states. While there are logical reasons to expect a higher rate of failure to capture data on Hispanic and other informal sector work-related fatalities, the magnitude of this problem is unknown. This error would lead to an underestimation of Hispanic fatality rates.

Estimating the number of hours worked is important in safety and health, because it reflects the duration of exposure to risks in the workplace. Using CPS data on hours worked for the denominator in the computation of fatal occupational injury rates depends on the accuracy of survey responses, where recall bias may be present. Given that CPS asks for the number of hours worked in the previous week, this recall bias should be minimal. However, some studies suggest that people tend to overestimate their hours in response to surveys [Robinsin and Bostrom, 1994]. This would tend to result in an underestimate of fatality rates in this paper. Since this question is included in each of the 12 monthly surveys, possible concerns about the seasonal nature of construction work should be addressed in the annual average.

The mobile workforce, existence of a cash or informal sector which workers may not report because of untaxed income, multi-family or shared housing, extended family households, and potentially reduced responses from undocumented immigrants in construction may result in an undercount in CPS. In a household sample which depends largely on telephone contacts and a stable residence, an undercount would be expected among those without telephones, with shared telephones, and without stable residences. To the extent that this Hispanic construction worker population is undercounted, the work hours in the denominators of the rate calculation would be smaller than actual, which would lead to an overestimate of fatality rates; assuming that similar factors do not equally effect the data sources used to identify occupational fatalities for CFOI. While all these limitations are of concern, given the size of the sampled Hispanic population and the magnitude of the excess risk it is improbable that these factors are large enough to cause an impact on the conclusions.

The way in which respondents define their occupation, also introduces potential social influences. For occupations where a small number of deaths occurred, we must pool data from multiple years in order to reliably compare occupational fatality rates within the construction industry. While both CFOI and CPS use the same standard occupational codes (SOC), the reliability of analyses may be limited by differences in what workers call themselves and how they describe their work (CPS), as compared to how their employer or documents collected in CFOI describe their occupation.

Differences in how individuals relate to, or interpret, the same list of occupations may effect the fatality rates for some occupational codes. This may limit our ability to reliably use occupation as a proxy for exposure to similar work site risks.

Industry classification systems define the population we consider to be construction workers. Although CFOI fatality records are coded by SIC, construction is coded as a single industry group in the CPS. Therefore, fatality rates, which require a work-hours denominator from the CPS, cannot discriminate between various segments of the construction industry (e.g., single family residential, commercial, highway). Starting in 2003, both CPS and CFOI industry coding is expected to follow the North American Industrial Classification System (NAICS), which should facilitate further analysis of sub-sectors of the construction industry. Further, many characteristics of construction workers including non-traditional schedules, complex work histories, precarious work, and their diverse health experiences cannot be observed in the existing CFOI data.

Comparison to Previous Studies

Occupational health priorities, and the NIOSH National Occupational Research Agenda (NORA) recognize the importance of addressing special populations at risk in order to advance occupational health. Hispanics, minorities, new immigrants, or non-English speakers represent populations which may require targeted interventions for effective prevention of injury [Robinson, 1989; Frumkin and Pransky, 1999; Frumkin et al., 1999]. Few studies have addressed fatal or non-fatal injuries among Hispanic construction workers, however, they have identified elevated risks in concurrence with our findings. Sorock et al. [1993] found that death rates are highest among Hispanics, with African-Americans having two-third the rate of Hispanics and whites less than one-third the rate of Hispanics. A 9-year study conducted through a University Emergency Department, focused on non-fatal injuries of Hispanic construction workers and observed that Hispanic construction workers sustained a high rate of non-fatal occupational injuries [Anderson et al., 2000]. The study's scope, however, considered only patients seen through a single emergency department in Washington, DC.

This can be extended beyond the construction industry. Weddle et al. [1993] reports that in all industries, Hispanics have a 2.5 time higher likelihood of being injured on the job than do non-Hispanics.

Studies not focusing specifically on the construction industry indicate that Hispanic workers may be at greater risk for occupational fatalities due to limited economic and political resources [Bollini and Siem, 1995], and poor living and working conditions. Language difficulties or workplace discrimination may also result in inadequate safety training [Corvalan et al., 1994]. If they are hurt on the job, Hispanic workers are less likely to obtain appropriate health care, and may have increased risk for prolonged disability [Bollini and Siem, 1995].

Community-based surveys and qualitative data collection [Moure-Eraso et al., 1997; Takaro et al., 1999] provide methodologies which could be productively applied to better understanding of the Hispanic construction workforce and organization of work in this high risk industry sector. A recent community-based study on non-agricultural Latino workers reveals that those workers have increased risk of occupational injuries, with adverse outcomes [Pransky et al., 2002]. Among this survey sample, nearly one-third were construction workers. According to this study, 10.6% of the respondents reported at least one work injury in the past 3 years, and 12% of male respondents were injured. The study also reported that safety training was typically not provided, or was not delivered in Spanish. The situation of Hispanic workers is exacerbated by inadequate health care benefits [Valdez et al., 1993; Dembe, 1999], lack of knowledge, and awareness of available health services including workers' compensation, and cultural barriers to accessing needed services.

CONCLUSIONS

This study provides an initial characterization of fatal occupational injuries among Hispanic construction workers in the US. The findings demonstrate that Hispanic construction workers face significantly higher risks in the workplace than non-Hispanic construction workers, even within specific high-risk occupations. The study also demonstrates Hispanic construction workers are different in many respects from their non-Hispanic counterparts, in terms of age, education, unionization, occupation, and English-language ability. It offers insight into general circumstances which may influence employer and worker decisions which result in elevated fatality rates and RR. It is likely that a variety of factors, including but not limited to English language ability, contribute to the higher fatal occupational injury rates for the Hispanic construction workers. Further research is required to determine whether the observed fatality rates are elevated because of some discrimination associated with Hispanic ethnicity, or because they are recent immigrants, younger, less educated, less unionized, employed in higher risk construction occupations, or employed in a higher risk segment of the construction industry (e.g., residential vs. commercial). The relative contributions of these factors to an elevated fatality rate remains largely unclear. Even within an occupation, risks and work assignments may vary considerably [Ore and Stout, 1997]. Addressing many of these issues would require additional data collection on those killed on the job using variables identified in the same way as in the CPS population data. With the adoption of the North American Industrial Classification System (NAICS) for

coding of both CPS and CFOI starting with 2003 data, it will become possible to discriminate between segments of the construction industry (commercial, residential, etc.). It is likely that several of these characteristics contribute to the observed elevated risk.

While efforts by the Occupational Safety and Health Administration (OSHA), employers, and unions in the past decade have improved safety in some industry sectors, occupational fatality rates in construction have remained relatively constant since 1992 when data collection began in the current form, while absolute numbers of deaths have increased. It is necessary to address the new demands of the changing labor force. Expanded injury prevention interventions targeting Hispanic construction workers are critical if we are to reduce the overall national fatality rate in this industry sector. Workforce projections show the increasing participation of Hispanics in the future labor force [Bureau of Labor Statistics (BLS), 2002]. The growing Hispanic workforce, and increasing fatal injury numbers and rates among them, deserves special attention of policy makers, employers, workers, and safety professionals.

Because a large portion of Hispanic construction workers are new immigrants, it is evident that there is a need for culturally and linguistically appropriate public health interventions. Poor access to services partly results from not understanding English. It will be increasingly important to provide appropriate training and services to these Hispanic construction workers in order to ensure their safety in the workplace and their integration into the safety culture on US worksites. As this study is based on the existing data sets, its results need to be tested in case studies and community-based studies.

We strongly recommend expanded initiatives to collect qualitative and quantitative data at the employer, work site, union, and community level to clarify the reasons for the observed elevated occupational fatality risks among Hispanic construction workers. We must develop and evaluate the effectiveness of interventions to reduce risk exposures and the resulting fatalities. This analysis of existing surveillance data suggests that fall protection would be a logical area to focus initial interventions. This should include multidisciplinary research to go beyond the cause of death, and assess economic incentives (for employers, employees, and site owners), organization of work issues, and safety culture issues which are critical in improving our understanding of how to prevent these fatalities. The National Institute of Occupational Safety and Health's (NIOSH) National Occupational Research Agenda (NORA) recognizes key aspects of this need in its priority areas related to the organization of work and the social and economic consequences of injury and illness. These social science aspects are critical to the overall success of the public health endeavor.

These excess deaths are not the result of unknown hazards which require complex engineering controls. They are, for the most part, common construction hazards with well recognized and accepted controls like guard rails, ground fault circuits, or fall arrest systems. Our challenge is to increase the use of these simple controls in the face of a complex web of economic, social, cultural, and perhaps language barriers. Research to improve our understanding of those barriers, in the context of moving specific interventions, should be a priority. To succeed we must go beyond simple translation into Spanish, and improve our understanding of the context within which the message is received and potentially acted upon, or ignored.

Future research initiatives should include evaluation of ethnicity and language data in the National Medical Expenditure Survey, and in the National Longitudinal Survey of Youth which may allow further clarification of this population using large scale surveys. However, since these other national surveys use smaller sample sizes than CPS, analysis of subgroups such as Hispanic construction workers may be severely limited. Recently added language data fields in OSHA fatality investigation Form-170 data (which includes roughly 70% of CFOI fatalities) may offer some additional information of use in preventing Hispanic construction fatalities. Research on reported non-fatal occupational injuries and illness also offer interesting opportunities, although this should be interpreted in light of factors which influence under reporting [Azaroff et al., 2002] of injuries and illness such as work culture and economic disincentives.

While language alone may well be a factor in the elevated fatality rates for Hispanic construction workers (for example, failed communication of warnings), economic circumstances and social and cultural issues are likely to be principal factors which may result in high risk task assignments, inadequate control of known hazards, inadequate safety equipment and practices, intimidation, fear of job loss or discrimination, inadequate safety training, acceptance of hazardous work practices, and underreporting of non-fatal injuries. The extent to which this workforce is engaged in the informal cash economy, other employment opportunities, and worker immigration status are likely to be critical factors to characterize and address [Chiswick et al., 1997]. Further research is needed to distinguish the importance of the diverse factors influencing the elevated fatality rates among Hispanic construction workers. Improving our understanding of the work organization and social contexts within which these deaths occur is critical in developing public health interventions to prevent these deaths.

REFERENCES

Anderson JTL, Hunting KL, Welch LS. 2000. Injury and employment patterns among Hispanic construction workers. J Occup Environ Med 42(2):176–186.

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

Bollini P, Siem H. 1995. No real progress toward equity: Health of migrants and ethnic minorities on the eve of the year 2000. Social science & medicine. Medical Services, International Organization for Migration, Geneva, Switzerland 41(60):819–828.

Bureau of Labor Statistics (BLS). 1995. Safer construction workplaces, evident during the early 1990s. Issues, summary 95-3. U.S. Department of Labor, Bureau of Labor Statistics.

Bureau of Labor Statistics (BLS). 2002. http://data.bls.gov/. Data was extracted on January 10, 2002. Fatalities for 2000 is primary data.

Buskin SE, Paulozzi LJ. 1984. Fatal injuries in the construction industry in Washington state. Am J Ind Med 11:453–460.

Butani SJ. 1988. Relative risk analysis of injuries in coal mining by age and experience at present company. J Occup Accidents 10: 209–216.

Census. U.S. Census Bureau, DP-1. Profile of General Demographic Characteristics: 2000. Data set: Census 2000 summary file (SF 1) 100-percent data. Geographic area: United States. http://factfinder.census.gov visited data: 7/26/02.

Chiswick BR, Cohen Y, Zach T. 1997. The labor market status of immigrants: Effects of unemployment rate at arrival and duration of residence. Ind Labor Relations Rev 50:289–303.

Corvalan C, Driscoll TR, Harrison JE. 1994. Role of migrant factors in work-related fatalities in Australia. Scand J Work Environ Health 20(5):364–370.

CPWR. 2002. The construction chart book, the U.S. construction industry and its workers. Third edition. Silver Spring, MD: The Center to Protect Workers' Rights.

Del Pinal JH. 1996. Hispanic Americans in the United States: Young, dynamic, and diverse. Stat Bull Metrop Insur Co 77(4):2–13.

Dembe A. 1999. Social inequalities in occupational health and health care for work-related injuries and illnesses. Int J Law Psychiatry 22:567–579.

Fronstin P, Goldberg LG, Robins PK. 1997. Difference in private health insurance coverage for working male Hispanic. Inquiry 34(2): 171–180.

Frumkin H, Pransky G. 1999. Special populations in occupational health. Occup Med 14:479–484.

Frumkin H, Walker ED, Friedman-Jimenez G. 1999. Minority workers and communities. Occup Med 14:495–517.

Jackson LL. 2001. Non-fatal occupational injuries and illnesses treated in hospital emergency departments in the United States. Injury Prevention 7:i21–i26.

Mora MT, Davila A. 1998. Gender, earnings, and the English skill acquisition of Hispanic workers in the United States. Econ Inquiry 36(4):631–644.

Moure-Eraso R, Wilcox M, Punnett L, MacDonald L, Levenstein C. 1997. Back to the future: Sweatshop conditions on the Mexico–US border, II: Occupational health impact of maquiladora industrial activity. Am J Ind Med 31:587–599.

Office of Management and Budget (OMB). 1977. Statistical policy directive no. 15: Race and ethnic standards for federal statistics and administering.

Ore T, Stout NA. 1997. Risk differences in fatal occupational injuries among construction laborers in the United States, 1980–1992. J Occup Environ Med 39(9):832–843.

Pollack ES, Chowdhury RT. 2001. Trends in work-related death and injury rates among U.S. construction workers, 1992–1998. Center to Protect Workers' Rights, Silver Spring, MD.

Pollack ES, Griffin M, Ringen K, Weeks J. 1996. Fatality in the construction industry in the United States, 1992 and 1993. Am J Ind Med 301:325–330.

Pransky G, Moschenberg D, Benjamin K, Portillo S, Thackrey JL, Hill-Fotouhi C. 2002. Occupational risk and injuries in non-agricultural immigrant Latino worker. Am J Ind Med 42:117–123.

Richardson S, Schulman A. 1994. Texas study finds older workers at relatively high risk of fatal occupational injury. Compensation and Working Conditions, April 1994.

Ringen K, Stafford EJ. 1996. Intervention research in occupational safety and health: Examples from construction. Am J Ind Med 29(4): 314–320.

Ringen K, Englund A, Welch L, Weeks JL, Seegal JL. 1995. Why construction is different. Occup Med 10(2):255–259.

Robinsin JP, Bostrom A. 1994. The overestimated workweek? What time diary measures suggest. Monthly Labor Rev 117:11–23.

Robinson JC. 1989. Exposure to occupational hazards among Hispanics, Blacks, and Non-Hispanic Whites in California. Am J Pub Health 79(5):629–630.

Ruser JW. 1995. A relative risk analysis of workplace fatalities, fatal workplace injuries in 1993: A collection of data and analysis, report 891, U.S. Department of Labor, Bureau of Labor Statistics. pp 18–22.

SAS Institute, 2000. SAS version 8.1 statistical software application.

Sorock GS, O'Hagen Smith E, Goldoft M. 1993. Fatal occupational injuries in the New Jersey construction industry 1983 to 1989. J Occup Med 35(9):916–921.

Takaro TK, Gonzalez Arroyo M, Brown GD, Brumis SG, Knight EB. 1999. Community-based survey of maquiladora workers in Tijuana and Tecate, Mexico. Int J Occup Environ Health 5:313–315.

Tucker C, Kojetin B. 1996. Testing racial and ethnic origin questions in the CPS supplement. Monthly Labor Rev 119(9):3–7.

Valdez BR, Morgenstern H, Brown R, Wyn R, Wang C, Cumberland W. 1993. Insuring Latinos against the costs of illness. JAMA 269(7): 889–894.

Weddle MG, Bissell RA, Shesser R. 1993. Working women at risk: Results from a survey of Hispanic injury patients. J Occup Med 35: 712–715.

Windau J. 1997. Occupational fatalities among the immigrant population. Compensation and Working Conditions. Bureau of Labor Statistics, http://data.bls.gov/