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Occupational injuries among construction workers treated in a major metropolitan emergency department in the United States

by Laura S Welch, MD,[1] Katherine L Hunting, PhD,[2] Judith Anderson Murawski, MSc [2, 3]

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Objectives The aim of this study was to profile construction workers' injuries for more information about the causes of nonfatal construction worker injuries and identify injury trends for further investigations and prevention programs.

Methods An injury-tracking program for emergency departments was established in 1990 to gather the data needed for the study. Profiles were obtained for 2916 construction workers' injuries that were identified on hospital registration forms at the George Washington University Emergency Department in Washington, DC, from November 1990 through October 1997. Laborers and construction workers who did not specify a trade were combined, and together they made up the largest group—29% of the injured workers.

Results The leading cause of injury was contact with cutting or piercing objects—most often pieces of metal, razors, knives, power tools, and nails. Workers striking against objects or being struck by objects (including falling objects) accounted for the second-largest group of injuries, and the third leading injury circumstance was falling—either from a height or on the same level. Detailed injury statistics are presented by trade, showing patterns of injury that reflect tasks of these trades and which injuries predominated in each trade. Although many previous reports have described construction workers' injuries, very few have provided detailed data by trade.

Conclusions The details presented in this analysis allow for a better understanding of the injury circumstances and provide a starting point for injury prevention programs.

Key terms carpenter; construction; injury; laborer; occupational health and safety; surveillance.

Construction work is dangerous, with high rates of both fatal and nonfatal injuries. In 2000, 20% of all fatal on-the-job injuries occurred in construction work—more than three times its 6% share of the total employment [Bureau of Labor Statistics, US Department of Labor. Workplace injuries and illnesses in 2001. Washington, DC, BLS/USDOL. Cited January 2004, url: http://data.bls.gov/cgi-bin/surveymost?cf] Half of all fatal falls occur in construction. Construction also has a high rate of nonfatal injuries. In 2001 there were 4 lost workday cases per 100 full-time equivalent construction workers as opposed to the rate of 2.8/100 full-time equivalent workers in all private industry. The rate in construction exceeded all other sectors. The overall recordable injury rate in construction was 7.9/100 full-time equivalent workers in 2001, second only to manufacturing. Leading causes of injuries with days away from work among construction workers in 2001 were contact with objects (34.1%), falls (21.4%), and overexertion (20.1%). Leading specific diagnoses were strains and sprains (38.4%), cuts and lacerations (11.8%), fractures (10.7%), and bruises and contusions (6.9%) [Bureau of Labor Statistics, US Department of Labor. Workplace injuries and illnesses in 2001. Washington, DC, BLS/USDOL. Cited January 2004, url: http://www.bls.gov/iif/].

Injury data are collected in many different ways, and the source of data can affect our interpretation of injury patterns. The data of the Bureau of Labor Statistics (BLS) are drawn from injuries reported by employers. The Occupational Safety and Health Administration (OSHA) requires employers to report injuries according

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to a specific definition of a recordable injury; these logs are the basis for the BLS annual survey. Another source of statistics is reports from workers' compensation claims. In this case a recordable injury is defined in a different way in each state, and many state workers' compensation databases only contain injuries that entail lost worktime. Injury statistics obtained from medical sources, such as hospital discharge data or emergency visits, are not directly comparable to either BLS data or workers' compensation data. Medical providers do not use the OSHA definition of medical treatment, nor do they include lost worktime in a definition of an injury. No one source is the "right" one; each gives us a different view of injury patterns. In addition, few data sources contain enough detail on job, task, materials, and circumstances to point to specific preventive actions.

For more information about the causes of nonfatal injuries among construction workers and the identification of injury trends for further investigations and prevention programs, an injury tracking program for emergency departments was established in 1990. The program was motivated by (i) the high rate of nonfatal injuries in the construction industry, (ii) the lack of specific information describing the causes of these injuries, and (iii) the lack of information describing the short- and long-term impact of injuries on workers' lives. This report profiles construction workers' injuries that were identified on hospital registration forms at the George Washington University Emergency Department in Washington, DC, from November 1990 through October 1997.

Material and methods

Each week from October 1990 through December 1998, a member of the research team reviewed all of the hospital registration forms in the George Washington University (GWU) Emergency Department in Washington, DC. For the patients whose job title, employer, or insurance carrier suggested construction work, demographic, diagnosis, cause-of-injury, and hospital discharge information was abstracted onto a standardized form. People employed in maintenance capacities in construction trades were also included. The job titles were coded according to the Standard Occupational Classification Manual (1980), and the diagnoses and external causes of injury were coded according to the ninth revision of the International Classification of Diseases (ICD-9 CM, 5th edition). All of the variables were entered into an Epi Info Version 6.04b database (Centers for Disease Control, Atlanta, GA, USA). The methods and general results have been previously described (1, 2). The study protocol was reviewed and approved by the Institutional Review Board for research involving human subjects at the George Washington University School of Medicine.

We included any worker whose job title was coded by 1980 Standard Occupational Code (US Department of Commerce) as "construction trades", "construction laborers", "construction helpers", "construction managers", "construction supervisors", "construction inspectors", "sheet metal workers", or "elevator installers and repairers". Thus we included construction trades people with nonconstruction industry employers—such as maintenance painters, carpenters, electricians, and plumbers employed primarily by government agencies, educational institutions, and museums or theaters. Finally, certain other job titles, such as welders and material moving equipment operators, were also included if they appeared (from the employer name) to be engaged in construction work. Table 1 describes which workers were included in this tracking system, and also how the job titles were grouped for the data analysis.

Injuries were determined to be work-related on the basis of a combination of data in the medical record (ie, the patient's presenting complaint, an indication that the payment was to be through workers' compensation insurance, notes made by any treating health care worker about the circumstances of the injury, and the physician's check in a box labeled "work-related").

During the first 7 years of data collection, 2916 injured construction workers were identified. Of these, three were fatally injured. Each injured worker was categorized into one of sixteen trade groups. The following data were collected from the medical chart of each construction worker with a work-related condition: medical record number, name, address, state and zip code of residence, phone number, gender, date of birth, social security number, ethnicity, employer name, city and state, occupation, up to two diagnoses, circumstances of injury, and physician's recommendation for time off work or light duty. If a patient was admitted to the hospital, the discharge date was also noted. Data collection was continuous except for July through December 1994. During this period, only the following two groups of injuries were identified: people from one large local construction project and those with serious injuries that required the services of the trauma team of the Emergency Department. During these 6 months of partial data collection, about 200 other cases were probably missed.

In 1994, at the midpoint of this project, approximately 9000 construction workers were employed in the District of Columbia (DC), and approximately 113 000 were employed in the DC area (including surrounding Maryland, Virginia, and West Virginia counties) [Bureau of Labor Statistics, US Department of Labor. Non-Farm Wage and Salary Employment. 2001.

Washington, DC, BLS/USDOL. Cited January 2004, url: http://www.bls.gov/iif]. However, it is not clear how many of these people worked downtown and, if injured, would have been treated at a downtown hospital. Furthermore, the GWU Emergency Department is only one of several emergency departments located in downtown Washington, DC. Therefore, injury rates could not be calculated, and the analyses were based on the percentage or proportion of construction injuries that were treated at GWU during this time.

Information was collected on a total of 2916 visits that construction trades workers made to the emergency department for work-related injuries. Workers who were treated more than once on different occasions for different injuries accounted for 279 of these visits. In this report, each hospital visit is counted as a separate injury case, and, for simplicity, the total set of cases has been referred to as 2916 injured workers.

Results

The 2916 workers were generally young; two of every three workers were under 40 years of age. Those from ethnic minorities comprised just over half of the injured workers; Hispanics, who made up almost one-fifth of the injured workers, could have been either black or white. Only 3% of the injured workers were female. As seen in figure 1, workers from every construction trade were treated in the emergency department. Laborers and construction workers who did not specify a trade were combined, and together made up the largest group—29% of the injured workers. Carpenters and electricians were the next most common trades to be treated. Some trades that perform similar work were grouped together for the analysis. Maintenance carpenters, electricians, plumbers, and painters were grouped with their construction counterparts. Exhibit technicians were assigned to their own trade group because their tasks were considered to be unique.

Figure 2 and table 2 show the causes of injury among this group of workers. The leading cause of injury was contact with cutting or piercing objects—most often pieces of metal, razors and knives, power tools, and nails. Workers striking against objects or being struck by objects (including falling objects) accounted for the second-largest group of injuries. The most common objects were pipes, boards and wood, beams, and pieces of metal or duct. The third leading injury circumstance was falling—either from a height or on the same level. Since the categories in figure 2 are so general, the detailed information presented in table 2 for the top six causes of injury provides a better insight into how the workers really got hurt.

Table 1. Standard occupational classification (SOC) criteria for inclusion and grouping. SOC category descriptions include every injured worker in that category, and the code is indicated in parentheses after the job titles.

Job titles	Trade group for analysis
General managers & top executives (121) [a]	Supervisors
Construction managers (133) [b]	Supervisors
Construction inspectors (1472)	Supervisors
Architects (161) [a]	Supervisors
Engineers (162x–163x) [a]	Supervisors
Heating, air conditioning & refrigeration mechanics (616)	Sheet metal workers
Elevator installers & repairers (6176)	Elevator constructors & mechanics
Mechanics & repairers, NEC (only sprinkler fitters) (6179) [a]	Plumbers & sprinkler fitters
Supervisors, construction (631x)	Supervisors
Brick masons, stone masons & hard tile setters (641x)	Brick, stone, & concrete masons
Carpenters (6422) [c]	Carpenters & carpet layers or exhibit technicians
Drywall installers (6424)	Drywall & plaster workers
Electricians (6432)	Electricians
Electrical power installers & repairers (6432)	Electricians
Painters (6442)	Painters & glaziers
Paperhangers (6443)	Painters & glaziers
Plasters (6444)	Drywall & plaster workers
Plumbers, pipe fitters & steamfitters (645)	Plumbers & sprinkler fitters
Carpet & soft tile installers (6462)	Carpenters & carpet layers
Concrete & terrazzo finishers (6463)	Brick, stone, & concrete masons
Glaziers (6464)	Painters & glaziers
Insulation workers (6465)	Asbestos & insulation workers
Paving, surfacing, & tamping equipment operators (6466)	Heavy equipment operators
Roofers (6468)	Roofers & waterproofers
Sheet metal duct installers (6472)	Sheet metal workers
Structural metal workers (6473)	Ironworkers
Drillers, earth (6474)	Heavy equipment operators
Air hammer operators (6475)	Laborers
Pile driving operators (6476)	Heavy equipment operators
Construction trades, not elsewhere classified (6479)	Laborers
Boilermakers (6814) [a]	Welders & boilermakers
Sheet metal workers (6824)	Sheet metal workers
Cabinet makers & bench carpenters (6832) [a]	Carpenters & carpet layers
Sawing machine operators (7634) [a]	Carpenters & carpet layers
Welders & cutters (7714) [a]	Welders & boilermakers
Motor vehicle operators (821x) [a]	Heavy equipment operators
Material moving equipment operators (831x) [a]	Heavy equipment operators
Helpers, construction trades (864x)	With respective trade
Construction laborers (871)	Laborers
Freight, stock, & material movers—hand (872x) [a]	Laborers
Nonconstruction trades injured on construction sites (other) [a, d]	Laborers

[a] Only injured workers whose employer was engaged in construction work were included.
[b] Supervisor group includes 7 self-employed “contractors” with no trade specified. Self-employed workers who specified a trade were coded with that trade.
[c] Carpenters and technicians who did exhibit work were sometimes identified as such by their job titles. We also identified workers as exhibit technicians by referencing a complete list of contractors who do trade show or exhibit work in our area.
[d] The nonconstruction trades workers injured on construction sites included 1 emergency medical technician, 2 security guards, and 3 elevator operators. These workers were grouped with the laborers for the analysis.

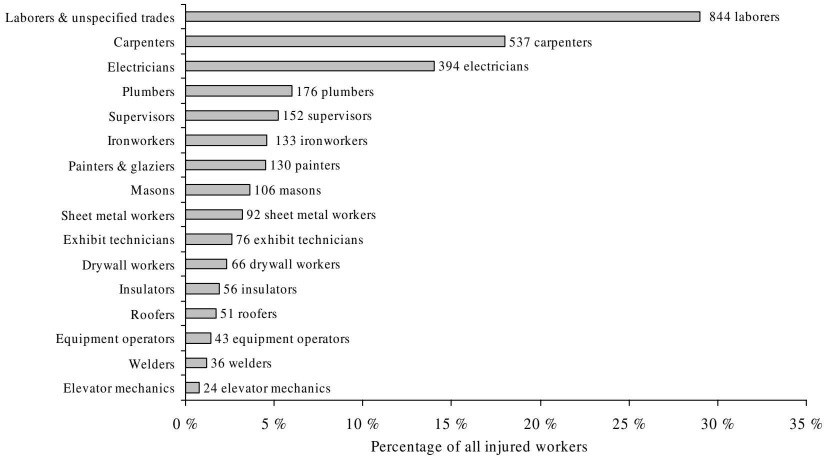

Figure 1. Trades of 2916 injured construction workers (George Washington University, Emergency Department, data, 1 November 1990–3 October 1997).

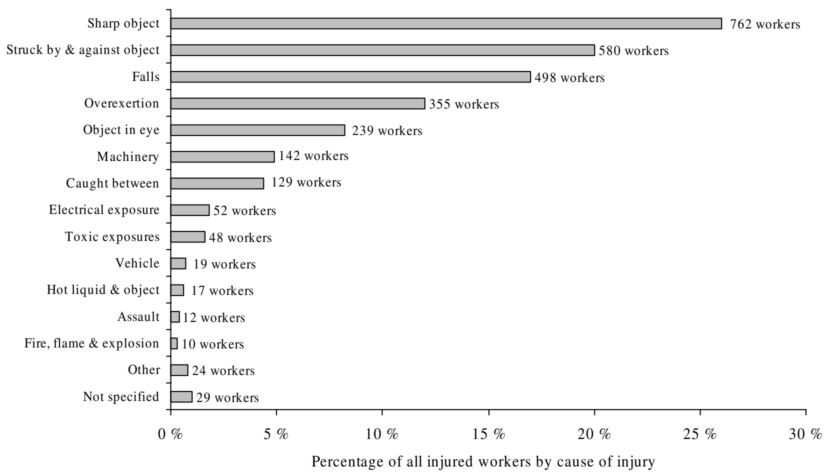

Figure 2. Causes of injury of 2916 injured construction workers (George Washington University, Emergency Department, data, 1 November 1990–3 October 1997).

Figure 3 and table 3 show the injury diagnoses and body location of the injuries. About 10% of the injured workers had two injury diagnoses, sometimes to different parts of the body. For example, a worker might have been treated for both a bruised arm and a strained shoulder as a result of a fall. Therefore, some workers are counted in more than one category, and the percentages add up to more than 100. Approximately every one in three workers was treated for a laceration. Table 3 shows that over half of these lacerations were to the fingers, thumb, hand, or wrist. One in five of the injured workers were treated for strains, sprains, or musculoskeletal pain, making this the second most common diagnosis. Of these workers, almost 40% had a back injury, making the back the most common body part by far for sprains and strains. Contusions and abrasions (serious bruises and scrapes) formed the third leading injury category, followed by eye injuries and fractures, which ranked fourth and fifth, respectively.

Over this 7-year period, 105 workers had injuries that were serious enough to require inpatient admission to the hospital—3.6% of all visits (figure 4). Three workers died from their injuries; these cases are also included in this report. While approximately 60% of the workers admitted to the hospital had short stays of 1 or 2 days, the remaining workers had lengthy stays—several longer than a month. The percentage of people with injuries admitted to the hospital varied substantially between trades. For instance, 6% of 844 laborers and unspecified construction workers who came to the emergency department were then admitted to the hospital. Iron workers, painters, and plumbers also had a higher proportion of hospital admissions than did workers in other trades. Hospital admission is an indicator of the seriousness of an injury, and the trades and ethnic groups with a higher-than-average percentage of hospital admissions appeared to be suffering more severe injuries.

The proportion of cases admitted to the hospital also varied by ethnicity (figure 5); a larger-than-expected proportion of the injured Hispanic workers were admitted to the hospital. Falling was by far the leading cause of serious (hospitalized) injury, responsible for 52% of the hospitalizations. Being struck by an object and exposed to electrical current were ranked second and third, at 17% and 11%, respectively. The diagnoses that appeared the most often among the construction workers

Table 2. Detailed causes of injury among 2916 hurt construction workers. Only the more common causes are listed.

Cause of injury	N
Ranking 1 (26% of injuries)	
Sharp object (N=762)	
Metal, sheet metal or duct	170
Razor or knife	128
Power tool, including saw (25), drill (18), screw gun (17), nail gun (13)	92
Nail or screw	78
Hand tool, including hacksaw (12), chisel (8)	48
Metal stud	40
Cable or wire	36
Glass	34
Light fixture	21
Wood or splinter	17
Saw (unspecified type)	13
Ceramic or ceiling tile	10
Metal bar or rebar	9
Pipe	9
Metal ceiling frame	8
Other causes	32
Not specified	17
Ranking 2 (20% of injuries)	
Struck by or against an object (including falling objects) (N=580)	
Pipe	52
Board or wood	46
Beam	44
Metal, sheet metal or duct	39
Hammer or sledge	33
Metal object or plate	36
Scaffold	26
Ceiling or wall	25
Rebar or metal bar	24
Cinder block, brick or stone	17
Granite, marble or stone	16
Hand tool, other than hammer	15
Door	14
Concrete or cement	13
Drill	13
Drywall or plaster	13
Box, crate or toolbox	12
Power tool, other than drill	12
Wire or cable	11
Light fixture	7
Cart or dolly	6
Door jamb or doorway	5
Truck	5
Table	4
Other	64
Not specified	28
Ranking 3 (17% of injuries)	
Fall (N=498)	
From ladder	135
Slip, trip or stumble	99
From scaffold	80
From another level	59
From stairs	30
Out of a building or structure	26
Into a hole	21
Not specified	48

(continued)

Table 2. Continued.

Cause of injury	N
Ranking 4 (12% of injuries)	
Overexertion or strenuous movement (N=355)	
Lifting or carrying	193
Pushing or pulling	32
Stepping on or off or walking	24
Bending over	10
While drilling	9
Using hammer or sledge	7
Stopping a fall or falling object	6
Overhead	4
Using jackhammer	4
Other	36
Not specified	30
Ranking 5 (8% of injuries)	
Object in eye (N=239)	
Concrete or cement (dust or wet)	53
Metal dust	39
Chemical	25
Dirt, dust or debris	24
Drywall or plaster	12
Paint (dust or wet)	11
Wood dust	10
Insulation	9
Rock, stone or gravel	6
Ceiling tile	5
Other	11
Not specified	34
Ranking 6 (5% of injuries)	
Machinery-related injuries (N=142)	
Power saw (woodworking)	32
Grinder	18
Welder or solderer	17
Crane	13
Forklift	10
Bobcat or front-end loader	8
Air compressor	7
Elevator	5
Other	
Lifting machine	9
Woodworking machine	6
Metalworking machine	4
Miscellaneous	7
Not specified	6

who were admitted to the hospital were fractures—in over a third of the cases—followed by head injuries (15%) and contusions (9%). Many of these seriously injured workers had more than one diagnosis.

Of the 498 construction falls that were treated at the GWU Emergency Department, 352 were falls from a height (figure 6). The remaining 146 workers had either fallen on the same level or had fallen in unspecified circumstances; they have been excluded from this chart. Painters and drywall workers had the highest proportion of falling injuries. In these two trades, falls from a height accounted for slightly more than one quarter of the injuries. Insulators (although few in number) also suffered a relatively high proportion of falls from a height, as did laborers, supervisors, and welders.

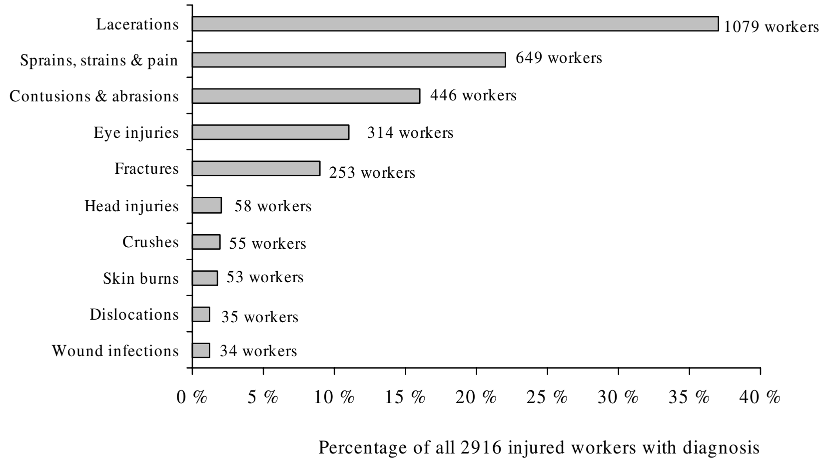

Figure 3. Tob ten injury diagnoses of 2916 injured construction workers treated for 3207 diagnoses (George Washington University, Emergency Department, data, 1 November 1990–3 October 1997). Percentages add to more than 100 because some injured workers had more than one diagnosis.

Workers who were struck by a falling object are shown in figure 7. Equipment operators (although few in number) and exhibit technicians had the highest proportion of such injuries, with injuries from falling objects accounting for almost one-fifth of all injuries in each of these trades. In addition, 15% of the 844 laborers were struck by a falling object.

Fifty-two injuries were caused by electrical current. There were striking differences between the trades in the proportion of injuries that were caused by exposure to electrical current. Almost 9% of the electricians were injured as a result of such exposure, compared to 1.8% of all of the workers. The proportion of electrical-related injuries in the supervisor group was also above average.

Eye injuries (figure 8) are another example of an injury that varied substantially across trades. Overall, 11% of the injured construction workers were treated for eye injuries, compared with 19% of the injured plumbers, and 31% of the injured welders. Insulators, painters, supervisors, electricians, and roofers also had a higher percentage of eye injuries than did other trades.

Sixty-seven workers sustained burns, and there were dramatic differences in the proportions of burn injuries between the trades. Roofers (although a small trade group) had by far the largest fraction of burn injuries (20% of 51 cases). Of the 36 welders, 3 were treated for burns. Electricians were treated for twice the proportion of burn injuries than all workers as a whole. The causes of burns differed substantially by trade. For example, roofers were often splashed with hot tar, while electricians and supervisors were frequently burned by electrical current.

Forty-eight workers were treated for injury from a toxic exposure. Work-related health effects from toxic exposures—including poisoning, skin rashes, skin burns from caustic and corrosive materials, and breathing problems—are relatively uncommon when compared with work-related injuries, but they can be fatal. The proportion of workers treated for these problems varied substantially by trade. Brick, stone, and cement masons had the highest proportion of toxic exposure injuries, followed by plumbers and laborers. Carbon monoxide was the most common exposure, and such exposure occurred when workers used gas-powered jet washers, concrete saws, forklifts, and other combustion equipment in inadequately ventilated spaces.

Severe finger and hand injuries are shown in figure 9. Fingers and hands were the body locations most often injured among construction workers, accounting for one-third of the cases treated in the emergency room during this study. Approximately 15% of these finger and hand injuries were amputations, partial amputations, crushes, or fractures. A total of 68% of these injuries were lacerations, 12.5% were due to a fracture, 11% were due to a contusion or abrasion, and 8% were due to a sprain or strain. The following four trades had a substantially higher proportion of these injuries than the average for all workers: elevator mechanics (17% of all injuries); heavy equipment operators (9.5%); brick, stone, and concrete masons (8.5%); and plumbers (8.5%). [The small numbers for elevator mechanics and heavy equipment operators should, however, be interpreted cautiously.]

Discussion

We have presented data on construction workers treated in an emergency department in a large city in the United States. By looking at injury statistics by trade, we can see patterns of injury that reflect tasks in these trades and see which injuries dominate in each trade. Although many previous reports have described construction worker's injuries, very few have provided detailed data by trade. An important exception is an ongoing data collection effort by the Construction Safety Association of Ontario, Canada [Construction Safety

Association of Ontario. Injury Atlas, Ontario Construction: based on WCB injury reports from 1997 to 1999. Toronto, Ontario, Construction Safety Association of Ontario. Cited January 2004, url: http://www.csao.org.], which describes lost-time construction injuries for each trade in considerable detail.

The detailed causes of injury presented in table 2 show additional information that could be used to design solutions to prevent injury. We have also presented more detailed data on hospital admissions, falls, eye injuries, electrical injuries, and injuries to hands, wrists, and fingers. These outcomes were chosen because they proved to be frequent or severe. Some injuries are preventable, and presenting this data by trade shows which groups of workers should be targeted.

This injury-tracking project was based at the GWU Emergency Department, which is a large, urban hospital in Washington, DC. The types of construction in the surrounding downtown area are primarily new commercial construction, commercial renovation, and commercial maintenance. Much of the commercial construction is high-rise office and apartment buildings. There is also some road and bridge repair work, but very little residential construction. The types of construction projects influence the mix of trade specialties working downtown. The mix of trades, in turn, influences injury risk. When different sources of construction injury data are being compared, it is important that readers consider whether the types of construction projects are similar.

In this report, injuries were grouped by their causes into 1 of 10 general categories, such as falls, struck by object, and machinery-related. These causes-of-injury categories were based on "E-codes" that are part of the International Classification of Diseases and are commonly used to describe injuries and diseases in medical settings such as emergency departments. More-detailed categories were also used for grouping injuries by cause, diagnosis, and injured body part. Injuries are also frequently classified using the BLS system. These two classification systems are not directly comparable. For example, there is an E-code specifically for an injury by a cutting or piercing object, while, in the BLS system, these injuries are generally included in the "struck-against" group and are usually described as "contact with a sharp object". With E-codes, any injury involving machinery is coded in that category, which supersedes other groupings; under the BLS system, most of these injuries would be in "struck-by" or "caught in or between", and then identified as machine-related. Vehicular injuries are coded separately by E-code and included under "struck-by" in the BLS system. When the results of a study are interpreted, it is important to know which coding system was used.

The information sources that researchers have commonly used to describe nonfatal work-related injuries

Table 3. Injured body parts of 2916 injured construction workers treated for 3207 diagnoses. [a]

Injured body part	N
Ranking 1 (37% of all body parts)	
Laceration (N=1079)	
Finger or thumb	408
Hand or wrist	226
Face or head	195
Elbow or forearm	125
Ankle or foot	63
Knee, leg or hip	55
Shoulder or upper arm	4
Trunk	4
Ranking 2 (22% of all body parts)	
Sprain, strain, pain (N=649)	
Low or upper back	252
Ankle or foot	93
Knee, leg or hip	77
Neck	61
Shoulder or upper arm	56
Hand or wrist	54
Elbow or forearm	27
Trunk	27
Finger or thumb	22
Not specified	4
Ranking 3 (15% of all body parts)	
Contusion, abrasion, foreign object (excluding injuries of the eye) (N=446)	
Knee, leg or hip	92
Ankle or foot	61
Hand or wrist	56
Finger or thumb	51
Trunk	46
Face or head	43
Back	35
Shoulder or upper arm	31
Elbow or forearm	30
Multiple	18
Neck	7
Not specified	2
Ranking 4 (11% of all body parts)	
Eye injury (N=314)	
Ranking 5 (9% of all body parts)	
Fracture (N=253)	
Finger or thumb	73
Ankle or foot	59
Hand or wrist	44
Elbow or forearm	21
Trunk	21
Knee, leg or hip	16
Shoulder or upper arm	14
Face or head	13
Multiple	4

[a] Percentages are out of 2916 injured workers. The percentages will add to more than 100 because some injured workers had more than one diagnosis or injured body part.

and illnesses include annual employer survey data published by the Bureau of Labor Statistics (BLS), workers' compensation data, medical records from emergency departments, and employer injury logs. Injury profiles vary depending on where the data come from and what the definition of an "injury" is (3). In some cases,

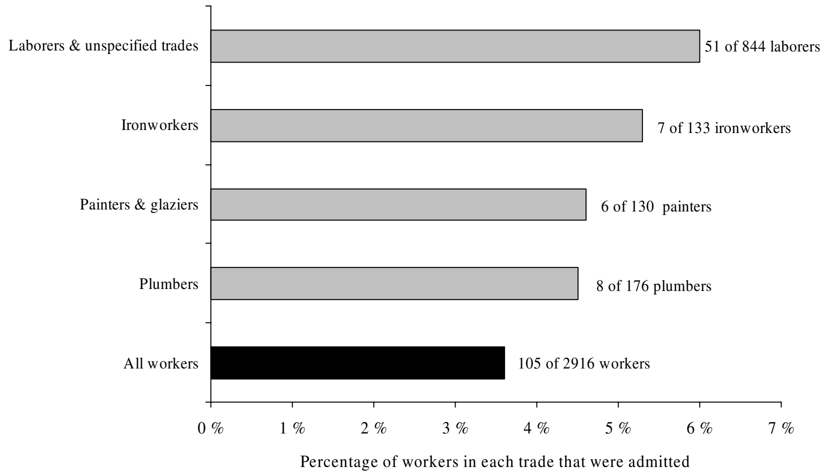

Figure 4. Percentage of injured workers in selected trades admitted to the hospital (105 out of 2916 injured workers were admitted to the hospital; George Washington University, Emergency Department, data, 1 November 1990–3 October 1997).

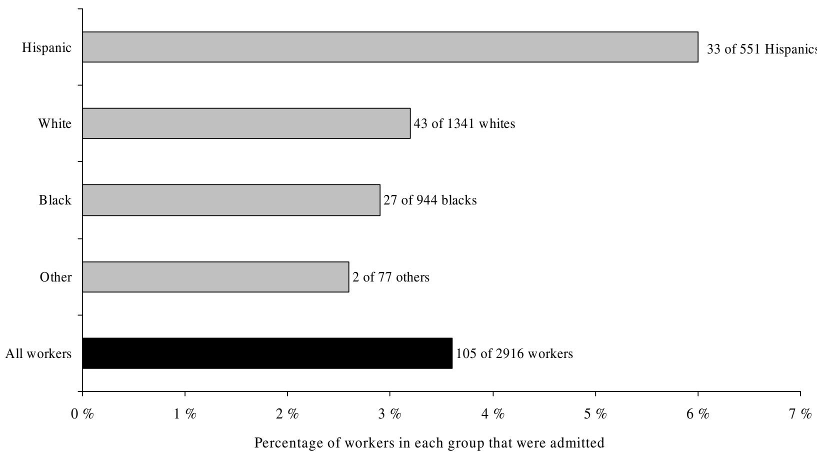

Figure 5. Percentage of injured workers in each ethnic group that were admitted to the hospital (105 out of 2916 injured workers were admitted to the hospital; George Washington University, Emergency Department, data, 1 November 1990–3 October 1997).

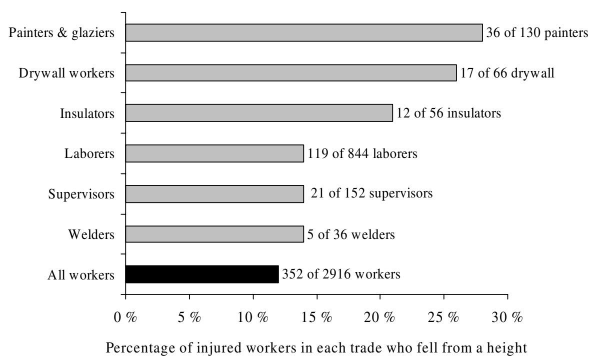

Figure 6. Percentage of injured workers in selected trades who fell from a height (352 out of 2916 injured workers fell from a height; George Washington University, Emergency Department, data, 1 November 1990– 3 October 1997).

medical reports from emergency departments will include the injuries of workers who would not show up in other sources of injury data. For example, people who are self-employed or do not take time off work as a result of their injury may be treated at the emergency department, even if they do not qualify for workers' compensation or show up in reports that count only lost-time injuries. In other cases, medical reports from emergency departments could exclude workers with less urgent injuries such as low-back pain and other pain and strains. As one might expect, a smaller proportion of the construction workers that were identified in the emergency department were treated for sprains and strains, as compared with the numbers in reports based on workers' compensation data or employers' injury logs (3). Despite this limitation, medical records from emergency departments are a rich resource from which to identify nonfatal injuries, and they are likely to capture virtually all injuries that require immediate medical attention. This data set also allows more detailed follow-back of subsets of injuries (4, 5).

Our data show differences in the proportion of all injuries and hospitalizations by trade. Laborers were the most likely to be hospitalized. The hypothesis of an increased risk of occupational injury and disease among construction laborers is not new (6–8). Common sense dictates that members of the basic construction trades are more likely to be delegated to less desirable jobs. Such jobs are more likely to be characterized by higher chemical and dust exposures, more heavy materials handling, and a higher risk of traumatic injury. More-detailed information on injuries among laborers from this dataset has been previously described (9).

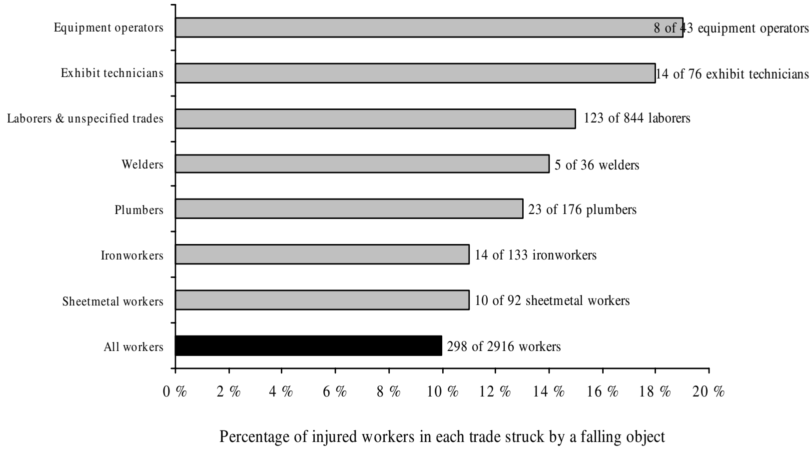

Figure 7. Percentage of injured workers in selected trades struck by a falling object (298 out of 2916 injured workers were struck by a falling object; George Washington University, Emergency Department, data, 1 November 1990–3 October 1997).

Figure 8. Percentage of injured workers in selected trades treated for eye injuries (314 out of 2916 injured workers were treated for an eye injury; George Washington University, Emergency Department, data, 1 November 1990–3 October 1997). Causes of injury: getting caught between objects (34), falling (32), being struck by a falling object (31), machinery-related (20), being struck by a moving object or striking against a stationary object (18), contact with a sharp object (16), overexertion (1), and vehicle-related (1).

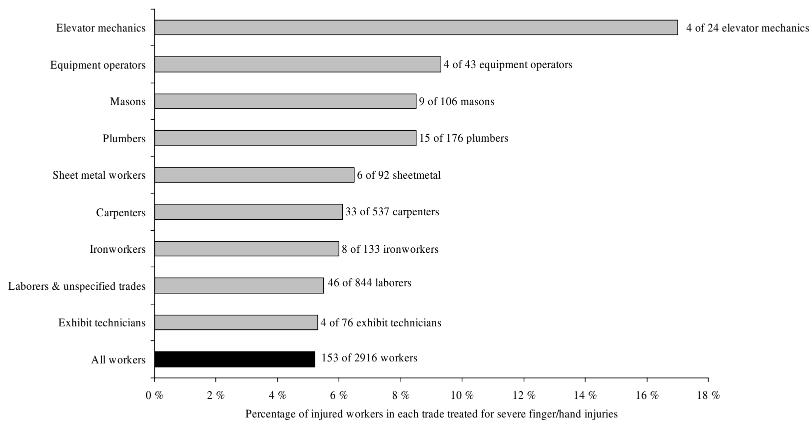

Figure 9. Percentage of injured workers in selected trades treated for amputations, crushes, or fractures to their fingers or hands (153 out of 2916 injured workers were treated for a severe finger or hand injury; George Washington University, Emergency Department, data, 1 November 1990–3 October 1997).

Hispanic workers were more likely to be hospitalized. We could not tell from these data whether Hispanic workers have more injuries overall, or a higher proportion of more serious injuries in particular. We know that Hispanic workers are over-represented in the more basic trades, which are often considered to be more dangerous. Hispanic workers may also otherwise be assigned more hazardous work. Alternatively, perhaps injured Hispanic workers are more reluctant to seek treatment for some of their less-serious injuries because of immigration status or other issues. If this were the case, a proportional analysis would show a higher percentage of hospitalized Hispanics. Historically, immigrants have been relegated to low-paying, dangerous jobs (10, 11), and the modern construction industry does not seem to be any different. We previously performed an analysis of our data to see if ethnicity was a significant risk for injury (12). We found that ethnicity was not a significant injury risk factor once we took into account the worker's trade and that trade is the best predictor of injury risk. Ethnicity is a "risk factor" for working in the more basic (and dangerous) trades in the first place.

Eye injuries (figure 8) are largely preventable by implementing and enforcing straightforward eye protection policies. Eye injuries from all causes form the leading cause of monocular blindness, and injuries cause 7% of binocular blindness in the 20–64 year age group (13). Studies of serious eye injuries report that 19–36% are work-related (14, 15). In 2001 there were about 7700 eye injuries among construction workers that involved days away from work. These eye injuries accounted for almost 4.2% of all lost-time injuries to construction workers and represent a lost-time eye injury rate of 12.7 per 10 000 full-time workers [Bureau of Labor Statistics, US Department of Labor. Workplace injuries and illnesses in 2001. Washington, DC, BLS/USDOL. Cited January 2004, url: http://www.bls.gov/iif]. In a Finnish study, the proportion of perforating eye injuries was highest in the construction industry as compared with other industries (16). Lipscomb et al (17) described work-related eye injuries among carpenters and reported that eye injuries accounted for 12% of all workers' compensation claims over a 6-year period. Eye injuries tend to occur among younger workers. In the study of penetrating eye injuries in the National Eye Trauma Registry, workers aged 20–40 years had 66% of these injuries, even though they made up only 29% of the total civilian labor force (14). Preventing serious eye injuries would have a life-long impact for these younger workers.

A detailed analysis of this dataset showed that eye-injury prevention programs are particularly needed for plumbers and welders (4). The worker activities most frequently associated with eye injuries among this group of workers were power-tool use, overhead work, and power-tool use by co-workers. Among our workers with eye injuries, we found that 56% were wearing some type of eye protection. Among this 56%, a high proportion were performing a task that they knew involved a high risk and the task often involved using power tools or working overhead. Yet only a third were using eye protection that had side, top, and bottom shields, and a third were wearing safety glasses with no shields. If we believe the injuries occurred because a particle or liquid passed between the glasses and the workers' faces, increased use of goggles or full shields would have prevented two-thirds of this group of injuries. The OSHA standard for construction, 29 CFR 1926.102, specifies standards for eye protection. This regulation requires the use of eye protection where a hazard exists, and it cannot be removed through engineering or administrative controls. The standard specifies which type of protective eye wear should be used for which type of hazard and refers to the appropriate standards of the American National Standards Institute for specification. Clearly, not all construction employers comply with this standard, and it may be that they are not aware of the useful data it contains on appropriate protection.

Electrical injuries are also, for the most part, preventable through changes in work practices and administrative oversight. Contact with electric current is a major cause of injury and death among construction workers (18–23). Electrocutions are the fourth leading cause of death among construction workers. A high proportion of workers injured by electrical current in this study were admitted to the hospital. In a detailed analysis of these electrical injuries and data from the Census of Fatal Occupational Injuries, we found that direct or indirect contact with energized electrical wiring was the major cause of electrical injuries and deaths of electrical workers (5). For nonelectrical workers, the major causes of electrical injuries and deaths were contact with overhead power lines, direct or indirect contact with energized electrical wiring and equipment, and contact with defective electrical appliances and machinery. The adoption of a lockout or tag-out standard for the construction industry in the United States, as exists for general industry, could prevent many electrical deaths of both electrical and nonelectrical construction workers.

Severe finger and hand injuries were highlighted because they are frequent and can be disabling. Fingers and hands are the body locations most often injured among construction workers, accounting for one-third of the cases treated in the emergency room during this study. Altogether 68% of these injuries were lacerations, 12.5% were due to a fracture, 11% were due to a contusion or abrasion, and 8% were due to a sprain or strain. In 2001 in the United States, injuries involving the finger and hand–wrist comprised 17.3% and 19.5% of nonfatal injuries with days away from work for all private industry, and among construction workers, respectively [Bureau of Labor Statistics, US Department of Labor. Workplace injuries and illnesses in 2001. Washington, DC, BLS/USDOL. Cited January 2004, url: http://www.bls.gov/iif/]. Thirteen percent of lost time injuries among construction workers in Ontario were to hands or wrists as well. Figure 9 presents the distribution of the most severe of these injuries by trade.

We recommend that other investigators establish ongoing surveillance systems that track injury by trade and collect detailed information on injury circumstances. The Construction Safety Association of Ontario has developed a model for such a system, collecting detailed information on lost time injuries. They find that the more important factors are the nature of the injury, body part injured, project type, construction type, activity type, and work surface. Activities are employee activity (what he was doing), acted upon (materials or equipment being changed, such as lumber, earth, scaffold), and acted with (materials or equipment used to do the activity, such as saw or forklift). This report, and the one from the Construction Safety Association of Ontario [Construction Safety Association of Ontario. Injury Atlas, Ontario Construction: Based on WCB Injury Reports from 1997 to 1999. Toronto, Ontario, Construction Safety Association of Ontario. Cited 2004, url: http://www.csao.org.], illustrate how detailed injury data can outline the appropriate steps needed to prevent future occurrence of the same injuries.

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