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Occupational Injuries among Construction Workers Treated at the George Washington University Emergency Department, 1990-97

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Abbreviations

BLS	**U.S. Bureau of Labor Statistics**
GWU	**George Washington University**
NOS	**Not otherwise specified**
OSHA	**U.S. Occupational Safety and Health Administration**
SOC	**Standard Occupational Classification**

Summary

TO LEARN more about the causes of nonfatal injuries affecting construction workers, and in order to identify injury patterns for further investigations and prevention programs, an injury tracking program was established in 1990. The program was motivated, in part, by the high rate of nonfatal injuries in the construction industry and a lack of specific information that describes the causes of these injuries.

Each week from November 1990 through December 1998, a member of the research team reviewed all of the hospital registration forms at the George Washington University (GWU) Emergency Department in Washington, D.C. The demographic and injury information for patients listing a construction occupation was copied onto a standardized form. All personal information was kept confidential.

This report profiles the first seven years of injury tracking, from November 1, 1990 through October 31, 1997. During this period, 2,637 construction workers visited the emergency room a total of 2,916 times. Each injured worker was categorized into one of 16 groups by trade (occupation). The information on demographics, cause of injury, diagnosis, and injured body part was grouped into categories in order to examine injury patterns. Although 279 workers visited the emergency room more than once in the seven years studied, the focus of this report is on each injury case. Thus, this report refers to ‘2,916 injured ‘workers.”

The introductory section of this chart book details the background and methods of this research project. Along with charts that provide an overview of demographics and injuries of the inured workers, charts cover the 105 workers who were admitted to the hospital and their injuries. Trade-specific charts follow, with accompanying text that draws attention to any trade-specific injury trends and recommends ways to reduce injuries in each trade. The inside back cover provides a guide to interpreting the charts.

The results of follow-up with injured workers and their families to determine short- and long-term effects of the injuries are reported elsewhere.

Contents

Background and Methods

CONSTRUCTION is a dangerous industry, with high rates of fatal and nonfatal injuries. In order to learn more about the causes of nonfatal injuries affecting construction workers and to identify injury trends for further investigations and prevention programs, an emergency department-based injury tracking program was established in 1990. The program was motivated, in part, by the high rate of nonfatal injuries in the construction industry and a lack of specific information about the causes of the injuries. This report profiles construction workers' injuries that were identified on hospital registration forms at the George Washington University Emergency Department in Washington, D.C., from November 1, 1990 through October 31, 1997.

Each week, a member of the research team reviewed all of the hospital registration forms to identify injured workers in all construction occupations. Included was any worker whose job title was coded by the 1980 Standard Occupational Code (U.S. Department of Commerce) as "construction trades," "construction laborers," "construction helpers," "construction managers," "construction supervisors," "construction inspectors," "sheetmetal workers," or "elevator installers and repairers." Thus, the list included construction tradespeople employed by non-construction-industry employers, such as maintenance painters, carpenters, electricians, and plumbers employed primarily by government agencies, educational institutions, and museums or theaters. Finally, some other job titles, such as, "welders" and "material moving equipment operators," were included if they appeared (from the employer name) to be engaged in construction work (*see* table 1).

Table 1. Standard Occupational Classification (SOC) criteria for including and grouping job titles

SOC code	SOC category description	Trade group for analysis
121	General managers and top executives	Supervisors
133	* Construction managers *[see* note a]	Supervisors
1472	* Construction inspectors	Supervisors
161	Architects	Supervisors
162-3	Engineers	Supervisors
616	Heating, air conditioning, and refrigeration mechanics	Sheet Metal Workers
6176	* Elevator installers and repairers	Elevator Constructors & Mechanics
6179	Mechanics and repairers, NEC (only sprinkler fitters)	Plumbers & Sprinkler Fitters
631x	* Supervisors, construction	Supervisors
641x	* Brick masons, stone masons, and hard tile setters	Brick, Stone, & Concrete Masons
6422	* Carpenters [*see* note b]	Carpenters & Carpet Layers OR Exhibit Technicians
6424	* Drywall installers	Drywall & Plaster Workers
6432	* Electricians	Electricians
6433	* Electrical power installers and repairers	Electricians

Table 1. Standard Occupational Classification (SOC) criteria for including and grouping job titles (continued)

SOC code	SOC category description	Trade group for analysis
6442	* Painters	Painters & Glaziers
6443	* Paperhangers	Painters & Glaziers
6444	* Plasters	Drywall & Plaster Workers
645	* Plumbers, pipefitters and steamfitters	Plumbers & Sprinkler Fitters
6462	* Carpet and soft tile installers	Carpenters & Carpet Layers
6463	* Concrete and terrazzo finishers	Brick, Stone, & Concrete Masons
6464	* Glaziers	Painters & Glaziers
6465	* Insulation workers	Asbestos & Insulation Workers
6466	* Paving, surfacing, and tamping equipment operators	Heavy Equipment Operators
6468	* Roofers	Roofers & Waterproofers
6472	* Sheetmetal duct installers	Sheet Metal Workers
6473	* Structural metal workers	Ironworkers
6474	* Drillers, earth	Heavy Equipment Operators
6475	* Air hammer operators	Laborers
6476	* Pile driving operators	Heavy Equipment Operators
6479	* Construction trades, not elsewhere classified	Laborers
6814	Boilermakers	Welders & Boilermakers
6824	* Sheet metal workers	Sheet Metal Workers
6832	Cabinet makers and bench carpenters	Carpenters & Carpet Layers
7633	Sawing machine operators and tenders	Carpenters & Carpet Layers
7714	Welders and cutters	Welders & Boilermakers
821	Motor vehicle operators	Heavy Equipment Operators
831	Material moving equipment operators	Heavy Equipment Operators
864	* Helpers, construction trades	With Respective Trade
871	* Construction laborers	Laborers
872	Freight, stock, and material movers –hand	Laborers
other	Non-construction trades injured on construction sites [*see* note c]	Laborers

* Category includes every injured worker, whether or not employer was a construction company; other categories included only injured workers whose employer was engaged in construction work.

a. "Construction managers" include 9 self employed contractors with no trade specified; self-employed managers who specified a trade were coded with that trade.

b. Carpenters and technicians who did exhibit work (for conventions) 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/exhibit work in the area.

c. Non-construction trades workers injured on construction sites included 1 emergency medical technician, 2 security guards, and 3 elevator operators.

Injuries were determined to be work-related based on a combination of data in the medical record: the patient's initial complaint, 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, or the physician's check in a box labeled "work-related."

During the seven years of data collection reported here, 2,916 visits to the Emergency Department were made by 2,637 injured construction workers, and 3,207 diagnoses were recorded among those visits for this study. Three workers were fatally injured. Although some workers visited the emergency room more than once in the seven years studied, this report focuses on each injury case. Thus this report refers to the total set of cases as "2,916 injured workers."

The following data were collected from the medical chart of each construction worker with a work-related condition (if available): 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. The George Washington University Committee on Human Research approved this project and all personal information has been kept confidential. Occupation was coded according to 1980 Standard Occupational Classification (SOC) codes. Diagnosis codes and cause-of-injury codes (E-codes) were assigned according to the International Classification of Diseases, 9th Revision (ICD-9).

Data collection was continuous except for July through December 1994, when only two groups of injuries were recorded: those from one large local construction project, and those serious injuries that required the services of the emergency department trauma team. During the 6 months of partial data collection, about 200 cases were probably missed.

In 1994 at the midpoint of this project, approximately 9,000 construction workers were employed in the District of Columbia and about 113,000 were employed in the area (including surrounding Maryland, Virginia, and West Virginia counties). (*See* a Bureau of Labor Statistics website, Non-Farm Wage and Salary Employment.) However, it is not known how many of these people work downtown and, if injured, would be treated at a downtown hospital such as George Washington University (GWU). Furthermore, GWU's emergency department is only one of several emergency departments in downtown Washington. Because of this, injury rates cannot be calculated and the analyses are based on the <u>percentage</u> or <u>proportion</u> of construction injuries that were treated at GWU. Similarly, it is not known types of construction work done near GWU – or injuries treated at the emergency department – reflects the pattern of work and injuries for each trade or all construction.

For the trades that are represented by fewer than 70 injured workers (an average of fewer than 10 each year), selected injury causes, diagnoses, and injured body parts are profiled on a single chart (chart A in each section). Among these trades, some injuries or

diagnoses were infrequent, and it is not possible to present a reliable percentage; those outcomes are not displayed. The accompanying list of injury causes (chart B) and diagnoses (chart C) is comprehensive.

Comparison to Other Construction Injury Research

This injury tracking project is based at the George Washington University Emergency Department, which is a large hospital in Washington, D.C. Because the data come from one location, and because they are based on emergency room visits, the information presented here will look different from reports based on other data sets and other data collection methods. When comparing different sources of construction injury data, it is important to consider whether the types of construction projects and the data sources are similar.

Construction near the hospital is mainly 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 tasks and trades, in turn, influences injury risk.

Injury profiles vary, depending on where the data come from and how "injury" is defined. In some cases, emergency department medical reports include the injuries of workers who wouldn't show up in other sources of injury data. For example, this project includes workers who didn't lose time from work as a result of their injuries, these same workers might not qualify for workers' compensation or show up in reports that count only lost-time injuries. On the other hand, emergency department data might not capture workers with less-urgent injuries, such as low-back pain and other sprains and strains. Different sources of information will describe different pieces of the pie, in terms of the proportion of construction workers who are injured on the job and the types of injuries they suffer. For example, a worker might go to a family doctor for a knee that won't stop aching, but he or she will go the emergency department for an amputated finger. Despite this limitation, emergency department medical records are a rich resource for identifying nonfatal injuries and are likely to capture virtually all injuries that require immediate medical attention.

As one might expect, a smaller proportion of the construction workers who were identified in these emergency department data were treated for sprains and strains, as compared to other reports that were based on workers' compensation data or employers' injury logs (*see* Hunting and others 1999; also *see* Welch and Hunting 2003).

The information sources that researchers have commonly used to describe nonfatal work-related injuries and illnesses include annual employer survey data published by the Bureau of Labor Statistics (BLS), workers' compensation data, emergency department medical

records, and employer injury logs (*see* the BLS website; Culver, Marshall, and Connolly 1992; and Brown and Connolly 1992). *The Construction Chart Book* profiles construction injuries using these and other sources (CPWR 2002).

In this report, injuries have been grouped by their causes into one of 10 general categories such as "falls," "struck by object," and "machinery related." These cause of injury categories are 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 are also used for grouping injuries by cause, diagnosis, and injured body part. The reader should be aware that other coding systems exist. For example, the Bureau of Labor Statistics has its own system. When interpreting the results of a study, it is important to know which coding system was used.

Although many previous reports have described construction worker injuries, very few have provided detailed data by trade. An important exception is a 1995 injury atlas from the Construction Safety Association of Ontario, Canada, which described lost-time construction injuries for each trade in detail. The atlas has been updated; see **www.csao.org**. This chart book has in many ways been modeled on the Ontario report; our hope is that it will be as valuable for establishing trade-specific prevention priorities.

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Injury Profiles for All Construction Workers

IN SEVEN YEARS, information was collected on a total of 2,916 visits by construction workers to the emergency department for work-related injuries. Two hundred and seventy-nine of the visits were made by workers who were treated more than once on different occasions for different injuries. In this report, each hospital visit is counted as a separate injury case and, for simplicity, the total set of cases is referred to as '2,916 injured workers."An overview of the injuries and injured is presented in charts 1-A through 1-Q.

Demographic characteristics (charts 1-A through 1-C): The injured workers were generally young; two of every three workers were under the age of 40. Just over half of the injured workers were members of ethnic minorities. The hospital categorized each worker as Hispanic (which includes black and white), non-Hispanic black, and non-Hispanic white. Only 3% of the injured workers were female. For statistical analysis, construction workers who didn't specify a trade were grouped with laborers, with the result making up the largest group –29% of injured workers. Some trades that pe rform similar work were grouped together for analysis. For instance, maintenance carpenters, electricians, plumbers, and painters were grouped with their construction counterparts. Exhibit technicians were assigned to their own group because their tasks were considered to be unique.

Causes of injury (charts 1-D and 1-E): The leading cause of injury was contact with cutting or piercing objects –most often pieces of metal, razors and knives, power tools, and nails.

Injury diagnoses and body parts (charts 1-F through 1-H): About 10% of the workers had two injury diagnoses, sometimes to different parts of the body; for instance, a worker might have been treated for a bruised arm and a strained shoulder following a fall. Because of this, some workers are counted in more than one category and the percentages add to more than 100.

About one in three workers was treated for a laceration (cut). Of the workers treated for strains, sprains, or musculoskeletal pain, almost 40% had a back injury.

Hospital admissions (charts 1-I through 1-L): Over this seven-year period, 105 workers had injuries that were serious enough to require inpatient admission to the hospital –3.6% of all visits. Three workers died from their injuries; these cases are included here. While about 60% of the workers admitted to the hospital had short stays of one or two days, the remaining workers had lengthy stays –several longer than a month. The percentage of injuries admitte d to the hospital varied substantially among trades and by ethnicity or race.

The large proportion of Hispanic workers admitted to the hospital might be because that group is over-represented in the more basic trades, which are often considered to be more dangerous, or may 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 (s*ee* Anderson, Hunting, and Welch 2000).

Selected injuries and circumstances by trade (charts 1M through 1S): The injury patterns reflect the job tasks and hazards and provide a starting place for deciding how to make the job safer. More detail for each of these types of injury can be found in the trade-specific injury profiles. Except on charts 1-M, 1-N, and 1-P, the injuries that are highlighted are fairly uncommon within most trades. Thus these analyses are based on small numbers of injuries, and should be interpreted cautiously.

Of the 498 construction falls that were treated at the GWU Emergency Department, 352 were falls from a height. These falls from a height are highlighted because of their potentially serious consequences. The remaining 146 workers had either fallen from the same level or had fallen in unspecified circumstances; they are excluded from this chart. The nature of the falls, along with possible prevention strategies, are described in the injury profiles for each trade (*see* Gillen, Faucett, Beaumont, and McLoughlin 1997).

Injuries caused by a falling object are highlighted, largely because of the serious potential outcomes. One-tenth of the 2,916 construction workers were struck by a falling object.

Injuries caused by electrical current are highlighted because of the potential for a worker to be killed and because such a high proportion of these workers was admitted to the hospital. There were striking differences among the trades in the proportion of injuries that were caused by exposure to electrical current.

Eye injuries are highlighted because they are largely preventable by implementing and enforcing straightforward eye protection policies. Developing eye injury prevention programs should be a priority (*see* Lipscomb, Dement, McDougall, and Kalat 1999, and Welch, Hunting, and Mawudeku 2001).

Burns are highlighted because they can be serious and there were dramatic differences in the proportions of burn injuries among the trades. Also, the causes of burns differ substantially by trade. For instance, roofers are often splashed with hot tar, while electricians and supervisors are frequently burned by electrical current.

Toxic exposures are highlighted because, like electrical exposures, they can be fatal. Work-related health effects from toxic exposures –including poisoning, skin rashes, skin burns from caustic a nd corrosive materials, and breathing problems –are relatively uncommon compared to work-related injuries. The proportion of workers treated for toxic exposures varied substantially by trade. Carbon monoxide was the most common exposure and occurred when workers used gas-powered jet washers, concrete saws, forklifts,

and other combustion equipment in inadequately ventilated spaces (see Nessel-Stephens and others 1995). Many construction workers with these types of problems will not seek emergency treatment and may, instead, visit their family doctor or not seek treatment at all.

Severe finger and hand injuries are highlighted because they can be disabling. Fingers and hands are the body parts most often injured among these construction workers, accounting for one-third of cases treated in the emergency room during this study. Approximately 15% of these finger and hand injuries were amputations, partial amputations, crushes, and fractures. (Because of small numbers, the information for elevator mechanics and heavy equipment operators should, however, be interpreted cautiously.)

Chart 1-A

2,916 injured construction workers

Age of injured workers

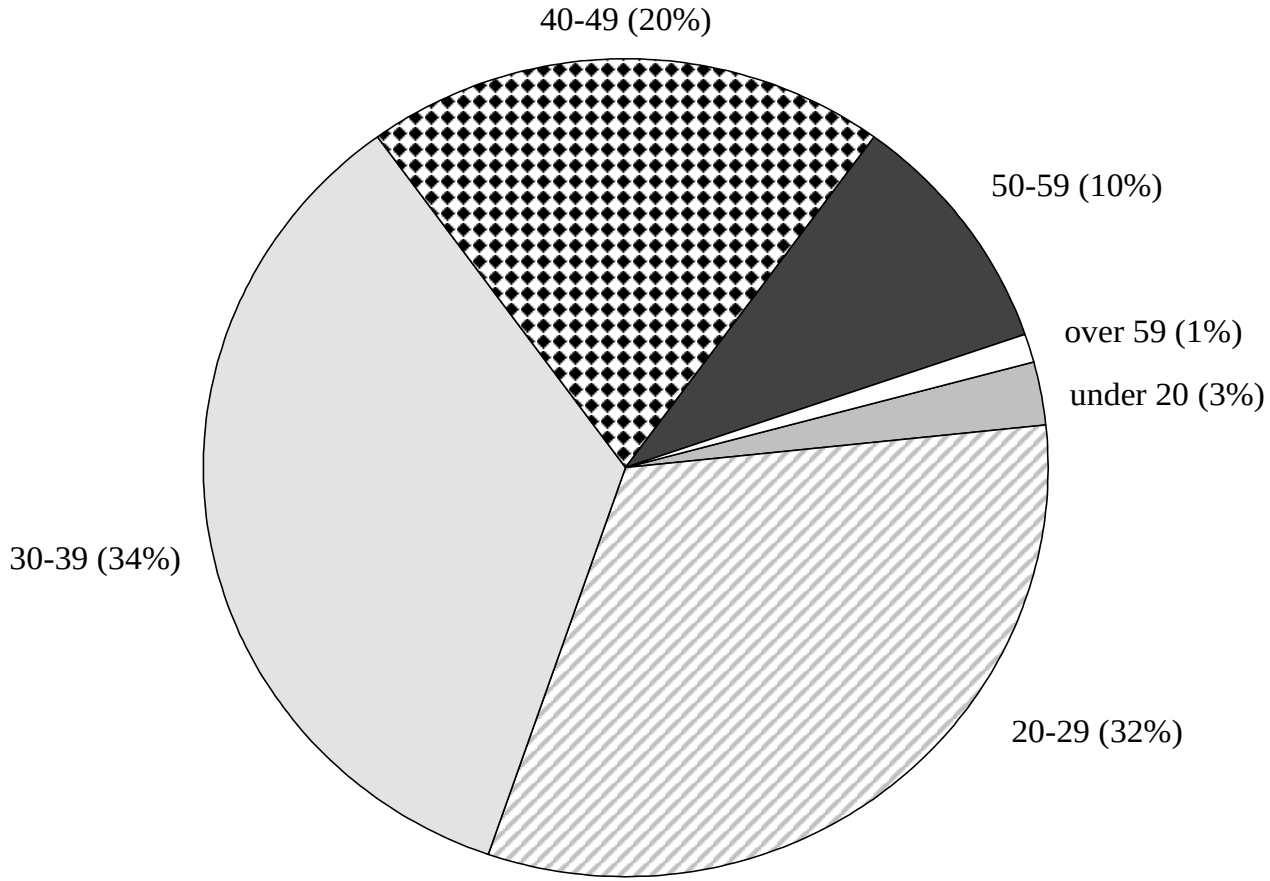


Chart 1-B

2,916 injured construction workers

Ethnicity and race of injured workers

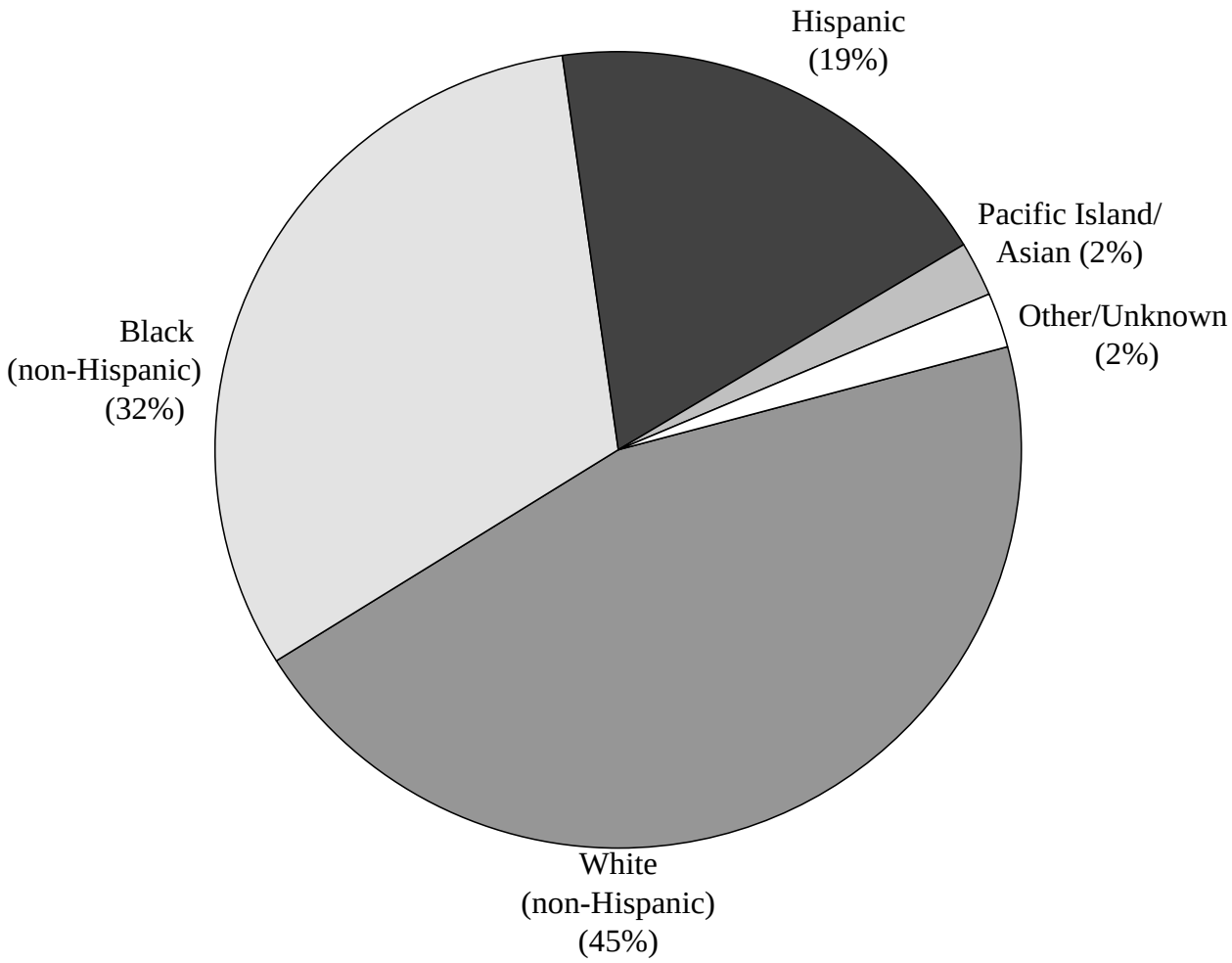


Chart 1-C

2,916 injured construction workers

Trades of injured workers

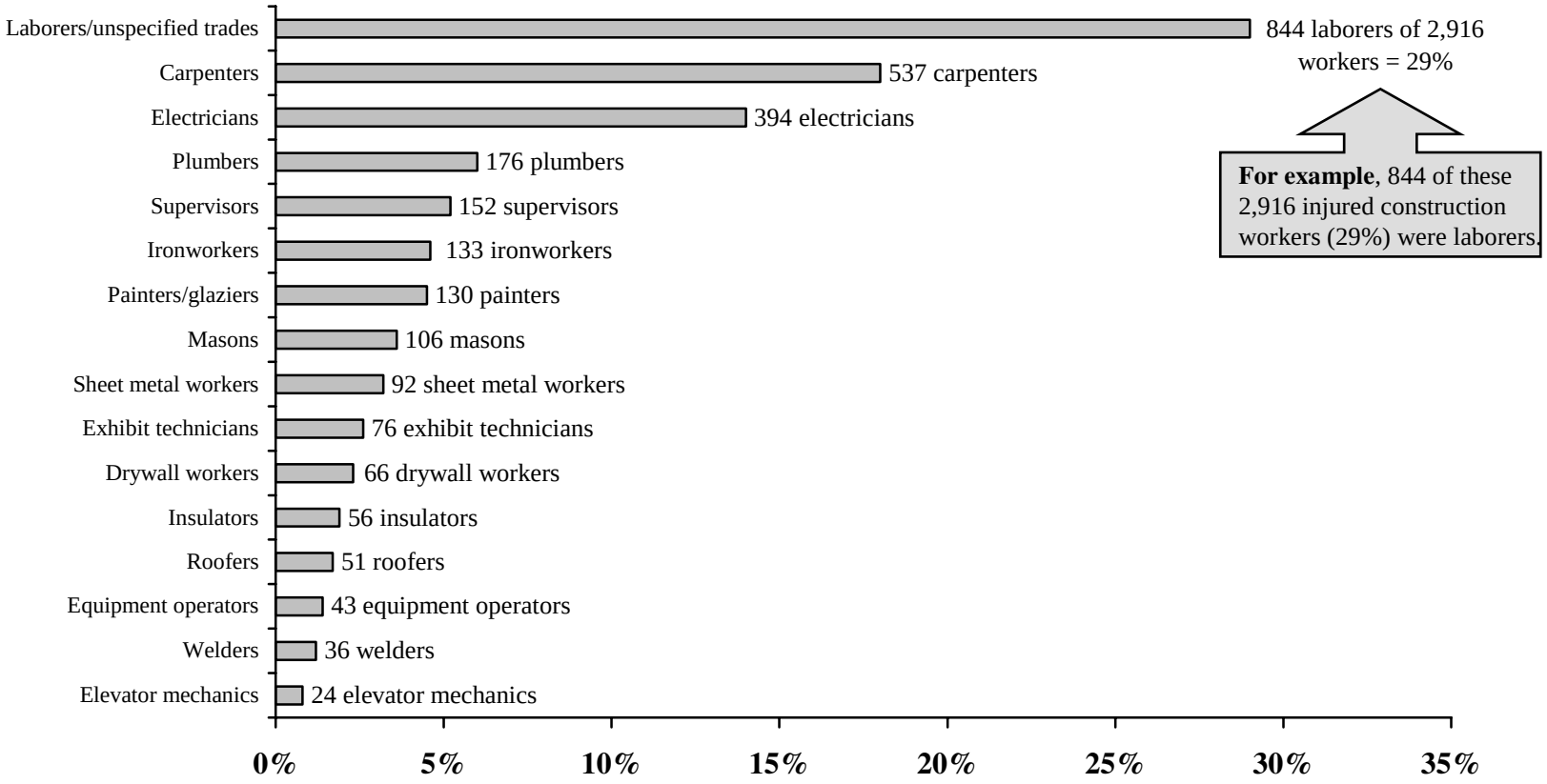
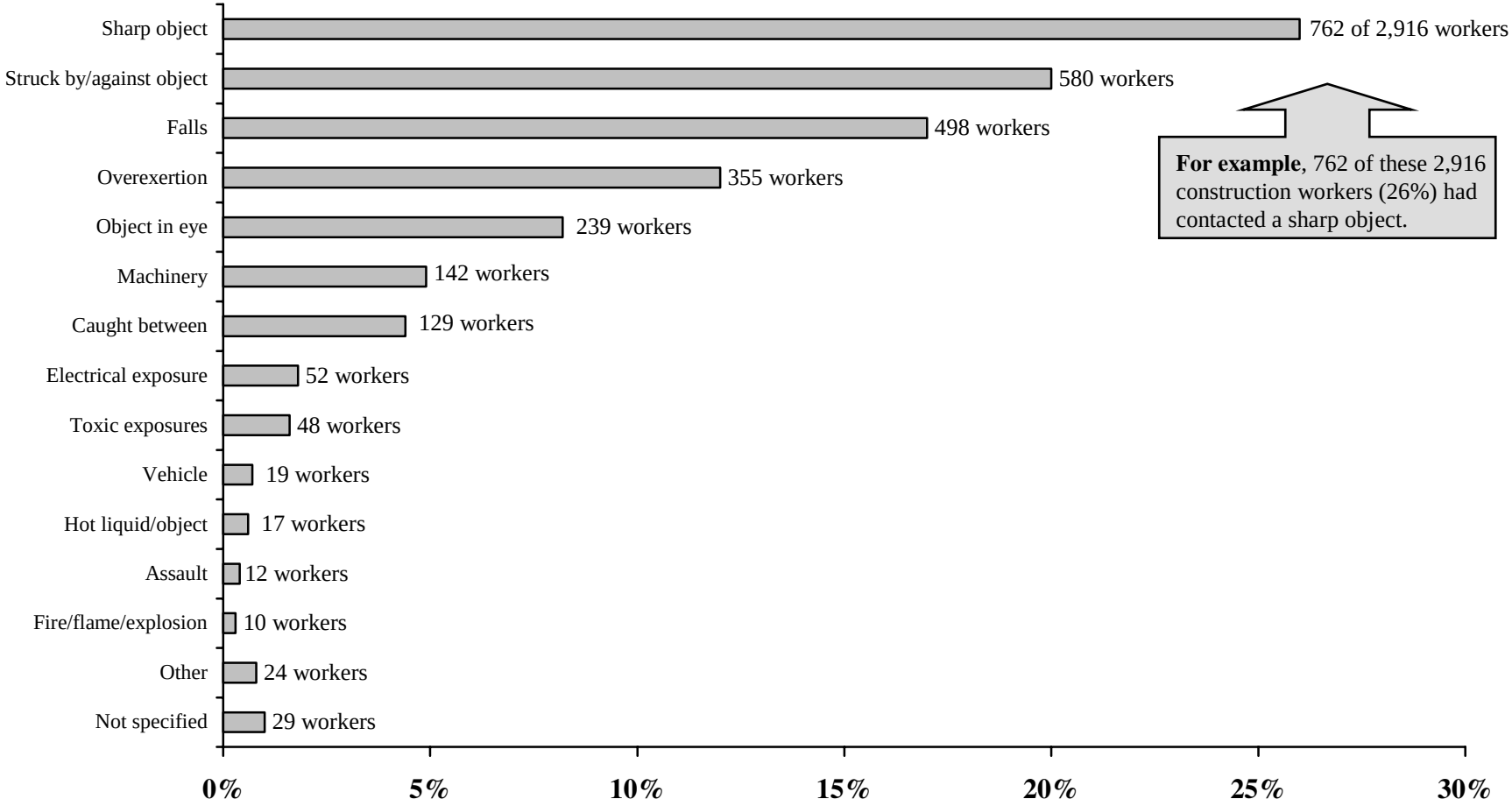


Chart 1-D

2,916 injured construction workers

Causes of injury



Percentage of all injured workers by cause of injury

Chart 1-E

2,916 injured construction workers

Detailed causes of injury, rank 1-3

RANK #1	26%
SHARP OBJECT	**762**
metal/sheetmetal/duct	170
razor/knife	128
power tool, incl. saw (25), drill (18), screw gun (17), nail gun (13)	92
nail/screw	78
hand tool, incl. hacksaw (12), chisel (8)	48
metal stud	40
cable/wire	36
glass	34
light fixture	21
wood/splinter	17
saw (unspecified type)	13
ceramic/ceiling tile	10
metal bar/rebar	9
pipe	9
metal ceiling frame	8
other	32
not specified	17

RANK #2	20%
STRUCK BY/AGAINST OBJECT (INCL. FALLING OBJECT)	**580**
pipe	52
board/wood	46
beam	44
metal/sheetmetal/duct	39
hammer/sledge	33
metal object/plate	36
scaffold	26
ceiling/wall	25
rebar/metal bar	24
cinder block/brick/stone	17
granite/marble/stone	16
hand tool, other than hammer	15
door	14
concrete/cement	13
drill	13
drywall/plaster	13
box/crate/toolbox	12
power tool, other than drill	12
wire/cable	11
light fixture	7
cart/dolly	6
door jamb/doorway	5
truck	5
table	4
other	64
not specified	28

RANK #3	17%
FALL	**498**
from ladder	135
slip/trip/stumble	99
from scaffold	80
from another level	59
from stairs	30
out of a building/structure	26
into a hole	21
not specified	48

Note: Only the more common causes of injury are listed.

Chart 1-E, continued
2,916 injured construction workers
Detailed causes of injury, rank 4-6

RANK #4	12%
OVEREXERTION / STRENUOUS MOVEMENT	**355**
lifting/carrying	193
pushing/pulling	32
stepping on/off, walking	24
bending over	10
while drilling	9
using hammer/sledge	7
stopping a fall/falling object	6
overhead	4
using jackhammer	4
other	36
not specified	30

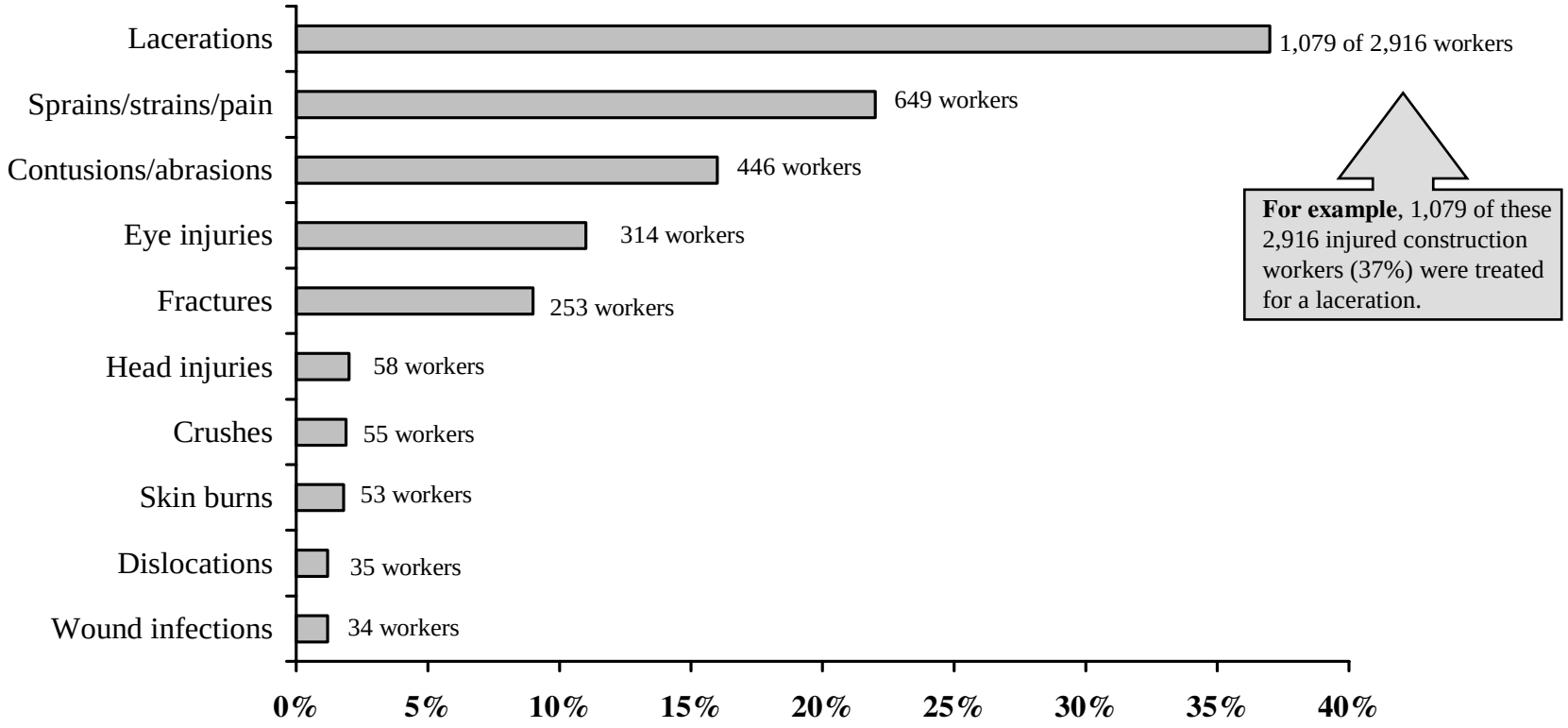
RANK #5	8%
OBJECT IN EYE	**239**
concrete/cement (dust or wet)	53
metal dust	39
chemical	25
dirt/dust/debris	24
drywall/plaster	12
paint (dust or wet)	11
wood dust	10
insulation	9
rock/stone/gravel	6
ceiling tile	5
other	11
not specified	34

RANK #6	5%
MACHINERY RELATED	**142**
power saw (woodworking)	32
grinder	18
welder/solderer	17
crane	13
forklift	10
bobcat/front-end loader	8
air compressor	7
elevator	5
other: lifting machine	9
woodworking machine	6
metalworking machine	4
miscellaneous	7
not specified	6

Chart 1-F

2,916 injured construction workers treated for 3,207 diagnoses

Top ten injury diagnoses

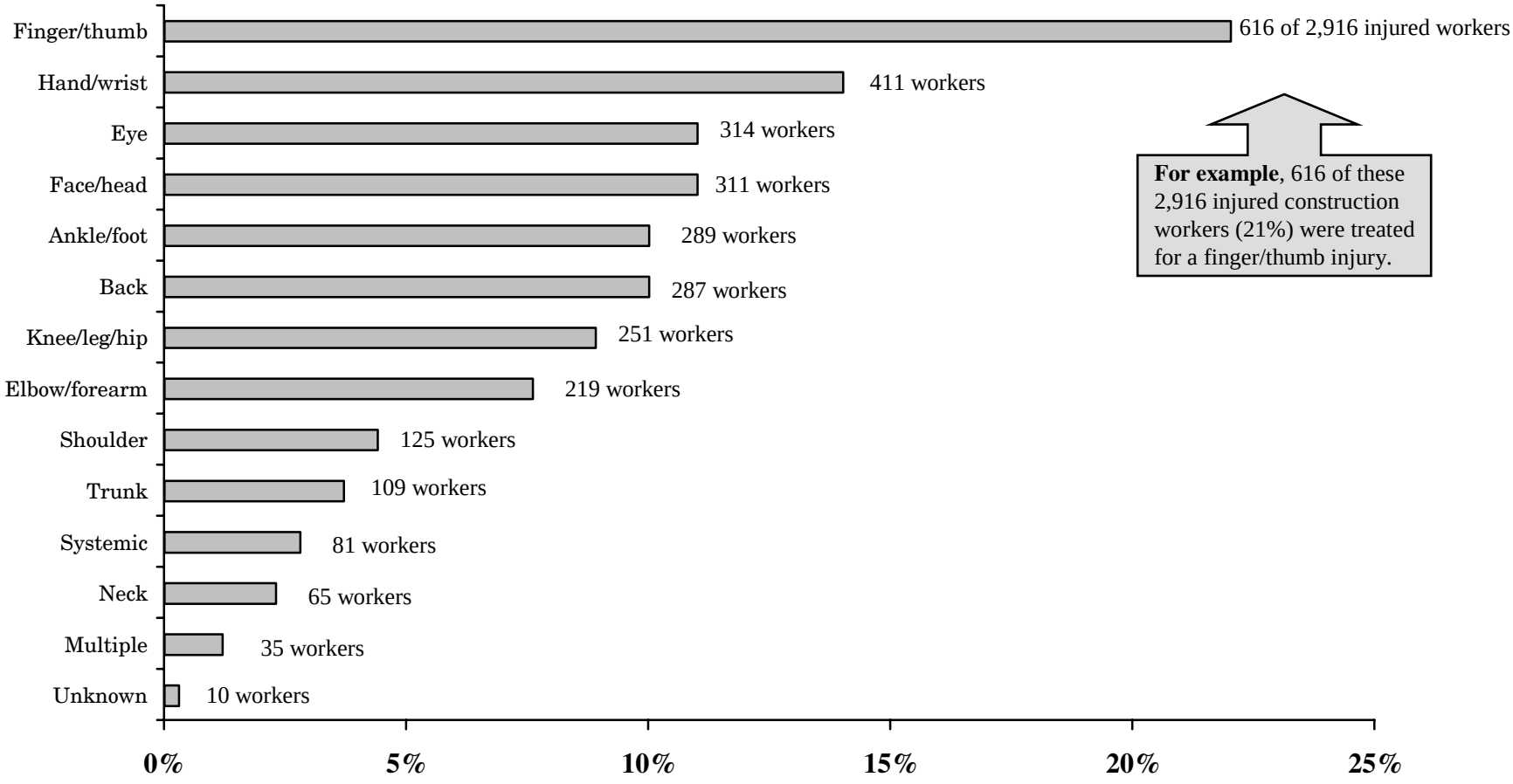


*Note: Percentages add to more than 100 because some injured workers had more than one diagnosis.

Chart 1-G

2,916 injured construction workers treated for 3,207 diagnoses

Injured body parts



Percentage* of all 2,916 workers with injured body part

*Note: Percentages add to more than 100 because some injured workers had more than one diagnosis/injured body part.

Chart 1-H

2,916 injured construction workers treated for 3,207 diagnoses

Injured body parts for selected diagnoses*

RANK #1	37%
LACERATION	**1,079**
finger/thumb	408
hand/wrist	226
face/head	195
elbow/forearm	125
ankle/foot	63
knee/leg/hip	55
shoulder/upper arm	4
trunk	4

RANK #2	22%
SPRAIN, STRAIN, PAIN	**649**
low/upper back	252
ankle/foot	93
knee/leg/hip	77
neck	61
shoulder/upper arm	56
hand/wrist	54
elbow/forearm	27
trunk	27
finger/thumb	22
not specified	4

RANK #3	15%
CONTUSION, ABRASION, FOREIGN OBJECT (excl. eye)	**446**
knee/leg/hip	92
ankle/foot	61
hand/wrist	56
finger/thumb	51
trunk	46
face/head	43
back	35
shoulder/upper arm	31
elbow/forearm	30
multiple	18
neck	7
not specified	2

RANK #4	11%
EYE INJURY	**314**

RANK #5	9%
FRACTURE	**253**
finger/thumb	73
ankle/foot	59
hand/wrist	44
elbow/forearm	21
trunk	21
knee/leg/hip	16
shoulder/upper arm	14
face/head	13
multiple	4

* Percentages are out of 2,916 injured workers. Some injured workers have more than one diagnosis/ injured body part.

Chart 1-I

Percentage of injured workers in selected trades admitted to the hospital

(105 of 2,916 injured workers were admitted to the hospital)

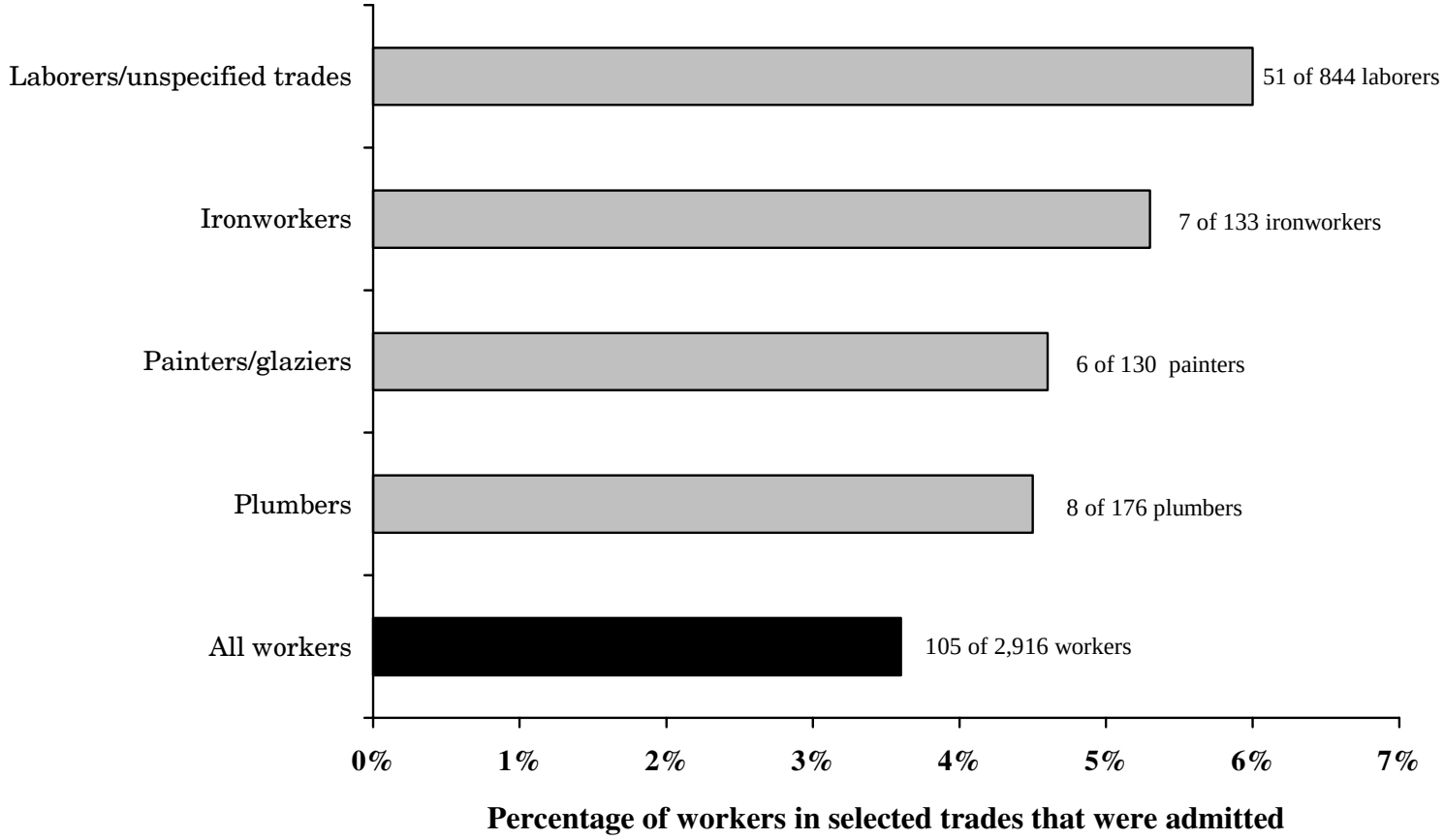
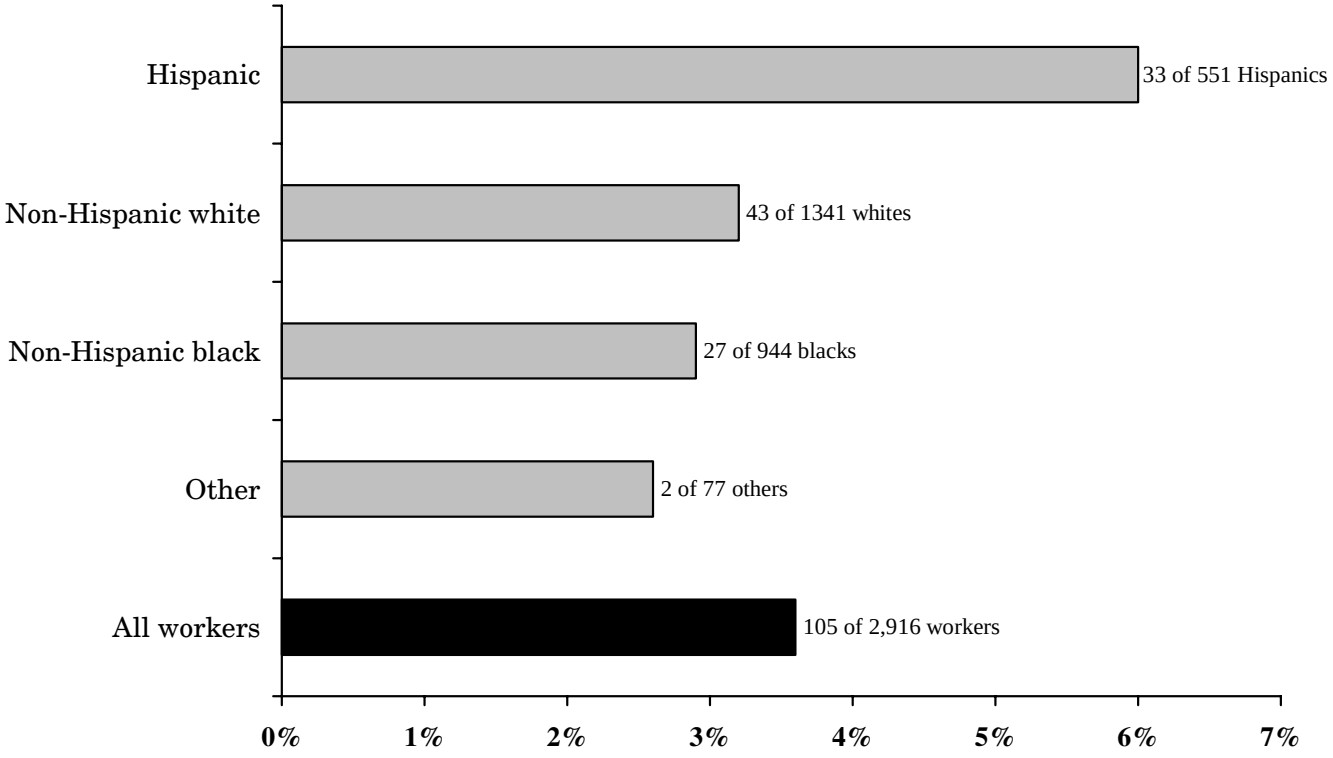


Chart 1-J

Percentage of injured workers in each ethnic or racial group admitted to the hospital

(105 of 2,916 injured workers were admitted to the hospital)



Note: Hispanic includes white and black.

Chart 1-K

Causes of injury for 105 workers admitted to the hospital

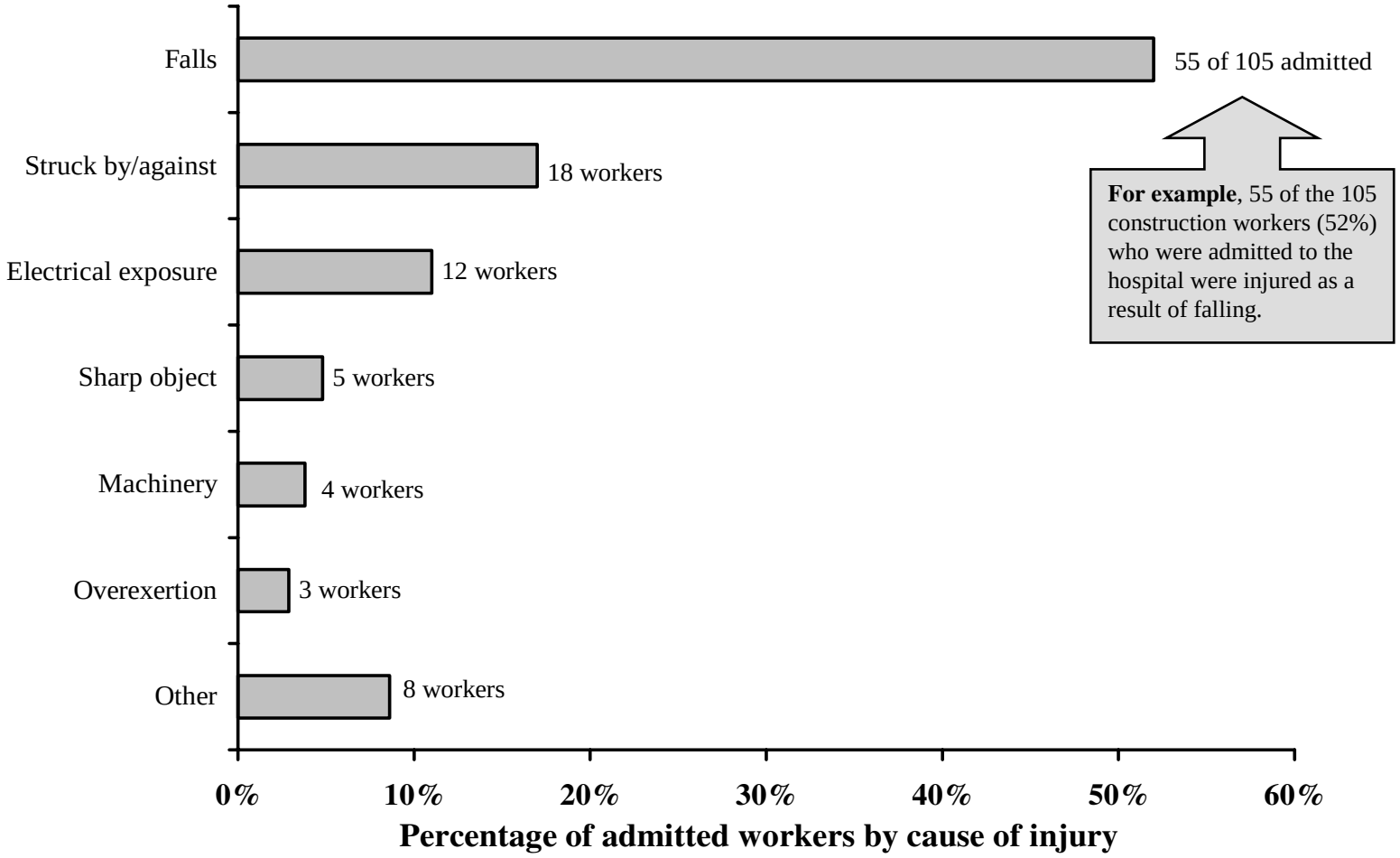
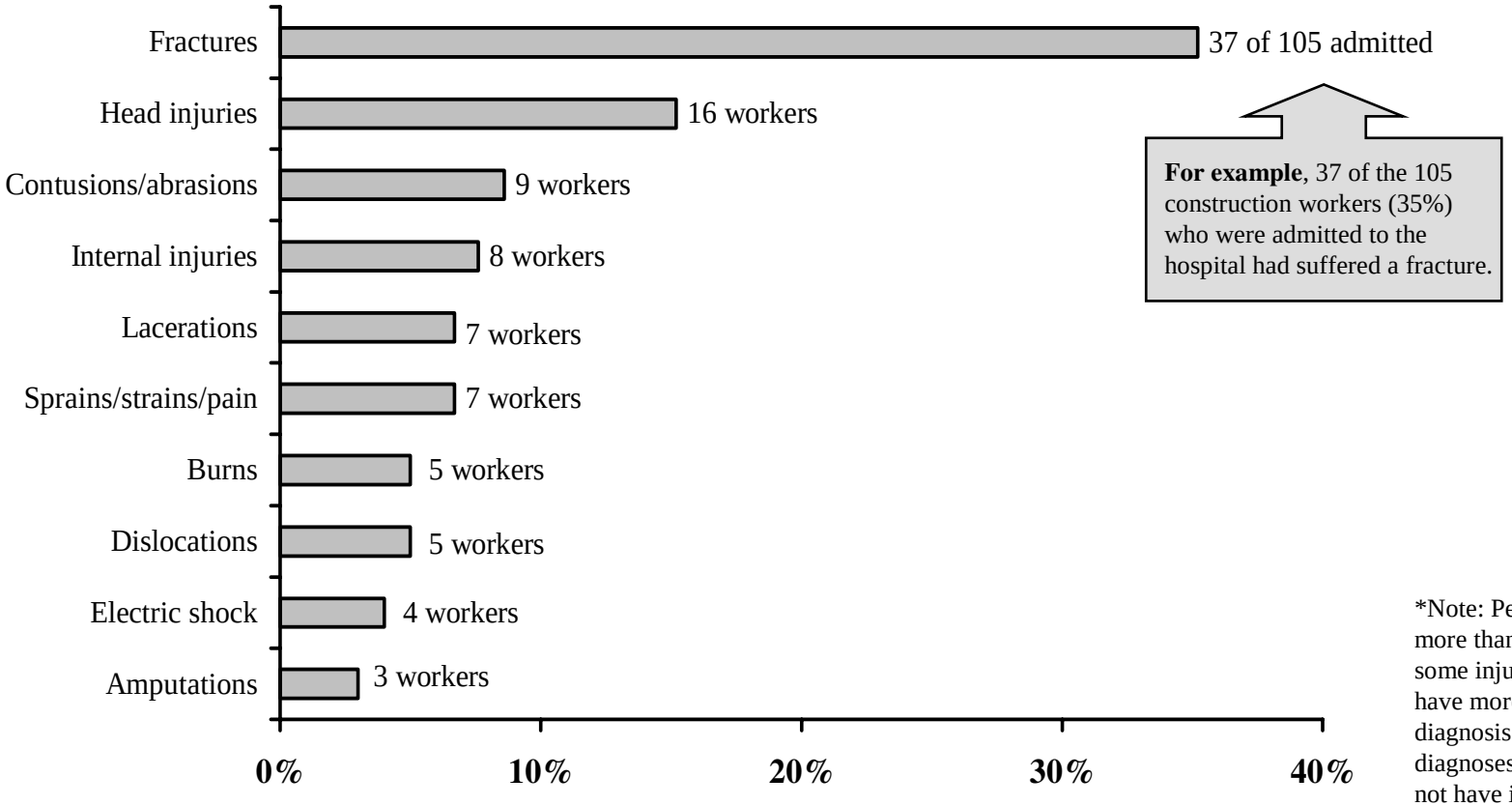


Chart 1-L

Top ten injury diagnoses* for 105 workers admitted to the hospital



Percentage* of 105 admitted workers by injury diagnosis

*Note: Percents add to more than 100 because some injured workers have more than one diagnosis. Minor diagnoses which would not have influenced hospitalization have been omitted.

Chart 1-M

Percentage of injured workers in selected trades who fell from a height

(352 of 2,916 injured workers fell from a height)

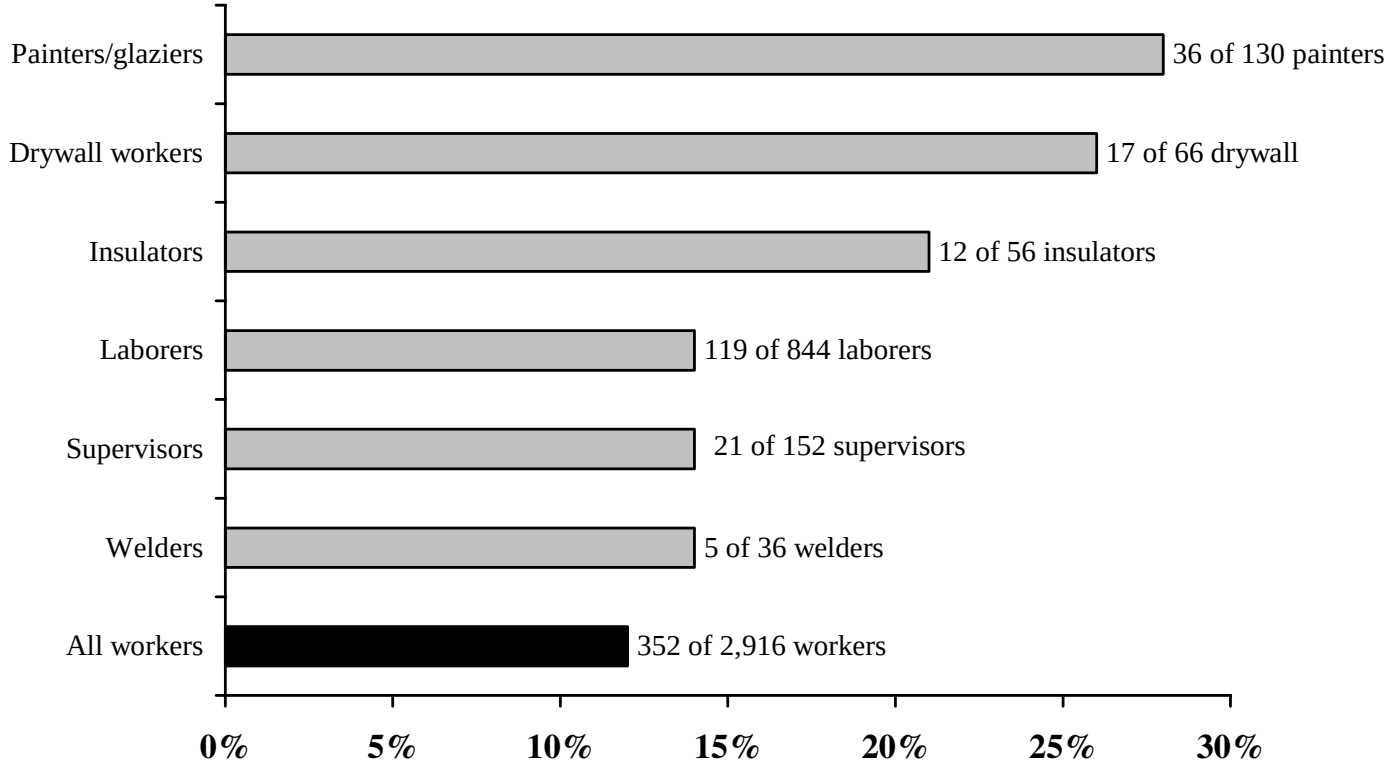
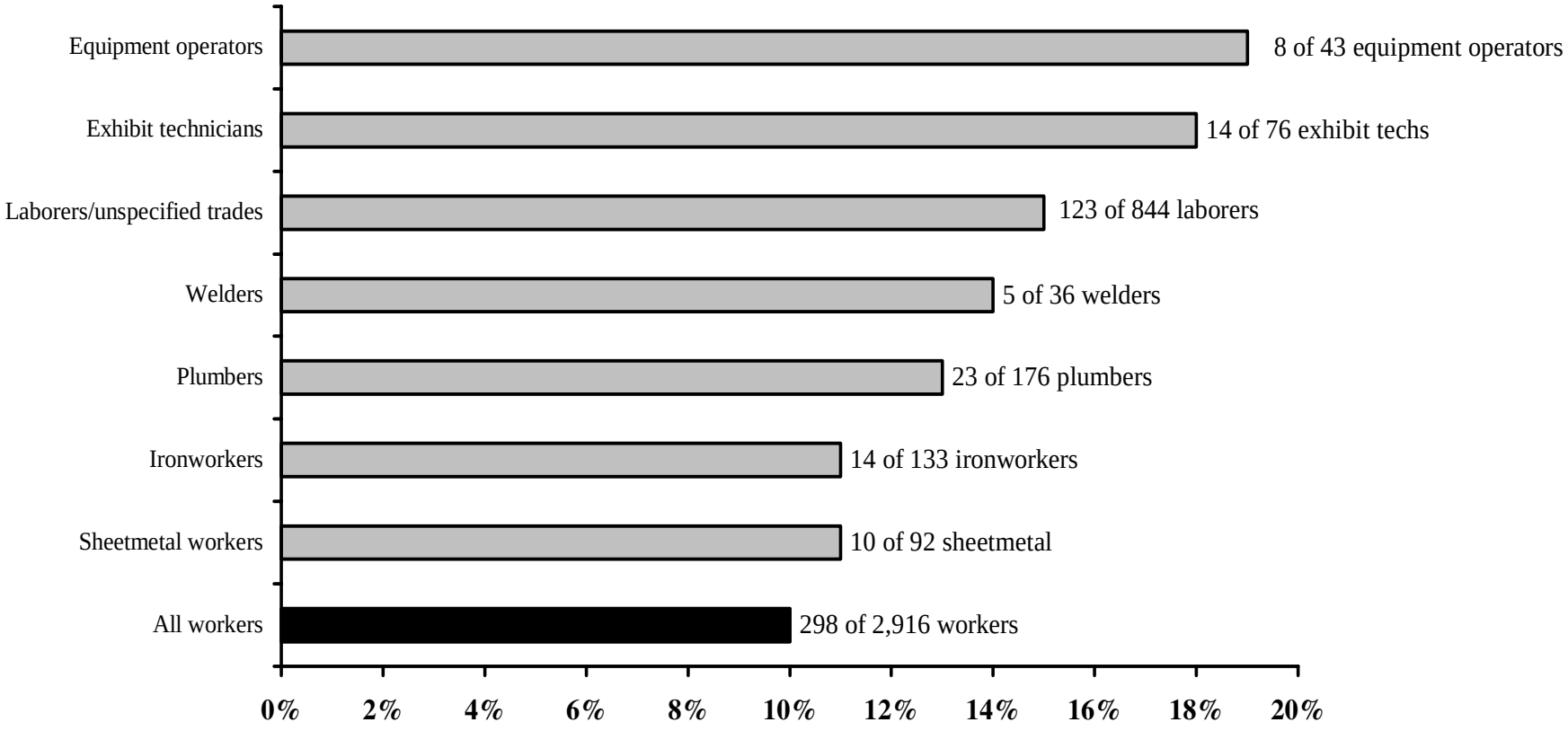


Chart 1-N

Percentage of injured workers in selected trades struck by a falling object

(298 of 2,916 injured workers were struck by a falling object)

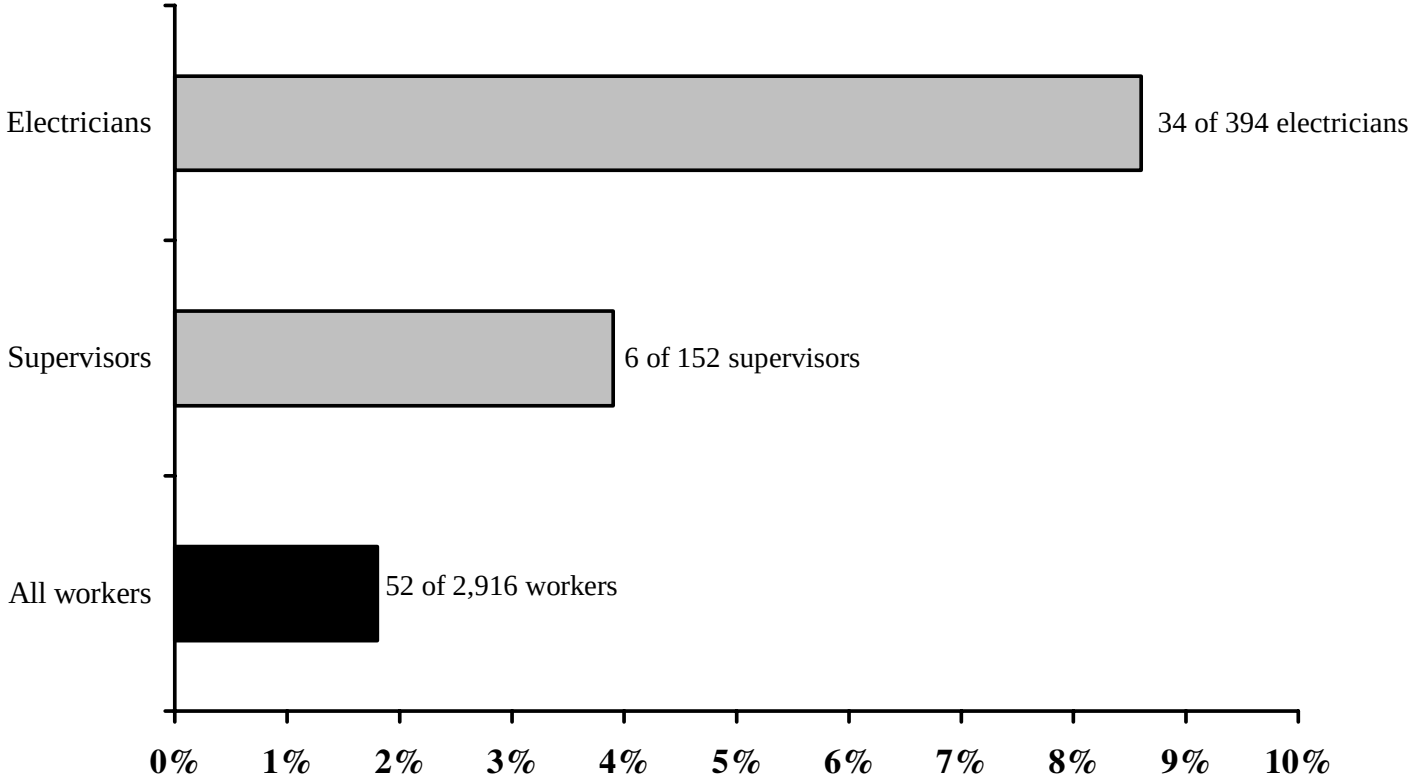


Percentage of injured workers in each trade struck by a falling object

Chart 1-O

Percentage of injured workers in selected trades injured by electrical current

(52 of 2,916 injured workers were injured by electrical current)



Percentage of injured workers in each trade injured by electrical current

Chart 1-P

Percentage of injured workers in selected trades treated for eye injuries

(314 of 2,916 injured workers were treated for an eye injury)

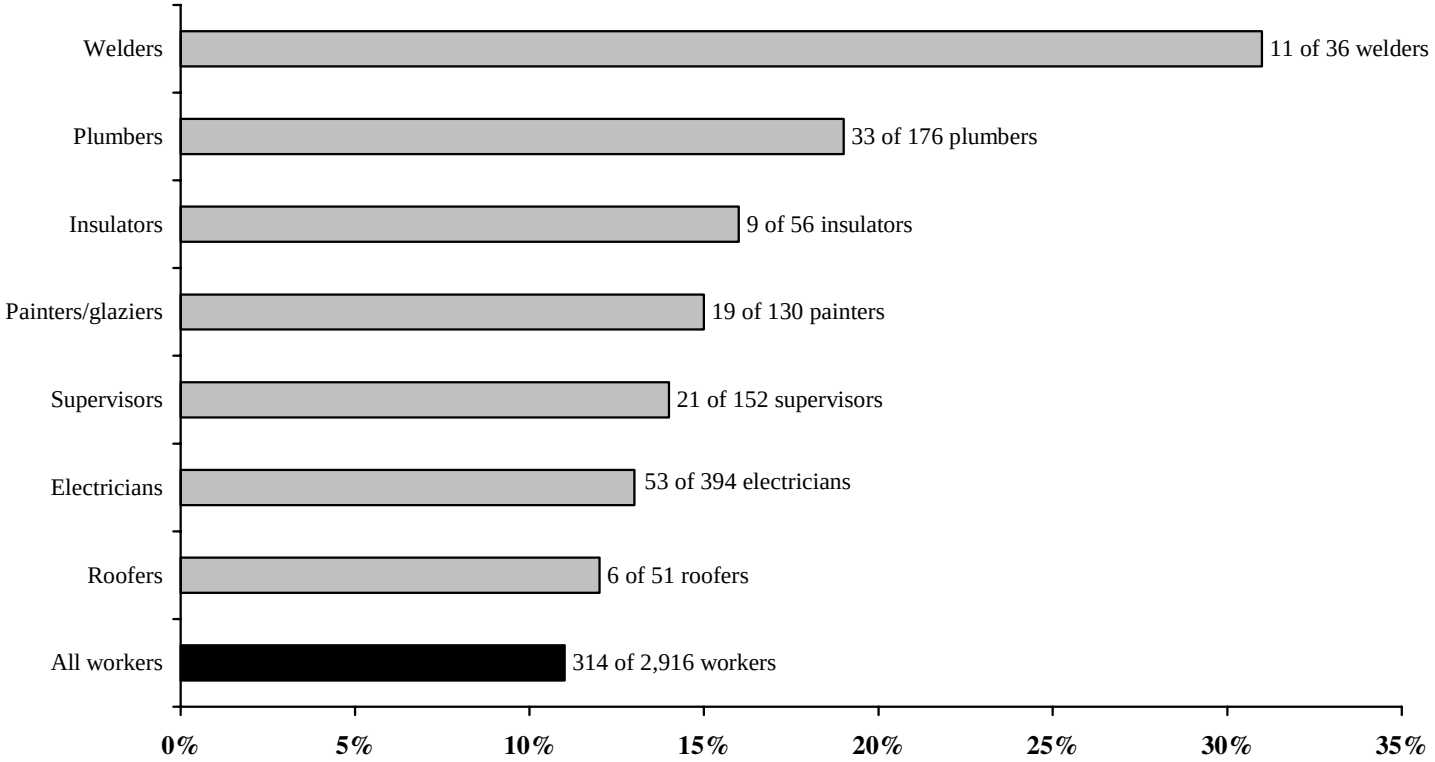
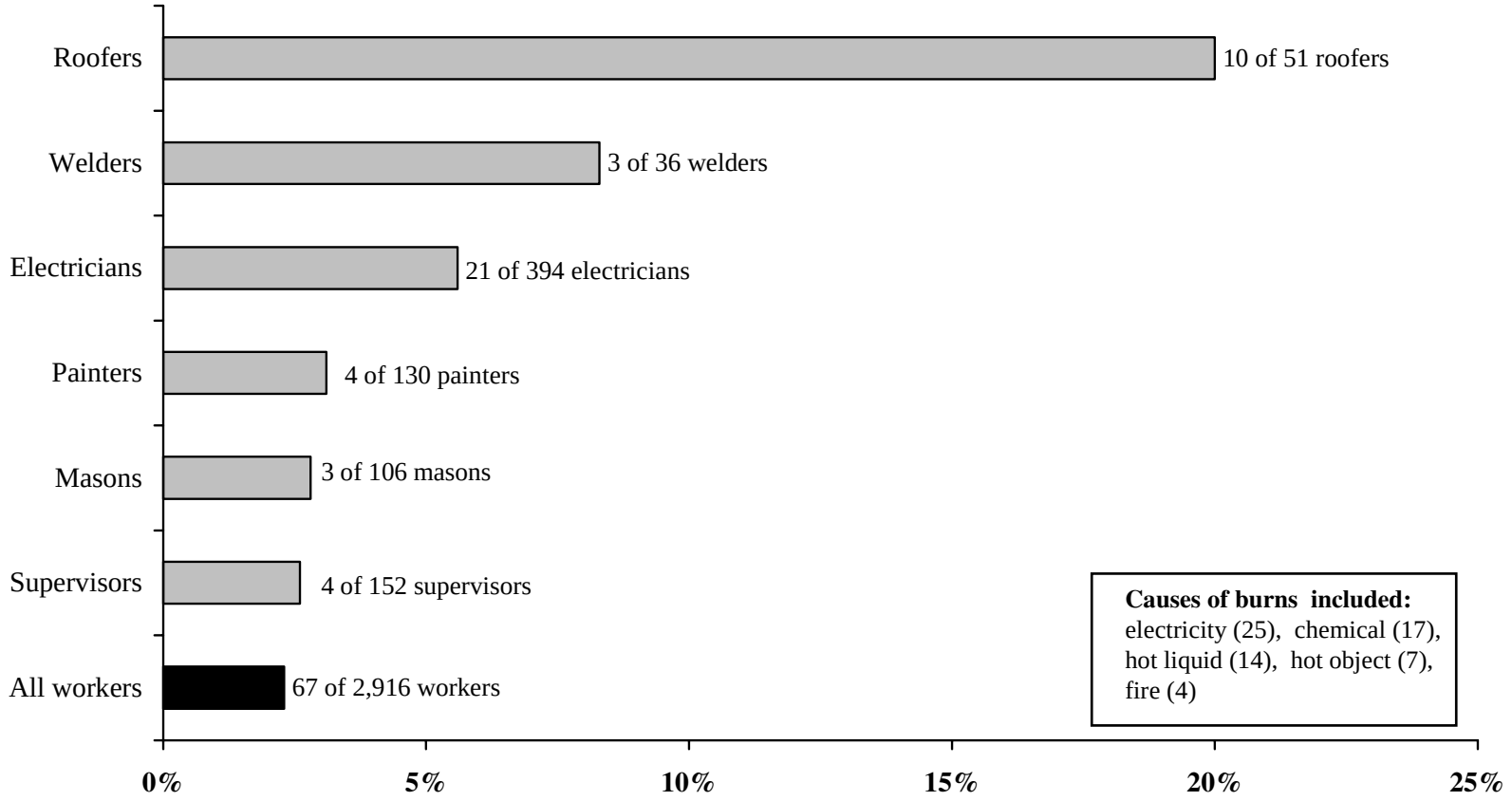


Chart 1-Q

Percentage of injured workers in selected trades treated for burns

(67 of 2,916 injured workers were treated for a skin or eye burn)



Percentage of injured workers in each trade treated for skin or eye burns

Chart 1-R

Percentage of injured workers in selected trades treated for toxic liquid/gas/dust exposure

(48 of 2,916 injured workers were treated for a toxic exposure injury)

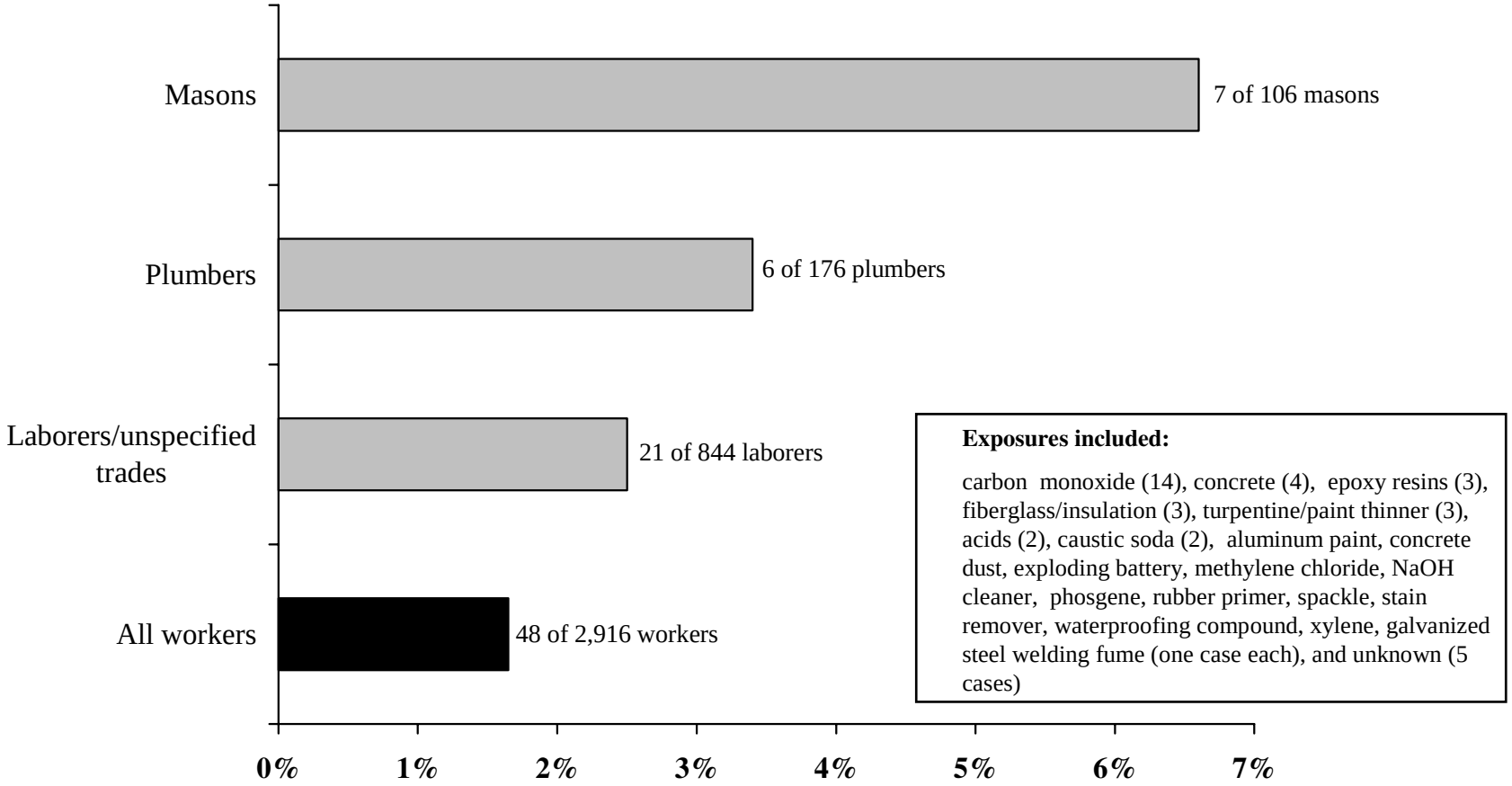
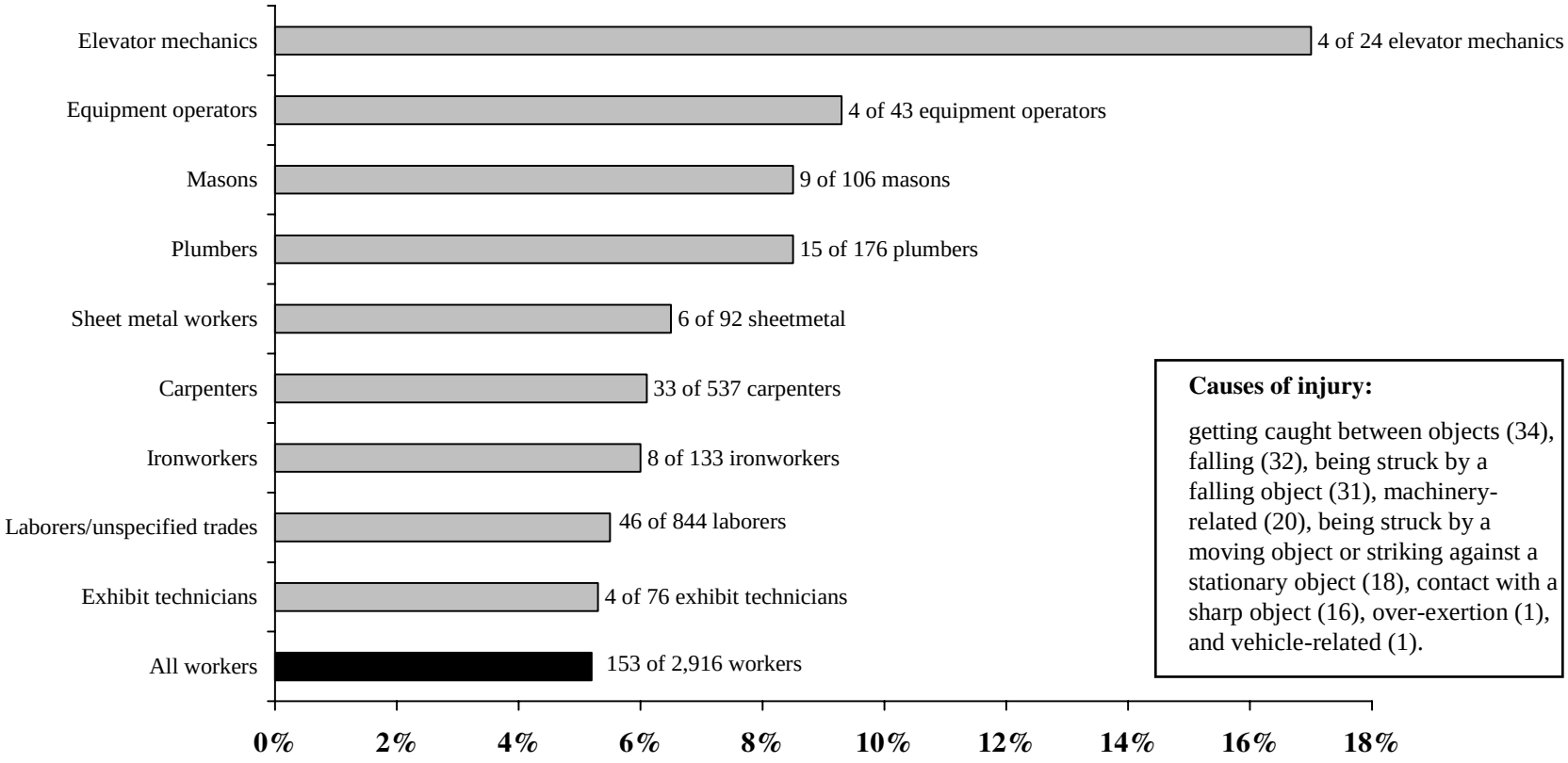


Chart 1-S

Percentage of injured workers in selected trades treated for amputations/crushes/fractures to their fingers/hands

(153 of 2,916 injured workers were treated for a severe finger/hand injury)



Percentage of injured workers in each trade treated for severe finger/hand injuries

Laborers

IN THIS REPORT, we have combined the 612 workers who called themselves laborers with the 232 workers who described themselves only as "construction workers" when they visited the GWU Emergency Department. Interviews with some of these workers who did not specify a trade when they registered in the emergency department confirm that most of them are laborers. Also, there were no obvious differences between the injury profiles of workers who called themselves laborers and those who called themselves general construction workers. The two groups combined (844 cases) were seen more frequently than any other trade, and make up 29% of all the construction injury cases seen at the George Washington University Emergency Department (*see* Welch, Hunting, and Anderson 2000).

Demographic Characteristics: The age range of laborers was similar to the range of all workers, with two-thirds of injured workers younger than 40. The age range was broad, from 12 to 74 years. Forty-one percent of the injured laborers were black and 36% were Hispanic. This is in contrast to injured construction workers from other trades, where only 29% were black and 12% were Hispanic. Hispanics may be black or white, but are included here in their own group.

Causes of Injury, Diagnoses, and Body Locations (charts 2A –2E) : The circumstances of injury for laborers differed from those of all other construction workers. For instance, one-quarter of the laborers were treated for an injury that was caused by being struck by or striking against an object. This includes being struck by a falling object. Although the types of objects involved were generally similar whether the worker was a laborer or from another trade, certain objects – such as beams and masonry blocks, bricks, or stone – were involved in a higher proportion of laborers' injuries. For laborers compared with all other trades, a higher proportion of falls resulted from slips, trips, and falls on the same level and falls from scaffolds.

Some of the rare but serious injuries were more common among laborers. For example, 29 of the 844 laborers (3.4%) were treated for head injuries compared to 29 of the 2092 workers in the other trades (1.4%). Information on hard hat usage was not available, but there is no reason to believe that laborers are less likely than workers in other trades to wear hard hats.

Laborers were more likely to have lower-extremity injuries (foot/ankle and knee/leg/hip).

Hospital admissions (charts 2-F and 2-G): Compared to injured workers in all other trades, a greater proportion of the injured laborers were admitted to the hospital. Among laborers 57% of admissions were the result of falls, compared to 43% among other trades combined. Fifteen of the seventeen construction workers hospitalized after being struck by beams were laborers, indicating that

laborers may be at particular risk for this type of injury. Fully half of the hospitalized laborers had fractures, some to more than one part of their body.

Although a rate of injury or hospitalization for laborers cannot be calculated from these data, the patterns here suggest that laborers have more serious injuries than do other construction workers. Other studies of construction injuries show that laborers have more severe injuries (*see,* for example, Ore and Stout 1997 and Pollack, Griffin, Ringen, and Weeks 1996).

Recommendations: The pattern of laborer injuries by cause, diagnosis, and injured body part most certainly reflects differences in the tasks performed by laborers versus the tasks of other construction workers. Laborers perform a great deal of the preparation, set-up and cleanup work on construction sites. In the Washington, D.C., area, laborers perform concrete reinforcement work (along with other trades). These aspects of construction expose laborers to machinery, earth moving, materials moving, cluttered work environments, and other situations where falls and struck-by injuries might occur.

Appropriate fall protection should definitely be a priority for laborers, as well as comprehensive scaffold safety programs. Aerial lifts could replace ladders, in some cases, especially on larger job sites. Improved jobsite housekeeping might help to prevent falls resulting from slips and trips. Proper work boots might provide some protection from the ankle and foot injuries seen disproportionately in this trade. Finally, both laborers and other construction trades must develop safe procedures for handling heavy objects such as beams and masonry materials.

Chart 2-A

844 injured laborers

Causes of injury

Compared to 2,072 other injured construction workers

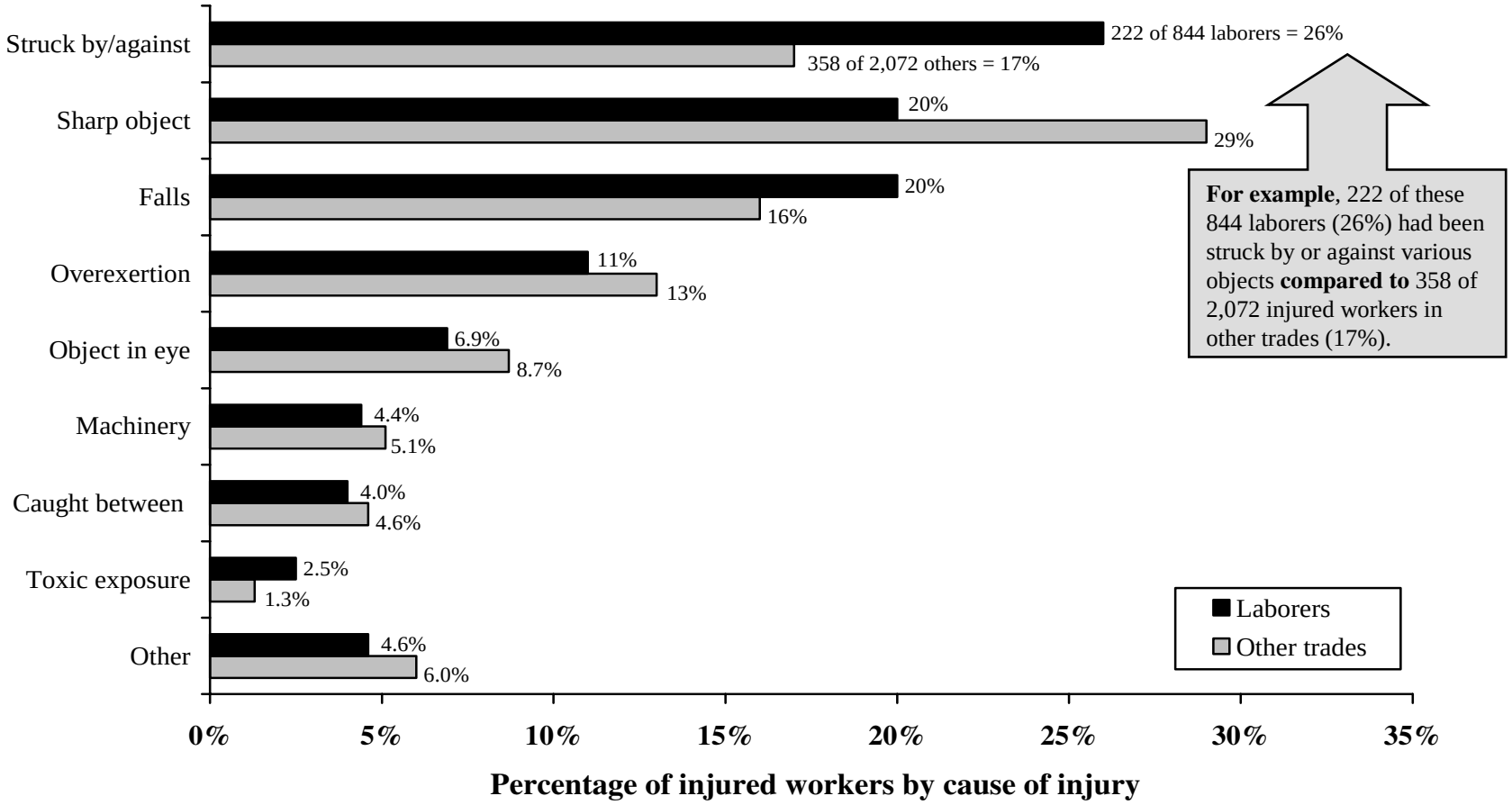


Chart 2-B

844 injured laborers

Detailed causes of injury

RANK #1	26%
STRUCK BY/AGAINST OBJECT (INCL. FALLING OBJECT)	**222**
metal: object, piece, sheetmetal duct, rebar, plate	31
beam	25
cinder block/brick/stone	23
board/wood	21
pipe	18
power tool	11
scaffold	10
hammer/sledge	10
ceiling/wall	10
other	55
not specified	8

RANK #2	20%
SHARP OBJECT	**172**
metal/sheetmetal	43
nail	38
razor/knife	21
power tool, incl. power saw (6), jackhammer (5)	20
metal stud	9
hand tool	8
wire/cable	8
glass	6
other	18
not specified	1

RANK #3	20%
FALL	**171**
slip/trip/stumble	39
from scaffold	37
from ladder	30
from another level	19
out of building/structure	15
from stairs	10
into a hole	8
not specified	13

RANK #4	11%
OVEREXERTION / STRENUOUS MOVEMENT	**90**
lifting/carrying	53
pushing/pulling	9
using hammer/sledge	3
stepping on/off, walking	2
using jackhammer	2
bending over	2
other	12
not specified	7

RANK #5	6.9%
OBJECT IN EYE	**58**
concrete/cement (dust or wet)	25
dirt/dust/debris	7
metal dust	6
chemical	5
wood dust	3
other	8
not specified	4

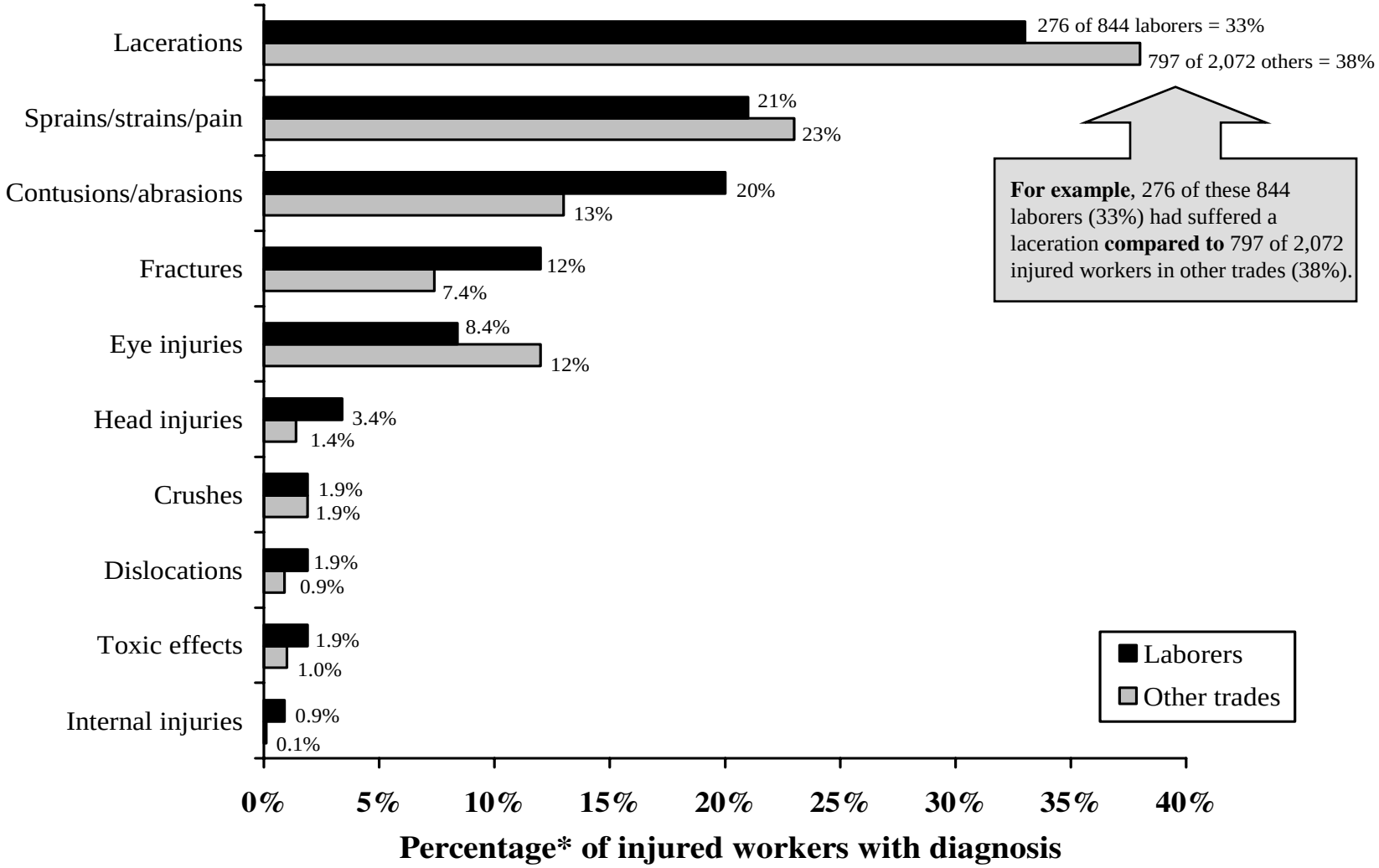
RANK #6	4.4%
MACHINERY-RELATED	**37**
lifting machinery, incl. forklift (5) crane (3)	10
power saw	6
grinder	6
air compressor	5
bobcat/front-end loader	5
other	3
not specified	2

Chart 2-C

844 injured laborers treated for 962 diagnoses

Injury diagnoses

Compared to 2,072 other injured construction workers treated for 2,245 diagnoses



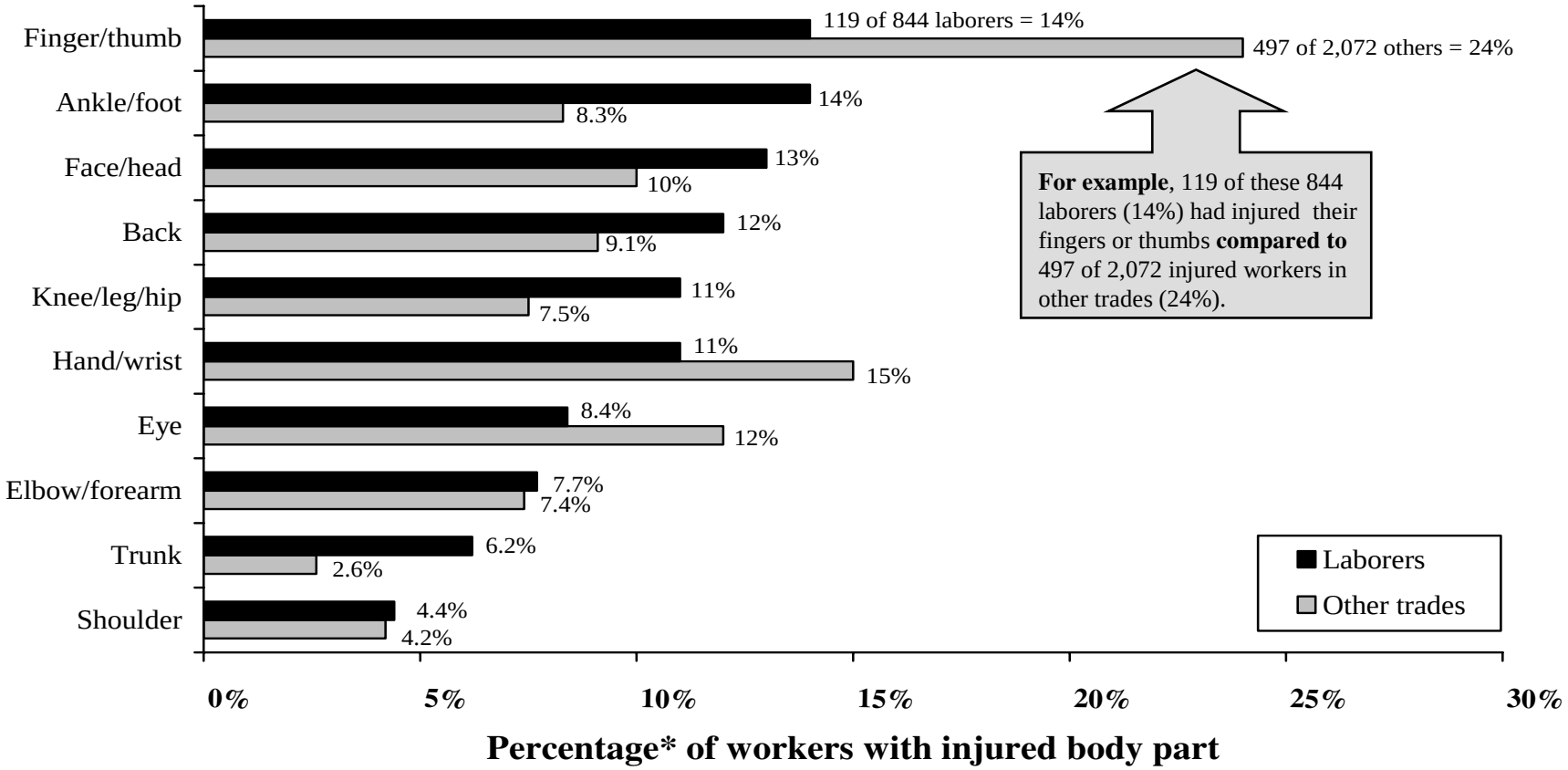
*Note: Percents add to more than 100 because some injured workers had more than one diagnosis.

Chart 2-D

844 injured laborers treated for 962 diagnoses

Injured body parts

Compared to 2,072 other injured construction workers treated for 2,245 diagnoses



*Note: Percents add to more than 100 because some injured workers had more than one diagnosis/injured body part.

Chart 2-E

844 injured laborers treated for 962 diagnoses

Diagnoses by body part

RANK #1	33% *
LACERATION	**276 ****
finger/thumb	68
face/head	60
hand/wrist	51
elbow/forearm	38
ankle/foot	33
knee/leg/hip	26
shoulder/upper arm	1
trunk	1

RANK #2	21%
SPRAIN, STRAIN, PAIN	**178**
low back	83
ankle/foot	29
knee/leg/hip	25
neck	18
trunk	10
shoulder/upper arm	7
hand/wrist	6
elbow/forearm	5
finger/thumb	3
not specified	2

RANK #3	20%
CONTUSION, ABRASION, FOREIGN OBJECT (excl. eye)	**167**
knee/leg/hip	37
ankle/foot	31
trunk	28
back	16
hand/wrist	14
shoulder/upper arm	12
face/head	12
multiple	8
elbow/forearm	7
finger/thumb	7
neck	4
not specified	2

RANK #4	12%
FRACTURE	**99**
finger/thumb	27
ankle/foot	22
hand/wrist	17
elbow/forearm	9
trunk	8
knee/leg/hip	8
shoulder/upper arm	6
face/head	6
multiple	3

For example:
* Percentage of laborers with one or more lacerations. Percents add to more than 100 because some injured workers had more than one diagnosis.
** Number of laborers with one or more lacerations

Chart 2-F

844 injured laborers

Causes of injury for 51 laborers admitted to the hospital

Falls

29 cases (57% of admissions)

Falls from Scaffolds (14)

fell 20 to 50 ft off scaffolds (7 cases)
fell 12 to 15 ft off scaffolds (4 cases); one of these workers was then struck on the abdomen by the falling scaffold bar
fell 10 ft or less (3 cases); one of these fell on his head and has no memory of the incident

Falls from Buildings and Other High Places (9)

fell 50 ft from either overpass scaffold or open elevator crane
fell 30-40 ft from unspecified location (2 cases)
fell 20 ft from roof onto pile of 2x4's
fell 12-14 ft from roof of house when attempting to climb down ladder
fell 8-10 ft from building, landing on feet
fell 8-10 feet from collapsing wall
fell 6 ft from metal electrical box
fell out 1st floor window, struck by 150-300 lb piece precast concrete

Falls from Ladders (4)

fell from ladder 25 ft onto sand, went to ED after later vomiting blood
fell 18 ft; while removing pipes on ceiling, struck himself with pipe
fell 15 ft thru open stairway under construction after ladder tipped
fell 12-15 ft from ladder

Slips/Falls (2)

slipped on ice
fell & struck head on way to bathroom

Struck by/Struck Against

15 cases (29% of admissions)

Struck by Beams (7)

struck by I-beam, thrown 5 ft to the ground
struck in head & abdomen by 1200 lb beam
struck in leg by 2000 lb steel I-beam
struck from back by heavy wood beam
struck in head by metal "cargo beam" while in the back of truck
struck on head and face by falling steel beam after worker removed bolt from beam
struck in back & face by falling steel beam

Struck by Other Objects (8)

300 lbs of wood fell 6ft. off truck onto face & chest while unloading truck
wall fell onto his leg
struck by 150 lb concrete funnel which fell 10 ft onto back and neck
struck on leg by 10-15 sheets falling drywall
struck in hand by trash chute which fell off building
struck on back and knocked down by falling rebar
struck by falling scaffold
struck by heavy stone which fell 10-15 ft

Other Injuries

7 cases (14% of admissions)

Machinery Related

pinned between bobcat (front end loader) & concrete pillar in parking garage
caught arm in cement mixer

Vehicle Related

crushed between truck and dumpster

Caught In/Between Objects

heavy electric wheelbarrow pinned leg against wall as it fell over

Sharp Objects

piece of metal went through boot into sole

Electrical Exposure

electrical burn

Overexertion

lifting 50 lb cement bags, felt chest pain

Chart 2-G

844 injured laborers

Diagnoses* of 51 laborers admitted to the hospital

Falls

29 cases, 57% of admissions

Among 20 workers who fells more than 10 feet:

10 had fractures, including: face (2), shoulder (2), collarbone (2), ribs (2), pelvis (2), leg (2), wrist

7 had head injuries, with or without loss of consciousness

5 had internal injuries, including: severe chest injuries (2), blood loss anemia , vomiting blood, bruised kidney

2 had lacerations, both to the face/head

1 had bruised ribs

3 had sprains, strains, or musculoskeletal pain, including: ankle sprain, chest pain, low back pain

Among 9 workers who fell less than 10 feet:

5 had fractures, including: ankle (2- both with dislocation), elbow (2), lower leg, face

2 had head injuries, with or without loss of consciousness

1 had a puncture wound 4" deep to the anal/scrotum area

1 (a hemophiliac) had a hemorrhage in his leg muscle

1 dislocated his shoulder

Struck by/Struck Against

15 cases, 29% of admissions

Among these 15 workers struck by beams or other objects:

7 had fractures, including: leg (3), face (2), skull, multiple finger, toe

3 had internal injuries, including: one with a bruised kidney, one with a ruptured spleen and blood loss anemia, and one with a nosebleed and coughing blood

3 had unspecified injuries, including: multiple injuries (2), face and neck injuries

1 had a head injury with seizures

1 had pain in his left side

Other Injuries

7 cases, 14% of admissions

Among the 7 workers with other injuries:

4 had fractures, including: forearm, wrist, shoulder, pelvis, lower leg, ankle

1 had skin graft complications following a burn

1 had a wound infection following a laceration

1 had heart palpitations and chest pain

*Note: Some of these laborers had more than one diagnosis. Minor diagnoses which were not likely to lead to hospital admission have been omitted from this chart.

Carpenters and Carpet Layers

BETWEEN November 1, 1990 and October 31, 1997, 537 construction workers identified themselves as carpenters or carpet layers when they were treated for work-related injuries at the George Washington University Emergency Department. Of these workers, most were carpenters (96%) who work in construction settings (436 workers) or maintenance settings (77 workers); the other 24 were carpet layers. In the interest of brevity, carpenters (whether construction or maintenance) and carpet layers are referred to as "carpenters."

Compared to other construction trades, carpenters had the second-highest number of emergency department visits during this time (chart 1-C). The proportion of hospital visits for injuries related to carpentry work might be even higher, given that other trades sometimes perform carpentry tasks. For example, laborers are sometimes assigned formwork (making wood frames for pouring concrete) and drywallers, plasterers, and glaziers are assigned finishing work. This section does not include workers who construct and install conference exhibit booths. The injuries of exhibit technicians (who sometimes identify themselves as carpenters) were studied separately because their tasks are likely to be considerably different from those of more traditional carpenters.

Demographic Characteristics: Women made up a small fraction (3.2%) of the injured carpenters. The ethnicity of the injured carpenters differed somewhat than for the other injured workers. A higher proportion of injured carpenters was white (60% of carpenters versus 43% of other trades) and a lower proportion were black (21% of carpenters versus 35% of other trades). The age distribution of carpenters was similar to that of the other injured workers.

Causes of Injury, Diagnoses, and Body Locations (charts 3-A through 3-E): Almost 40% of the carpenters who visited the emergency department had been injured by contact with a cutting or piercing object, most commonly a knife, power tool, or piece of metal. Of the 24 carpet layers alone, 17 cut themselves with a knife. Slips and trips on the same level made up most of the Emergency Department visits that resulted from carpenters falling on the job.

Power saws were responsible for many lacerations as well as contusions and more serious injuries from kickback of cut materials. Similarly, power tools other than saws (such as drills, screw guns, and nail guns) accounted for a disproportionate portion of injuries among carpenters (5.0% versus 2.8% among other workers). Another cause of injury seen more often among carpenters was being struck by scaffolds (1.7% versus 0.7%); some carpenters assemble and disassemble scaffolds.

It is interesting to compare the GWU Emergency Department injury data for carpenters with workers' compensation data evaluated by Lipscomb, Kalat, and Dement (1996).The workers' compensation data for carpenters found a higher proportion of strains and sprains,

and a lower proportion of lacerations. This is usually the pattern that is seen when comparing emergency department and workers' compensation data on occupational injuries. Falls made up almost identical proportions of the two injury studies.

Hospital Admissions (chart 3-F): The 12 injuries that resulted in a hospital admission represent 2.2% of carpenters' injuries treated at the Emergency Department.

Recommendations: A high priority for this trade should be to prevent injuries from table saws and other stationary woodworking machinery, from portable power saws, and from other power tools. Guards should not be removed from these machines and tools unless there is a written procedure describing how a cut will be done safely. Workers should be thoroughly trained in how to use machinery safely and how to inspect it properly. Another injury prevention program might focus on identifying and using utility knives with safety features, and encouraging workers to take special precautions when cutting materials and changing the blades. It would also be worthwhile to explore the feasibility of wearing gloves that could protect the hands from sharp metal edges. Given the number of slips and trips on the same level, regular housekeeping and the use of slip-resistant boots need to be promoted. A comprehensive scaffold safety program should address some of the injuries identified. Finally, the number of strains might be reduced with lift-assist devices and a buddy system protocol for lifting heavy objects.

Chart 3-A

537 injured carpenters

Causes of injury

Compared to 2,379 other injured construction workers

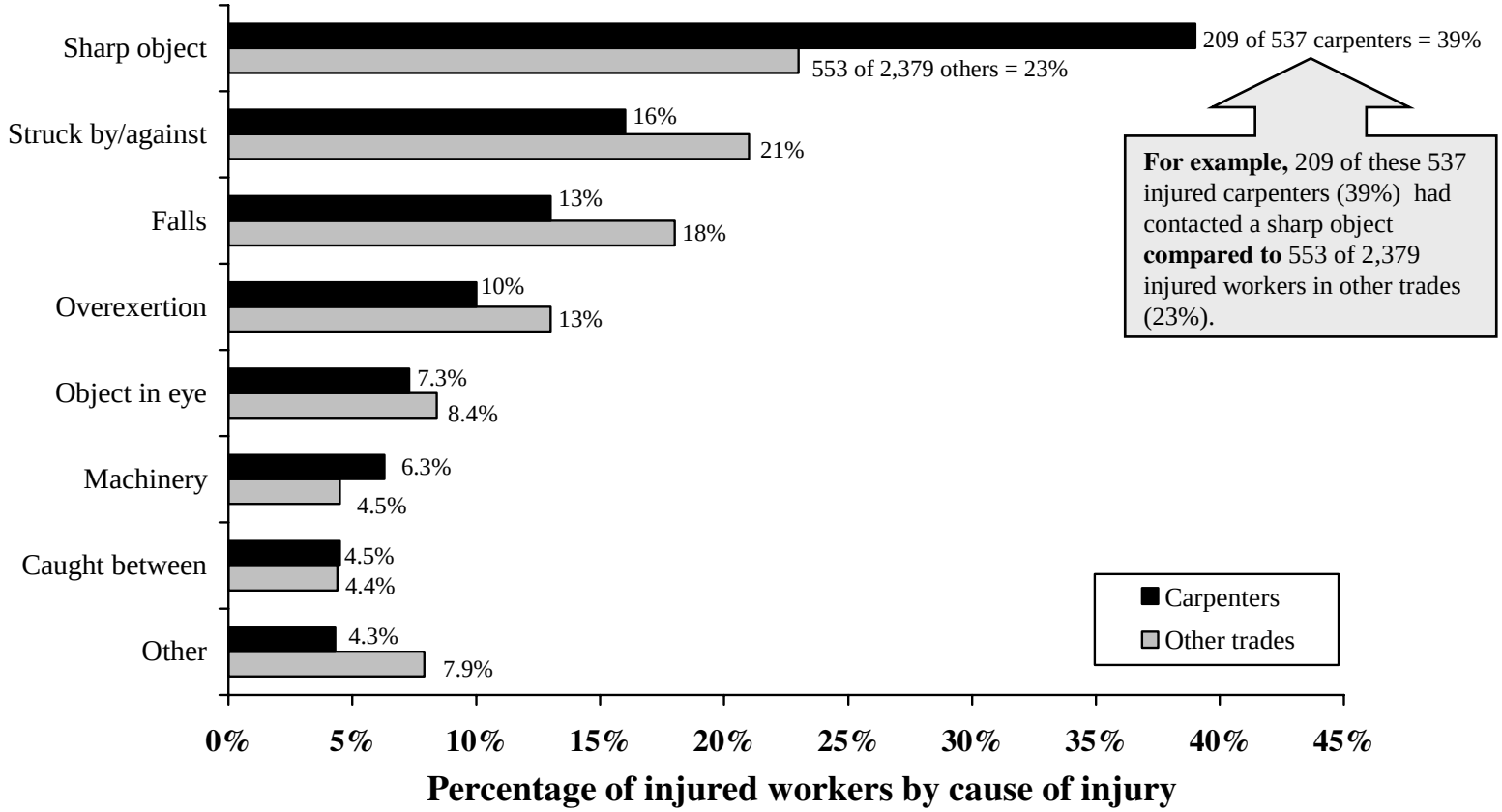


Chart 3-B
537 injured carpenters
Detailed causes of injury

RANK #1	39%
SHARP OBJECT	**209**
razor/knife	46
power tool, incl. saw (16), screwgun (9), nail gun (8), drill (5)	43
metal/ sheetmetal, ductwork	34
metal stud, ceiling frame	15
nail	12
hand tool	12
wood/splinter	8
glass	7
saw, NOS	6
wire/cable	4
screw	3
other	11
not specified	6

RANK #2	16%
STRUCK BY/AGAINST OBJECT (INCL. FALLING OBJECT)	**85**
metal: object, piece, sheetmetal duct, rebar	12
board/wood	11
scaffold	9
hammer/sledge	7
beam	7
pipe	5
drywall/plaster	3
door	3
other	18
not specified	6

RANK #3	13%
FALL	**67**
slip/trip/stumble	18
from scaffold	11
from another level	11
from ladder	10
out of building/structure	4
from stairs	4
into a hole	3
not specified	6

RANK #4	10%
OVEREXERTION / STRENUOUS MOVEMENT	**56**
lifting/carrying	34
pushing/pulling	5
stepping on/off, walking	4
other	10
not specified	3

RANK #5	7.3%
OBJECT IN EYE	**39**
metal dust	11
drywall/plaster	6
wood dust	3
concrete/cement (dust or wet)	3
dirt/dust/debris	2
other	4
not specified	10

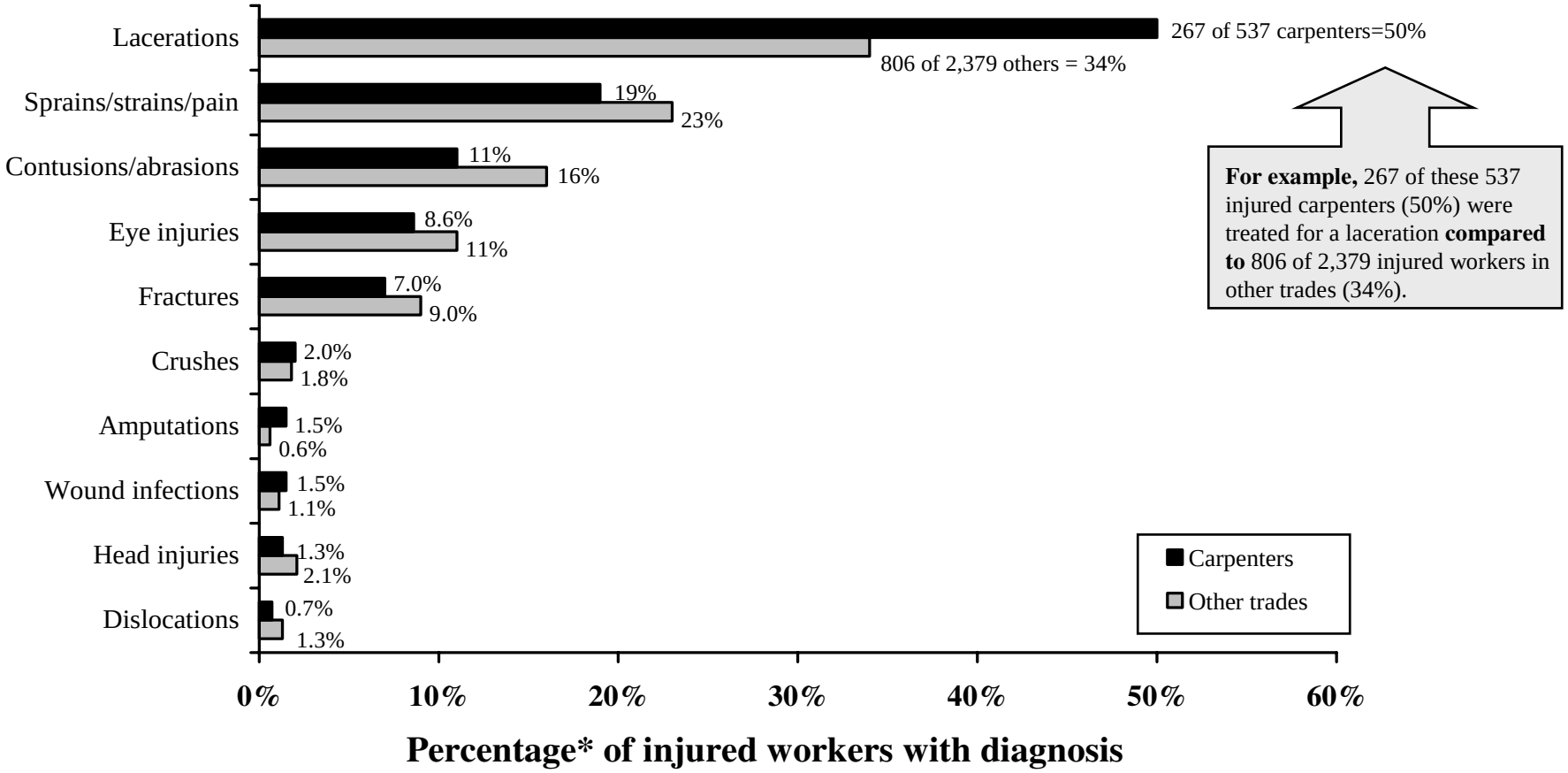
RANK #6	6.3%
MACHINERY-RELATED	**34**
woodworking machinery, incl. power saw (22)	28
metal working machinery	3
lifting machinery	2
other: working next to welder	1

Chart 3-C

537 injured carpenters treated for 568 diagnoses

Injury Diagnoses

Compared to 2,379 other injured construction workers treated for 2,639 diagnoses



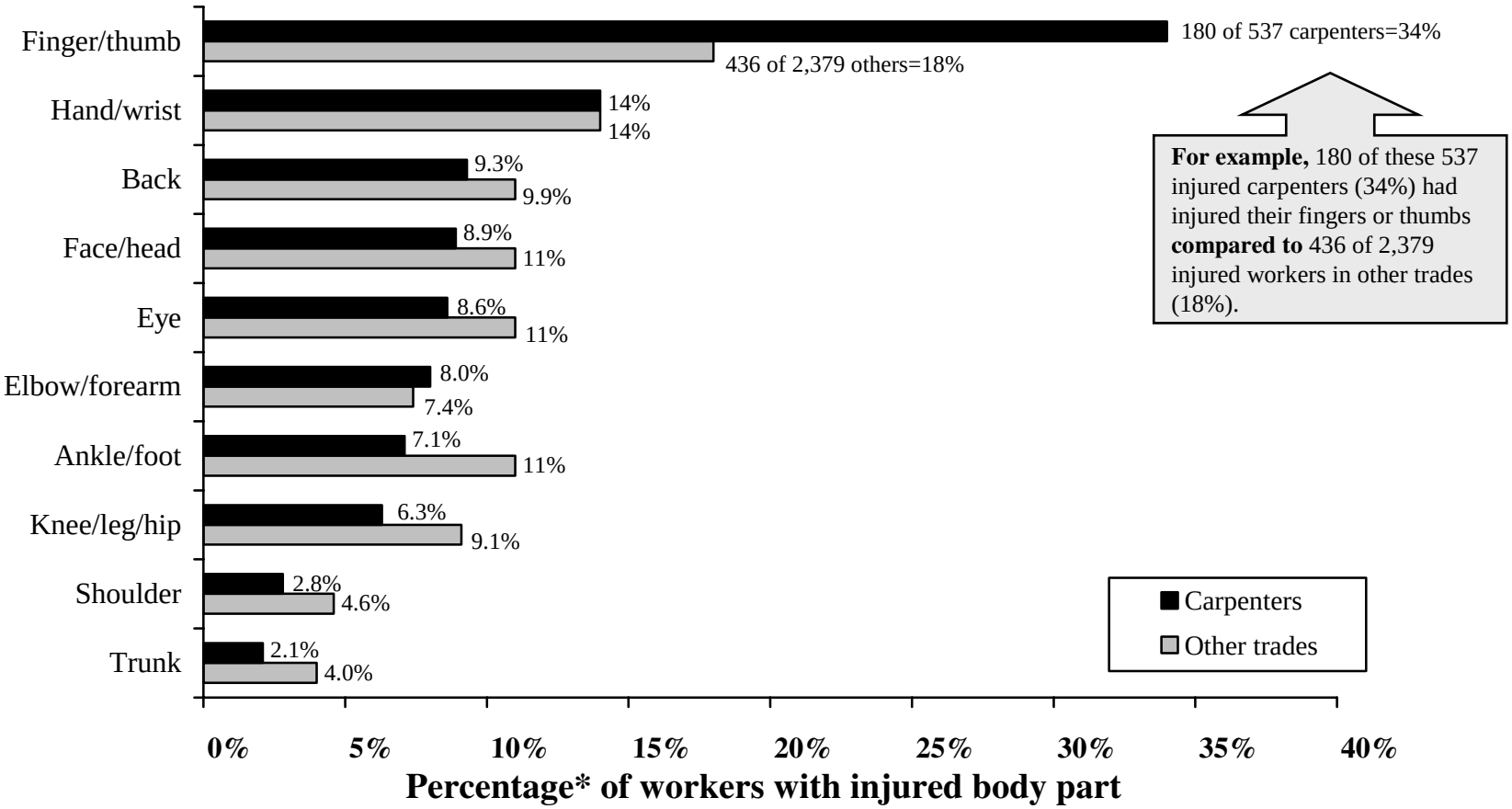
*Note: Percents add to more than 100 because some injured workers had more than one diagnosis.

Chart 3-D

537 injured carpenters treated for 568 diagnoses

Injured Body Parts

Compared to 2,379 other injured construction workers treated for 2,639 diagnoses



*Note: Percents add to more than 100 because some injured workers had more than one diagnosis/injured body part.

Chart 3-E

537 injured carpenters treated for 568 diagnoses

Diagnoses by body part

RANK #1	50% *
LACERATION	**267 ****
finger/thumb	136
hand/wrist	46
face/head	38
elbow/forearm	27
knee/leg/hip	11
ankle/foot	10

RANK #2	19%
SPRAIN, STRAIN, PAIN	**101**
back	45
ankle/foot	14
shoulder/upper arm	10
knee/leg/hip	8
hand/wrist	7
neck	6
elbow/forearm	5
finger/thumb	5
trunk	3
not specified	1

RANK #3	11%
CONTUSION, ABRASION, FOREIGN OBJECT (excl. eye)	**59**
knee/leg/hip	13
hand/wrist	13
finger/thumb	8
elbow/forearm	7
back	5
ankle/foot	4
trunk	3
face/head	3
multiple	3
shoulder/upper arm	1

RANK #4	8.6%
EYE INJURY	**46**

RANK #5	7.1%
FRACTURE	**38**
finger/thumb	14
ankle/foot	7
hand/wrist	6
trunk	4
knee/leg/hip	3
elbow/forearm	3
shoulder/upper arm	2

For example:

* Percentage of carpenters with one or more lacerations. Percents add to more than 100 because some injured workers had more than one diagnosis.

** Number of carpenters with one or more lacerations.

Chart 3-F

537 injured carpenters

Causes of injury for 12 carpenters admitted to the hospital

Falls

5 carpenters (42% of admissions)

Fell 25 ft and landed on feet after jumping from steel column that was falling. Patient suffered loss of consciousness and was admitted with severe sprains to both ankles and his wrist.

Fell 12-20 feet from ladder; suffered closed head injury with brief loss of consciousness.

Fell 12 ft off scaffold, landing on feet; suffered spinal fracture.

Fell 6 ft off scaffold; worker landed on side and sustained multiple rib fractures.

Stumbled down one step and fractured his ankle.

Other Injuries

7 carpenters (58% of admissions)

Power Tool-Related

Cut off left thumb with skil saw; thumb was reattached in emergency room.

Accidentally shot left knee with nail gun; nail imbedded in femur.

Overexertion

Twisted leg and dislocated ankle while climbing down scaffold.

Twisted ankle while stepping off a curb; fracture to right ankle.

Struck By or Against Object

Struck by a falling scaffold; sustained lower leg fractures.

Vehicle-Related

*Fell 2 to 7 ft off the back of a truck and lost consciousness; admitted with closed head injury.

Electrical Exposure

Suffered an electrical shock after grabbing a sander with wet hands.

*Although this injury might be considered a fall, the coding system used by the hospital listed the injury as vehicle related.

Note: Minor diagnoses that were not likely to lead to hospital admission have been omitted from this chart.

Electricians

FROM November 1, 1990 through October 31, 1997, 394 electricians were treated for work-related injuries at the George Washington University Emergency Department..

Demographic Characteristics: Only 1.8% of the injured electricians were women, compared to 3.4% of the other 2,522 injured construction workers who were treated for work-related injuries during this time. The injured electricians were slightly younger than injured workers in other trades. For example, the average age of the electricians was 33, and 78% were under the age of 40. This is compared to the other injured workers as a group whose average age was 36 and of whom only 65% were under age 40. Only 2.3% were Hispanic compared to 22% of the other injured workers.

Causes of Injury, Diagnoses, and Body Locations (charts 4-A through 4-E): Many of the lacerations to the head, such as bumping one's head against ductwork or poking oneself in the face with a tool, seem to have resulted from working in an awkward position or confined space.

The circumstances for electrical exposure injuries varied; one electrician grabbed a live wire to steady himself as he was falling off a ladder; another was working on an electrical panel when it exploded in his face; another was working with a wrench on a disconnect box that he did not realize was live. Nine of the 34 workers with electrical injuries were working on a ladder when they were injured; another two were working adjacent to other electricians who created an explosion hazard.

The circumstances that resulted in eye injuries among electricians included carrying out "typical tasks" such as installing a light fixture or working on a live circuit; other eye injuries resulted from drilling into concrete, sanding metal, or cutting wood, plaster, or metal. In addition, five electricians splashed chemical agents such as cleaning oil or glue into their eyes. The hospital registration form did not usually state whether eye protection was worn at the time of an injury.

This excess of hand and wrist injuries is explained by more lacerations, strains and sprains, and burns to these body parts.

Hospital Admissions (chart 4-F): The 13 injuries serious enough to require hospital admission included one electrocution.

Recommendations: Given that most lacerations were to the hands and fingers, it would be worthwhile to identify some fitted protective gloves that can be worn without too much loss in manual dexterity. Bicycle-type gloves (with fingers) are one possibility.

Given that more than one in ten electricians studied was treated for an eye injury, it is particularly important to find eye protection that fits properly and is comfortable to wear for long periods of time for those working overhead or using power tools.

Injuries from exposure to electric current are potentially fatal and largely preventable. Electric current caused nearly one-tenth of the injuries that sent electricians to the emergency room during this period. No doubt electricians are acutely aware of the hazards of working with electric current, but training for these hazards could be refreshed periodically with an emphasis on working very conservatively when electric current is involved. That nine workers were injured when they were standing on a ladder that came into contact with electric current illustrates that it is especially important to draw attention to the dangers of this combination.

Chart 4-A

394 injured electricians

Causes of injury

Compared to 2,522 other injured construction workers

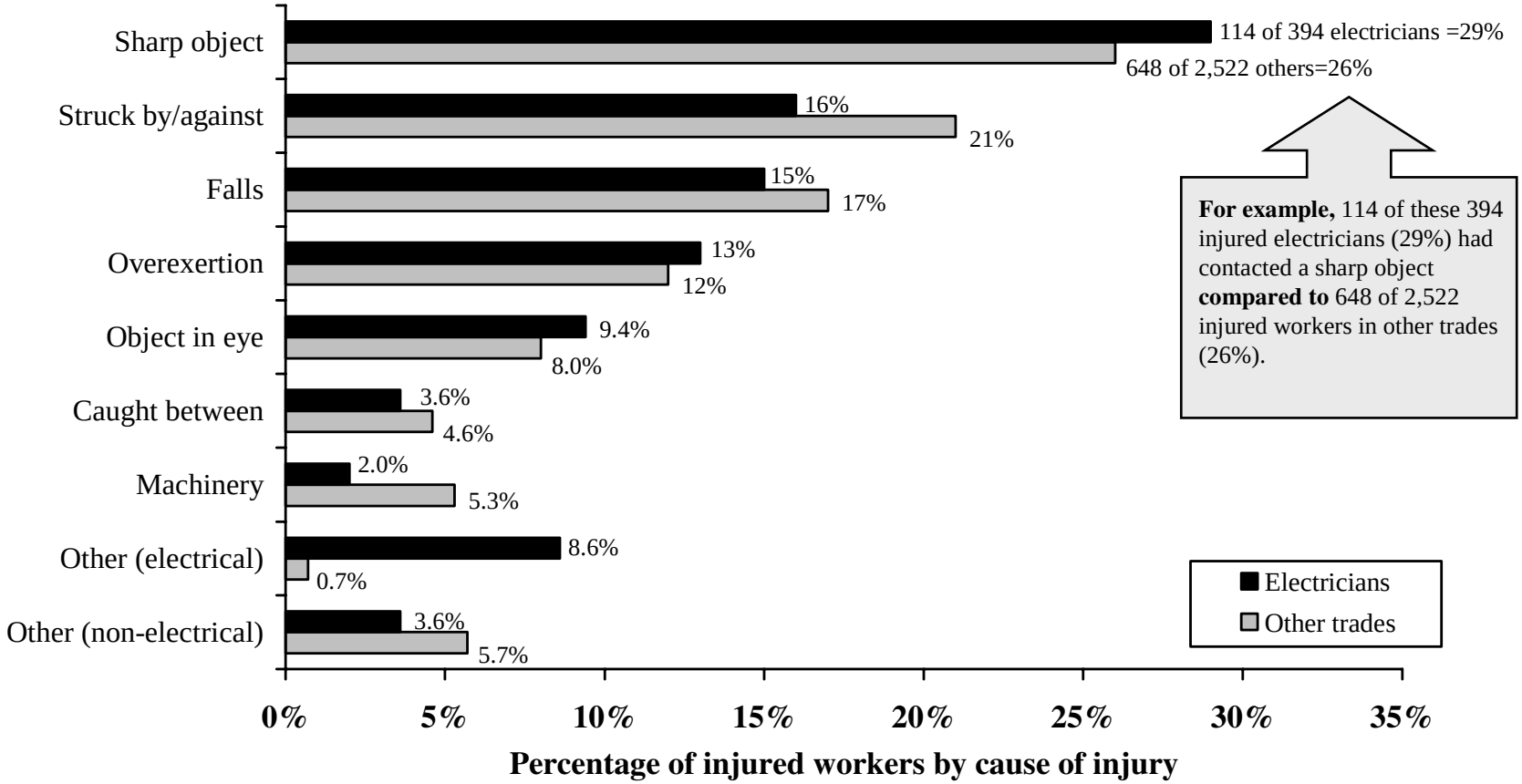


Chart 4-B
394 injured electricians
Detailed causes of injury

RANK #1	29%
SHARP OBJECT	**114**
metal/sheetmetal	22
light fixture	16
hand tool	14
razor/knife	11
metal stud	9
wire/cable	7
power tool	5
saw, NOS	3
metal ceiling frame	3
pipe	2
glass	2
nail	2
other	12
not specified	6

RANK #4	13%
OVEREXERTION / STRENUOUS MOVEMENT	**52**
lifting/carrying	27
pushing/pulling	5
stepping on/off, walking	3
while drilling	3
overhead	2
bending over	1
other	6
not specified	5

RANK #2	16%
STRUCK BY/AGAINST OBJECT (INCL. FALLING OBJECT)	**61**
metal: object, piece, sheetmetal duct, rebar, plate	9
hand tool, hammer/sledge	7
wire/cable	6
light fixture	4
board/wood	4
pipe	4
drill	4
door/door jamb/doorway	4
ceiling/wall	3
other	13
not specified	3

RANK #5	9.4%
OBJECT IN EYE	**37**
concrete/cement (dust or wet)	7
dirt/dust/debris	6
metal dust	5
chemical	5
drywall/plaster	2
wire	1
rock/stone/gravel	1
ceiling tile	1
other	1
not specified	8

RANK #3	15%
FALL	**60**
from ladder	25
slip/trip/stumble	9
from another level	8
into a hole	5
from scaffold	3
from stairs	2
out of building/structure	1
not specified	7

RANK #6	8.6%
OTHER (ELECTRICAL)	**34**

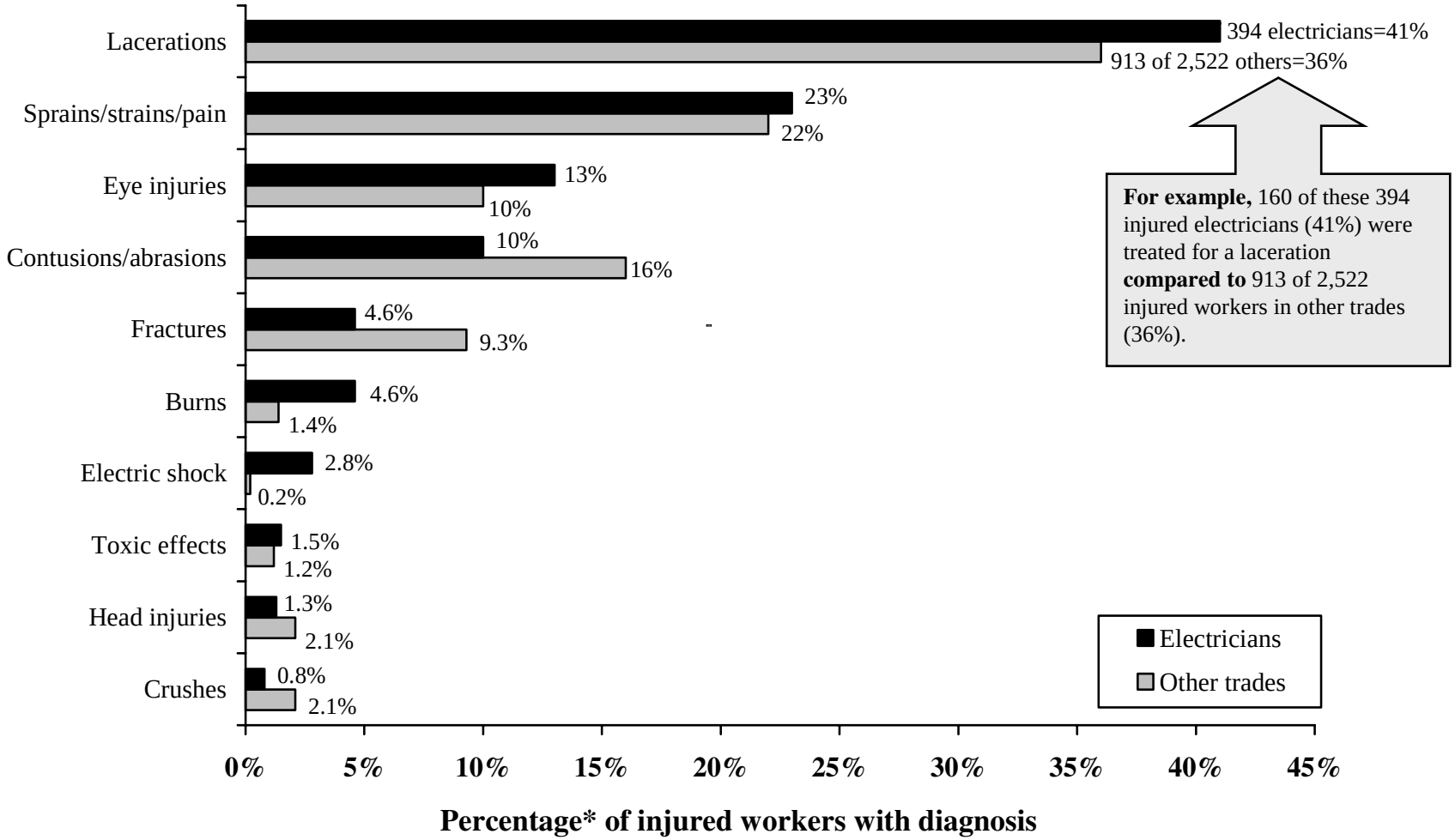
RANK #7	3.6%
CAUGHT BETWEEN	**14**
involving door	4
gangbox/dumpster lid	2
while drilling	2
other	5
not specified	1

Chart 4-C

394 injured electricians treated for 425 diagnoses

Injury diagnoses

Compared to 2,522 other injured construction workers treated for 2,782 diagnoses



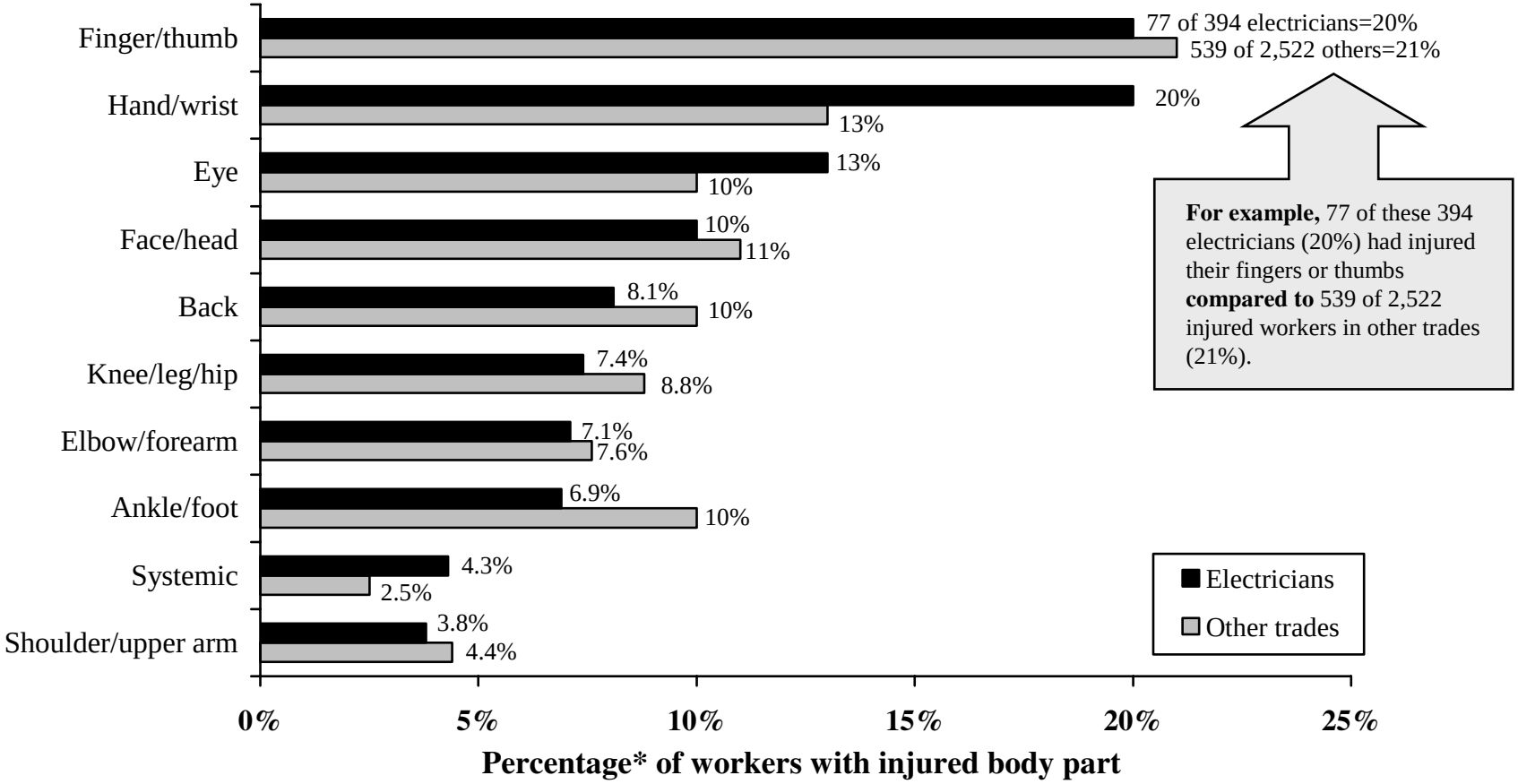
*Note: Percents add to more than 100 because some injured workers had more than one diagnosis.

Chart 4-D

394 injured electricians treated for 425 diagnoses

Injured body parts

Compared to 2,522 other injured construction workers treated for 2,782 diagnoses



*Note: Percents add to more than 100 because some injured workers had more than one diagnosis/injured body part.

Chart 4-E

394 injured electricians treated for 425 diagnoses

Diagnoses by body part

RANK #1	41% *
LACERATION	**160 ****
finger/thumb	64
hand/wrist	42
face/head	29
elbow/forearm	18
knee/leg/hip	4
trunk	2
ankle/foot	2

RANK #2	23%
SPRAIN, STRAIN, PAIN	**91**
low back/upper back	30
hand/wrist/finger/thumb	15
knee/leg/hip	14
ankle/foot	13
shoulder/upper arm	10
trunk	6
neck	5
elbow/forearm	3

RANK #3	13%
EYE INJURIES	**53**

RANK #4	10%
CONTUSION, ABRASION, FOREIGN OBJECT (excl. eye)	**39**
knee/leg/hip	8
hand/wrist	6
ankle/foot	6
face/head	5
trunk	3
shoulder/upper arm	3
finger/thumb	3
elbow/forearm	3
back	2
neck	1
multiple	1

For example:

* Percentage of electricians with one or more lacerations. Percents add to more than 100 because some injured workers had more than one diagnosis.

** Number of electricians with one or more lacerations.

Chart 4-F
394 injured electricians
Causes of injury for 13 electricians admitted to the hospital

Electrical Exposures
8 electricians

Electrocution (death); working on ladder on electrical wire; was found on ground by co-worker.

Worker suffered high voltage electrical burns. He was kneeling on metal casing while using probe to work on 13,000 v main line. Current went through left hand to right hand, exiting on right knee.

Worker in manhole was standing in water holding 1,300 v cable when it exploded in his hand.

Disconnecting cables to a switch board; wrench contacted the positive and initiated a flash; worker suffered 2nd degree burns to arm and face.

Working on "exit" sign; suffered 270 v electrical shock and fell from stepladder; treated for bruise to forehead.

Working on 277 v wires; current entered right arm and exited left arm; worker then fell 4-5 from ladder.

Working on lighting box and contacted either 270 v or 480 v. Unable to break away from electrical source for about 1 minute, finally kicked ladder out from under him to throw himself off box. Brief loss of consciousness; treated for forearm burn; returned to emergency department a few days later complaining of upper extremity and lower extremity pain.

Working with fuse box and received 277 v shock for 5-10 seconds.

Other Injuries
5 electricians

Falls
Worker caught hand between ladder rung and heavy drill, and hung there for 45 minutes before falling 8 ft from ladder. He was treated for closed head injury.

Worker fell 3-4 ft onto 270 v transformer. There were no witnesses and he may have received a shock also. Treated for closed- head injury.

Involving Lifting Machinery
An elevator accident (not described) resulted in a two-ton air conditioner's falling on a worker's foot. Amputation of 5th toe, and fractures of his 2nd, 3rd, and 4th toes.

Worker was changing a parking lot light bulb and fell 20-30 feet off boom lift onto concrete. Lost consciousness, suffered multiple fractures (pelvic, facial, leg), and dislocated hip.

Toxic Exposure
Working in enclosed freezer, where a propane-powered forklift was being used. Two electricians suffered carbon monoxide poisoning; one of these workers was admitted.

Note: Minor diagnoses that were not likely to lead to hospital admission have been omitted from this chart.

Pipe Trades: Plumbers and Sprinkler Fitters

INJURED WORKERS from the pipe trades –plumbers and sprinkler fitters –made up 6% of injured construction workers treated at the George Washington University Emergency Department during the seven-year study. Of the 176 injured pipe trades workers, 158 were plumbers or pipefitters and 18 were sprinkler fitters.

Demographic Characteristics: The age range and average age, 35, of the injured pipe trades workers was similar to the age range of all workers. Injured workers from this trade were more likely to be white and less likely to be black or Hispanic than in all other trades; 61% of plumbers and sprinkler fitters were white, compared to 45% for construction workers from other trades. Among injured plumbers and sprinkler fitters, 2.3% were female, comparable to the 3.2% female representation among other workers.

Causes of Injury, Diagnoses, and Body Locations (charts 5-A through 5-E): Injuries for this trade differed in a number of respects from injuries seen among other construction workers. For instance, eye injuries accounted for one in five visits by pipe trades workers to the emergency room, about twice the percentage seen for all other workers and higher than for all other trades except welders. Injury by an object in the eye, which accounts for most eye injuries, was twice as frequent in this group as for all other workers. Eye splashes from chemicals such as PVC primer, trichloroethane, and hydraulic fluid led the list, but eye injuries resulted also from a variety of other materials: paint, soldering or welding debris, grinding dust, and concrete (wet or chips). Toxic exposures resulted from a variety of situations: two workers suffered allergic skin rashes from construction site exposures; one worker was treated for smoke inhalation during a gas leak; one worker was sprayed with caustic soda while working on a pump, and one worker inhaled phosgene gas while working on an air conditioning unit.

Hospital Admissions: Eight plumbers had injuries that required hospital admission. One of these workers –who fell 30 feet from a ladder into a manhole entrance shaft, fracturing spinal vertebrae and becoming paralyzed –died several weeks later from his in juries. Three other admissions resulted from falls from ladders: one worker was admitted for back and shoulder injuries after falling four feet from a ladder; another missed a step on his ladder and fell eight feet –he struck his head and lost consciousness, in addition to dislocating his finger; and the third contacted a 120 volt electric current for five seconds, which caused his seven-foot fall. Another severely injured worker fell through a ceiling or skylight, suffering spinal fractures and multiple bruises. Of the three other pipe trades workers who were admitted to the hospital, one suffered a chemical burn after getting PVC primer in his eye. Finally, two workers fractured their upper legs –the first when he was pressuring a system and the standpipe ruptured, blowing him back about ten feet, and the second when he was struck by a 300-pound metal object (not described) which fell on him.

Recommendations: Plumbing work involves several types of tasks that are risky for eye injuries: working overhead around ceiling tiles and insulation, working with chemicals, working with pressurized systems, grinding and cutting pipes, and soldering. Although some of these hazards may be reduced through engineering controls, safety glasses and goggles are probably the most practical solution. Since there are so many risky tasks and environments, universal use of eye protection would be a reasonable policy. Certainly, workers should understand which activities put them at greatest risk. Contractors should make it a priority to identify comfortable and appropriate protective eyewear, and should develop policies that encourage workers to use this eyewear.

Pipe trades workers are injured particularly often by heavy materials that strike against or fall onto workers' hands or heads. Pipes are involved in many of these injuries. Pipes are often hard to handle because they can be long and heavy –plus they roll. They al so cast a wide swath when they swing. There are specific material-moving devices and techniques that contractors could introduce and workers could use to make injury from pipes less likely. Improved material-handling practices will also help to prevent back injuries. Glove use could help also to prevent lacerations, crushes, and fractures when materials do fall or shift.

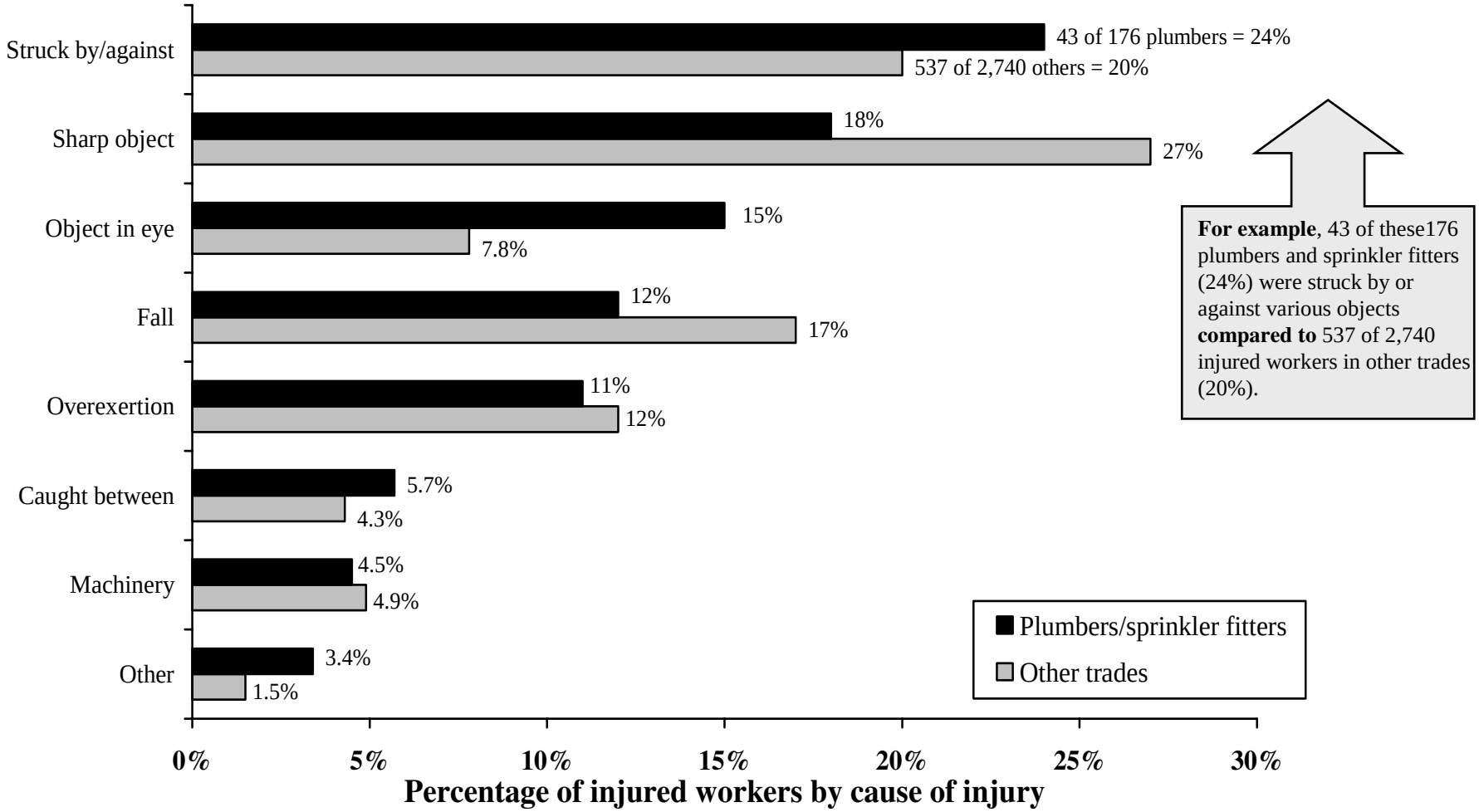
Plumbers and sprinkler fitters often work in tight spaces where materials aren't secured over their heads, and must use considerable force to loosen and connect fittings. Such work puts a strain on the neck, shoulders, and low back. The problem occurs throughout new construction, renovation, demolition, and maintenance work

Chart 5-A

176 injured plumbers and sprinkler fitters

Causes of injury

Compared to 2,740 other injured construction workers



For example, 43 of these176 plumbers and sprinkler fitters (24%) were struck by or against various objects **compared to** 537 of 2,740 injured workers in other trades (20%).

Chart 5-B

176 injured plumbers and sprinkler fitters

Detailed causes of injury

RANK #1	24%
STRUCK BY/AGAINST OBJECT (INCL. FALLING OBJECT)	**43**
pipe	12
metal: object, piece, sheetmetal duct, rebar, plate	7
hand tool	5
power tool	2
ceiling/wall	2
box/crate/toolbox	2
other	12
not specified	1

RANK #2	18%
SHARP OBJECT	**32**
metal/sheetmetal	9
nail	4
power tool	3
pipe	3
ceramic	3
wire	2
saw, not otherwise specified	2
other	5
not specified	1

RANK #3	15%
OBJECT IN EYE	**26**
chemical	6
paint (dust or wet)	3
dirt/dust/debris	3
metal dust	3
concrete/cement	3
water	2
insulation	2
wood dust	1
not specified	3

RANK #4	12%
FALL	**21**
from ladder	11
slip/trip/stumble	4
from stairs	2
into a hole	1
not specified	3

RANK #5	11%
OVEREXERTION / STRENUOUS MOVEMENT	**20**
lifting/carrying	6
pushing/pulling	3
stepping on/off, walking	2
other	6
not specified	3

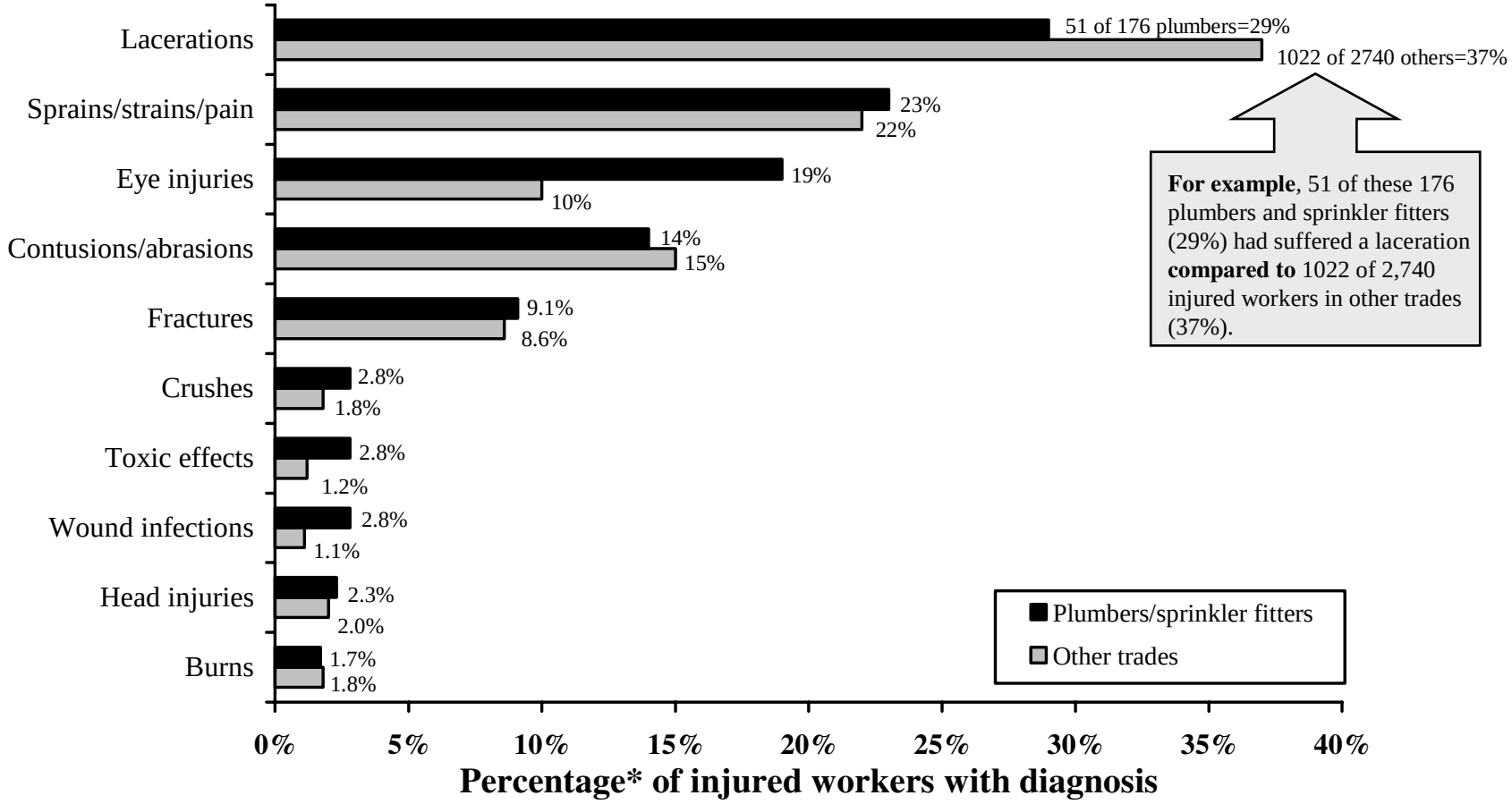
RANK #6	5.7%
CAUGHT BETWEEN OBJECTS	**10**
involving pipe	7
involving door	1
involving beam	1
other: involving grate lid	1

Chart 5-C

176 injured plumbers and sprinkler fitters treated for 195 diagnoses

Injury diagnoses

Compared to 2,740 other construction workers treated for 3,012 diagnoses



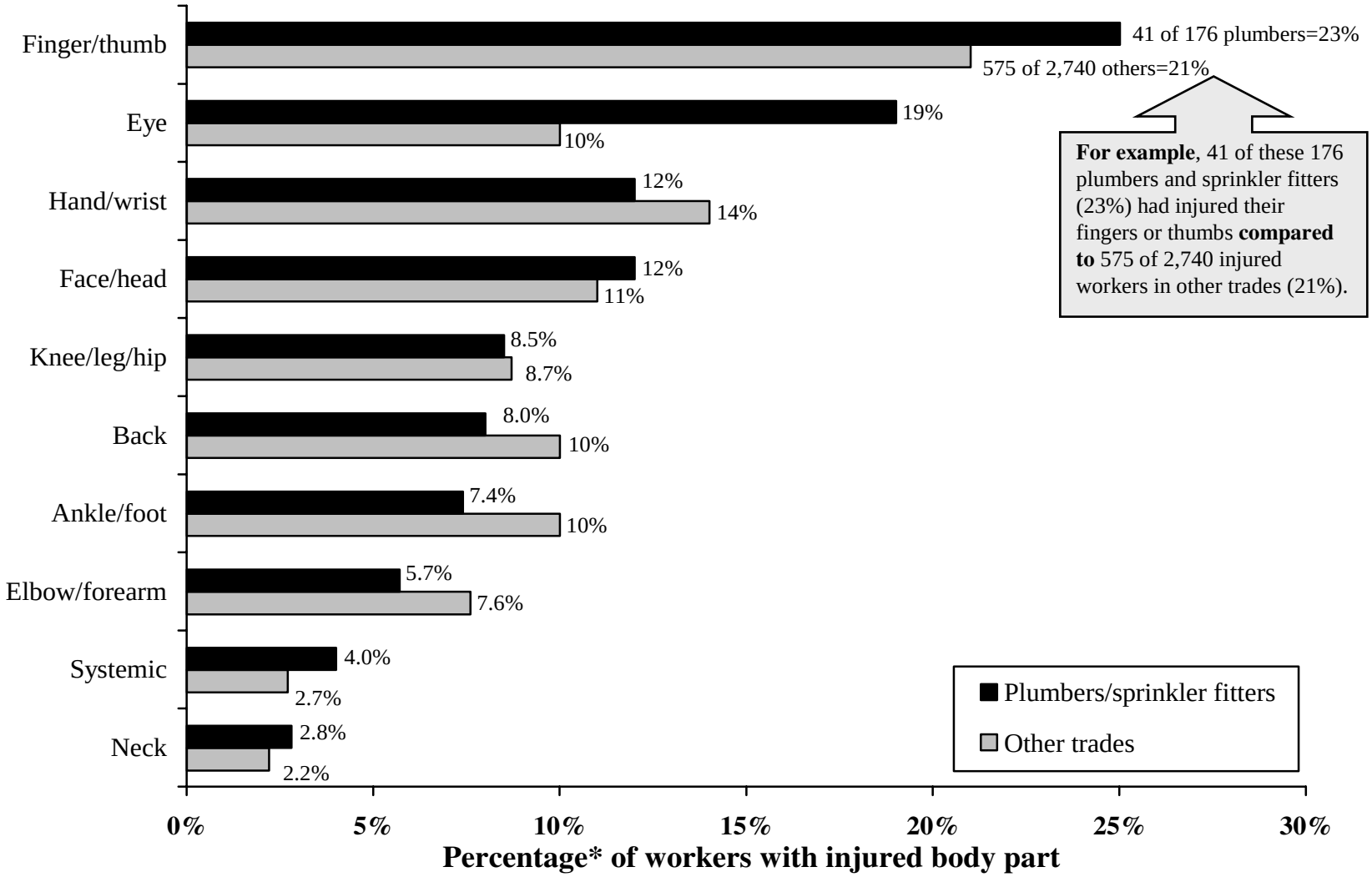
*Note: Percents add to more than 100 because some injured workers had more than one diagnosis.

Chart 5-D

176 plumbers and sprinkler fitters treated for 195 diagnoses

Injured body parts

Compared to 2,740 other construction workers treated for 3,012 diagnoses



*Note: Percents add to more than 100 because some injured workers had more than one diagnosis/body part.

GWU Emergency Department injury data, 11/90-10/97

Chart 5-E

176 injured plumbers and sprinkler fitters treated for 195 diagnoses

Diagnoses by body part

RANK #1	29% *
LACERATION	**51 ****
finger/thumb	19
face/head	13
hand/wrist	9
elbow/forearm	7
ankle/foot	2
knee/leg/hip	1

RANK #2	23%
SPRAIN, STRAIN, PAIN	**41**
back	11
knee/leg/hip	7
ankle/foot	6
neck	5
shoulder/upper arm	4
hand/wrist	3
elbow/forearm	3
finger/thumb	3

RANK #3	19%
EYE INJURIES	**33**

RANK #5	9.1%
FRACTURES	**16**
finger/thumb	8
hand/wrist	2
trunk	2
knee/leg/hip	2
ankle/foot	2

RANK #4	14%
CONTUSION, ABRASION, FOREIGN OBJECT (excl. eye)	**24**
knee/leg/hip	4
hand/wrist	4
face/head	4
finger/thumb	4
back	3
trunk	2
ankle/foot	2
shoulder/upper arm	1
multiple	1

For example:

* Percentage of plumbers with one or more lacerations. Percents add to more than 100 because some injured workers had more than one diagnosis.

** Number of plumbers with one or more lacerations.

Supervisors and Foremen

FROM November 1, 1990 to October 31, 1997, 152 construction supervisors were treated for work-related injuries at the George Washington University Emergency Department. Job titles that are classified into this category include both general and trade-specific foremen, supervisors, inspectors, engineers, managers, contractors, and superintendents. (Self-employed contractors who specified a trade are included with that group.) Such diversity in the job titles suggests that their tasks (and associated hazards) were also diverse. There is more opportunity for job title misclassification among supervisors than in other occupational groups; for example, an electrical supervisor may describe him- or herself as an electrician or as a supervisor. Also, depending on whether a supervisor works alongside his or her crew, the hazards encountered may be more or less similar to those of the trade being supervised. The injury patterns and conclusions presented here are based on a relatively small number of injuries.

Demographic Characteristics: The age distribution of the injured supervisors was narrower than the age distribution of the other 2,764 injured. The youngest supervisor was 21, the oldest was 59. The average age was 37, comparable to an average of 35 for other workers. Ninety-seven percent of injured supervisors were male and most were white (64%). Blacks and Hispanics represented only 24% and 8% of the injured supervisors, respectively, compared to 33% and 20% of the workers in all other trades.

Injury Circumstances, Diagnoses, and Injury Locations (charts 6-A through 6-E): Unfortunately, this study is unable to evaluate whether the rate of injuries among supervisors is similar to that of the people that they are supervising. Certainly though, the injury diagnoses and circumstances among supervisors were similar to those of the other 2,764 injured.

As with the other 2,764 injured, lacerations were the most common injury among the 152 injured supervisors. Most of the lacerations were to the hands and fingers, and they were caused by sharp objects ranging from sheet metal to tile, glass, and electric saws. Most of the lacerations to the head and face occurred when workers walked into pipes, bumped against a low ceiling, or were struck by a falling crowbar or hammer.

Sprains and strains to the low back were caused usually by lifting something heavy or bending and twisting.

For contusions and abrasions, the range of severity, the body locations, and the circumstances varied. One supervisor had a forklift back onto his ankle, while another got a splinter in his hand from a broom handle; one scraped his foot against a piece of rebar, while another had a nail from a nail gun ricochet off the working surface and lodge in his scalp.

In the case of eye injuries, the supervisors sometimes reported that they were creating the hazard (for example, one sheet metal foreman was welding and got slag in his eye) and other times that they were bystanders (for example, one foreman was standing near another welder). Two supervisors sustained eye injuries while inspecting electrical boxes; one box blew a fuse and another exploded.

The most serious electrical injury resulted when a field engineer was manipulating a ladder while standing in a puddle. His ladder contacted a live wire and he was admitted to the hospital for treatment of burns.

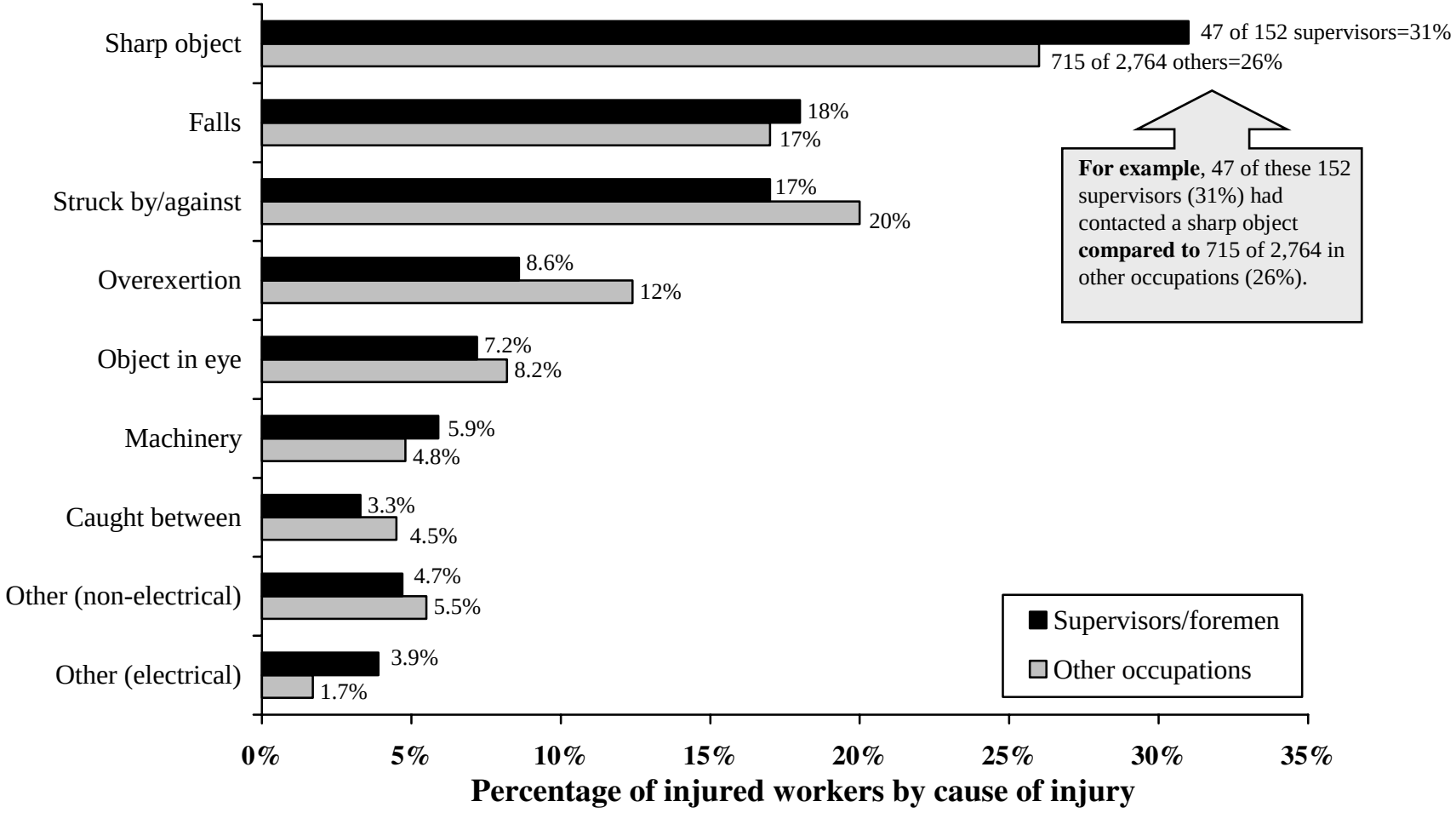
Recommendations: Given that there were few distinct patterns in the injury profiles for supervisory construction workers, it is difficult to identify distinct hazards for this group. In some way, the absence of any distinct hazard is a finding. That is, workers in supervisory roles are subject to the same array of hazards as the trades they supervise.

Chart 6-A

152 injured supervisors and foremen

Causes of injury

Compared to 2,764 injured in other construction occupations



GWU Emergency Department injury data, 11/90-10/97

Chart 6-B

152 injured supervisors and foremen

Detailed causes of injury

RANK #1	31%
SHARP OBJECT	**47**
metal/sheetmetal/ductwork	15
razor/knife	7
power tool, incl. power saw(2)	6
glass	5
light fixture	3
rebar/metal bar/metal stud	2
wire	2
hand tool	2
other	4
not specified	1

RANK #2	18%
FALL	**28**
from ladder	8
slip/trip/stumble	5
from stairs	4
from scaffold	3
from another level	3
not specified	3
into a hole	2

RANK #3	17%
STRUCK BY/AGAINST OBJECT (INCL. FALLING OBJECT)	**26**
piece of metal/sheetmetal/duct	3
metal object	3
ceiling/wall	3
pipe	2
hammer/sledge	2
beam	2
cinder block/brick/stone	1
drywall/plaster	1
concrete/cement	1
other	7
not specified	1

RANK #4	9%
OVEREXERTION / STRENUOUS MOVEMENT	**13**
lifting/carrying	4
stepping on/off, walking	3
pushing/pulling	1
using jackhammer	1
bending over	1
other: using nail gun	1
not specified	2

RANK #5	7%
OBJECT IN EYE	**11**
concrete/cement (dust or wet)	4
wood dust	3
dirt/dust/debris	1
rock/stone/gravel	1
metal dust	1
not specified	1

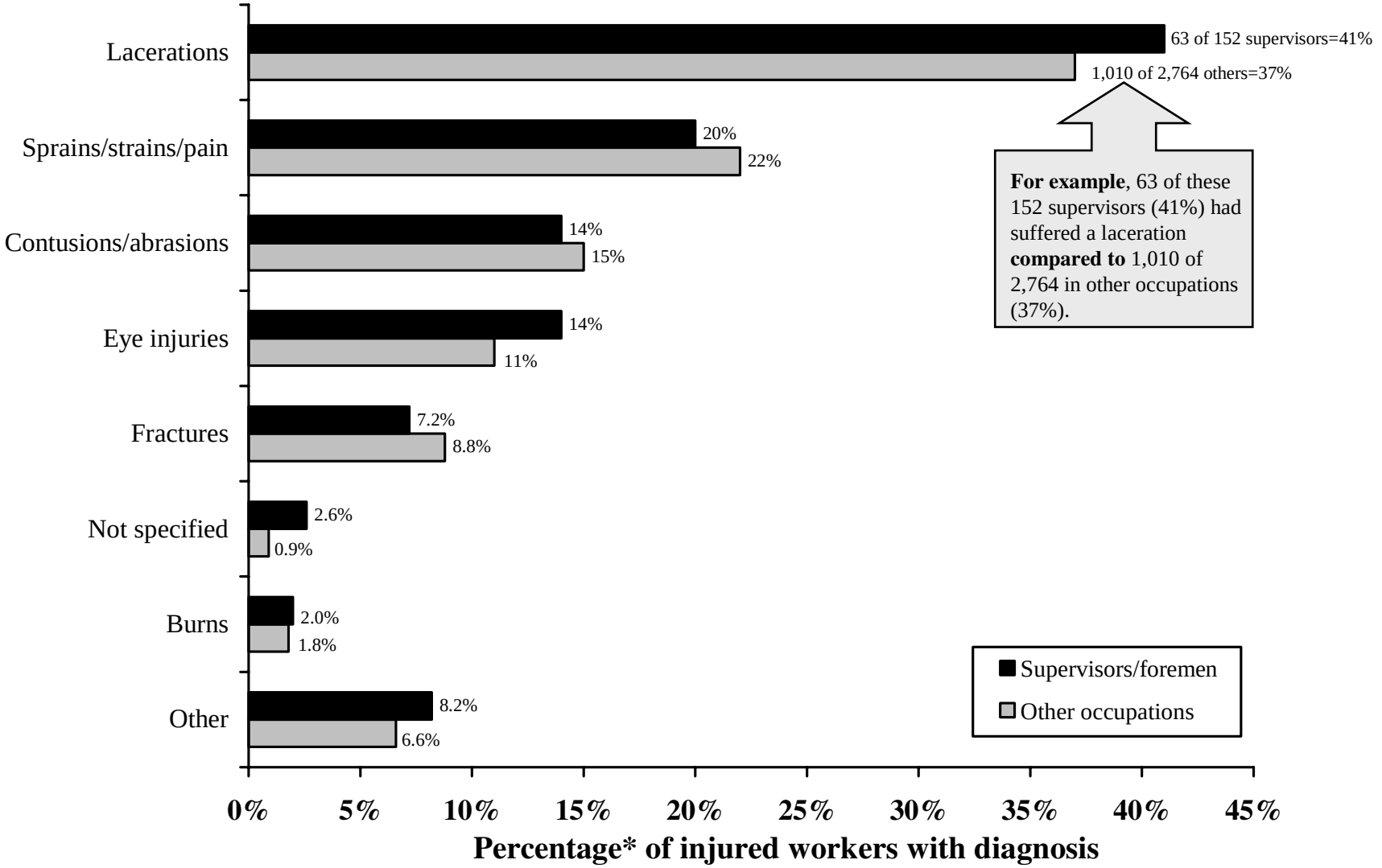
RANK #6	6%
MACHINERY RELATED	**9**
woodworking machinery	3
metal working machinery	1
lifting machinery	1
other:	
welding/soldering machinery (3)	4

Chart 6-C

152 injured supervisors and foremen treated for 167 diagnoses

Injury diagnoses

Compared to 2,764 other injured treated for 3,040 diagnoses



*Note: Percents add to more than 100 because some injured workers had more than one diagnosis.

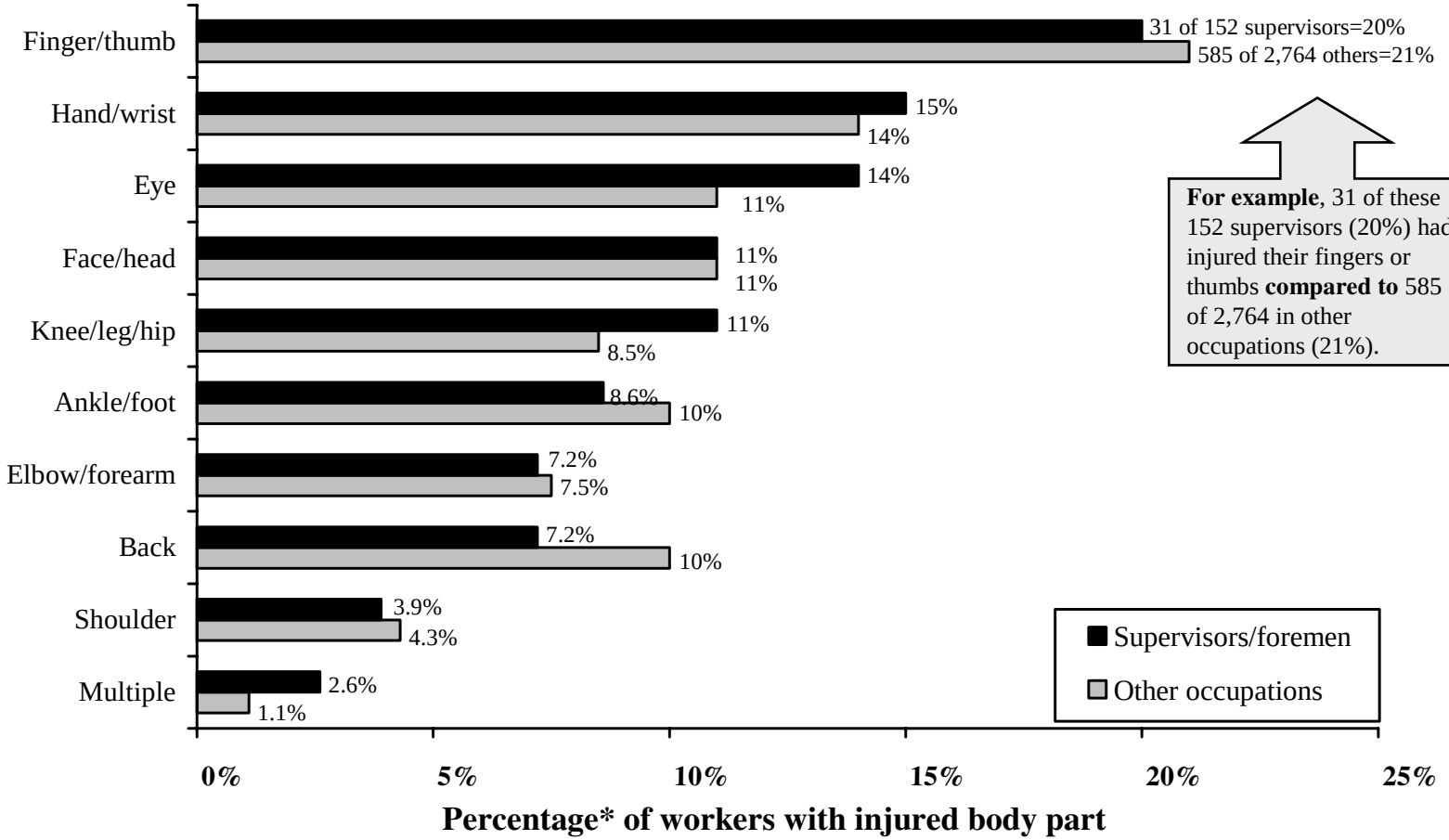
GWU Emergency Department injury data, 11/90-10/97

Chart 6-D

152 injured supervisors and foremen treated for 167 diagnoses

Injured body parts

Compared to 2,764 injured in other construction occupations treated for 3,040 diagnoses



*Note: Percents add to more than 100 because some injured workers had more than one diagnosis/injured body part.

Chart 6-E

152 injured supervisors and foremen treated for 167 diagnoses

Diagnoses by body part

RANK #1	41% *
LACERATION	**63 ****
finger/thumb	26
face/head	12
hand/wrist	12
elbow/forearm	7
knee/leg/hip	4
ankle/foot	1
shoulder/upper arm	1

RANK #2	20%
SPRAIN, STRAIN, PAIN	**31**
low back	8
knee/leg/hip	6
ankle/foot	5
hand/wrist	5
neck	3
shoulder/upper arm	3
elbow/forearm	1

RANK #3	14%
CONTUSION, ABRASION, FOREIGN OBJECT (excl. eye)	**22**
knee/leg/hip	5
ankle/foot	3
back	3
trunk	2
face/head	2
finger/thumb	2
elbow/forearm	2
hand/wrist	1
shoulder/upper arm	1
multiple	1
not specified	1

RANK #4	14%
EYE INJURY	**21**

RANK #5	7.2%
FRACTURES	**11**
hand/wrist	4
ankle/foot	3
face/head	2
elbow/forearm	2
finger/thumb	1

For example:

* Percentage of supervisors with one or more lacerations.
Percents add to more than 100 because some of the injured had more than one diagnosis

** Number of supervisors with one or more lacerations.

Ironworkers

FROM November 1, 1990 through October 31, 1997, 133 construction workers who identified themselves as ironworkers, reinforced ironworkers, rodmen, or steelworkers were treated for work-related injuries at the George Washington University Emergency Department. This group of workers is referred to as ironworkers in this section.

Demographic Characteristics: The average age of the ironworkers was 39, which was four years older than the average age of workers in all other trades. The youngest injured ironworker was 18 and the oldest was 62. Injured ironworkers were most likely to be white (65%), and only 4% were Hispanic. Also, only one of the injured ironworkers was a woman, compared to the 3.3% female representation among injured workers in all other trades.

Causes of Injury, Diagnoses, and Body Locations (charts 7-A through 7-E): Injuries for this trade differed in some respects from injuries seen among other construction workers.

Most commonly, ironworkers were treated in the Emergency Department after they struck against or were struck by various objects (23%). Not surprisingly, a leading cause of such injuries was rebar, steel bars used to reinforce concrete. For example, one ironworker was cutting rebar when a piece snapped up and struck him in the face; another had a 400-pound steel Bar fall onto his fingers. A variety of other tools and materials fell and struck ironworkers from above. For example, one ironworker was trapped under a collapsed metal beam; another had a brick fall from 2 stories above, onto his head. One was hit by a 70-pound drill attached to a rope that swung and hit him in back; another had a railing fall on his hand, crushing his middle finger. The fact that ironworkers are laying out the structural framework of the building, and initially laying out rebar at ground level may explain the number of injuries due to being struck from above by falling objects.

Even though few of the falls were from a height, some of them were very serious. Nationwide, ironworkers are often injured in falls from height, and ironworkers have proportionally more deaths from falls than any other construction trade. The fact that the majority of the falling injuries here were a result of slipping or tripping reflects the fact that concrete construction predominates in Washington, D.C., and most local ironworkers are rodmen. Rodmen work on the same level with horizontal rebar or at modest elevations with vertical rebar, rather than at the heights seen in structural ironwork.

Hospital Admissions: Seven of these 133 ironworkers were hospitalized, and one died from multiple injuries after falling 11 stories onto a stack of windows. Apparently, he had temporarily unhooked his safety line to step around the outside edge of a column. Four other ironworkers were hospitalized after falls: One fell 30 to 60 feet from an elevated highway construction site and suffered a spinal

fracture and internal injuries; another fell one story and had a closed head injury and broke his collarbone; the third fell 14 feet from a scaffold and hit his head on a beam; and the fourth worker fell 10 to 15 feet from a ladder and sustained a skull fracture. Another ironworker's lower leg was amputated after he was struck by and trapped under a collapsed metal beam while welding on a bridge. His partner was killed in the bridge collapse (he was not brought to the GW Emergency Department). The seventh hospitalized ironworker was treated for a serious infection resulting from a wire puncture to his finger.

Recommendations: Because material handling is an important and strenuous part of ironwork, attention to staging of materials may reduce exposure to lifting and carrying over uneven surfaces. Reducing the number of times heavy materials are moved would help to prevent strains and sprains which plague ironworkers and also some of the serious hand and finger injuries. In addition, injuries that result from slips and trips on the rebar grid could be reduced by more-efficient staging practices. Use of heavy gloves could help to reduce the severity of finger and hand injuries that occur when workers are struck by or get their hands caught between heavy objects.

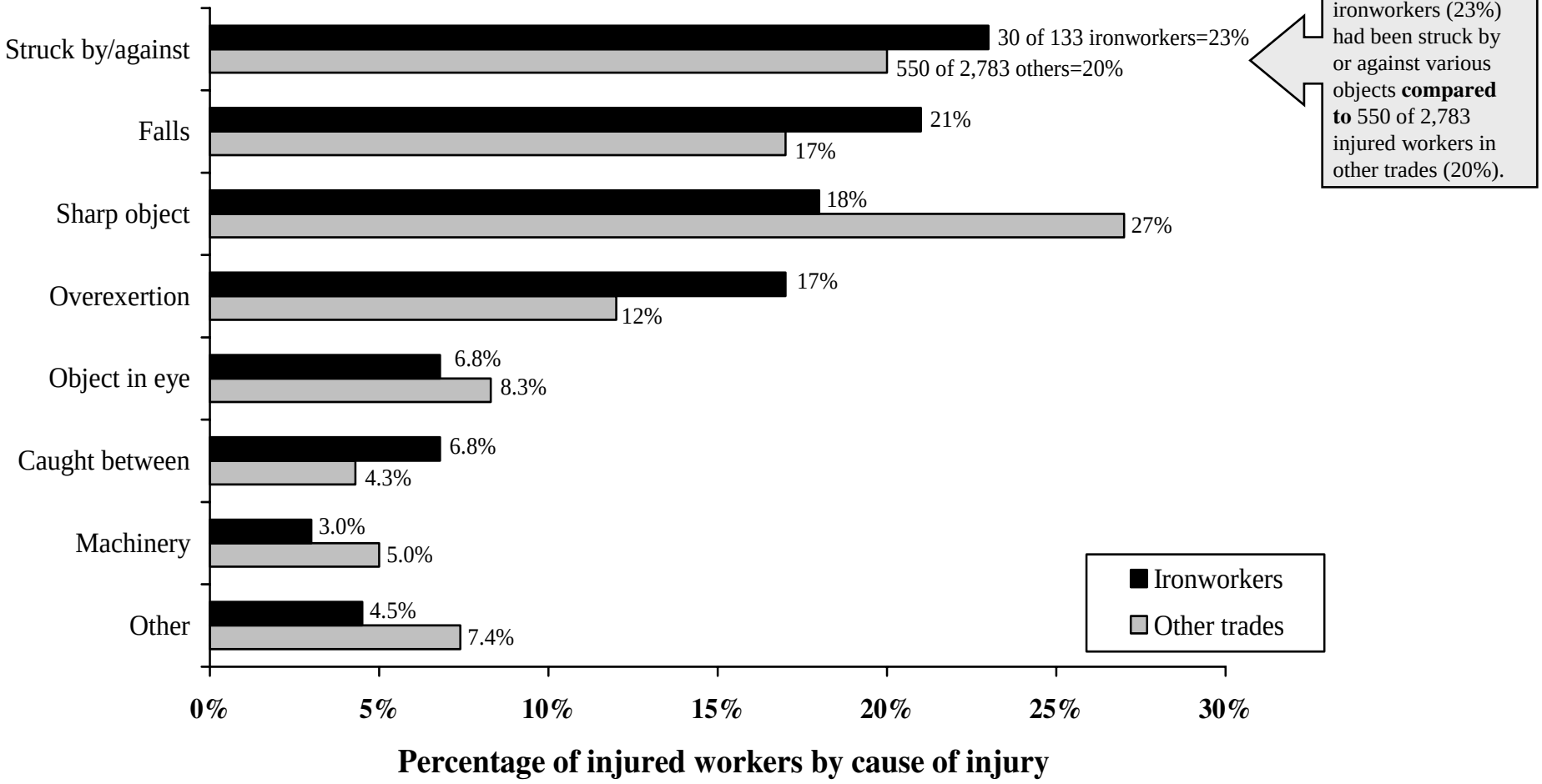
The usual method for tying horizontal rebar requires a nearly constant double-bent posture, and different approaches to this work may be desirable. One such approach is to tie sections of rebar on a vertical frame (standing up), and then to use a crane to move the whole section into horizontal position. Another approach – rebar-tying devices that can be used in an upright posture – may be suitable for some types of jobs and may help to reduce musculoskeletal stress among rodmen.

Chart 7-A

133 injured ironworkers

Causes of injury

Compared to 2,783 other injured construction workers



For example, 30 of these 133 ironworkers (23%) had been struck by or against various objects **compared to** 550 of 2,783 injured workers in other trades (20%).

Chart 7-B
133 injured ironworkers
Causes of injury

RANK #1	23%
STRUCK BY/AGAINST OBJECT (INCL. FALLING OBJECT)	**30**
rebar/metal bar	12
piece of metal/sheetmet/duct	4
beam	4
power, incl. drill (2),	3
wire/cable	1
truck	1
cinder block/brick	1
hammer/sledge	1
not specified	1
other:	
metal fitting from hose, metal railing	2

RANK #2	21%
FALL	**28**
slip/trip/stumble	9
from ladder	4
out of building/structure	3
from stairs	2
from scaffold	1
from another level	1
into a hole	1
not specified	7

RANK #3	18%
SHARP OBJECT	**24**
wire	5
power tool	5
metal/sheetmetal	4
rebar/metal bar	2
nail	2
metal stud	1
razor/knife	1
hand tool	1
wood/splinter	1
saw, not otherwise specified	1
other: metal clips	1

RANK #4	17%
OVEREXERTION / STRENUOUS MOVEMENT	**23**
lifting/carrying	10
stepping on/off, walking	5
pushing/pulling	2
stopping a fall/falling obj	1
using drill	1
not specified	2
other:	
twisting in awkward position; reaching	2

RANK #5/#6 (tie)	6.8%
CAUGHT BETWEEN OBJECTS	**9**
metal plate/object	6
cart/dolly	1
other: manhole cover	1
gutter and other object	1

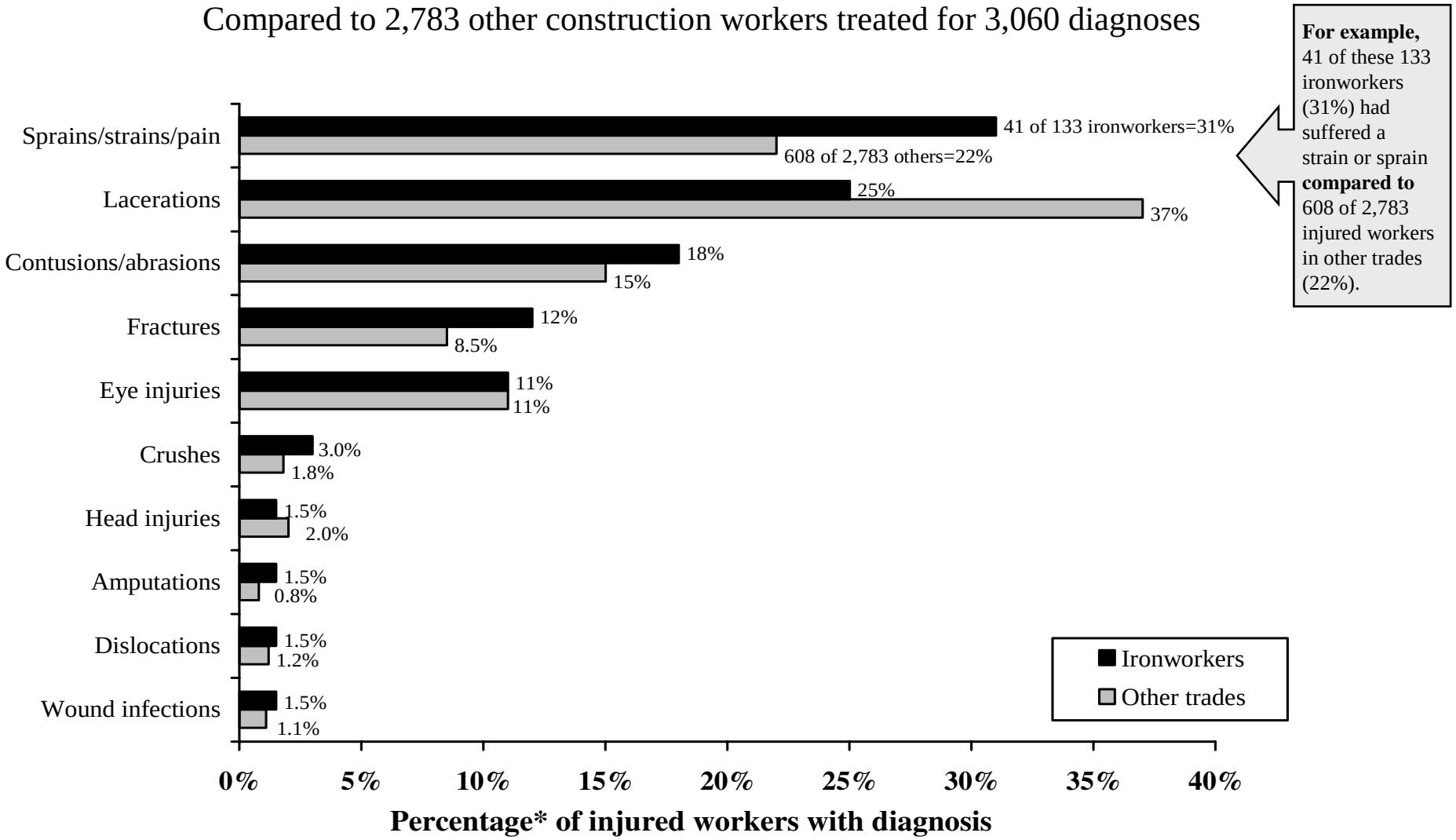
RANK #5/#6 (tie)	6.8%
OBJECT IN EYE	**9**
metal dust	3
concrete/cement	2
insulation	1
dirt/dust/debris	1
chemical	1
not specified	1

Chart 7-C

133 injured ironworkers treated for 147 diagnoses

Injury diagnoses

Compared to 2,783 other construction workers treated for 3,060 diagnoses



For example, 41 of these 133 ironworkers (31%) had suffered a strain or sprain **compared to** 608 of 2,783 injured workers in other trades (22%).

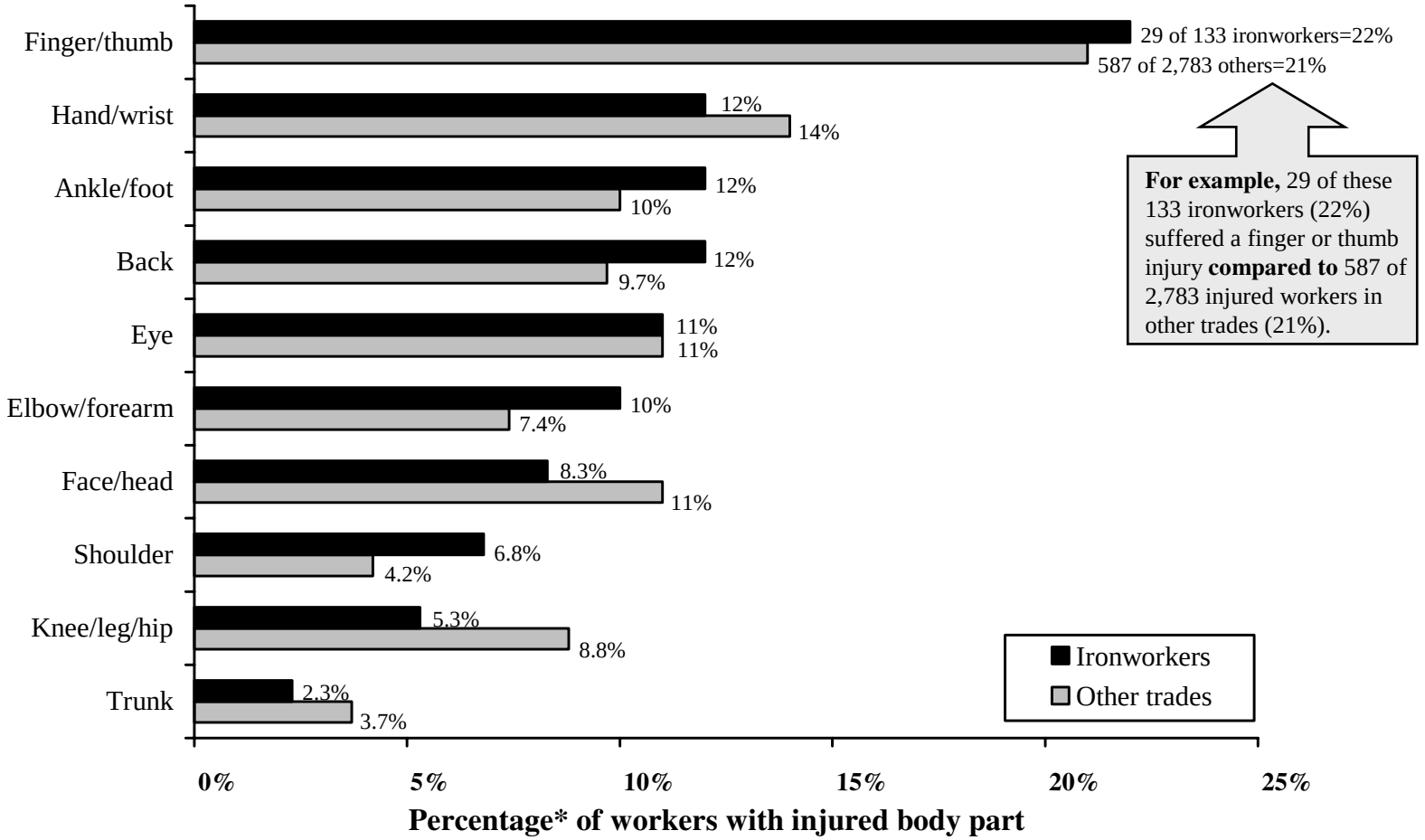
*Note: Percents add to more than 100 because some injured workers had more than one diagnosis.

Chart 7-D

133 injured ironworkers treated for 147 diagnoses

Injured body parts

Compared to 2,783 other construction workers treated for 3,060 diagnoses



*Note: Percents add to more than 100 because some injured workers had more than one diagnosis/injured body part.

GWU Emergency Department injury data, 11/90-10/97

Chart 7-E

133 injured ironworkers treated for 147 diagnoses

Diagnoses by body part

RANK #1	31% *
SPRAIN, STRAIN, PAIN	**41****
low back	14
ankle/foot	9
hand/wrist	6
shoulder/upper arm	3
elbow/forearm	3
trunk	2
neck	2
upper back	1
finger/thumb	1

RANK #2	25%
LACERATION	**33**
finger/thumb	8
face/head	7
hand/wrist	7
elbow/forearm	5
knee/leg/hip	4
ankle/foot	2

RANK #3	18%
CONTUSION, ABRASION, FOREIGN OBJECT (excl. eye)	**24**
finger/thumb	12
shoulder/upper arm	3
hand/wrist	3
elbow/forearm	2
knee/leg/hip	1
face/head	1
ankle/foot	1
back	1

RANK #4	12%
FRACTURE	**16**
finger/thumb	6
ankle/foot	3
elbow/forearm	2
trunk	1
shoulder/upper arm	1
knee/leg/hip	1
face/head	1
hand/wrist	1

For example:

* Percentage of ironworkers with one or more sprains or strains. Percents add to more than 100 because some injured workers had more than one diagnosis.

** Number of ironworkers with one or more sprains or strains.

Painters and Glaziers

OVER SEVEN YEARS, 130 construction workers who identified themselves as painters, glaziers, window installers, or paperhangers were treated for work-related injuries at the George Washington University Emergency Department. Of these, 111 were painters, 39 of whom did maintenance painting on a fixed site. During this time, only 15 glaziers or window installers and four paperhangers were treated for work-related injuries. The painters, paperhangers, and glaziers were grouped together for analysis and referred to here as painters. Additional painting-related injuries might have occurred among other finishing trades, such as drywall and plaster workers.

Demographic Characteristics: Of the 130 injured painters and glaziers, three were female. The injured painters were slightly older than the other tradespeople; 30% were in their forties, compared to 20% of the injured workers in all other trades. The average age of the injured painters was 39, compared to a average age of 35 for other workers. The ethnic distribution of injured painters was similar to that of the other injured workers, although the proportion of Hispanic painters was slightly greater than that of the other injured workers (25% compared to 19%).

Causes of Injury, Diagnoses, and Body Locations (charts 8-A through 8-E): Many of the razor- and knife-related cuts occurred while cutting wallpaper and drywall.

Most of the falls were from ladders. Such a high proportion of falling injuries is alarming given that falling often results in serious injuries.

Overall, one in four painters had injured his/her fingers or hands. Nine of the 20 strains were the result of heavy lifting or sudden movement. For example, some workers strained themselves by lifting furniture or large paint cans; another was painting from a rolling cart that was not secured; the cart moved suddenly and he sprained his neck. Another nine strains and sprains occurred when workers fell –mostly from ladders, scaffolds, or st airs. For example, one worker was moving from a scaffold to a ladder when the ladder slipped and he fell.

Eight of the eye injuries were from a paint splash or paint remover splash. Six of the 19 injuries appear to have been the result of overhead work while doing such tasks as painting, installing ceiling tile, or sanding. Three workers got metal in their eyes: one while grinding metal, one while cutting aluminum with a chop saw, and one from a welding operation on the floor below where he was working.

Two painters during this period suffered injuries to their hands from using airless spray guns. One of these was a severe paint injection wound, and required hospital admission for plastic surgery. This is a unique hazard that painters should be aware of.

Only one painter during this seven-year period was treated for respiratory problems related to solvent exposure. This does not necessarily mean that solvent-related illnesses do not exist among painters, because such conditions are not generally treated at an emergency department.

Hospital Admissions: Five of the six painters who were admitted to the hospital were injured in falls from a ladder or a scaffold. The range of falling injuries that resulted in hospital admission illustrates that a worker does not have to fall from a great height to become seriously injured. For example, one of the painters simply slipped off the fifth rung of his ladder, fell four feet, and fractured his foot. Unfortunately, some of the painters who were admitted did have very serious injuries. Two of these were falls from scaffolds – one painter who fell 55 feet onto a pile of debris sustained multiple fractures of his trunk and lower extremities, while another fell 18 feet onto his wrists and face and lost consciousness. Two workers were admitted to the hospital after falls from ladders: one worker fell 27 feet from a ladder head first and sustained multiple facial fractures, while another fell 12 feet and was treated for scrapes to his side. The sixth hospital admission was the spray gun injury described above.

Recommendations: Even though the cuts were not the most severe injuries, they were severe enough to require medical treatment in an emergency department and they accounted for 38% of the injury cases. Protective gloves are the most universal protection against contact with sharp objects. In addition, razors or knives with safety features should be used whenever possible.

Given the high proportion and severity of falling injuries, the procedures for work on ladders and scaffolds need to be improved. The scaffold injuries suggest the need for improved protections. If a scaffold platform is 10 feet or more above a level, OSHA requires fall protection –guardrails, personal fall protection (tying off), or both. A common problem faced by many construction trades, including painters, is that workers carry a lot of materials while climbing ladders and scaffolds. However, workers need both hands free to safely climb ladders. Safer methods must be developed and used for moving materials safely up ladders and scaffolds.

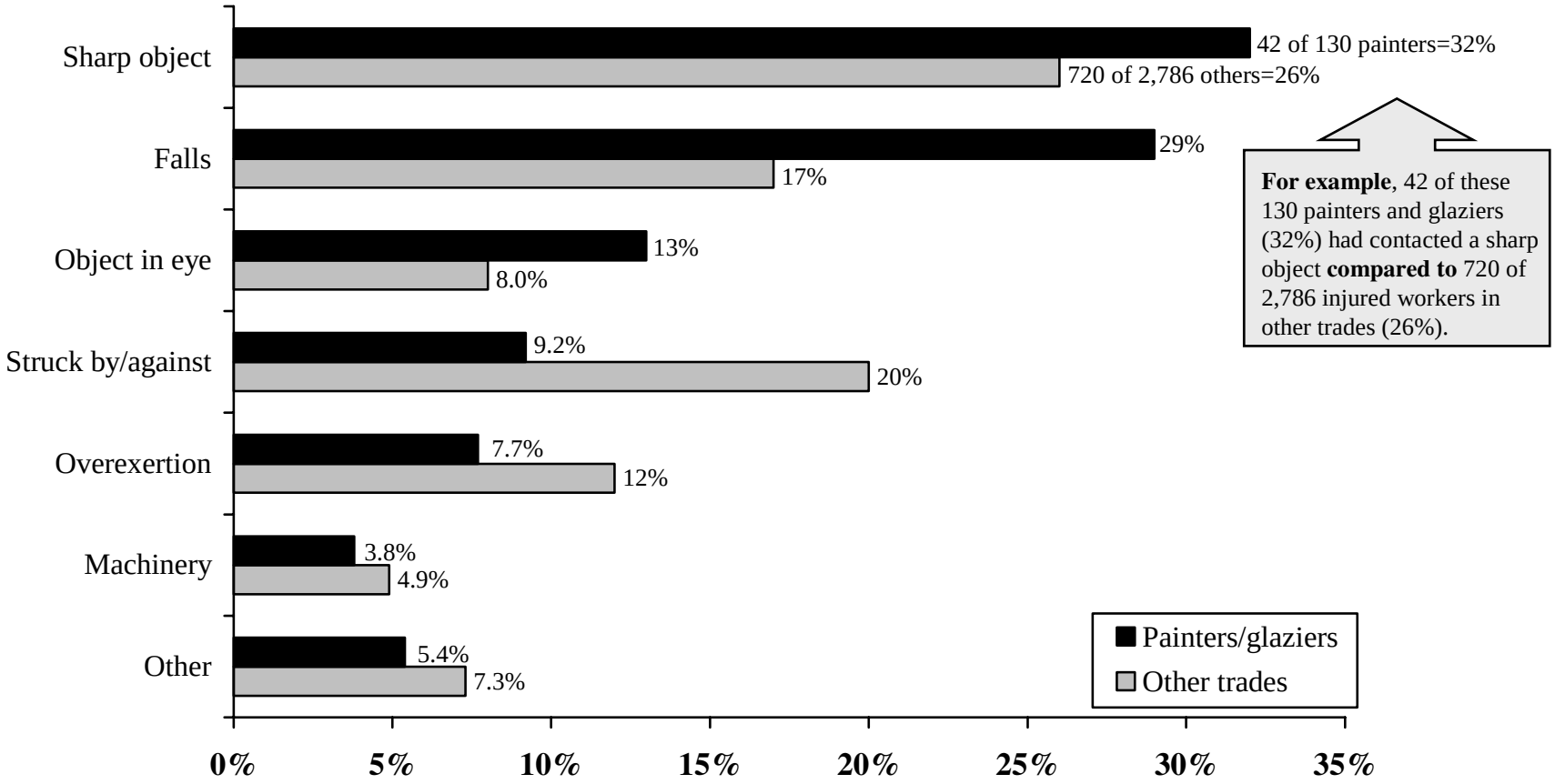
Finally, although eye injuries are a problem in this trade, it is not customary for painters to wear eye protection. Painters who are working overhead, using power tools, or handling paint or chemical products should wear appropriate eye protection.

Chart 8-A

130 injured painters & glaziers

Causes of injury

Compared to 2,786 other injured construction workers



Percentage of injured workers by cause of injury

Chart 8-B

130 injured painters & glaziers

Detailed causes of injury

RANK #1	32%
SHARP OBJECT	**42**
razor/knife	17
glass	6
metal/sheetmetal	5
power tool	4
hand tool	3
wood/splinter	3
metal stud	2
not specified	1
other: metal railing	1

RANK #2	29%
FALL	**37**
from ladder	21
from scaffold	7
from another level	5
from stairs	3
not specified	1

RANK #3	13%
OBJECT IN EYE	**17**
paint (dust or wet)	5
chemical	3
dirt/dust/debris	2
metal dust	2
rock/stone/gravel	1
concrete/cement	1
ceiling tile	1
not specified	2

RANK #4	9.2%
STRUCK BY/AGAINST OBJECT (INCL. FALLING OBJECT)	**12**
pipe	2
board/wood	2
scaffold	1
metal object	1
cart/dolly	1
ceiling/wall	1
door jamb/doorway	1
not specified	1
other: fire extinguisher, glass sheets	2

RANK #5	7.7%
OVEREXERTION / STRENUOUS MOVEMENT	**10**
lifting/carrying	7
other	3

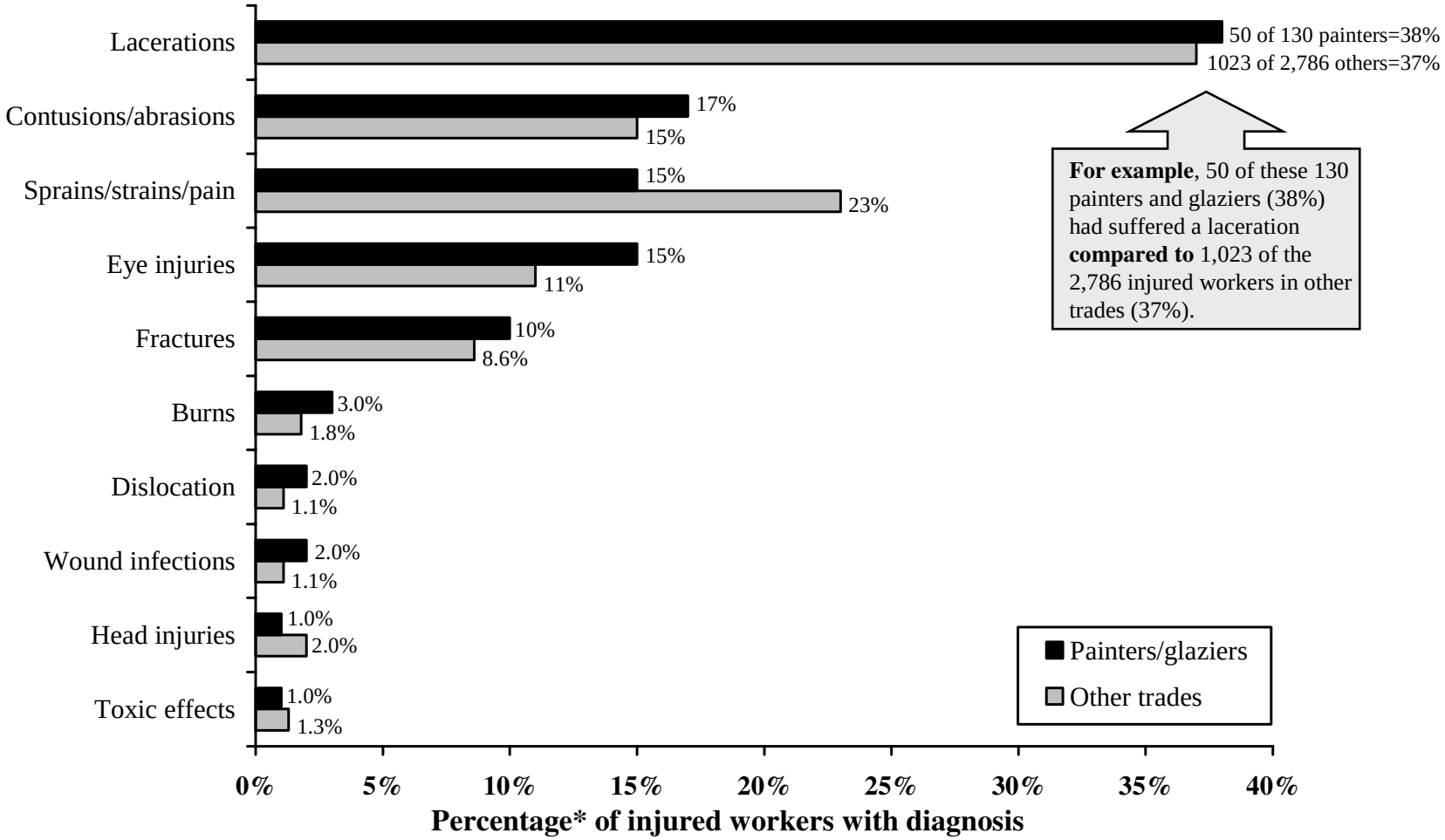
RANK #6	3.8%
MACHINERY RELATED	**5**
metal working machinery	2
woodworking machinery	1
lifting machinery	1
other:	
working near welder	1

Chart 8-C

130 injured painters & glaziers treated for 143 diagnoses

Injury diagnoses

Compared to 2,786 other injured construction workers treated for 3,064 diagnoses



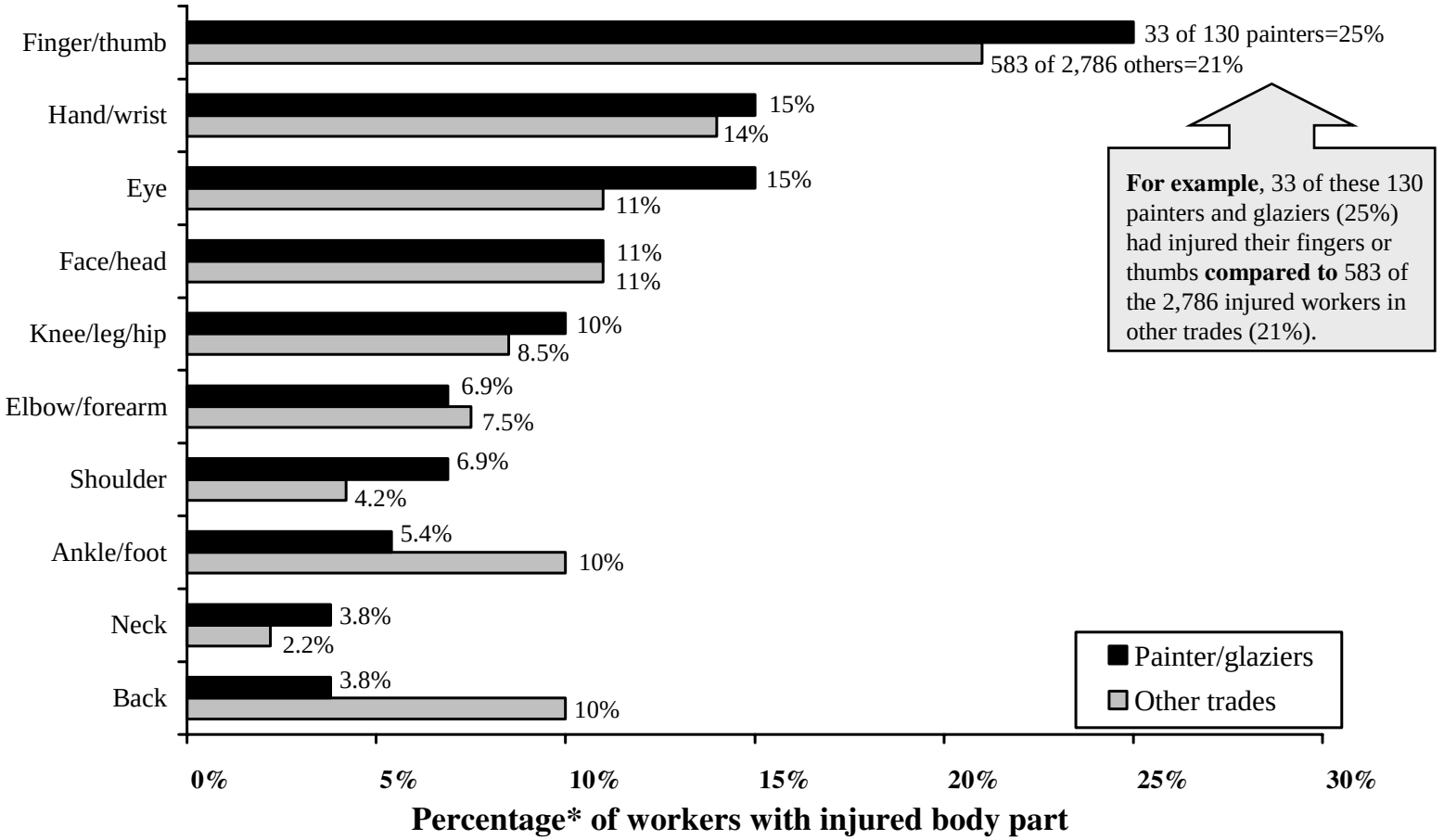
*Note: Percents add to more than 100 because some injured workers had more than one diagnosis.

Chart 8-D

130 injured painters & glaziers treated for 143 diagnoses

Injured body parts

Compared to 2,786 other injured construction workers treated for 3,064 diagnoses



*Note: Percents add to more than 100 because some injured workers had more than one diagnosis/injured body part.

Chart 8-E

130 injured painters & glaziers treated for 143 diagnoses

Diagnoses by body part

RANK #1	38% *
LACERATION	**50 ****
finger/thumb	24
hand/wrist	14
face/head	6
elbow/forearm	4
knee/leg/hip	2
shoulder/upper arm	1
ankle/foot	1

RANK #2	17%
CONTUSION, ABRASION, FOREIGN OBJECT (excl. eye)	**22**
knee/leg/hip	6
face/head	6
finger/thumb	3
hand/wrist	2
shoulder/upper arm	2
back	2
trunk	1
neck	1
ankle/foot	1
elbow/forearm	1
multiple	1

RANK #3	15%
SPRAIN, STRAIN, PAIN	**20**
neck	4
shoulder/upper arm	3
low back	3
knee/leg/hip	3
ankle/foot	3
hand/wrist	2
finger/thumb	1
elbow/forearm	1

RANK #4	15%
EYE INJURIES	**19**

RANK #5	10%
FRACTURES	**13**
trunk	2
shoulder/upper arm	2
elbow/forearm	2
hand/wrist	2
finger/thumb	2
ankle/foot	2
face/head	1
multiple	1

For example:
* Percentage of painters with one or more lacerations. Percents add to more than 100 because some injured workers had more than one diagnosis.
** Number of painters with one or more lacerations.

Brick, Stone, and Concrete Masons

FROM November 1, 1990 to October 31, 1997, 106 construction workers who identified themselves as masons were treated for work-related injuries at the George Washington University Emergency Department. From the workers' job titles, it was not always clear what material they worked with –brick, st one, or concrete. For this analysis, all of the masons were grouped together. Even so, the reader is reminded that the group of injured masons is still relatively small and it is difficult to draw firm conclusions.

Demographic Characteristics: All but one of the injured masons were male and the age distribution was similar to that of the other trades, with an average age of 36.

Injury Circumstances, Diagnoses, and Injury Locations (charts 9-A through 9-E): Most of the overexertion injuries were caused by lifting or carrying heavy objects, including bags of concrete and blocks of stone or brick that reportedly weighed as much as 400 pounds. Almost half of the over-exertion injuries resulted in back strains. Sometimes the workers reported a sharp pain immediately, other times they reported the pain after a day of lifting, and other times they reported the pain days later.

Of the eleven masons who fell, seven fell from scaffolds at heights that ranged from four feet to seven stories. Two masons were struck by falling scaffolds.

A few masons were exposed to toxic materials: two suffered concrete burns to their legs; three were poisoned with carbon monoxide – two while cutting stone with power saws in a confined space, and one who sandblasted with a hood whose intake valve was near an electric generator exhaust; one worker inhaled fiberglass; the last suffered a skin rash after handling epoxy.

Hospital Admissions: Two masons were hospitalized for their injuries: one worker who fell seven stories from a scaffold, was hospitalized with spinal fractures, a closed-head injury, and many cuts, scrapes, and bruises; the other was the carbon-monoxide poisoned sandblaster mentioned above.

Recommendations: It is challenging to consider how to lighten the load of inherently heavy work. The first line of intervention should be to shift at least some of the burden to lifting aids such as hoists or cranes. For example, load-leveling devices can be used to keep a stack of bricks at working height, which would reduce the frequency and degree of bending. A hoist might assist in transporting heavy pieces of stone. Scissor lifts or adjustable scaffolds could also be used to keep the workers themselves at comfortable working heights.

If mechanical lifting aids are not available, the buddy system should be used whenever possible. A "healthy back" class might r aise awareness. In addition, the weight of each object could be reduced. For example, concrete should be made available in smaller bags, and lightweight concrete block could be substituted.

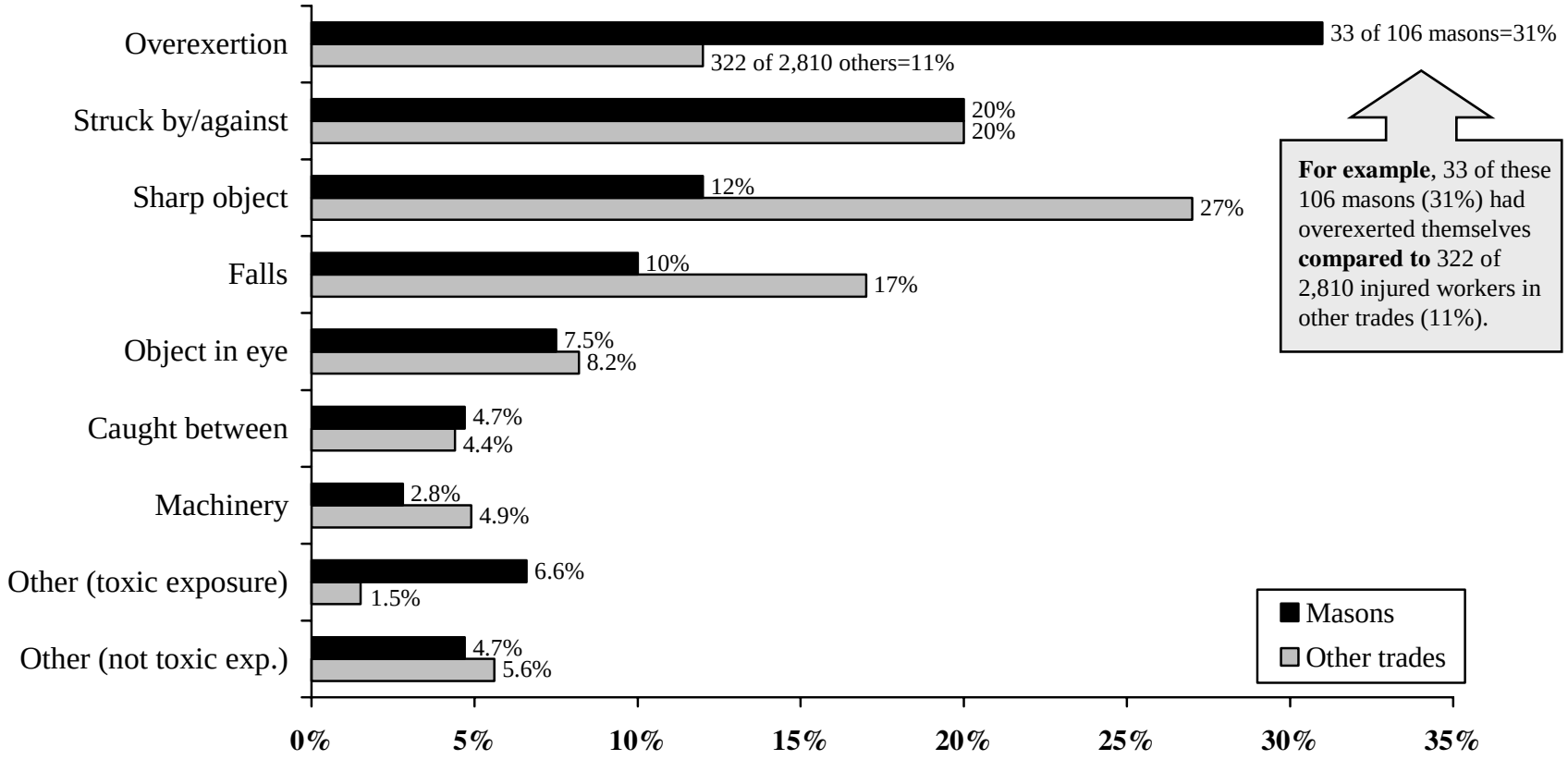
Finally, the scaffold injuries suggest the need for comprehensive scaffold safety programs that include the installation of adequate guardrails and the use of fall protection. The carbon monoxide poisonings (although few) act as a reminder of the importance of proper safety procedures.

Chart 9-A

106 injured brick, stone, & concrete masons

Causes of injury

Compared to 2,810 other injured construction workers



Percentage of injured workers by cause of injury

Chart 9-B

106 injured brick, stone, & concrete masons

Detailed causes of injury

RANK #1	31%
OVEREXERTION / STRENUOUS MOVEMENT	**33**
lifting/carrying	21
pushing/pulling	3
stepping on/off, walking	2
bending over	2
stopping a fall/falling object	1
while drilling	1
other:	
carrying box, prolonged kneeling	2
not specified	1

RANK #2	20%
STRUCK BY/AGAINST OBJECT (INCL. FALLING OBJECT)	**21**
granite/marble/stone	4
concrete/cement	3
scaffold	2
pipe	2
board/wood	2
metal: object, plate	2
hammer/sledge	2
wrench	1
box/crate/toolbox	1
beam	1
not specified	1

RANK #3	12%
SHARP OBJECT	**13**
wire/cable	3
glass	2
rebar/metal bar/metal stud	2
ductwork	1
nail	1
wood/splinter	1
pipe	1
razor/knife	1
other: sharp rock	1

RANK #4	10%
FALL	**11**
from scaffold	7
slip/trip/stumble	3
not specified	1

RANK #5	7.5%
OBJECT IN EYE	**8**
concrete/cement	4
rock/stone/gravel	2
chemical	1
ceiling tile	1

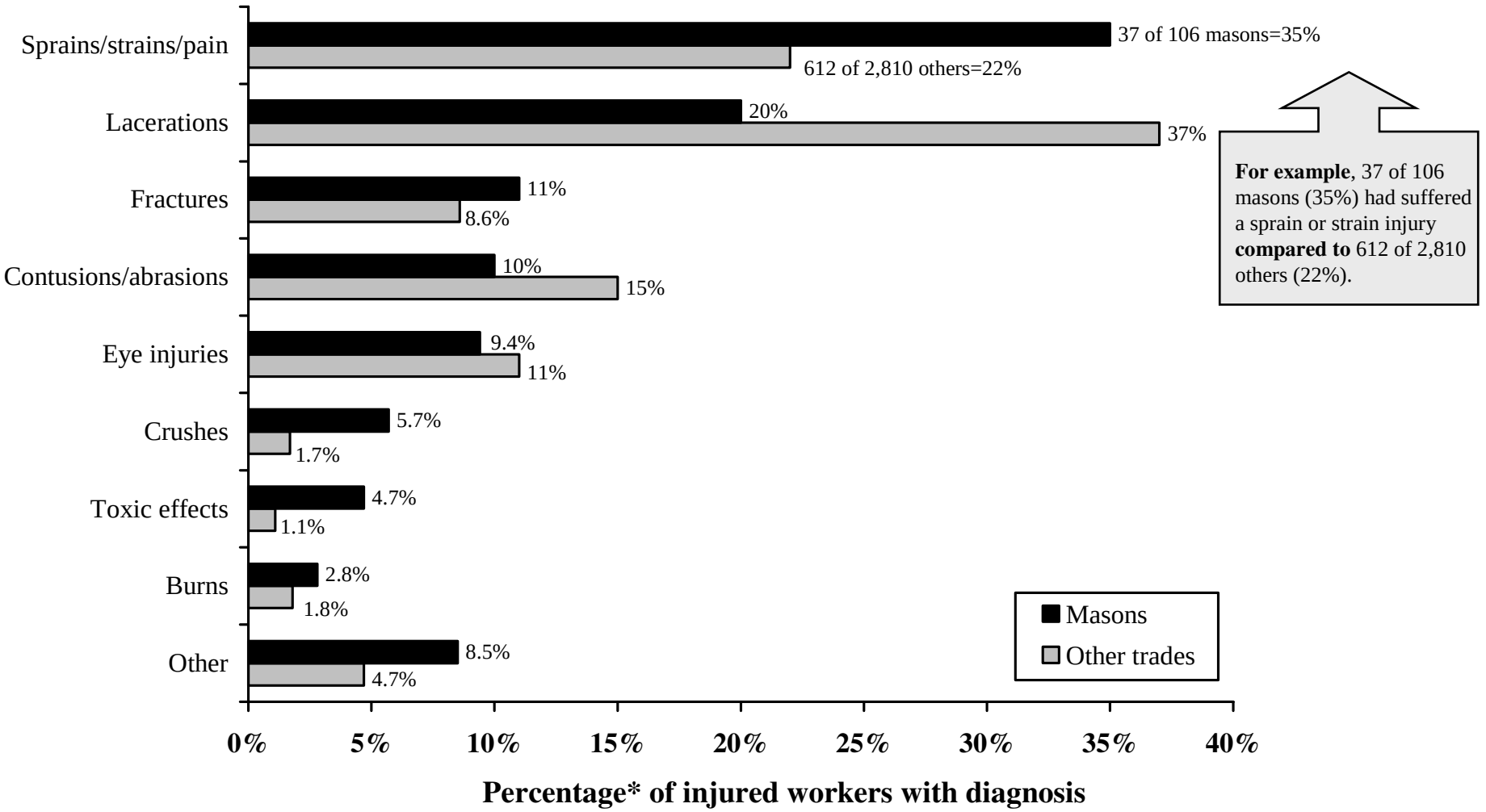
RANK #6	6.6%
OTHER: TOXIC EXPOSURE	**7**
carbon monoxide	3
concrete	2
fiberglass	1
epoxy	1

Chart 9-C

106 brick, stone, & concrete masons treated for 117 diagnoses

Injury diagnoses

Compared to 2,810 other construction workers treated for 3,090 diagnoses



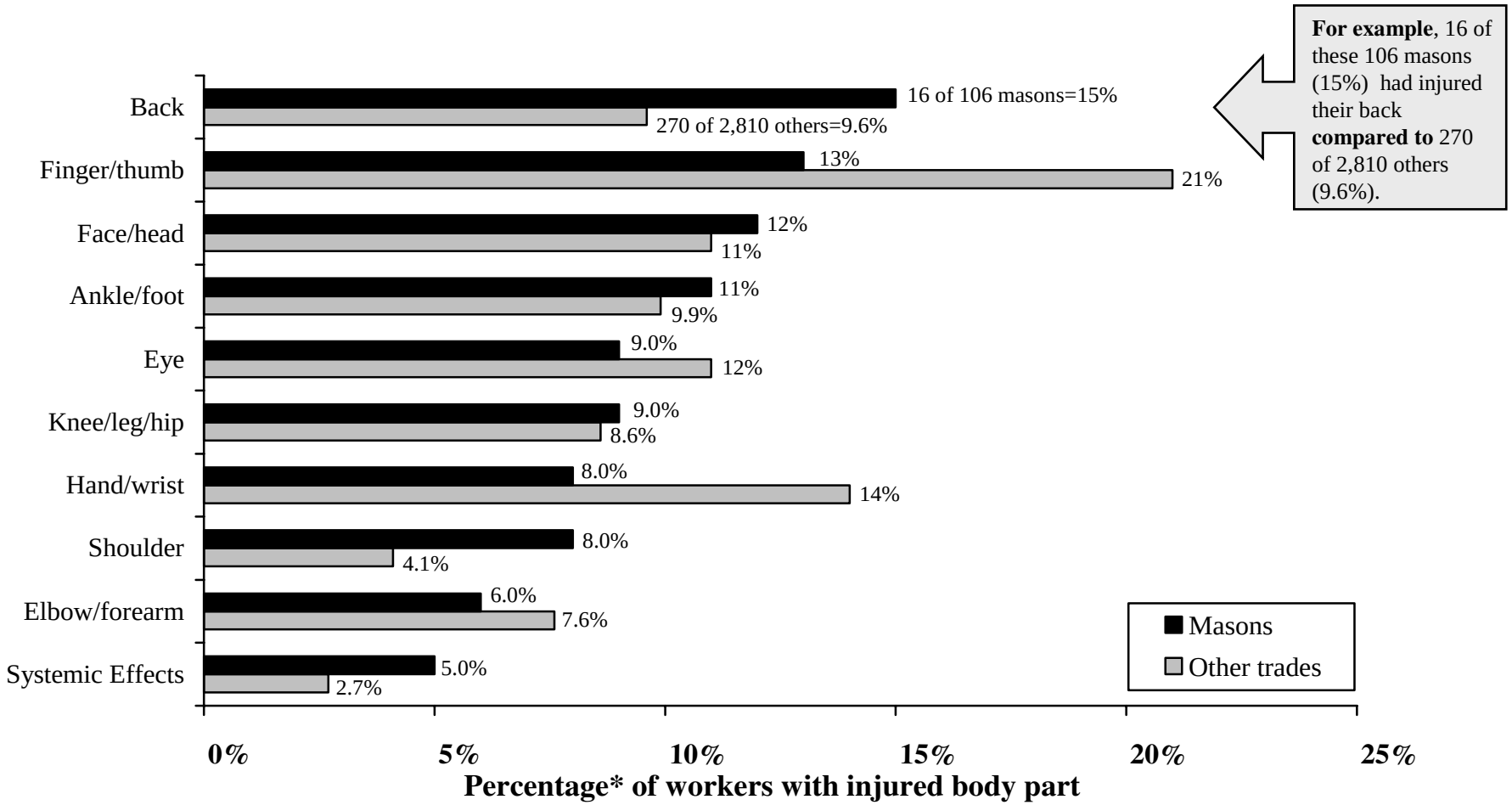
*Note: Percents add to more than 100 because some injured workers had more than one diagnosis.

Chart 9-D

106 brick, stone, & concrete masons treated for 117 diagnoses

Injured body parts

Compared to 2,810 other injured construction workers treated for 3,090 diagnoses



*Note: Percents add to more than 100 because some injured workers had more than one diagnosis/injured body part.

Chart 9-E

106 injured brick, stone, & concrete masons treated for 117 diagnoses

Diagnoses by body part

RANK #1	35% *
SPRAIN, STRAIN, PAIN	**37****
low back	13
knee/leg/hip	5
upper back	4
shoulder/upper arm	4
neck	4
ankle/foot	3
finger/thumb	3
trunk	1
elbow/forearm	1

RANK #2	20%
LACERATION	**21**
face/head	8
hand/wrist	6
ankle/foot	3
finger/thumb	3
elbow/forearm	2

RANK #3	11%
FRACTURE	**12**
finger/thumb	5
ankle/foot	3
trunk	2
hand/wrist	1
elbow/forearm	1

RANK #4	10%
CONTUSION, ABRASION, FOREIGN OBJECT (excl. eye)	**11**
ankle/foot	3
shoulder/upper arm	2
knee/leg/hip	2
face/head	2
hand/wrist	1
finger/thumb	1
elbow/forearm	1

For example:

* Percentage of masons with one or more strains, sprains, or feeling of pain. Percents add to more than 100 because some injured workers had more than one diagnosis.

** Number of masons with one or more strains, sprains, or feeling of pain.

Sheet Metal Workers

IN SEVEN YEARS, 92 injured sheet metal workers were seen at the George Washington University Emergency Department. Sheet metal workers were 3.2% of all injured construction workers. The number of injuries is small for statistical purposes and readers should use caution in drawing conclusions from these 92 cases. Sheet metal workers generally fabricate duct in shop settings or install duct on construction sites; workers from both types of settings were included in this study. In addition, this category included two individuals who described themselves as HVAC mechanics or technicians.

Demographic Characteristics: The age range of sheet metal workers was similar to the age range of other injured workers, and the proportion of injured female workers (2.2%) was also roughly comparable. Seventy-three percent of the injured sheet metal workers were white, compared to 45% of all other construction workers.

Causes of Injury, Diagnoses, and Body Locations (charts 10-A through 10-E): Metal objects, sheet metal, or pieces of duct accounted for many of the "struck by" or "struck against" injuries to sheet metal workers. In fact, almost 30% of sheet metal worker emergency department visits were for injuries resulting from contact with metal objects, sheet metal, or duct.

Serious cuts are the most common type of injury seen among sheet metal workers; handling sheet metal or duct is the most common cause. The two amputations were finger injuries, consistent with the high rate of injuries to the fingers and hands among sheet metal workers. One of these injured workers caught his hand in a fan, while the other caught his hand in a lifting platform.

Hospital Admissions: One sheet metal worker was admitted to the hospital. He fell from a ladder, catching his foot in one of the steps, and suffered an open fracture to his ankle, as well as a dislocation.

Recommendations: Although glove use might be a solution for the large proportion of serious cuts, many workers don't like to wear gloves because of the decrease in dexterity. For tasks where gloves are appropriate, safety managers and others need to identify and provide workers with gloves that will protect from metal cuts.

While many of the overexertion injuries occur while lifting or carrying heavy objects, other factors, such as exertion in awkward postures also appear to play a role. To prevent these injuries, sheet metal contractors should promote teamwork or mechanical aids for handling heavy materials. Some shops rely heavily on wheeled carts so that workers don't need to carry materials across the shop. On the construction site, appropriate positioning of ladders for overhead work is important. In addition, for some jobs, especially on large jobs, scissor lifts could be considered for positioning workers.

Chart 10-A

92 injured sheet metal workers

Causes of injury

Compared to 2,824 other injured construction workers

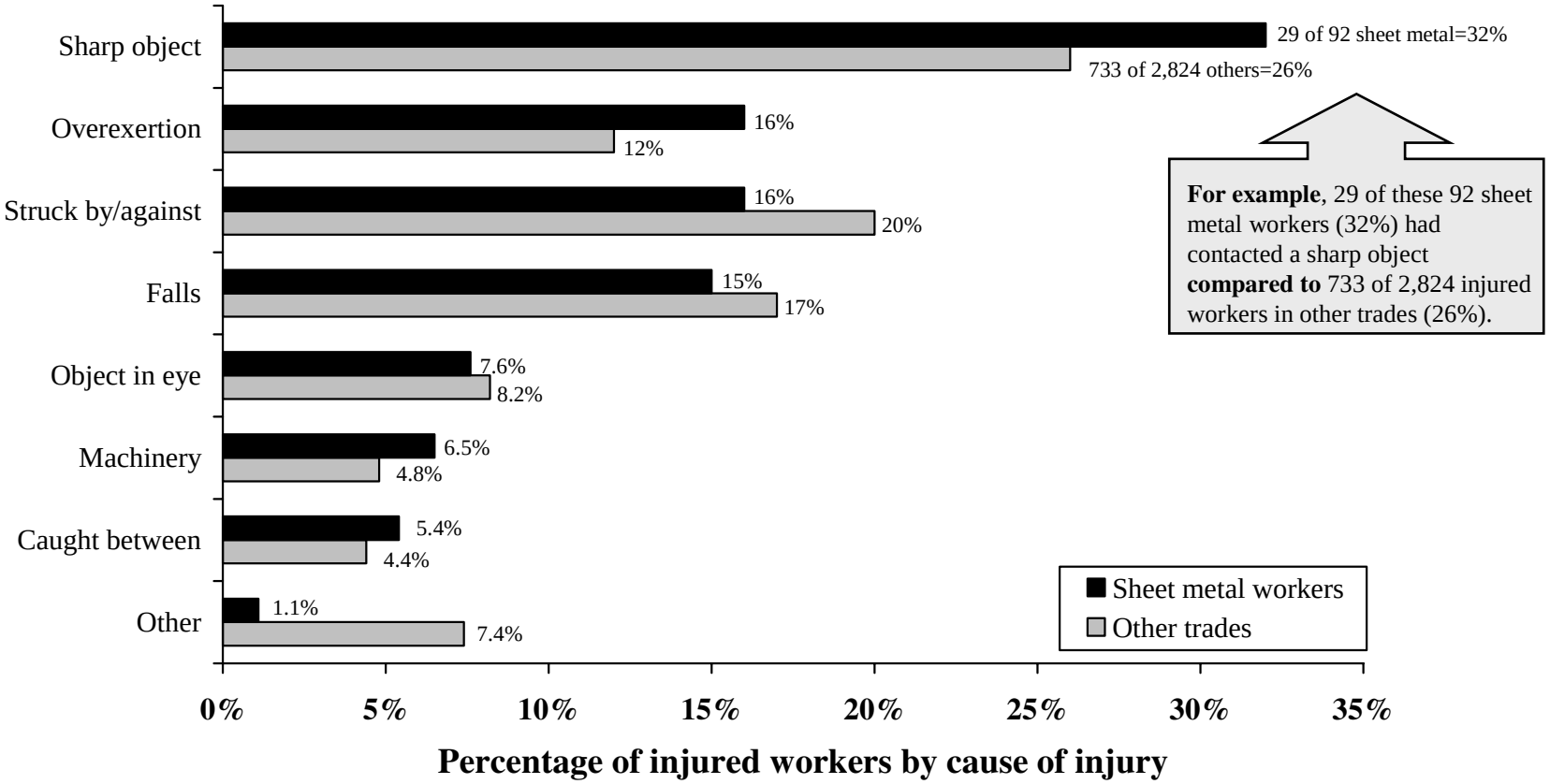


Chart 10-B

92 injured sheet metal workers

Detailed causes of injury

RANK #1	32%
SHARP OBJECT	**29**
metal/sheetmetal/duct	21
hand tool	3
nail	2
razor/knife	1
other: metal fan	1
not specified	1

RANK #2/3 (tie)	16%
OVEREXERTION/ STRENUOUS MOVEMENT	**15**
lifting/carrying	5
stepping on/off, walking	2
stopping a fall/falling obj.	1
pushing/pulling	1
overhead	1
other:	
riding forklift, drilling	2
not specified	3

RANK #2/3 (tie)	16%
STRUCK BY/AGAINST OBJECT (INCL. FALLING OBJECT)	**15**
metal/sheetmetal/duct	6
hammer/sledge	3
truck	1
pipe	1
light fixture	1
other	3

RANK #4	15%
FALLS	**14**
from ladder	5
from stairs	2
slip/trip/stumble	2
out of building/structure	2
from scaffold	1
not specified	2

RANK #5	7.6%
OBJECT IN EYE	**7**
rock/stone/gravel	1
metal dust	1
dirt/dust/debris	1
concrete/cement	1
other: charcoal dust	1
not specified	2

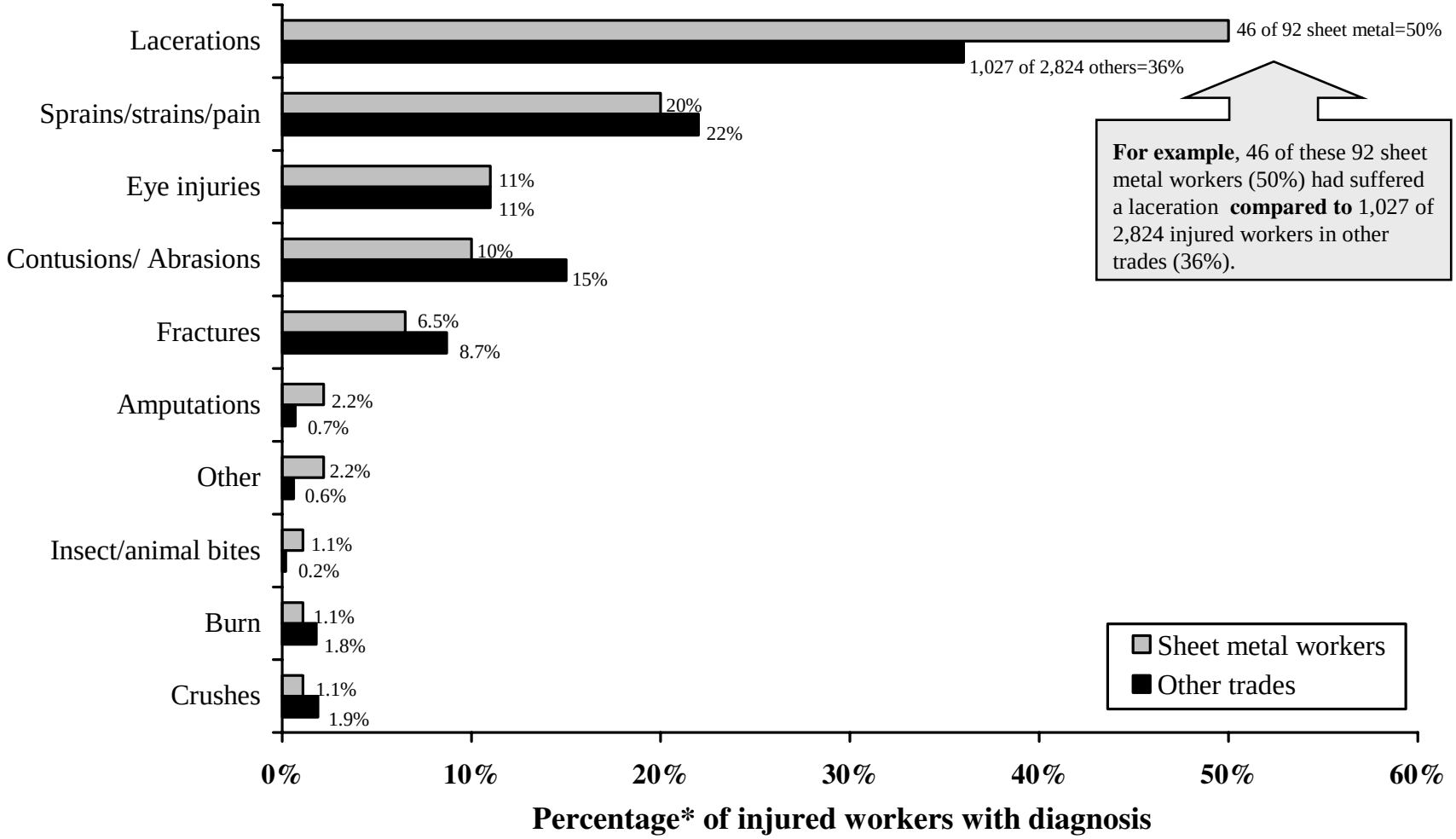
RANK #6	6.5%
MACHINERY RELATED	**6**
lifting machinery	2
metal working machinery	1
other: welding machine	1
grinder (type not specified)	1
not specified	1

Chart 10-C

92 injured sheet metal workers treated for 99 diagnoses

Injury diagnoses

Compared to 2,824 other injured construction workers treated for 3,109 diagnoses



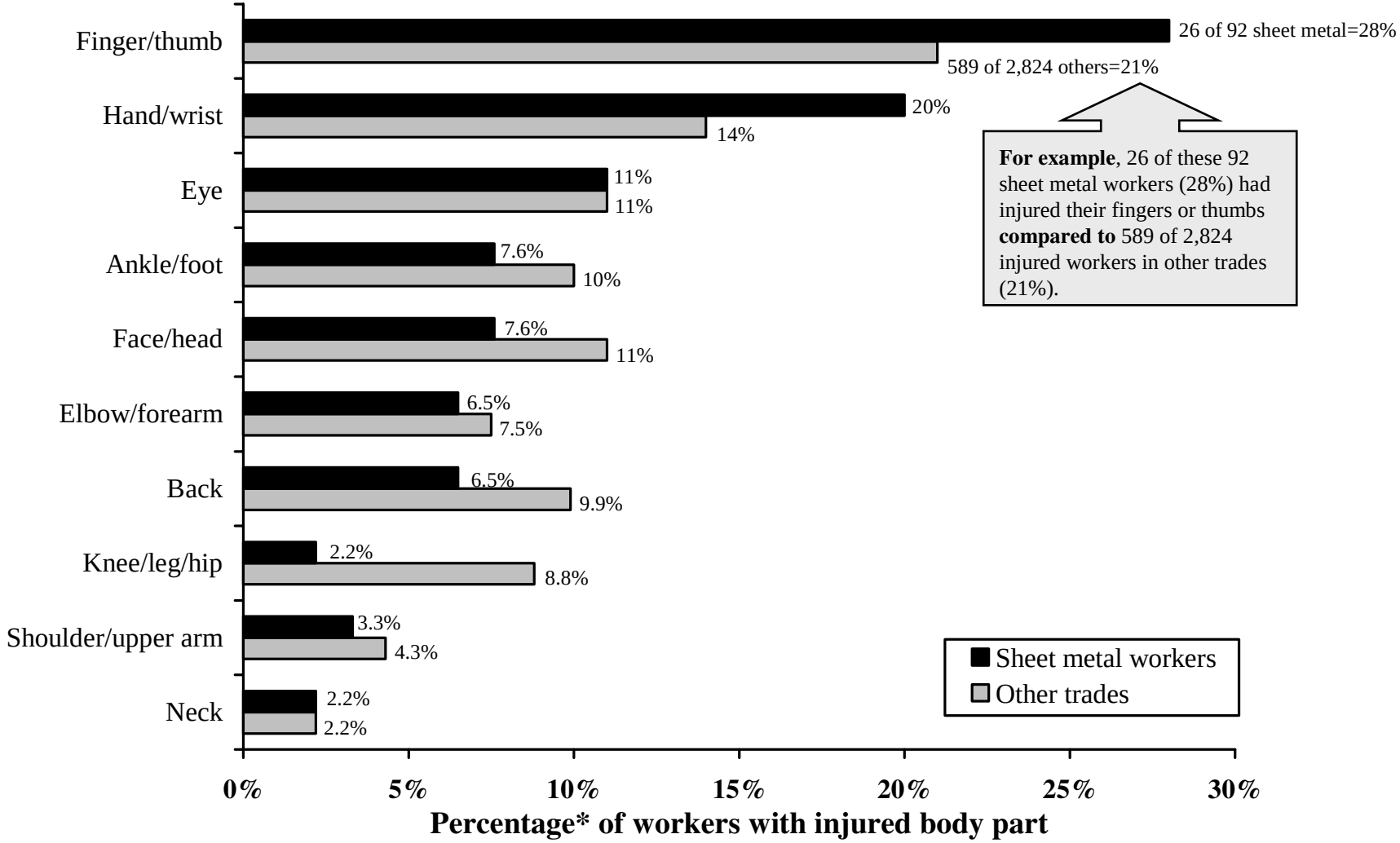
*Note: Percents add to more than 100 because some injured workers had more than one diagnosis.

Chart 10-D

92 injured sheet metal workers treated for 99 diagnoses

Injured body parts

Compared to 2,824 other injured construction workers treated for 3,109 diagnoses



*Note: Percents add to more than 100 because some injured workers had more than one diagnosis/injured body part.

Chart 10-E

92 injured sheet metal workers treated for 99 diagnoses

Diagnoses by body part

RANK #1	50% *
LACERATION	**46 ****
finger/thumb	21
hand/wrist	13
elbow forearm	6
face/head	5
ankle/foot	1

RANK #2	20%
SPRAIN, STRAIN, PAIN	**18**
low back	6
hand/wrist	3
shoulder/upper arm	3
ankle/foot	2
neck	2
upper back	1
not specified	1

RANK #3	11%
EYE INJURIES	**10**

RANK #5	6.5%
FRACTURES	**6**
ankle/foot	3
hand/wrist	2
finger/thumb	2

RANK #4	10%
CONTUSION,ABRASION, FOREIGN OBJECT (excl. eye)	**9**
knee/leg/hip	3
ankle/foot	2
trunk	2
face/head	1
hand/wrist	1

For example:

* Percentage of sheet metal workers with one or more lacerations. Percents add up to more than 100 because some injured workers had more than one diagnosis.

** Number of sheet metal workers with one or more lacerations.

Exhibit Technicians

FROM November 1, 1990 through October 31, 1997, 76 workers who were employed as exhibit technicians were treated for work-related injuries at the George Washington University Hospital Emergency Department. They identified themselves as carpenters, exhibit technicians, exhibit carpenters, or trade show decorators. For this analysis, the name of their employer was used to distinguish them from carpenters who work on traditional construction jobs or maintenance jobs. (The injuries of carpenters who do not construct or install exhibit booths are characterized in a separate section.)

The demand for exhibit technicians in the District of Columbia is higher than in most cities, given the business in local trade shows, conferences, and exhibits. Even so, a relatively small number of exhibit technicians were treated for work-related injuries over this seven-year period.

Demographic Characteristics: Of the injured exhibit technicians, 25% were women. Presumably, a greater proportion of exhibit technicians (not just injured exhibit technicians) are women; however, demographic information is not available for the working population. Most of the exhibit technicians were white (57%).

Causes of Injury, Diagnoses, and Body Locations (charts 11-A through 11-E): When considering injured body parts, most striking is the proportion of foot injuries, which accounted for 25% of the exhibit technician injuries compared to 10% of injuries among other workers. None of the injuries to exhibit technicians was serious enough to require hospital admission.

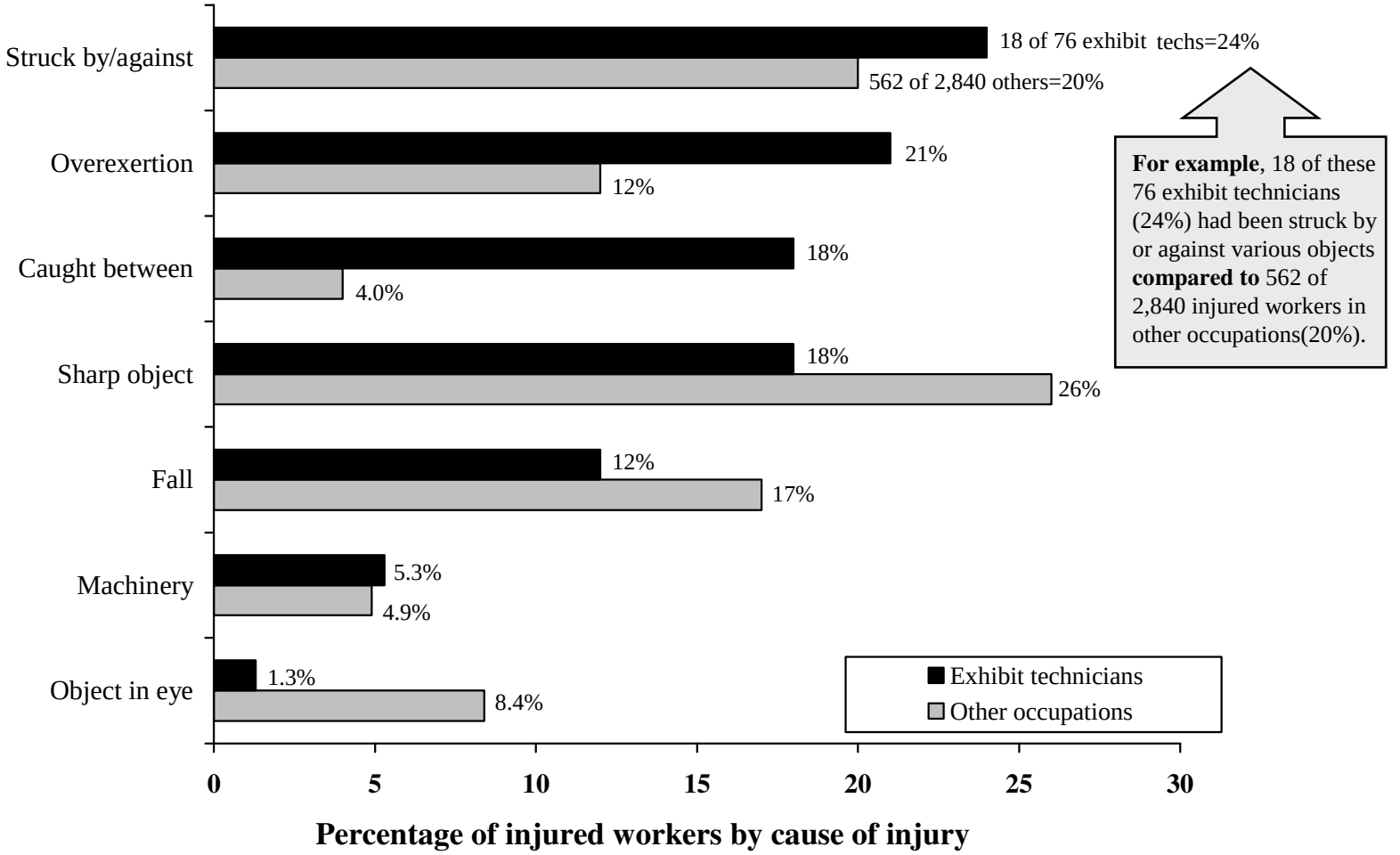
Recommendations: Several remedies should reduce the frequency and severity of foot injuries. Dollies and carts should be equipped with inertial or safety brakes that can handle inclines, and should steer easily enough to handle corners. As a second line of defense, boots with steel toes and metatarsal guards can help to protect the feet. The high proportion of overexertion injuries from lifting heavy objects suggests the need for exhibit companies to provide lift-assist devices for such heavy and awkward objects as large rolls of carpet or metal base plates. Further, exhibit technicians should be trained in materials handling, including asking for help when a load is too heavy or unmanageable. Another injury prevention program might focus on identifying and using utility knives with safety features, and encouraging workers to take special precautions when cutting materials and changing the blades.

Chart 11-A

76 injured exhibit technicians

Causes of injury

Compared to 2,840 other injured workers



For example, 18 of these 76 exhibit technicians (24%) had been struck by or against various objects **compared to** 562 of 2,840 injured workers in other occupations(20%).

Chart 11-B
76 injured exhibit technicians
Detailed causes of injury

RANK #1	24%
STRUCK BY/AGAINST OBJECT (INCL. FALLING OBJECT)	**18**
board/wood	3
table	2
pipe	2
box/crate/toolbox	2
metal: plate, rebar, metal bar	2
scaffold	1
drill	1
ceiling/wall	1
cart/dolly	1
other	3

RANK #2	21%
OVEREXERTION / STRENUOUS MOVEMENT	**16**
lifting/carrying	9
pushing/pulling	3
stepping on/off, walking	1
bending over	1
other: lowering object into crate	1
not specified	1

RANK #3/4 (tie)	18%
CAUGHT BETWEEN OBJECTS	**14**
involving cart/dolly	8
involving metal plate/object	2
involving door	2
involving board/wood	1
involving beam	1

RANK #3/4 (tie)	18%
SHARP OBJECT	**14**
razor/knife	6
nail	3
hand tool	2
wire	1
metal/sheetmetal	1
glass	1

RANK #5	12%
FALL	**9**
slip/trip/stumble	3
from ladder	3
from another level	1
from scaffold	1
not specified	1

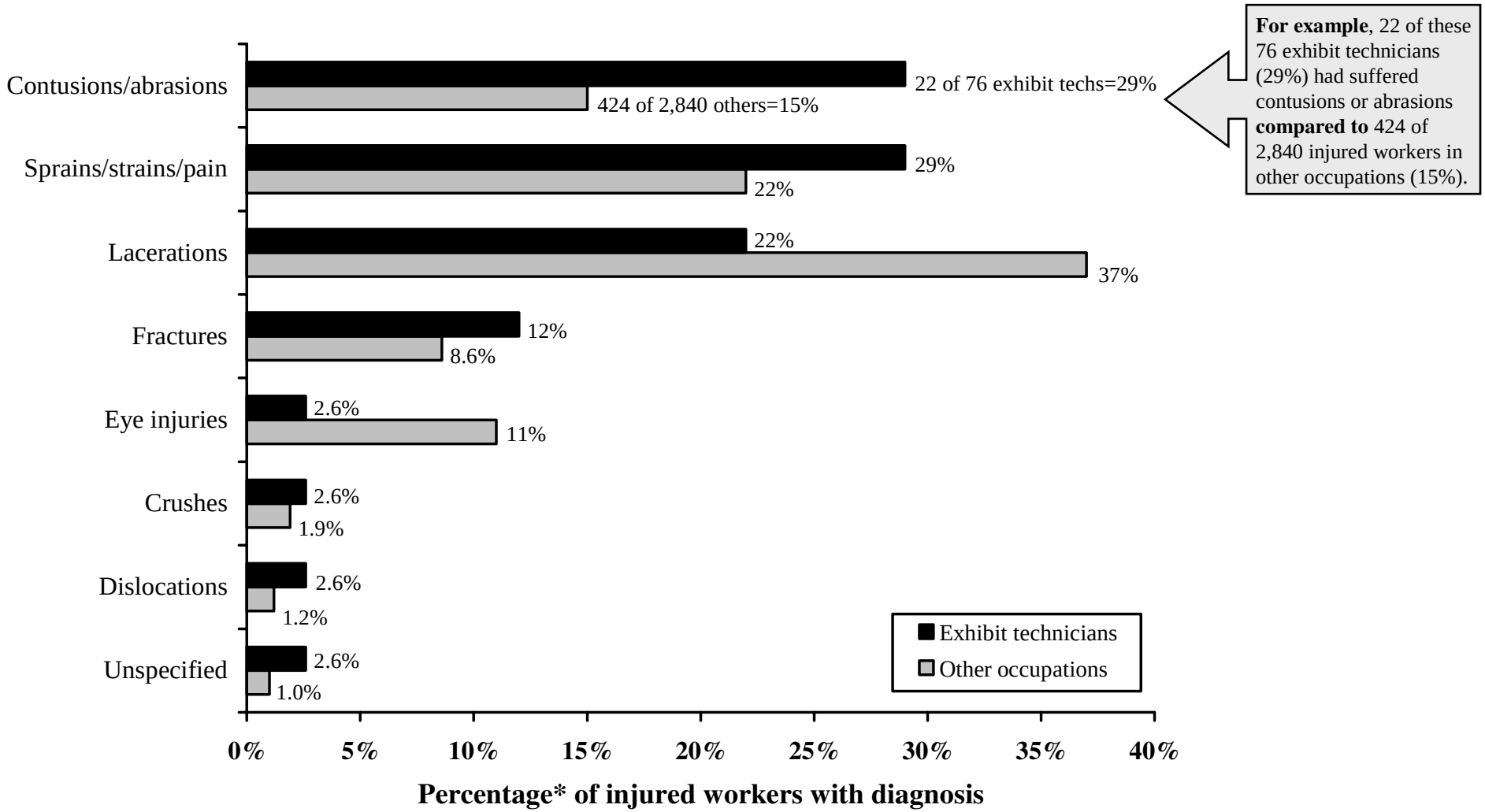
RANK #6	5%
MACHINERY RELATED	**4**
lifting machinery	3
other: operating banding machine	1

Chart 11-C

76 injured exhibit technicians treated for 80 diagnoses

Injury diagnoses

Compared to 2,840 other injured workers treated for 3,127 diagnoses



For example, 22 of these 76 exhibit technicians (29%) had suffered contusions or abrasions **compared to** 424 of 2,840 injured workers in other occupations (15%).

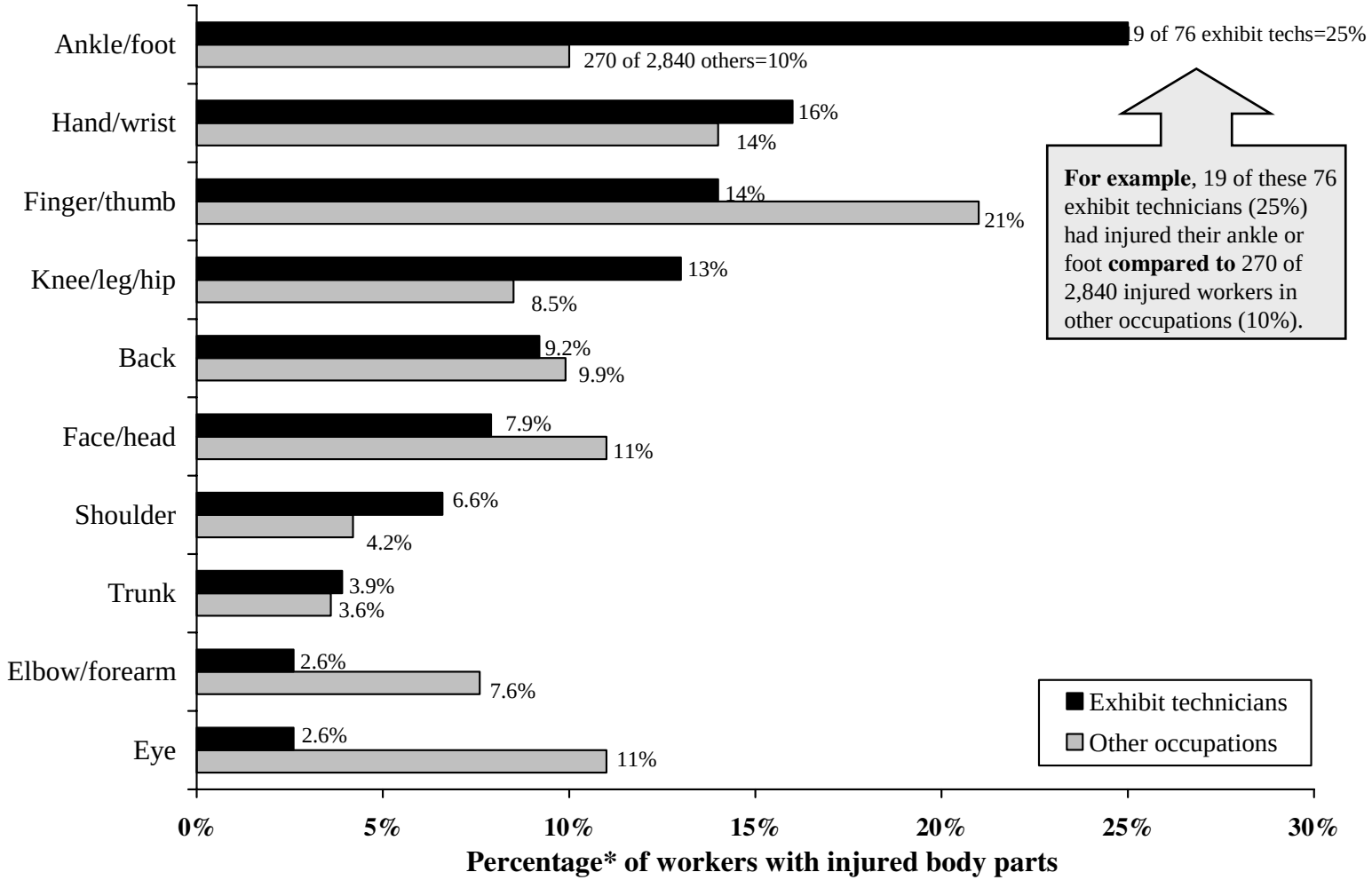
*Note: Percents add to more than 100 because some injured workers had more than one diagnosis.

Chart 11-D

76 injured exhibit technicians treated for 80 diagnoses

Injured body parts

Compared to 2,840 other injured workers treated for 3,127 diagnoses



*Note: Percents add to more than 100 because some injured workers had more than one diagnosis/injured body part.

Chart 11-E

76 injured exhibit technicians treated for 80 diagnoses

Diagnoses by body part

RANK #1/2 (tie)	29% *
CONTUSION,ABRASION, FOREIGN OBJECT (excl. eye)	**22****
knee/leg/hip	4
hand/wrist	4
ankle/foot	4
face/head	3
shoulder/upper arm	2
back	2
elbow/forearm	2
trunk	1
finger/thumb	1

RANK #1/2 (tie)	29%
SPRAIN, STRAIN, PAIN	**22**
ankle/foot	6
low back	5
knee/leg/hip	3
shoulder/upper arm	2
neck	2
hand/wrist	2
finger/thumb	2
trunk	1

RANK #3	22%
LACERATION	**17**
finger/thumb	5
hand/wrist	4
face/head	3
ankle/foot	3
knee/leg/hip	2

RANK #4	12%
FRACTURES	**9**
ankle/foot	6
trunk	1
hand/wrist	1
finger/thumb	1

For example:

* Percentage of exhibit techs with one or more contusions. Percents add to more than 100 because some injured workers had more than one diagnosis.

** Number of exhibit techs with one or more contusions.

Drywall Workers and Plasterers

DURING this seven-year period (11/90 through 10/97), 66 construction workers identified themselves as drywall workers or plasterers when registering at the Emergency Department. Of these, 14 were plasterers and 52 were drywall workers. It is not clear whether the drywall workers tended to be restricted to finishing work or if they also hung sheetrock. Because of some similarity between the tasks of the two trades and no real differences in injury types or circumstances, they were grouped together and are referred to here as drywall workers.

Carpenters, laborers, and painters are assigned drywall work also, so the proportion of drywall-related injuries in the construction trades might be underestimated by these cases alone. For instance, on union jobs in the Washington, D.C., area, laborers often move drywall to the location, while carpenters generally hang drywall and painters do drywall finishing; 12 carpenters and 11 laborers, whose injuries are analyzed elsewhere in this report, said their injury involved drywall or plaster. Readers should bear in mind that any conclusions in this section on injury patterns or risk are based on a very small statistical sample.

Demographic Characteristics: Hispanics made up 44% of this trade group, compared to 18% Hispanics among injured construction workers from other trades.

Causes of Injury, Diagnoses, and Body Locations (Charts 12-A through 12-C): Most of the workers injured by falls fell from a height of 3 to 6 feet. Unfortunately, details on the hospital registration forms tended to be sparse, so it was not possible to determine whether the workers fell as a result of leaning too far from the center of gravity, carrying something while climbing up a ladder, or something else.

Cuts were often as a result of a worker's drywall knife slipping, or from the worker's catching his/her hand on a metal stud. Most of the overexertion injuries resulted from lifting heavy objects such as sheets of drywall, a bucket of mud, a window, or sheets of steel. Most of the strains and sprains were a result of lifting something heavy or falling from a height.

One drywall worker was hospitalized for her injuries during this period. She fell 5 to 10 feet from a scaffold and landed straddling a scaffold bar.

Recommendations: Although this group of drywall and plaster workers is relatively small, their injury patterns do identify some of the hazards of their trades. The most obvious risk is falling, especially from ladders. Workers need to be taught ladder safety and provided with the means to get materials safely up a ladder or scaffold. The most effective control for sprains and strains caused by lifting

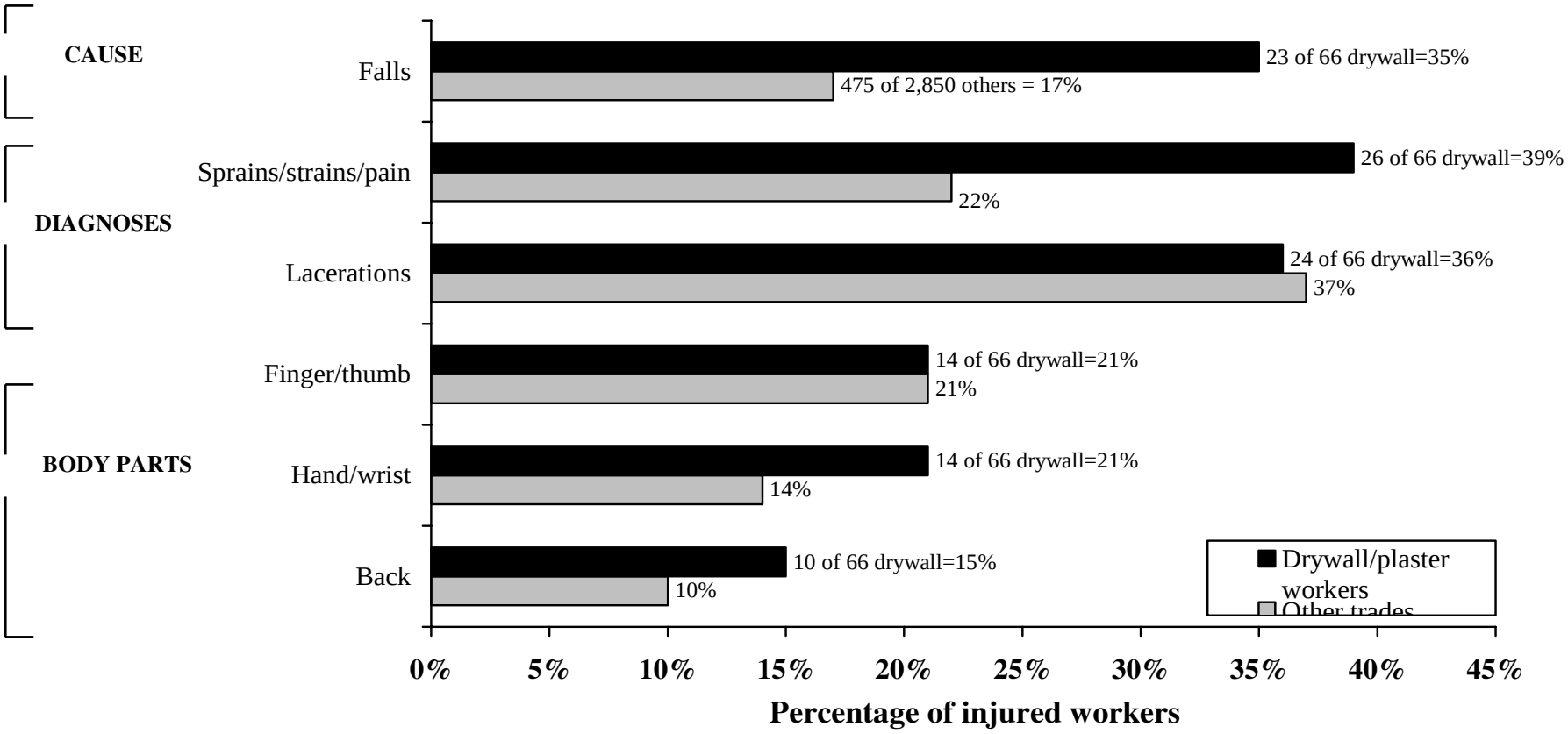
something heavy is to reduce the weight of the objects. In Europe, smaller sheets of drywall have been marketed as an answer to this problem. However, smaller sheets require more finishing, so the tradeoff needs to be considered. Mud buckets are large and heavy. Even if drywall mud is purchased in large buckets, each worker could transfer a portion into a smaller bucket, which could then be refilled as necessary. Flat boxes are used on many drywall jobs to distribute joint compound over flat joints. However, finishers must use a great deal of force with these boxes. Spring-powered boxes have been shown to reduce the required muscle force (*see* article at www.elcosh.org). Finally, using drywall knives with safety features might reduce the number of lacerations to the hands and wrists. Wearing gloves might reduce the number of cuts to the hands and wrists, but the tradeoff between dexterity and protection would need to be considered.

Chart 12-A

66 injured drywall and plaster workers

Percentage of workers in selected injury categories

Compared to 2,850 other injured construction workers



Note: For diagnoses and body parts, percents add to more than 100 because some injured workers had more than one diagnosis/injured body part.

Chart 12-B

66 injured drywall and plaster workers

Detailed causes of injury

RANK #1	35%
FALL	**23**
from ladder	9
from another level	5
slip/trip/stumble	3
from scaffold	3
not specified	3

RANK #2	29%
SHARP OBJECT	**19**
razor/knife	5
power tool	5
metal stud	4
metal/sheetmetal	2
wood/splinter	1
glass	1
ceiling tile	1

RANK #3	15%
OVEREXERTION / STRENUOUS MOVEMENT	**10**
lifting/carrying	7
other	1
not specified	2

RANK #4	9%
OBJECT IN EYE	**6**
drywall/plaster	3
metal dust	1
concrete/cement	1
not specified	1

RANK #5	6%
STRUCK BY/AGAINST OBJECT (INCL. FALLING OBJECT)	**4**
piece of metal/sheetmetal/duct	1
drywall/plaster	1
door	1
ceiling/wall	1

	3%
ALL OTHERS	**2**
CAUGHT BETWEEN OBJECTS	
gangbox/dumpster lid	1
MACHINERY RELATED	
earth moving machinery	1

Chart 12-C

66 injured drywall and plaster workers treated for 75 diagnoses

Diagnoses by body part

RANK #1	39% *
SPRAIN, STRAIN, PAIN	**26 ****
low back	9
neck	5
hand/wrist	5
shoulder/upper arm	2
knee/leg/hip	2
upper back	1
trunk	1
ankle/foot	1
elbow/forearm	1

RANK #3	15%
CONTUSION,ABRASION, FOREIGN OBJECT (excl. eye)	**10**
knee/leg/hip	3
shoulder/upper arm	2
face/head	2
trunk	1
hand/wrist	1
finger/thumb	1
ankle/foot	1
multiple	1

RANK #2	36%
LACERATION	**24**
finger/thumb	13
hand/wrist	7
elbow forearm	2
trunk	1
face/head	1

RANK #4	14%
EYE INJURIES	**6**

	14%
ALL OTHERS	**5**
FRACTURE	
hand/wrist	1
elbow/forearm	1
ankle/foot	1
HEAD INJURY	
head	1
OTHER	
finger	1

For example:

* Percentage of drywall workers with one or more sprains or strains. Percents add to more than 100 because some injured workers had more than one diagnosis.

** Number of drywall workers with one or more sprains or strains.

Asbestos and Insulation Workers

FROM November 1990 to October 1997, 56 construction workers who identified themselves as insulators or asbestos workers were treated for work-related injuries at the George Washington University Emergency Department. Of these, 31 specified that they worked with asbestos and the remaining 25 simply called themselves insulators or installers. This number of workers is too small a statistical sample to use to precisely identify risks and recommendations.

Demographic Characteristics: Six of the 56 injured insulators were female. The average age of the injured insulators was 33 and 79% were under the age of 40. Thirty-eight percent of the insulators were Hispanic, 30% were black, and 27% were white.

Causes of Injury, Diagnoses, Body Locations (charts 13-A through 13-C): Falls from ladders accounted for one out of every eight injuries in this group. For instance, one worker was removing asbestos from a ceiling and fell backward off his ladder from a height of 7 Feet; another worker fell through a ladder and bruised her knee on a rung. One insulation worker was hospitalized; he had fallen 20 to 25 feet down an elevator shaft and was treated for chest and abdominal pain, as well as multiple abrasions.

The nine eye injuries all appeared to be directly related to installing or removing insulation. Seven of the insulators had suffered a back injury, primarily as a result of falling or straining. One of the falls illustrates the hazard of poor housekeeping: an insulation worker strained his lower back after tripping over a container while carrying a box of insulation. Another worker strained his back while working in a tunnel in an awkward posture. One insulator suffered a contusion after hitting his hand while demolishing a wall; another was struck on his shoulder and hip by a collapsing brick wall.

Recommendations: The injuries reflect the wide variety of assigned tasks for this group (demolition, sanding, operating power tools, and installing insulation) and the general hazards of the construction environment. Demolition in particular appears to result in substantial risk of injury, which is not surprising given that pulling down structural materials often requires workers to use a lot of force. One injury prevention priority should be to explore and promote safer demolition work practices.

Given that about one-quarter of the injuries in this group were caused by contact with a sharp object to the hand, wrist, or fingers, gloves are one solution. Protective equipment is not always an ideal choice, given that a worker's manual dexterity is reduced; identification of gloves that allow more dexterity should be a priority. The most obvious solution to reducing the number of eye injuries also involves protective equipment; protective eyewear should be worn for overhead work and dusty tasks. Training workers

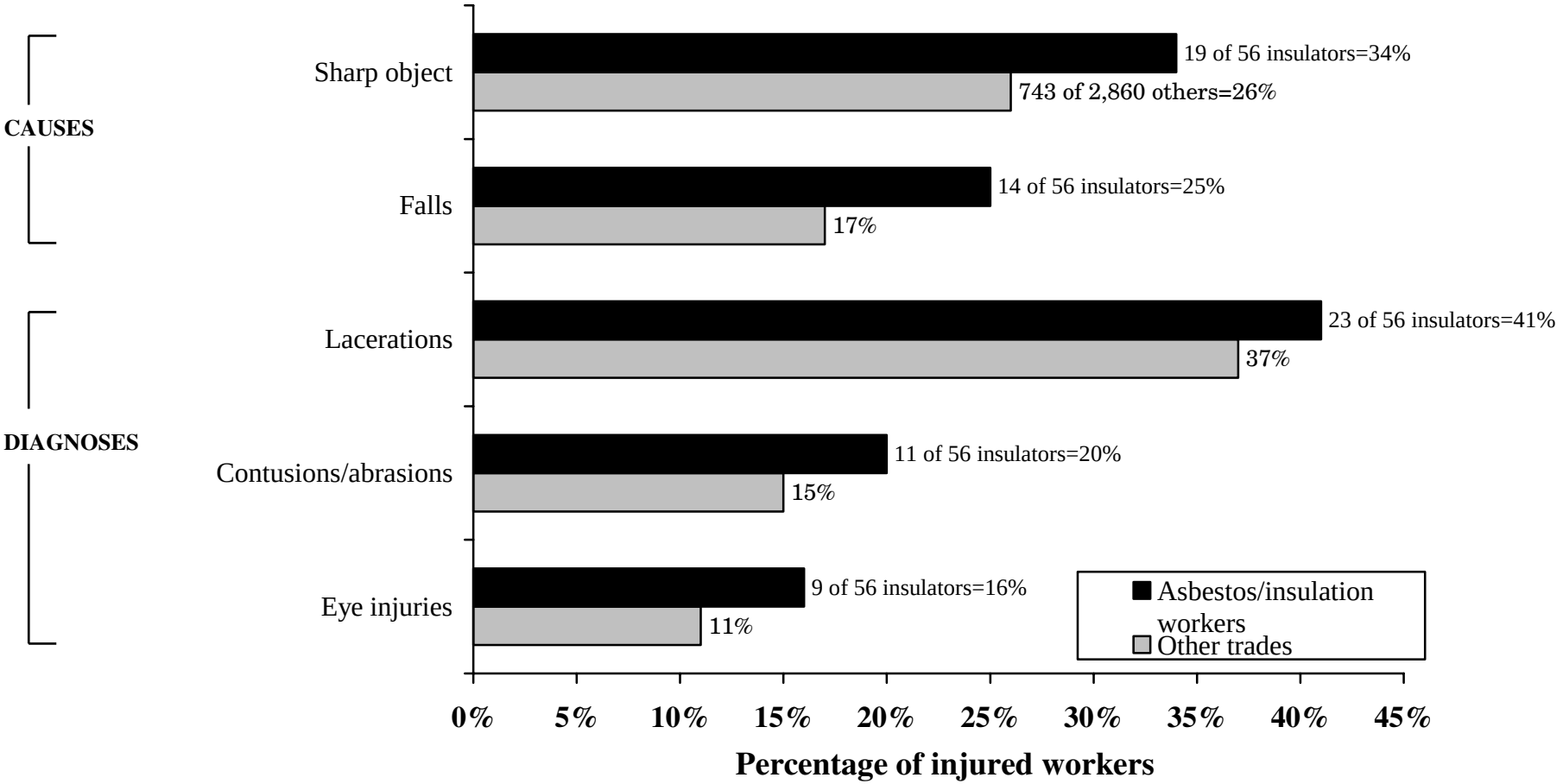
in ladder safety should also be considered, given the rigors and hazards of installing or removing overhead insulation. Where possible, the use of scissor lifts could position workers more safely for overhead work.

Chart 13-A

56 injured asbestos & insulation workers

Percentage of workers in selected injury categories

Compared to 2,860 other injured construction workers



Note: For diagnoses, percents add to more than 100 because some workers had more than one diagnosis.

Chart 13-B
56 injured asbestos & insulation workers
Detailed causes of injury

RANK #1	34%
SHARP OBJECT	**19**
razor/knife	5
metal/sheetmetal/duct	4
nail	3
glass	2
wire	2
other	3

RANK #2	25%
FALL	**14**
from ladder	7
slip/trip/stumble	2
from another level	2
from scaffold	1
from stairs	1
into a hole	1

	13%
ALL OTHERS	**7**
CAUGHT IN/BETWEEN	
arm caught between car and container	1
finger caught between crowbar and metal rail	1
OVEREXERTION	
while lifting/carrying	1
working in tunnel in awkward posture	1
MISCELLANEOUS	
effect of heat (weather)	1
assault	1
fainted while removing asbestos	1

RANK #3/4 (tie)	14%
OBJECT IN EYE	**8**
insulation	4
metal dust	1
chemical	1
not specified	2

RANK #3/4 (tie)	14%
STRUCK BY/ AGAINST OBJECT	**8**
ceiling/wall	2
wire/cable	1
metal/sheetmetal/duct	1
scaffold	1
pipe	1
not specified	2

Chart 13-C

56 injured asbestos & insulation workers treated for 61 diagnoses

Diagnoses by body part

RANK #1	41% *
LACERATION	**23 ****
finger/thumb	10
hand/wrist	4
elbow forearm	3
face/head	3
shoulder/upper arm	1
knee/leg/hip	1
ankle/foot	1

RANK #2	21%
CONTUSION,ABRASION, FOREIGN OBJECT (excl. eye)	**12**
hand/wrist	4
finger/thumb	2
elbow/forearm	2
trunk	1
back	1
face/head	1
multiple	1
knee/leg/hip	1

RANK #3/4 (tie)	16%
SPRAIN, STRAIN, PAIN	**9**
low back	6
trunk	2
neck	2
shoulder/upper arm	1

RANK #3/4 (tie)	16%
EYE INJURIES	**9**

	7%
ALL OTHERS	**4**
CRUSH	
hand/wrist	1
FRACTURE/DISLOCATION	
shoulder/upper arm	1
DIZZINESS	
systemic	1
HEAT	
systemic	1

For example:

* Percentage of insulators with one or more lacerations. Percents add to more than 100 because some injured workers had more than one diagnosis.

** Number of insulators with one or more lacerations.

Roofers and Waterproofers

FROM November 1, 1990 through October 31, 1997, 51 construction workers who identified themselves as roofers or waterproofers were treated at the George Washington University Emergency Department. There may have been additional injuries to roofers during this time, given that 211 injured workers did not specify a trade upon registration. Fifty-one injured workers is, of course, too many injuries but statistically too small a number from which to draw firm conclusions about injury patterns.

Demographic Characteristics: All of the injured roofers were male. The group's ethnic makeup and average age –35 –were similar to those of all other trades treated at GWU during this period.

Causes of Injury, Diagnoses, and Body Locations (charts 14-A through 14-C): Chart 14A combines information on causes of injury, diagnoses, and injured body parts that occurred (1) most often or (2) much more often among roofers compared with all other construction trades.

Among those injured by contact with a sharp object, four workers stepped on nails that penetrated their shoes (two of these acquired wound infections). Of those struck by/against an object, two roofers were struck by falling metal beams, three were hit by a falling hand tool, and one walked into a beam. The diagnoses included metal embedded in the arm and post-concussion syndrome.

Burns were far more common among roofers than among any other construction trade; *see* "heat and fire"and "toxic exposures." Most of the burns resulted from hot tar splashes, while two roofers were burned by torch flames and one worker sustained chemical burns to his arm and leg from rubber primer. Of the six workers who were burned with tar, one was splashed in the face, and one received third-degree burns when a machine splattered him with tar. Tar can create multiple hazards; one worker immersed his hands in a bucket of hot tar after slipping on a tarred roof; that worker suffered second-degree burns and had to be hospitalized. Another roofer seriously twisted his knee after getting his foot stuck on a tarred surface.

Five of the roofers needed to have material removed from their eye(s). The materials included cyanoacrylate (superglue), wet concrete that had fallen from nine stories up, and dusts that were generated by chipping or grinding.

One of the roofers who fell fractured his hand, two strained their backs, and one sustained multiple bruises. Surprisingly, falling injuries were not as common among roofers as among the construction trades as a whole. This may be explained by the fact that construction in downtown Washington, D.C., tends to be flat-roofed commercial buildings; the sloped roofs that are more typical of residential sites and present more falling hazards are uncommon in this urban location.

Tasks that resulted in acute muscle damage included repetitive hammering and lifting loads of rebar or roofing paper.

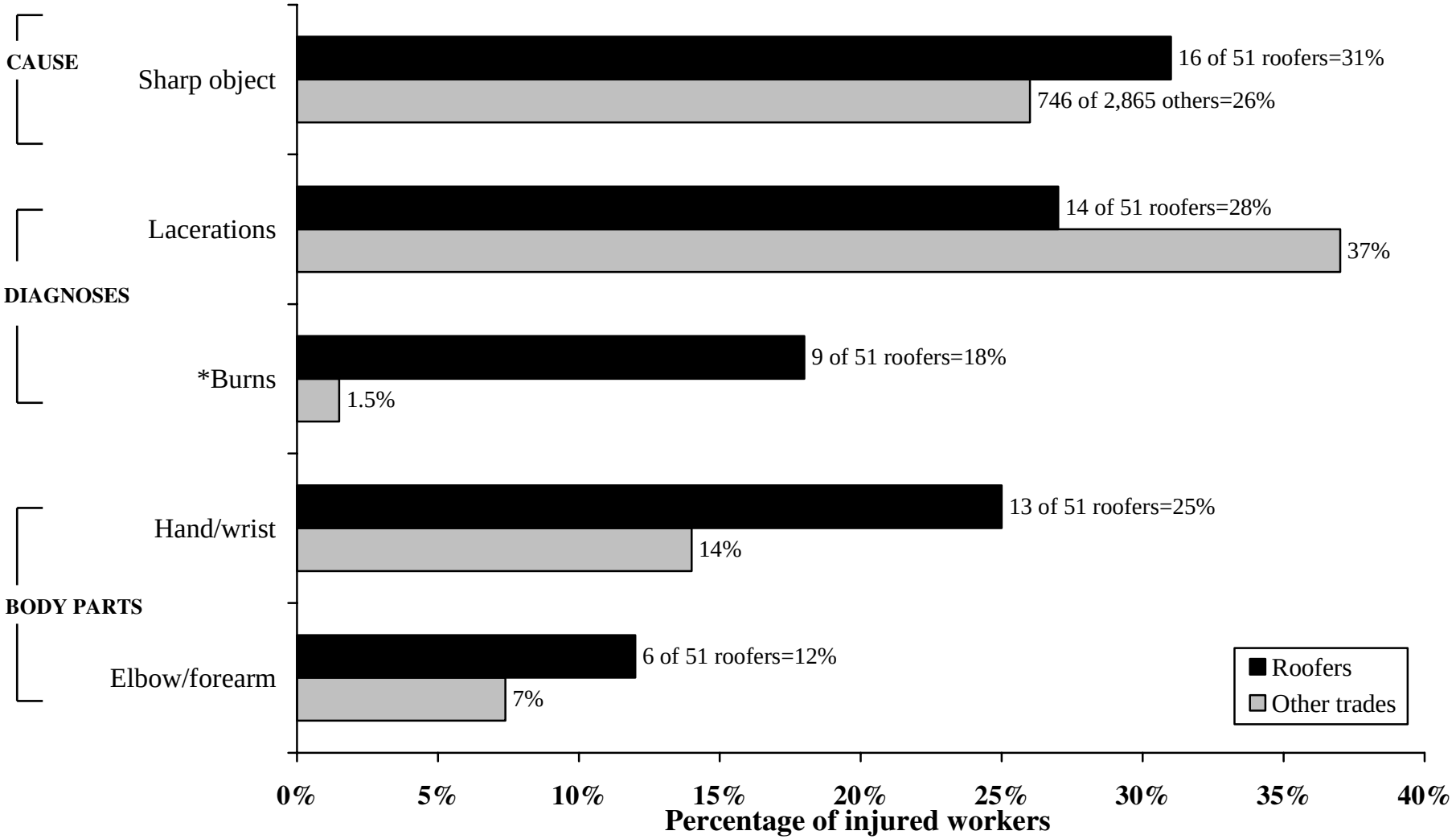
Recommendations: Although this group of injured roofers is small, their injury patterns point very clearly to some of the hazards of their trade. Injury prevention programs might focus on (1) identifying and using utility knives with blades that can be changed more safely, and encouraging workers to take special precautions while using knives and changing knife blades, (2) exploring the feasibility of splash-reducing covers for asphalt machines and tar buckets, (3) promoting protective eye wear, especially while grinding, chipping, or working with asphalt, (4) having workers wear long sleeves and long pants to protect from tar splashes, and (5) promoting the use of steel-shank and slip-resistant boots.

Chart 14-A

51 injured roofers and waterproofers

Percentage of workers in selected injury categories

Compared to 2,865 other injured construction workers



*Third-most-common diagnosis. For diagnoses and body parts, percents add to more than 100 because some injured workers had more than one diagnosis.

Chart 14-B
51 injured roofers and waterproofers
Detailed causes of injury

RANK #1	31%
SHARP OBJECT	**16**
metal/sheetmetal	5
razor/knife	5
nail	4
glass	1
other: hook blade	1

RANK #2	16%
STRUCK BY/ AGAINST OBJECT	**8**
beam	3
hand tool, other than hammer	2
hammer/sledge	1
not specified	2

RANK #3	16%
HEAT & FIRE	**8**
burn, hot liquid (tar)	5
effect of fire/flames	2
splattered with hot tar by machine	1

RANK #4	10%
OBJECT IN EYE	**5**
chemical	2
concrete/cement	1
dirt/dust/debris	1
metal dust	1

RANK #5/6 (tie)	8%
FALLS	**4**
from another level	1
from ladder	1
from scaffold	1
out of building/structure	1

RANK #5/6 (tie)	8%
OVEREXERTION/ STRENUOUS MOVEMENT	**4**
lifting/carrying	2
using hammer/sledge	1
other: foot stuck in tar	1

	12%
ALL OTHERS	**6**
TOXIC EXPOSURES	
burn, caustic/corrosive	1
toxic exposure	1
MACHINERY RELATED	
caught finger in slating machine	1
numbness/tingling from grinder	1
CAUGHT IN/BETWEEN	
caught in door	1
OTHER	
assault	1

Chart 14-C

51 injured roofers and waterproofers treated for 57 diagnoses

Diagnoses by body part

RANK #1	28% *
LACERATION	**14 ****
hand/wrist	6
elbow forearm	3
finger/thumb	3
ankle/foot	2

RANK #2	20%
SPRAIN, STRAIN, PAIN	**10**
low back	5
ankle/foot	1
elbow/forearm	1
hand/wrist	1
knee/leg/hip	1
shoulder/upper arm	1

RANK #3	18%
BURNS	**9**
hand/wrist	5
multiple	2
face/head	1
unspecified	1

RANK #4	14%
CONTUSION,ABRASION, FOREIGN OBJECT (excl. eye)	**7**
finger/thumb	2
ankle/foot	1
elbow/forearm	1
multiple	1
neck	1
shoulder/upper arm	1
trunk	1

	31%
ALL OTHERS	**16**
EYE INJURIES	6
FRACTURES	
ankle/foot	1
elbow/forearm	1
face/head	1
hand/wrist	1
WOUND INFECTIONS	
ankle/foot	2
finger/thumb	1
DISLOCATION	
ankle/foot	1
HEAD INJURY	1
TOXIC EFFECTS	
systemic	1

For example:

* Percentage of roofers with one or more lacerations. Percents add to more than 100 because some injured workers had more than one diagnosis.

** Number of roofers with one or more lacerations

Heavy-Equipment Operators

FROM November 1990 through October 1997, 43 heavy equipment operators were treated for work-related injuries at the George Washington University Emergency Department. This group included equipment operators, forklift drivers, pile driver operators, crane operators, drillers, riggers, and operating engineers. Fortunately, few equipment operators visited the GW Emergency Department during this study; but the small numbers make it difficult to generalize about injury risk.

Demographic Characteristics: All of the injured equipment operators were male. Only two (5%) were Hispanic.

Causes of Injury, Diagnoses, and Body Locations (charts 15-A through 15-C: In the 6 machinery-related injuries that involved a crane, workers were either sitting in cranes that overturned or were hit by swinging cables, counterweights, or arms. Among the injuries related to working with or near heavy equipment: one worker was burned with muriatic acid that he was using to clean cement off a piece of equipment, another was crushed by a bucket on a front-end loader, and another was hit in the shoulder by the side mirror of a moving van.

Some of the injuries were severe: one worker fractured his hand after a 500-pound hydraulic jack fell on it; another sustained an electrical burn to his knee after hitting a live wire with the jackhammer that he was operating; a third worker had part of his index finger amputated after a stone fell on it. None of the injuries to heavy equipment operators during this period was severe enough to require hospitalization.

Three operators strained their backs by heavy lifting, one by shoveling, and another by falling from a height of 3 feet and landing on his back. Heavy equipment operators must often work in awkward postures to see in front of and behind them and to operate controls. One worker's injury illustrates this hazard; he strained his neck as a result of turning his head suddenly. (Generally, chronic back pain resulting from longterm sitting in awkward positions or from machinery vibration does not appear in emergency department records.)

Because there were few serious injuries during this study, other sources of injury data for operators would provide valuable information.

Recommendations: Because of the potential for serious injury when working around heavy machinery and loads, safe equipment design and well-developed safety procedures are extremely important for this trade.

Chart 15-A

43 injured heavy equipment operators

Percentage of workers in selected injury categories

Compared to 2,873 other injured construction workers

Note: For body parts, percents add to more than 100 because some workers had more than one injured body part.

Chart 15-B
43 injured heavy equipment operators
Detailed causes of injury

RANK #1	30%
STRUCK BY/AGAINST OBJECT (INCL. FALLING OBJECT)	**13**
granite/marble/stone	2
piece of metal/sheetmetal/duct	2
power tool (excl. drill)	1
wire/cable	1
pipe	1
metal object	1
hammer/sledge	1
door jamb/doorway	1
other:	
electric box, window pane, motor	3

RANK #4	9%
SHARP OBJECT	**4**
metal/sheetmetal	2
nail	1
wire	1

RANK #2	26%
MACHINERY RELATED	**11**
lifting machinery	9
earth moving machine	2

	21%
ALL OTHERS	**9**
CAUGHT BETWEEN OBJECTS	
involving cable	1
involving a beam	1
FALL	
from another level	2
FOREIGN OBJECT, EYE	1
OTHERS	
burn, caustic/corrosive	1
electrical exposure	1
involving a vehicle	1
insect/animal bite	1

RANK #3	14%
OVEREXERTION / STRENUOUS MOVEMENT	**6**
lifting/carrying	4
stopping a fall/falling object	1
other: turning head suddenly	1

Chart 15-C

43 injured heavy equipment operators treated for 48 diagnoses

Diagnoses by body part

RANK #1	37% *
LACERATION	**16 ****
face/head	6
finger/thumb	4
hand/wrist	3
ankle/foot	2
elbow forearm	1

RANK #2	26%
SPRAIN, STRAIN, PAIN	**11**
low back	5
neck	2
knee/leg/hip	2
shoulder/upper arm	1
elbow/forearm	1

RANK #3	21%
CONTUSION,ABRASION, FOREIGN OBJECT (excl. eye)	**9**
knee/leg/hip	3
finger/thumb	3
hand/wrist	1
elbow/forearm	1
shoulder/upper arm	1
ankle/foot	1

	14%
ALL OTHERS	**6**
BURNS	
ankle/foot	1
knee/leg/hip	1
EYE INJURIES	2
AMPUTATION	
finger/thumb	1
INSECT/ANIMAL BITE	
elbow/forearm	1

RANK #4	12%
FRACTURES	**5**
finger/thumb	2
face/head	1
hand/wrist	1
ankle/foot	1

For example:

* Percentage of equipment operators with one or more lacerations. Percents add to more than 100 because some injured workers had more than one diagnosis.

** Number of equipment operators with one or more lacerations.

Welders

FROM November 1990 to October 1997, 36 construction workers who identified themselves as welders were treated for work-related injuries at the George Washington University Emergency Department. Although the group of injured welders was very small statistically, some distinct risk patterns were identified. Most tradespeople know that eye hazards and respiratory illness are commonly linked to welding. It is clear from the spectrum of injuries seen here that welders perform other tasks besides welding that put them at risk of injury.

Demographic Characteristics: All of the injured welders were male and their average age was 40. Only one injured welder was of Hispanic origin and 16 (44%) of the welders were black.

Injury Circumstances, Diagnoses, and Injury Locations (charts 16-A through 16-C): Eight of the 11 welders with eye injuries had a piece of metal or welding debris enter their eye. Of these, five were welding at the time, one was cutting metal studs, and two were doing unspecified tasks. The remaining three eye injuries involved a paint chip, cement dust, and an exploding grinding wheel. Four of the 11 welders volunteered that they had been wearing some type of eye protection at the time of their injury. (However, this number may underestimate the use of eye protection, because emergency room personnel do not systematically record this information.)

Welding and welding-related injuries and illnesses are not restricted to welders. For instance, of the 22 welding-related eye injuries seen among injured construction workers, half involved occupations other than welders, including two bystanders. A carpenter had some welding fume or slag enter his eye when he was working alongside a welder; a painter was working one floor below a welder when a metal particle got in his eye. Three of the 11 workers in other occupations told emergency department staff that they were wearing eye protection at the time of injury, and one reported that he had removed his face shield prematurely.

In an incident involving heavy masonry, a welder suffered serious bruises when he caught his hand under a two-ton concrete slab that was being lowered from a crane.

Of the six falls, four were from scaffolds.

In addition to the eye injuries discussed above, welders sustained the following injuries and illnesses while welding or cutting: a face contusion from a flying piece of metal, dizziness from unknown causes, and, metal fume fever after welding on galvanized steel

without any respiratory protection. Two workers burned their forearms after leaning against pipes that had recently been cut with a blowtorch. These injuries indicate the range of hazards that welders are exposed to, but the numbers are too small to make a reliable comparison to the overall construction injury patterns. Fortunately, none of the welders was seriously enough injured to require hospital admission.

Recommendations: Eye protection is the most obvious starting point for welding-related injuries. The welder must wear appropriate protection with sideshields to reduce the likelihood of radiation and particulate entering the eyes. Notably, not a single welder was treated for eye burns. That four of the 11 welders who sustained eye injuries reported that they were wearing eye protection at the time of their injury highlights that the eye protection must be appropriate for the task. The welder's face shield, while protecting from arc flash, does not protect the eyes from particles, nor does it protect the lungs from welding fume.

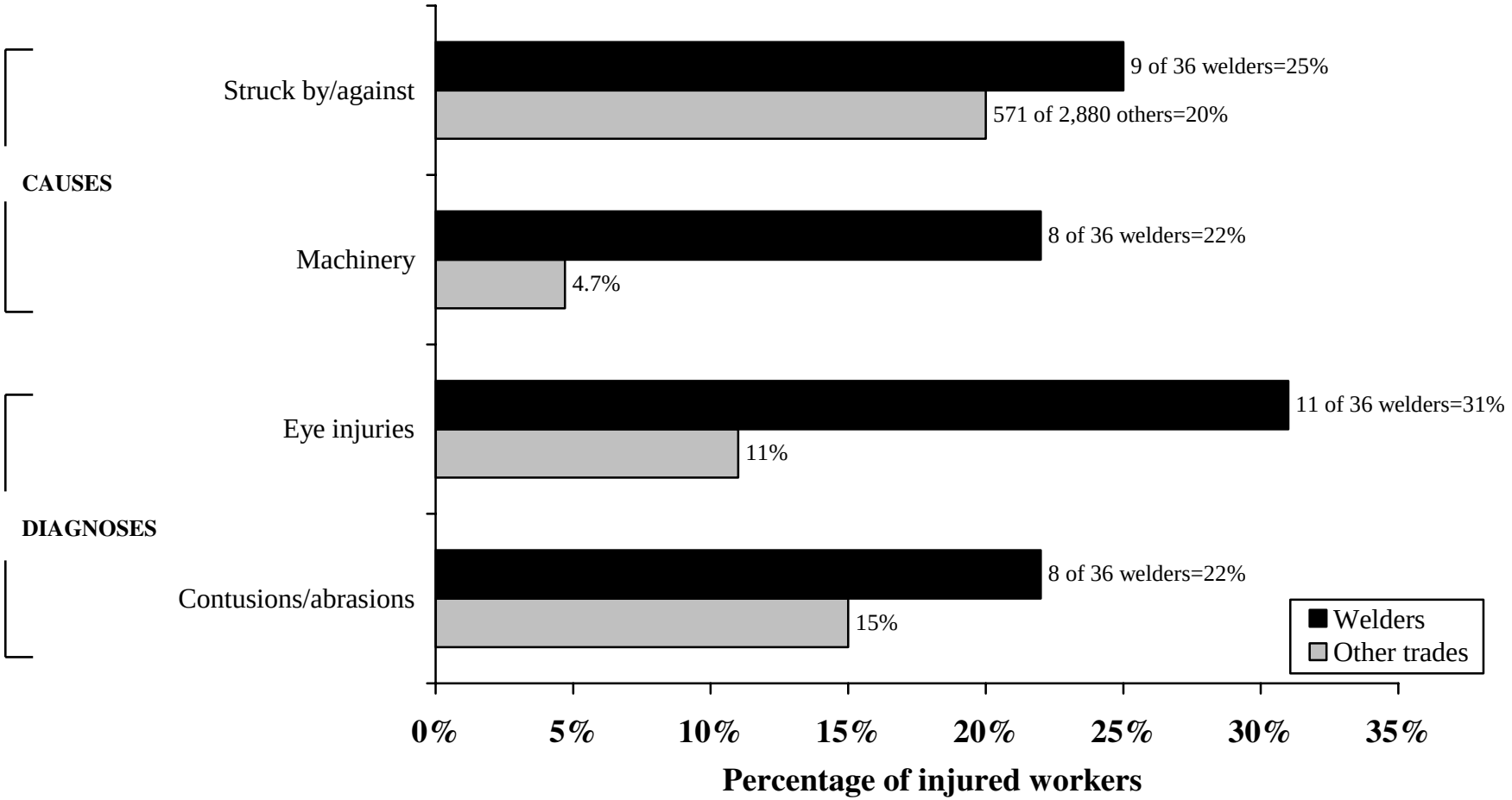
Aside from eye injuries, the diversity of injury circumstances and diagnoses makes it difficult to identify specific hazards. However, the range of injury circumstances (for example, falls from scaffolds, being struck by very heavy objects) does indicate that welders experience the hazards of the general construction environment, and that prevention measures should be accordingly implemented. Finally, the range of trades that were treated for welding-related eye injuries illustrates that workers from other trades are at risk and should be thoroughly instructed in welding safety if they will be welding or working alongside welders.

Chart 16-A

36 injured welders

Percentage of workers in selected injury categories

Compared to 2,880 other injured construction workers



Note: For diagnoses, percents add to more than 100 because some injured workers had more than one diagnosis.

GWU Emergency Department injury data, 11/90-10/97

Chart 16-B
36 injured welders
Detailed causes of injury

RANK #1	25%
STRUCK BY/AGAINST OBJECT (INCL. FALLING OBJECT)	**9**
sheetmetal/ metal piece/metal object	2
granite/marble/stone	1
pipe	1
scaffold	1
hammer/sledge	1
door	1
other: steel frames	1
not specified	1

RANK #2	22%
MACHINERY RELATED	**8**
lifting machinery	1
other machinery:	
welder	6
grinder	1

RANK #3	17%
FALL	**6**
from scaffold	4
slip/trip/stumble	1
from another level	1

RANK #4	14%
OBJECT IN EYE	**5**
metal dust	3
paint (dust or wet)	1
concrete/cement	1

	22%
ALL OTHERS	**8**
SHARP OBJECT	
wood/splinter	1
unspecified saw	1
CAUGHT BETWEEN	
metal plate/object	1
MISCELLANEOUS	
burn, hot object	1
toxic effects	1
not specified	3

Chart 16-C

36 injured welders treated for 36 diagnoses

Diagnoses by body part

RANK #1	31% *
EYE INJURIES	**11****

RANK #3	14%
SPRAIN, STRAIN, PAIN	**5**
shoulder/upper arm	2
trunk	1
hand/wrist	1
elbow/forearm	1

RANK #4	11%
LACERATION	**4**
finger/thumb	2
face/head	2

RANK #2	22%
CONTUSION, ABRASION, FOREIGN OBJECT (excl. eye)	**8**
knee/leg/hip	2
finger/thumb	2
face/head	1
hand/wrist	1
ankle/foot	1
elbow/forearm	1

	22%
ALL OTHERS	**8**
BURNS	
elbow/forearm	2
SYSTEMIC TOXIC EFFECTS	2
CRUSH	
ankle/foot	1
FRACTURE	
knee/leg/hip	1
HEAD INJURY	1
WOUND INFECTION	
knee/leg/hip	1

For example:

* Percentage of welders with one or more eye injuries. Percents add to more than 100 because some injured workers had more than one diagnosis.

** Number of welders with one or more eye injuries.

Elevator Constructors and Mechanics

DURING this seven-year period (11/90-10/97), 24 construction workers identified themselves as elevator constructors or mechanics when registering at the George Washington University Emergency Department. Elevator mechanics (who also work on escalators) make up the smallest trade-based group of injured workers during this study period. Although the numbers are too small to identify prevailing hazards, the injuries are worth discussing.

Demographic Characteristics: All but two workers were male, and 20 of 24 were white, and the average age of this group was 37.

Causes of Injury, Diagnoses, and Injury Locations (charts 17-A through 17-C): Chart 17A combines information on causes of injury, diagnoses, and injured body parts that occurred (1) most often or (2) much more often among elevator constructors and mechanics compared with all other construction trades.

Given the very heavy mechanical equipment that these workers handle, hazards exist for finger or hand crushes. Of the four finger or hand crushes, one was from an elevator door, another from the elevator itself, a third from a metal plate, and another by an unspecified heavy object. Other parts of the body are also at risk from mechanical equipment; one worker sprained his arm and seriously bruised his trunk when he was struck by a crane chain from a collapsed escalator.

Among head and face injuries, one worker was struck on his hard hat and then his chin by an unknown object while working in an elevator shaft, causing a laceration through his lip and jaw. Another worker was hit in the face by a heavy chain, a third was struck in the head by a piece of wood with a nail in it, and a fourth struck his head against a protruding pipe and was sent to the Emergency Department one month later with severe headache and nausea. A fifth worker suffered a bruised head and felt disoriented after a fall. Fortunately, none of the elevator constructors seen at the Emergency Department was seriously enough injured to require hospital admission.

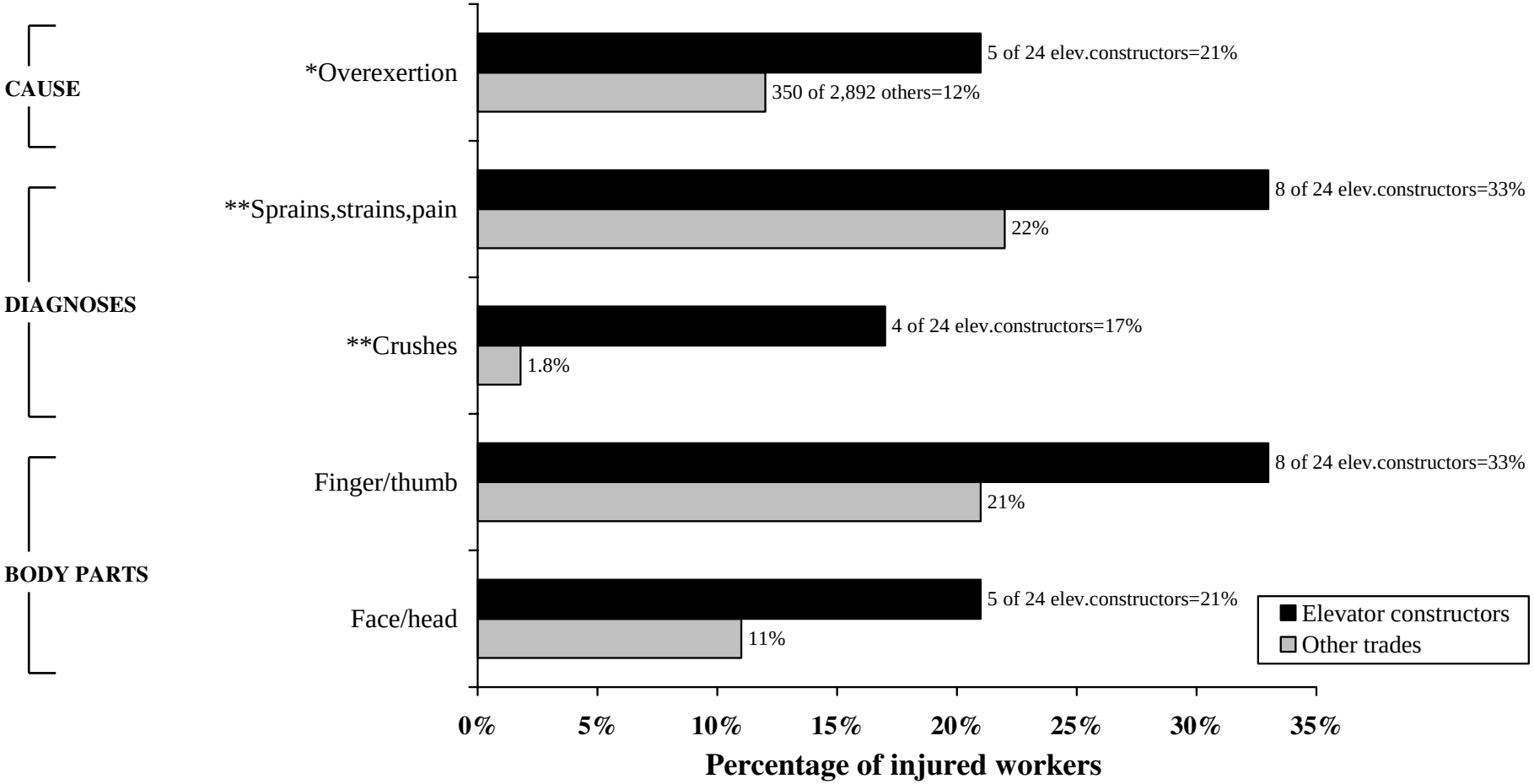
Recommendations: Mechanical construction and repair work on elevators and escalators involves working with very heavy metal objects such as doors, escalator plates, drive chains, and counterweights. Improved material handling procedures would help to prevent such injuries, as well as reduce strains and sprains from overexertion. As in any mechanical task, care must be taken when working on moving parts. Glove use could also help to protect the hands and fingers from lacerations and material handling injuries.

Chart 17-A

24 injured elevator constructors

Percentage of workers in selected injury categories

Compared to 2,892 other injured construction workers



*Second-most-common cause. **Second- and third most-common diagnoses. For diagnoses and body parts, percents total more than 100 because some injured workers had more than one diagnosis/injured body part.

Chart 17-B
24 injured elevator constructors
Detailed causes of injury

RANK #1	25%
SHARP OBJECT	**6**
metal/sheetmetal	2
hand tool	1
nail	1
razor/knife	1
wire	1

RANK #2/3 (tie)	21%
OVEREXERTION/ STRENUOUS MOVEMENT	**5**
lifting/carrying	3
drilling	1
not specified	1

RANK #2/3 (tie)	21%
STRUCK BY/ AGAINST OBJECT	**5**
pipe	1
board/wood	1
other: weight, chain	2
not specified	1

RANK #	13%
FALLS	**3**
slip/trip/stumble	1
from ladder	1
not specified	1

	33%
ALL OTHERS	**5**
CAUGHT IN/BETWEEN	
metal plate/object	1
door	1
MACHINERY-RELATED	
lifting machinery	2
OBJECT IN EYE	
metal dust	1

Chart 17-C

24 injured elevator constructors treated for 27 diagnoses

Diagnoses by body part

RANK #1/2 (tie)	33% *
LACERATION	**8 ****
face/head	2
finger/thumb	2
hand/wrist	2
elbow forearm	2

RANK #1/2 (tie)	33%
SPRAIN, STRAIN, PAIN	**8**
low back	2
finger/thumb	2
neck	1
knee/leg/hip	1
ankle/foot	1
elbow/forearm	1

RANK #3	17%
CRUSH INJURY	**4**
finger/thumb	3
hand/wrist	1

	29%
ALL OTHERS	**7**
HEAD INJURIES	
face/head	3
CONTUSION	
trunk	1
EYE INJURY	1
FRACTURE	
finger/thumb	1
WOUND INFECTION	
ankle/foot	1

For example:

* Percentage of elevator constructors with one or more lacerations. Percents add to more than 100 because some injured workers had more than one diagnosis.

** Number of elevator constructors with one or more lacerations.

Guide to Reading The Bar Charts

- All of the charts are based on the medical records of 2,916 construction tradespeople who were treated for work-related injuries at the George Washington University Emergency Department between **November 1, 1990 and October 31, 1997**. Construction tradespeople working in maintenance settings are included.

- The **charts do not predict or explain injury risk** because, even though we know how many workers were treated for on-the-job injuries at this hospital, we do not know how many workers were treated at other hospitals, or were injured and not treated at all, or were working but not injured during this time.

- In most cases, bars are included on a chart only if they represent **at least three workers**.

- If a bar is labeled **"other,"** it represents workers who did not fit into a category or whose category had fewer than three people.

- The study recorded **up to two injury diagnoses** (such as a bruised elbow and a strained shoulder) for each worker, so the number of diagnoses is often larger than the number of injured workers. Keep this in mind especially when interpreting the "Diagnoses by Body Part" charts.

- In some cases, the **diagnosis appears to be similar to the cause of injury**, but keep in mind that they can be quite different; for example, "electric shock" is a diagnosis, but "electrical exposure" is a cause of injury that might cause electric shock, but might also cause a fractured shoulder from losing balance and falling off a ladder. Causes of injuries included are struck by/against, sharp object, falls, over-exertion, object in eye, machinery-related, caught between, toxic exposure, electrical exposure, vehicle related, contact with hot liquid/object, fire/flame/explosion, assault, and other/not-specified. Diagnoses included are lacerations, strains/sprain/pain, contusions/abrasions, fractures, eye injuries, head injuries, crush injuries, dislocations, toxic effects, wound infections, head injuries, electric shock, burns, and internal injuries.

- When **several trades are listed on a chart**, the gray bars show specific trades and the black bar shows the average of all of the trades combined.

- When specific injuries or causes of injury are shown in charts 1-M through 1-S, only the trades with **"**above average**"** proportions of an injury or cause of injury are included.

- For charts that describe injuries or causes of injury for one trade, the bars are often presented in pairs**;** the black bars represent the trade of interest (such as, insulators) and the gray bars represent the comparison group (everybody but insulators, for example). Likewise, if the black bars represent roofers, the gray bars represent everybody but roofers.

- For trades that are represented by fewer than 70 injured workers (fewer than 10 each year, on average), selected causes, diagnoses, and injured body parts are combined on one bar chart instead of three (chart A). The accompanying lists of injury causes (chart B) and diagnoses (chart C) are comprehensive.