Occupational Burns Treated in Emergency Departments

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Background *Despite reported declines, occupational burn injuries remain a workplace safety concern. More severe burns may result in costly medical treatment and long-term physical and psychological consequences.*

Methods *We used the National Electronic Injury Surveillance System—Occupational Supplement to produce national estimates of burns treated in emergency departments (EDs). We analyzed data trends from 1999 to 2008 and provided detailed descriptions of 2008 data.*

Results *From 1999 to 2008 there were 1,132,000 (95% CI: ±192,300) nonfatal occupational burns treated in EDs. Burn numbers and rates declined approximately 40% over the 10 years. In 2008, men and younger workers 15–24 years old had the highest rates. Scalds and thermal burns accounted for more than 60% of burns. Accommodation and food service, manufacturing, and construction industries had the largest number of burns.*

Conclusions *Despite declining burn rates, emphasis is needed on reducing burn hazards to young food service workers and using job specific hazard analyses to prevent burns.*
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KEY WORDS: burns; occupational injuries; nonfatal; food service injuries; construction injuries

INTRODUCTION

Burn injuries continue to be common occurrences in the workplace despite reported incidence declines [McCullough et al., 1998; Baggs et al., 2002; Horwitz and McCall, 2004; NIOSH, 2004; Horwitz and McCall, 2005]. Combining results from four federal surveillance systems, the American Burn Association [ABA, 2013] estimated a total of 450,000 burns received medical treatment in 2013. The proportion of burns attributed to work varies based on the population of study. National survey estimates of self-reported injuries indicated that 42% of burns were work-related [Smith et al., 2005]; other national and international studies that were limited to persons admitted to the hospital [Rossignol et al., 1986; Taylor et al., 2002] or persons treated at a burn center [Inancsi and Guidotti, 1987; Munnoch et al., 2000; Mandelcorn et al., 2003; Mirmohammadi et al., 2012] reported that 22–29% of burns were work-related. The U.S. DOE [2003] examined major burn injuries defined by the ABA as "a burn covering at least 5%, 10%, or 20% of the body (depending on burn severity and age), a burn causing a functional or cosmetic threat, an electrical burn, a burn with inhalation injury, or a circumferential burn." They reported that nearly a quarter (23%) of burn injuries among adults were work-related. However, when the population was

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restricted to employed adults, 39% of major burns were work-related [U.S. DOE, 2003].

The Bureau of Labor Statistics (BLS) reports the annual number and rate of occupational burn injuries resulting in days away from work (DAFW) through the Survey of Occupational Injuries and Illnesses (SOII) [BLS, 2012b]. BLS estimated that 2,270 burns involving DAFW occurred to state and local workers in 2010. There were an estimated 19,770 nonfatal burns involving DAFW among private industry workers, with a third occurring in the leisure and hospitality industry (6,760). Most private industry occupational burns were heat and scald burns (14,620) and chemical burns (4,210). The rate for burns with DAFW in private industry was 2.2 per 10,000 full-time equivalent workers (FTE). The rate was highest among the younger age groups of 16–19 years old (6.7 per 10,000 FTE) and 20–24 years old (5.0 per 10,000 FTE).

Burns can result in physical and psychological complications that impact daily function, including return to work. Brych et al. [2001] reported that after 24 months only 37% of people with burns, regardless of whether they were work-related, returned to the same job without accommodations. People burned at work have a greater likelihood of unemployment 1 year after injury, compared to people burned outside of work [Schneider et al., 2011]. Barriers to returning to work after an occupational burn include pain, neurologic problems, psychiatric issues, and impaired mobility [Schneider et al., 2011].

The extent to which work-related burns are comprehensively identified is dependent on the data source. Previous studies of occupational burns included analyses of state-based workers' compensation data [McCullough et al., 1998; Islam et al., 2000; Baggs et al., 2002; Horwitz and McCall, 2004; Horwitz and McCall, 2005; Walters, 2009], burn center records [Inancsi and Guidotti, 1987; Taylor et al., 2002; ABA, 2011], and a combination of hospital/emergency department (ED) records and news reports [Rossignol et al., 1986]. The ABA [2011] reported that at least 13% of the injuries from select burn centers were work-related, but only about three-fourths of these work-related burns were covered by workers' compensation. Kica and Rosenman [2012] analyzed a combination of Michigan data from hospital/ED records, workers' compensation, poison control reports, and the state-based occupational fatality surveillance program. They reported that approximately 76% of people with occupational burns were seen in EDs, but only 21% were found in the workers' compensation data.

The purpose of our study was to describe nonfatal occupational burn injuries treated in U.S. EDs from 1999 to 2008, with an in-depth characterization of burns treated in 2008. Our results describe workers who incurred burn injuries, with no requirements for coverage by workers' compensation, injury-related days away from work, or treatment by a burn center.

METHODS

The Centers for Disease Control and Prevention (CDC) National Institute for Occupational Safety and Health (NIOSH) collects data for the occupational supplement to the National Electronic Injury Surveillance System (NEISS-Work). These data include all ED-treated occupational injuries, illnesses, and exposures that occur to a civilian worker during the performance of paid or volunteer duties.[1] As most NEISS-Work cases are injuries [Jackson, 2001], we refer solely to the term "injuries" for the remainder of this report. We analyzed data from NEISS-Work to describe trends in the number and rate of nonfatal occupational burn injuries treated in EDs from 1999 to 2008. We also detailed worker demographics, injury circumstances, and nature of injury for occupational burn injuries in 2008. The industry of the injured worker is not routinely classified for NEISS-Work data. However, for 2007 only, NIOSH assigned 2002 Census Bureau industry classification codes [U.S. Census Bureau, 2002] for all NEISS-Work cases based on employment information from the medical record. We used these data to derive industry estimates and rates for ED-treated burns in 2007.

NEISS-Work is a national probability sample of 67 U.S. hospitals. The hospitals are stratified by size based on the number of ED visits. The number of reporting hospitals fluctuated during the study period as some hospitals closed and various other issues contributed to temporary nonparticipation and nonresponse. Each case in NEISS-Work is assigned a statistical weight based on the probability of the treating hospital being selected within the designated stratum. These weights were summed to produce national estimates of the number of injuries. We also calculated 95% confidence intervals (95% CIs) to account for the variance within the NEISS-Work sample. To account for serial correlation while analyzing trends, first-order autoregressive models were used to examine trends in overall and discharge disposition burn rates using PROC AUTOREG in SAS version 9.3 (SAS Institute Inc., Cary, NC). In order to do this, burn rates per 10,000 FTE were calculated for each quarter during the 10-year study period by using quarterly injury data to reliably estimate autocorrelation. The Durbin–Watson statistic was used to test first-order autocorrelation. The slope in the regression model represents the average annual change in burn rates per 10,000 FTE.

NEISS-Work data are abstracted from ED medical records by abstractors at each hospital. The abstracted data are reviewed by NIOSH researchers for quality control purposes, including an assessment of whether the case meets

[1]NIOSH collects the occupational injury data through collaboration with the Consumer Product Safety Commission (CPSC). However, there are no implied or expressed endorsements of the results presented herein by the CPSC.

the NEISS-Work definition of work-related. The data include an injury narrative field containing descriptive information on the injury and associated circumstances. NIOSH staff reviewed the injury narratives for each NEISS-Work record and assigned Occupational Injury and Illness Classification System injury event and source codes [BLS, 1992].

For each NEISS-Work case, medical record abstractors identify the most severe diagnosis and assign a single general diagnosis code, but also note other diagnoses in the injury narrative. Among the 30 possible diagnoses there are six burn classifications: chemical, electrical, radiation, scald, thermal, or not specified. For treatment years 1999 through 2008, we reviewed the injury narratives for burn cases to confirm the diagnosis and performed a text search of all injury narrative fields to identify additional burn injuries not captured by the original diagnoses. We excluded burns related to exposure to cold (e.g., exposure to dry ice and liquid propane) and friction-related abrasions. We reclassified ocular injuries with diagnoses of "burn, not specified" to radiation burns when the burn resulted from welding activities without foreign body involvement.

We calculated employed labor force estimates for rate denominators from the Current Population Survey (CPS), a labor force survey of a probability sample of approximately 60,000 households [BLS, 2012a]. To match denominator data, all identified volunteer work cases were removed from the NEISS-Work numerator data for rate calculations. All rates were computed as injuries per 10,000 FTE, with one FTE representing 2,000 hr. worked in a year. FTE were estimated based on total hours worked for all jobs. For the regression model, CPS data were analyzed by month of interview to produce quarterly employment estimates. Injury rates by industry for ED-treated burns in 2007 were calculated using CPS estimates for primary job FTE only.

No review was required by NIOSH's Institutional Review Board since the analysis was conducted on existing data and did not include any personal identifiers. Informed consent was not required because the study used existing data sources.

RESULTS

Between 1999 and 2008, an estimated 1,132,000 (95% CI: ± 192,300) nonfatal occupational burn injuries were treated in EDs. The rate of ED-treated burns declined approximately 40% from 11.1 (95% CI: ± 1.9) per 10,000 FTE in 1999 to 6.3 (95% CI: ± 1.3) per 10,000 FTE in 2008. A regression analysis indicated an average rate decrease of 0.5 burns per 10,000 FTE per year ($P < 0.0001$) (Fig. 1). However, the percentage of burns among all nonfatal ED-treated occupational injuries per year remained relatively constant at an average of 3% per year. Most patients were treated and released (98%). The rate of treated and released

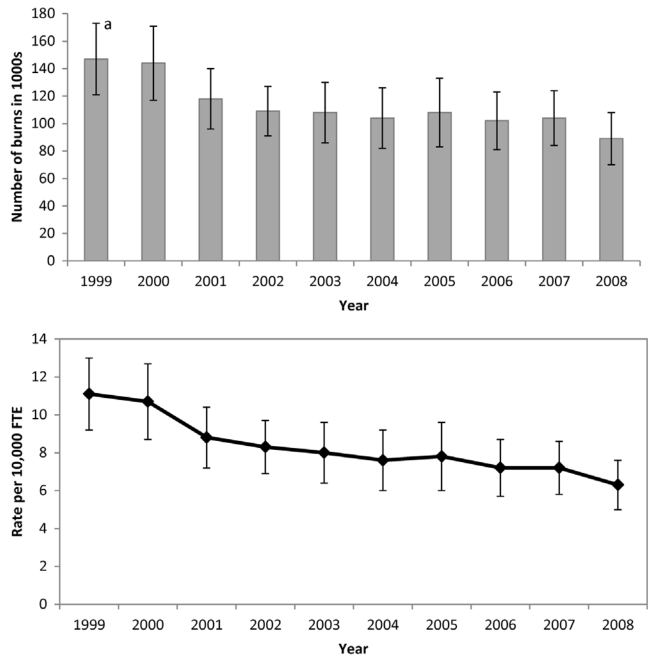

FIGURE 1. Number and rate of work-related nonfatal burns treated in hospital emergency departments by year, 1999–2008. [a]95% confidence interval.

burns declined from 10.9 (95% CI: ± 1.9) per 10,000 FTE in 1999 to 6.1 (95% CI: ± 1.3) per 10,000 FTE in 2008. This decline occurred at the same rate seen for total burns (0.5 per 10,000 FTE per year; $P < 0.0001$). Annually, an average of 2,600 (95% CI: ± 1,000; 2% of all burn cases) burn injuries resulted in hospitalization of the worker. In contrast to the declining rate for treated and released cases, a slight but nonsignificant increase in the rate for hospitalized burn injuries was observed over the 10 years (0.001 per 10,000 FTE per year; $P = 0.80$).

In 2008, there were 89,400 (95% CI: ± 18,500) work-related burns treated in EDs at a rate of 6.3 (95% CI: ± 1.3) burns per 10,000 FTE (Table I). Two-thirds of burns occurred to men and more than half to workers less than 35 years of age. Men had a higher rate of burns than women and younger workers had higher rates than older workers. Workers 15–19 years old had a rate (30.1; 95% CI: ± 9.4) more than twice as high as any other age group and nearly five times higher than the overall rate.

Hand and fingers were most commonly burned (23,700; 95% CI: ± 6,900), followed by eyes (21,500; 95% CI: ± 6,500), lower arm and wrist (14,200; 95% CI: ± 3,500), face (8,600; 95% CI: ± 2,400), and lower leg or foot (7,100; 95% CI: ± 2,400). Among injury events, 56% (49,900; 95% CI: ± 11,500) involved contact with hot objects or substances; 19% (16,800; 95% CI: ± 4,500) involved skin exposure to caustic, noxious, or allergenic substances; 13% (11,300; 95% CI: ± 4,800) involved exposure to welding light; and 6% (5,700; 95% CI: ± 1,600) resulted from fires

TABLE I. Characteristics of Workers With Burn Injuries, 2008

Characteristic	Number[a]	95% CI	%	Rate[b]	95% CI
Total	89,400	±18,500	100	6.3	±1.3
Sex					
Male	61,700	±12,400	69	7.6	±1.5
Female	27,700	±7,800	31	4.5	±1.3
Age groups (years)					
15–19	10,600	±3,300	12	30.1	±9.4
20–24	15,400	±5,000	17	12.8	±4.1
25–29	12,600	±3,300	14	7.9	±2.1
30–34	10,300	±3,000	12	6.7	±2.0
35–39	10,100	±2,300	11	6.1	±1.4
40–44	7,800	±2,000	9	4.5	±1.1
45–49	8,400	±2,100	9	4.5	±1.2
50–54	7,000	±2,300	8	4.1	±1.4
55–59	3,100	±1,300	3	2.4	±1.0
60+	4,000	±1,400	5	3.3	±1.2
Discharge disposition					
Treated and released	86,100	±18,300	96	6.1	±1.3
Hospitalized	3,000	±1,000	3	0.2	±0.1

CI, confidence interval.
[a]Numbers may not sum to total due to rounding.
[b]Burns per 10,000 FTE.

and explosions (data not shown). The most common injury sources were food products (15,100; 95% CI: ± 4,000), hand tools (13,900; 95% CI: ± 5,100), and steam vapors and liquids (11,700; 95% CI: ± 3,900). Chemical products were the source of 6,300 (95% CI: ± 2,000) burn injuries.

Scald burns caused by liquids, grease or steam accounted for one-third of all burns in 2008 (Table II). Men and women had similar rates of scalds (2.2; 95% CI: ± 0.5 for men and 2.0; 95% CI: ± 0.6 for women per 10,000 FTE). About one-third of scald burns occurred in younger workers aged 15–24 years at a rate of 6.5 (95% CI: ± 2.1) per 10,000 FTE. Scald burns largely occurred to the hand and fingers (37%) and lower arm and wrist (25%). Food products such as hot grease and cooking oil were the source of 44% of scald burns (13,000; 95% CI: ± 3,500).

Almost 30% of all work-related burns were thermal burns with a rate of 1.8 per 10,000 FTE (95% CI: ± 0.5). Workers aged 15–34 years sustained the most thermal burns (54%) (Table II). Hand and fingers (36%), lower arm and wrist (27%), and face (12%) were most commonly burned. Two of the most common sources of thermal burns were heating, cooling, and cleaning machinery, including grills and ovens, (4,800; 95% CI: ± 1,800) and handheld power tools, primarily torches (2,600; 95% CI: ± 1,400).

Chemical burns accounted for nearly 20% of all burns and occurred at a rate of 1.2 (95% CI: ± 0.3) per 10,000 FTE. The eye was the most commonly affected (41%) (Table II). In the majority of injury narratives the chemical source of the burn injury was not specified in detail. Acid was identified as the chemical in 15% (2,700; 95% CI: ± 1,200) of the cases.

Radiation and electrical burns accounted for the smallest numbers of occupational burns at 12,600 (95% CI: ± 5,300) (Table II) and 2,600 (95% CI: ± 1,100) (data not shown), respectively. Electrical burns are the only burn type that did not decline over 10 years with an estimate of 2,600 in 1999 (95% CI: ± 1,000). The respective rates for radiation and electrical burns were 0.9 (95% CI: ± 0.4) and 0.2 (95% CI: ± 0.1) per 10,000 FTE. Both burn types occurred most frequently among men (>90%). While all radiation burns were treated and released, only 78% of electrical burns were treated and released. Nearly all radiation burns (96%) affected the eye(s). Almost 90% were attributed to exposure to welding light from handheld welding torches.

In 2007, there were 103,500 (95% CI: ± 19,600) occupational burns at a rate of 7.2 (95% CI: ± 1.4) per 10,000 FTE (Table III). The industry sectors with the greatest numbers of burn injuries were accommodation and food services (21,800; 95% CI: ± 5,000) and manufacturing (18,200; 95% CI: ± 6,100). Accommodation and food services, agriculture, manufacturing, and construction industry sectors had the highest rates of burns. Scald burns accounted for 58% (12,600; 95% CI: ± 3,800) of burns in the accommodation and food services industry; another 30% were thermal burns (6,600; 95% CI: ± 2,300). Burn injuries in the manufacturing sector were largely thermal (29%) and radiation (29%). In construction, 42% of burn injuries were

TABLE II. Injury Characteristics of Work-Related Burns by Select Burn Type,[a] 2008

Characteristic	Scald			Thermal			Chemical			Radiation		
	Number[b]	95% CI	%	Number[b]	95% CI	%	Number[b]	95% CI	%	Number[b]	95% CI	%
Total	29,700	±6,900	100	25,900	±7,300	100	17,600	±4,900	100	12,600	±5,300	100
Sex												
Male	16,300	±3,900	55	17,400	±4,500	67	12,800	±3,500	73	12,000	±5,300	96
Female	13,400	±3,700	45	8,500	±3,400	33	4,800	±1,900	27	—[c]	—	—
Age groups (years)												
15–24	10,100	±3,300	34	7,600	±3,600	29	3,900	±1,400	22	4,100	±2,400	33
25–34	7,300	±2,700	25	6,400	±2,200	25	4,200	±1,400	24	3,900	±2,600	31
35–44	4,600	±1,400	15	5,600	±2,000	22	4,500	±1,600	26	2,600	±1,100	20
45–54	5,000	±1,800	17	4,600	±1,500	18	3,200	±1,200	18	1,500	±700	12
55+	2,700	±1,200	9	1,700	±800	7	1,700	±1,000	10	—	—	—
Discharge disposition												
Treated and released	29,100	±6,800	98	24,400	±7,000	94	17,100	±4,800	97	12,600	±5,400	100
Body part (select)												
Eye	—	—	—	—	—	—	7,300	±2,400	41	12,100	±5,200	96
Hand and finger	11,000	±2,900	37	9,200	±3,600	36	1,700	±800	10	—	—	—
Lower arm and wrist	7,300	±2,100	25	7,000	±2,800	27	2,100	±1,000	12	—	—	—
Face	3,000	±1,500	10	3,100	±1,100	12	2,100	±1,200	12	—	—	—
Lower leg and foot	2,900	±1,400	10	1,900	±900	7	2,000	±1,200	12	—	—	—

CI, confidence interval.
[a]Electrical burns and unspecified burns are not shown.
[b]Numbers may not sum to total due to rounding and/or omission of unreportable results.
[c]Did not meet minimum reporting requirements that insure confidentiality and reliability.

radiation burns. The construction industry accounted for almost half (1,200; 95% CI: ± 700) of all electrical burns.

Younger workers tended to have higher rates of burn injuries overall. This was particularly notable in the accommodation and food services industry sector. In 2007, younger workers aged 15–24 years old had almost half of all burns in the accommodation and food services industry (10,700; 95% CI: ± 2,900). The youngest workers, 15–19 years of age, incurred 5,300 (95% CI: ± 2,000) of these burns. The 15–19 and 20–24 year olds had the highest rates of burn injuries in this industry sector at 51.7 (95% CI: ± 19.3) and 34.9 (95% CI: ± 11.2), respectively—rates that were 5–7 times higher than the rate for all workers in all industry sectors.

DISCUSSION

From 1999 to 2008 the rate of all ED-treated injuries identified in NEISS-Work decreased about 26%. The rate of ED treated burn injuries declined by approximately 40%. Similarly, the BLS SOII data recorded a 45% decrease in the number of burn injuries among private industry workers that resulted in DAFW from 1999 to 2008 (41,015 to 22,380) [BLS, 2012b]. The SOII annual rate also declined from 4.5 to 2.3 per 10,000 FTE. Although the SOII data from 1999 to 2008 only capture private industry employer-reported DAFW cases consistently, the cases reported include burns treated in all kinds of medical venues, not just EDs. The ED-based NEISS-Work data do not include information on DAFW, but many of the more severe ED-treated burns likely resulted in DAFW. Unlike SOII, the NEISS-Work data also captured a significant portion of less severe burns. Together, the SOII and NEISS-Work provide a complementary overview of occupational burn injuries.

The risk for sustaining an occupational burn differs by sex. Men represent 57% of the employed labor force [BLS, 2012a], but they incurred 69% of ED-treated occupational burns. A similar pattern was noted by BLS in 2008 with men representing 69% (15,320) of the burn injuries resulting in DAFW. Kica and Rosenman [2012] reported that 61% of the burns in a mixed-source study occurred to men. The high proportion of burns among males may be related to industries of employment. In three of the four industries identified in NEISS-Work to have the highest burn rates (i.e., construction, manufacturing, and agriculture), the distribution of men is higher than the distribution of men in the total labor force [BLS, 2012a]. Men may not only have higher rates of burns than women, the severity may differ as well. Horwitz and McCall [2004] found that the average medical and workers' compensation claim costs for men with burn injuries were three times higher than the average costs for women.

TABLE III. Number and Rate of Work-Related Nonfatal Burn Injuries Treated in Hospital Emergency Departments by Select Industry Sectors,[a] 2007

	Number[b]	%	95% CI	Rate[c]	95% CI
Total	103,500	100	±19,600	7.2	±1.4
Industry group					
Accommodation and food services	21,800	21	±5,000	26.5	±6.1
Manufacturing	18,200	18	±6,100	10.6	±3.5
Construction	11,500	11	±3,500	9.7	±2.9
Health care and social assistance	10,800	10	±2,900	6.6	±1.7
Industry not identified	7,800	8	±3,000	—[d]	—
Retail trade	7,400	7	±3,100	4.9	±2.0
Other services[e]	7,200	7	±2,600	11.0	±4.0
Other industries[f]	4,300	4	±1,700	1.0	±0.5
Educational services	3,400	3	±2,200	3.2	±2.0
Transportation and warehousing	3,100	3	±1,400	3.9	±1.7
Public administration	3,000	3	±1,600	4.4	±2.3
Agriculture, forestry, fishing, and hunting	2,700	3	±1,300	12.2	±5.7
Wholesale trade	2,000	2	±1,000	4.5	±2.2

CI, confidence interval.
[a]Census Bureau industry coding classifications [U.S. Census Bureau, 2002].
[b]Numbers may not sum to total due to rounding.
[c]Burns per 10,000 FTE.
[d]Rate cannot be calculated for this category.
[e]Other services are defined as repair and maintenance; personal and laundry services; and membership associations and organizations [U.S. Census Bureau, 2002].
[f]Other industries include: utilities; mining; information; financial activities; professional and business services; real estate and rental and leasing; arts, entertainment, and recreation.

Our results show that workers less than 25 years old account for almost 30% of ED-treated burns but only 11% of the employed labor force [BLS, 2012a]. In 2007, 31% of the workers in the food service and accommodation industry were less than 25 years old [BLS, 2012a], but they represented almost half of the ED-treated burn injuries sustained in the industry. NIOSH has made recommendations to prevent injuries among young workers, including burns [NIOSH, 2003], and has also created an interactive workplace safety curriculum targeted at young workers that addresses hazard identification and injury prevention in a variety of workplaces [NIOSH, 2010]. Some states have made targeted efforts toward preventing young worker injuries, including Massachusetts [Massachusetts, 2014] and Oregon Occupational Safety and Health Administration [Oregon OSHA, 2014]. The federal OSHA also provides injury prevention guidance to young workers [OSHA, 2013]. More specifically, OSHA created an electronic tool aimed at reducing youth injuries in restaurants [OSHA, 2012a]. This tool contains recommendations targeted at reducing burn injuries while cooking, with a focus on safety when working around hot grease and oil.

Efforts to prevent occupational burn injuries among young workers should be specially tailored to youth. Rauscher and Myers [2013] found a positive association between self-reported receipt of safety training and adolescent work injuries, prompting them to hypothesize that barriers to providing effective safety training to adolescents may include inappropriate, incomplete, or inadequately delivered training. Ziergold et al. [2012] found that safety training administered to working teenagers is often job training rather than safety training; often provided via ineffective methods that hinder teenagers' ability to learn the material; and not specifically geared toward teenagers to accommodate their unique cognitive, physical, and social needs. In addition to providing age-specific safety training to young workers, it is important to evaluate and improve existing safety interventions to effectively promote long-term change in occupational safety among young workers. One method of doing this would be to use an existing, validated scale to measure occupational safety behaviors among young workers [Tucker and Turner, 2011].

There are distinct differences related to the mechanisms and sources of occupational burns compared to burns that occur outside of work. Consequently, common burn prevention efforts targeted to the general public may have little impact in reducing burns in the workplace [Hunt et al., 2000]. The prevention of work-related burns should begin with conducting and periodically reviewing job hazard analyses in jobs with high injury rates and jobs with the potential for burn injuries [OSHA, 2002]. Once identified, steps should be taken to eliminate or reduce job-specific hazards. Particularly relevant to occupational burn prevention, hazard assessments can provide the information needed to determine appropriate personal protective equipment (PPE) [OSHA, 2012b].

The number of ED-treated burns in the manufacturing industry was the second highest of all industries. Kica and Rosenman [2012] reported primary metal manufacturing accounted for 7% of work-related burns among all industries. Our study showed that burns in the manufacturing industry were primarily radiation and thermal. Radiation burns to the eyes commonly occur during welding to the welders, their helpers, and bystanders. The American National Standards Institute (ANSI) Z87.1 eye and face protection standard [ANSI/ISEA, 2010] identifies the appropriate type of optical radiation protection required for various brazing and welding activities. Baggs et al. [2002] identified the industrial job classifications of foundries, aluminum smelting, and plastic product manufacturing for priority thermal burn prevention efforts. Prevention in these varied areas should be addressed by efforts guided by the results of hazard assessments [OSHA, 2002]. Specific guidance for high-temperature PPE to be worn in foundries has been provided by an Oregon Occupational Safety and Health Division [2012] program directive.

ED-treated burn injuries in the construction industry do not appear to be declining. Schoenfisch et al. [2010] analyzed NEISS-Work data from 1998 to 2005 to describe injuries in the construction industry. They reported a total of 63,900 (±12,300) nonfatal burns over the 8 years and no significant difference in the trend for the number or rate of all construction injuries. Given our 2007 result of 11,500 (±3,500) burn injuries among construction workers, it seems unlikely that there is a downward trend of burn injuries in this industry. A previous description of ED-treated burns among construction workers identified that burns often occurred because of exposure to tar or hot fluids [Zwerling et al., 1996]. Likewise, roofing has been identified as an industry with high thermal burn-related workers' compensation claim frequencies and rates [Baggs et al., 2002]. Similar to our study, Zwerling et al. [1996] reported welding flash burns to the eyes were also a common cause of burns in construction.

Electrical burns were the only ED-treated burn type that did not decline from 1999 to 2008. They are more frequently work-related than other burn types [Hussman et al., 1995; Singerman et al., 2008]. Studies have reported that 22% to 57% of workers with electrical burns were hospitalized [Baggs et al., 2002; Walters, 2009; Kica and Rosenman, 2012] compared to less than 5% of workers hospitalized among all burn types [Kica and Rosenman, 2012]. In addition, the more severe nature of electrical burns is reflected in that 35% of people with electrical burns admitted to a burn center underwent major limb amputation [Hussman et al., 1995]. Among patients treated in a burn center in Chile, the odds of patients with electrical burn injuries undergoing an amputation were 13.7 times (95% CI: 6.8–28.2) greater than patients with other burn types [Soto et al., 2013]. The greatest numbers of electrical burns occurred in the construction and manufacturing industries [Cawley and Homce, 2008]. Electrical burn injuries can be prevented, in part, by de-energizing and using specially designed, employer provided PPE as described in the National Fire Protection Association (NFPA) 70E standard [McCann et al., 2003].

This study was designed to provide a national overview of occupational burns. It provides ED-treated burn injury estimates without restrictions on severity, medical payer, or locale, complementing existing research to result in a more complete understanding of occupational burns. We elected to use 1999–2008 data to describe trends and 2008 data to provide a detailed description. While the number of burns declined during the 10-year period, the demographic and burn type distributions remained similar from year-to-year. The results are constrained by several factors. First, NEISS-Work data represent only those injuries that were treated in an ED, omitting injuries that were treated in other medical venues, and self-treated injuries. Second, case capture relies on information found in the ED medical record identifying the case as work-related, and inaccuracies may occur due to the lack of information provided by the worker, incomplete medical records, or errors in abstracting the information from the record. Third, the lack of routine assignment of standardized industry codes in NEISS-Work prohibited analysis of burn trends by industry throughout the 10-year period and analysis of industry within the 2008 data.

CONCLUSION

Continued occupational safety efforts are needed to prevent work-related burns in order to prevent acute and long-term physical and psychological effects on workers, reduce workers' compensation and medical costs, and lessen the impact on the workforce related to job changes and the loss of experienced workers. Prevention efforts should focus on jobs in accommodation and food services, manufacturing, and construction industries. Other areas needing attention include young workers and workers susceptible to electrical burns. Job-specific hazard assessments can be used by employers to provide guidance for prevention efforts, including selection of appropriate PPE.

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