

# Nonfatal Work-Related Motor Vehicle Injuries Treated in Emergency Departments in the United States, 1998–2002

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**Background** Current data on nonfatal work-related motor vehicle injuries are limited and fragmented, often excluding government workers, self-employed workers, and workers on small farms. This study seeks to bridge the present data gap by providing a national profile of nonfatal work-related motor vehicle injuries across all industries and occupations.

**Methods** Study subjects were people who suffered nonfatal work-related motor vehicle injuries and were treated in a hospital emergency department in the United States. Subjects were identified from a stratified probability sample of emergency departments. National estimates and rates were computed.

**Results** From 1998 to 2002, the average annual rate of nonfatal work-related motor vehicle injuries was 7 injuries per 10,000 full-time equivalents. The rate was three times higher in men than in women. The rates were higher in workers 15–19 years of age and in workers 70 years or older. Justice, public order, and safety workers had the largest number of injuries, and taxicab service employees had the highest injury rate of all industries. Truck drivers had the largest number of injuries, and police and detectives, public service employees had the highest injury rate of all occupations.

**Conclusion** Future efforts need to develop and enhance the use of surveillance information at the federal and state level for work-related nonfatal motor vehicle injuries. Prevention efforts need to address occupational motor vehicle safety for both commercial truck/bus drivers and workers who are not commercial drivers but who drive light motor vehicles on the job. *Am. J. Ind. Med.* 52:698–706, 2009. © 2009 Wiley-Liss, Inc.

**KEY WORDS:** motor vehicle injury; motor vehicle crash; occupational injury; emergency department; surveillance

## BACKGROUND

Motor vehicle incidents are the leading cause of work-related fatalities [BLS, 1992; Personick and Mushinski, 1997; NIOSH, 2003, 2004; CDC, 2004; Driscoll et al., 2005] and include (1) highway incidents; (2) nonhighway incidents (i.e., injuries to motor vehicle occupants in parking lots; on unpaved access roads; roads under construction; logging roads; and industrial, commercial, residential, and farm premises); and (3) pedestrians or other nonpassengers struck by motor vehicles. According to the Bureau of Labor

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Accepted 10 May 2009  
DOI 10.1002/ajim.20726. Published online in Wiley InterScience  
(www.interscience.wiley.com)

Statistics [BLS, 2007a] Census of Fatal Occupational Injuries (CFOI), 2,168 workers were killed in motor vehicle incidents on the job in 2005, accounting for 38% of all work-related fatalities. Although there are many more nonfatal work-related motor vehicle injuries for every reported fatality, current surveillance systems only report a fraction of these injuries, because data are not collected in a systematic manner. For example, the BLS annual Survey of Occupational Injuries and Illnesses (SOII) excludes government workers, self-employed workers, and workers on farms with fewer than 11 employees. Workers' compensation data exclude self-employed workers and contingently employed workers who fall outside workers' compensation coverage. The case-capture criteria for workers' compensation data vary by states, that is, some states may exclude self-insured companies and others may not.

A data gap also exists on nonfatal motor vehicle injuries that occur outside of the workplace. At the January 2007 meeting of the Transportation Research Board, the Safety Data, Analysis and Evaluation Committee called for creating a new surveillance system to track nonfatal motor vehicle injuries. The National Highway Transportation Safety Administration (NHTSA) also recognizes this data gap, and its members are debating whether to use the National Electronic Injury Surveillance System (NEISS) or to create a new national surveillance system for monitoring nonfatal motor vehicle injuries.

This study aimed to (1) estimate national frequencies and rates of nonfatal work-related motor vehicle injuries that were treated in emergency departments across all industries and occupations, and (2) to explore the utility of using the NEISS work-related injuries/illnesses program (NEISS-Work) for monitoring nonfatal work-related motor vehicle injuries in the United States.

## METHODS

NEISS is a stratified probability sample of hospitals with 24-hr emergency departments in the United States and its territories. The sampling frame was stratified by hospital size (determined by the annual total of emergency department visits) and geographic region [see Jackson, 2001, for more information of NEISS methodology]. It was developed by the U.S. Consumer Product Safety Commission [CPSC, 1994c] to monitor injuries nationwide that involve consumer products. The NEISS sample includes 101 hospital emergency departments. Because of hospital closures and other nonparticipation/nonresponse factors, the number of reporting hospitals can vary monthly and yearly.

The CPSC collaborates with the Centers for Disease Control and Prevention (CDC) to collect data for two adjunct programs: the National Institute for Occupational Safety and Health (NIOSH) work-related injuries/illnesses program

(NEISS-Work) [CDC, 1998, 2006] and the NEISS All-Injuries Program (NEISS-AIP) [Vyrostek et al., 2004]. NEISS-Work tracks nonfatal work-related injuries and illnesses by using the CPSC emergency department surveillance system. These cases are in addition to the CPSC product-related cases and are mutually exclusive. NEISS-AIP collects data on all injuries, regardless of consumer product involvement or work-relatedness (i.e., it tracks all types of injuries). The cases-capture criteria are similar but not identical for the two adjunct programs (i.e., NEISS-Work includes illnesses, whereas NEISS-AIP does not). More information on how the three programs are reconciled with each other can be found in Vyrostek et al. [2004], Jackson [2001], and CDC [2006].

NEISS-Work collects data from approximately 67 of 101 hospital emergency departments. The 67 hospitals represent two-thirds of each hospital stratum within the sample of 101 and are weighted independently to be nationally representative. Work-related emergency department visits for injuries/illnesses were identified from admissions information and emergency department charts reviewed by CPSC hospital coders who were trained by CPSC and NIOSH. A work-related case was defined as any injury incurred by a person of any age while (1) performing work for compensation, (2) performing volunteer work for an organized group, or (3) performing work on a farm. A nonfatal injury was defined as an injury to a worker who was alive at the time of treatment and release or transfer from the emergency department.

NEISS-Work collects patient demographic information, occupation, business type, business name, injury sources, events, a short narrative description of the injury, and disposition after emergency department treatment. The categories for disposition include treated and released, treated and transferred to another hospital, treated and admitted to the same hospital, held for observation, left without being seen or left against medical advice, and not recorded. Injury sources and events were coded according to the BLS Occupational Injury and Illness Classification System (OIICS) [BLS, 1992]. Normally, NEISS-Work variables of the patient's occupation and industry are not coded. This study coded industry and occupation for the identified motor vehicle injury cases according to the 1990 Census Industrial and Occupational Classification Codes [Census Bureau, 1992], based on NEISS-Work variables of the patient's occupation, business type, and business name.

This study started in 2004. NEISS-Work data from 1998 through 2002 were used. NEISS-Work was treated as a surveillance data. Institutional review board approval was not needed at that time. Motor vehicle injuries were identified by using the following OIICS event codes: (1) highway accidents (41xx), (2) nonhighway accidents except rail, air, and water transportation (42xx), (3) pedestrian/nonpassenger

struck by vehicle/mobile equipment (43xx), and (4) transportation accidents, unspecified (40xx). According to the OIICS definition, the categories of 41xx, 42xx, and 43xx include events involving highway vehicles, powered industrial vehicles, and powered mobile industrial equipment. Highway vehicles include automobiles, buses, trucks, motorcycles, RVs, bicycles, and other nonpowered highway vehicles. The category of “transportation accident, unspecified” was included in the study because all of the cases in the category were found to be motor vehicle injuries (codes 40xx–43xx). The percentage of total motor vehicle injury cases that were coded as “transportation accident, unspecified” was 54% in 1998, 34% in 1999, 29% in 2000, and 2% in both 2001 and 2002. The decrease in the percentage of transportation accidents—unspecified in 2001 and 2002—reflected a coding improvement, because all injury events were required to be coded with greater specificity after 2000. Although the large percentage of unspecified motor vehicle cases in 1998–2000 could change national estimates and rates by event, they do not change the national estimates and rates by age, sex, occupation, and industry. Therefore, this study used NEISS-Work 1998–2002 to compute the national estimates and rates by age, sex, occupation, and industry. The 1998–2000 data were excluded when computing the number of injuries by event because of the large percentage of unspecified motor vehicle cases in these years.

Each case in NEISS-Work was assigned a statistical weight on the basis of the hospitals’ probability of selection in the sample. NIOSH calculated an adjusted weight to account for the use of the sample of 67 hospitals (out of 101). National estimates were obtained by extrapolating these adjusted statistical weights. PROC SURVEYMEANS in SAS, was used to compute national estimates with 95% confidence intervals (CIs), accounting for the complex sample design of NEISS [CPSC, 1994a,b]. All national estimates were rounded to the nearest 100 cases. In accordance with CPSC recommendations, any weighted estimate with a coefficient of variation greater than 33% was considered unstable and not reported.

Employment estimates were obtained from the 1998–2002 Current Population Survey (CPS). The CPS is a household survey of the civilian, noninstitutionalized population in the United States [Census Bureau, 2006]. The employment estimates included workers 15 years of age or older, wage and salary jobs, the self-employed, part-time workers, and unpaid workers who worked 15 hr a week or more in family operated enterprises, but excluded volunteers for organized groups. The estimates of full-time equivalents (FTEs) were calculated by dividing the number of actual hours worked per week reported by survey respondents by 40 hr and then multiplying this quotient by the weighted estimate of the number of working individuals. An FTE equals 2,000 hr worked annually (40 hr per week, 50 weeks per year). Injury rates were computed by industry, occupa-

tion, gender, age group, and calendar year. The rate was presented as the number of injuries per 10,000 FTEs. NEISS-Work collects injuries to workers 14 years of age or younger, although less than 0.5% of the total injuries occurred to these workers. These injuries were included in the total national estimate but were excluded from the rate calculation because employment data were not available for this age group. The categories of age groups used in this study differed from the categories used in the SOII reports (see Tables I and IV). This study used eight age groups (under 15, 15–19, 20–29, 30–39, 40–49, 50–59, 60–69, and 70 and older) and the SOII used seven (under 20, 20–24, 25–34, 35–44, 45–54, 55–64, and 65 and older). Although not represented in the employment data, volunteers were included in the injury and rate estimates because of the difficulty in reliably identifying volunteers within NEISS-Work [Jackson, 2001].

**TABLE I.** National Estimates, Average Annual Rates, and 95% Confidence Interval (CIs) by Gender, Age, and Calendar Year of Nonfatal Work-Related Motor Vehicle Injuries That Were Treated in Emergency Departments (NEISS-Work, 1998–2002)

| Demographics, years, and events | National estimates <sup>a</sup> | Rates <sup>b</sup> | 95% CIs |
|---------------------------------|---------------------------------|--------------------|---------|
| Total motor vehicle injuries    | 442,900                         | 7                  | 5–9     |
| Gender                          |                                 |                    |         |
| Female                          | 86,700                          | 3                  | 2–4     |
| Male                            | 356,200                         | 10                 | 7–12    |
| Age groups (years)              |                                 |                    |         |
| Under 15                        | NR <sup>c</sup>                 |                    |         |
| 15–19                           | 24,600                          | 12                 | 8–16    |
| 20–29                           | 118,100                         | 9                  | 7–12    |
| 30–39                           | 128,200                         | 8                  | 6–10    |
| 40–49                           | 97,500                          | 6                  | 4–7     |
| 50–59                           | 51,900                          | 5                  | 3–6     |
| 60–69                           | 16,800                          | 6                  | 4–7     |
| 70 and over                     | 6,100                           | 11                 | 7–15    |
| Calendar year                   |                                 |                    |         |
| 1998                            | 66,600                          | 5                  | 4–7     |
| 1999                            | 86,300                          | 7                  | 5–9     |
| 2000                            | 99,300                          | 8                  | 6–10    |
| 2001                            | 94,300                          | 7                  | 5–9     |
| 2002                            | 96,700                          | 8                  | 6–10    |

NEISS-Work, National Electronic Injury Surveillance System Work-related injuries/illnesses program.

<sup>a</sup>The national estimates are rounded to the nearest 100. As a result, the sum of individual groups is slightly larger than the total number.

<sup>b</sup>Number of injuries per 10,000 full-time equivalents.

<sup>c</sup>NR, not reported because of small number. According to CPSC recommendations, any estimate with coefficient of variation greater than 33% is considered unstable, hence not reported.

**RESULTS**

From 1998 through 2002, NEISS-Work collected approximately 6,400 nonfatal work-related motor vehicle injuries (an average of 1,300 injuries annually), yielding a national estimate of 442,900 injuries and an average of 88,600 injuries annually (Table I). The average annual injury rate for all workers during 1998–2002 was 7 per 10,000 FTEs. However, the rate was more than three times higher for males than females. Rates were higher for the youngest workers (15–19 years old) and oldest workers (70 years or older) and tended to decrease with age from 20 to 59 years old.

Table II presents national estimates, average annual rates, and 95% CIs for the industries and occupations that had the most nonfatal work-related motor vehicle injuries. Along with the industries listed in Table II, automobile repair and related service (the 1990 Census industrial code, 751); eating and drinking place (641); U.S. postal service (412); health service, not elsewhere classified (840); hospitals (831);

landscape and horticultural services (020); and lumber and building material retailing (580) also had a substantial number of motor vehicle injuries. Of all industries, taxicab service had the highest motor vehicle injury rate; justice, public order, and safety had the largest number of motor vehicle injuries.

Along with the occupations listed in Table II, grounds-keepers and gardeners, except farm (the 1990 Census occupational code, 486); farm workers (479); guards and police, except public service (426); firefighting occupations (417); and garbage collectors (875) also had a substantial number of motor vehicle injuries. Of all occupations, police and detectives, public service had the highest injury rate, more than two times higher than the second highest rate of taxicab drivers and chauffeurs. Truck drivers had the largest number of motor vehicle injuries.

Table III lists the percentage distribution of motor vehicle injuries by event for the industries and occupations that had the most motor vehicle injuries. Highway incidents accounted for more than 50% of all motor vehicle injuries in

**TABLE II.** National Estimates, Average Annual Rates, and 95% Confidence Intervals (CIs) for Industries and Occupations That Had Largest Number of Nonfatal Work-Related Motor Vehicle Injuries That Were Treated in Emergency Departments (NEISS-Work, 1998–2002)

| Census codes <sup>a</sup> | Industries and occupations                          | National estimates <sup>b</sup> | Rates <sup>c</sup> | 95% CIs |
|---------------------------|---|---------------------------------|--------------------|---------|
| <b>Industries</b>         |   |                                 |                    |         |
| 402                       | Taxicab service                                     | 6,200                           | 86                 | 42–131  |
| 471                       | Sanitary service                                    | 7,400                           | 46                 | 31–61   |
| 910                       | Justice, public order, and safety                   | 48,700                          | 38                 | 24–51   |
| 010                       | Agriculture production, crops                       | 16,000                          | 35                 | 20–49   |
| 410                       | Trucking service                                    | 44,800                          | 34                 | 23–44   |
| 901                       | General government, n.e.c.                          | 9,500                           | 28                 | 17–38   |
| 810                       | Miscellaneous entertainment and recreation services | 6,500                           | 9                  | 5–12    |
| 060                       | Construction  | 37,700                          | 8                  | 5–11    |
| 842                       | Elementary and secondary schools                    | 8,700                           | 3                  | 1–4     |
| 990                       | Unclassified  | 32,900                          | NA <sup>d</sup>    | NA      |
| <b>Occupations</b>        |   |                                 |                    |         |
| 418                       | Police and detectives, public service               | 35,000                          | 113                | 73–153  |
| 809                       | Taxicab drivers and chauffeurs                      | 7,600                           | 55                 | 30–80   |
| 804                       | Truck drivers                                       | 81,100                          | 49                 | 34–63   |
| 889                       | Laborers, except construction                       | 16,400                          | 28                 | 18–38   |
| 869                       | Construction laborers                               | 11,700                          | 26                 | 16–36   |
| 473                       | Farmers, except horticultural                       | 9,800                           | 20                 | 10–30   |
| 208                       | Health technologists and technicians, n.e.c.        | 5,800                           | 17                 | 9–25    |
| 999                       | Unclassified  | 121,300                         | NA                 | NA      |

NEISS-Work, National Electronic Injury Surveillance System Work-related injuries/illnesses program; n.e.c., not elsewhere classified.

<sup>a</sup>The 1990 Census Industrial and Occupational Classification Codes.

<sup>b</sup>National estimates are rounded to the nearest 100.

<sup>c</sup>Number of injuries per 10,000 full-time equivalents.

<sup>d</sup>Denominator was not available.

**TABLE III.** Percentage Distribution by Injury Event for the Industries and Occupations That Had Largest Number of Nonfatal Work-Related Motor Vehicle Injuries (NEISS-Work, 2001–2002)

| Census codes <sup>a</sup> | Industries and occupations                          | Injury events             |                              |                              |   |
|---------------------------|---|---------------------------|------------------------------|------------------------------|---|
|                           |   | Highway incidents (Row %) | Nonhighway incidents (Row %) | Pedestrian incidents (Row %) | Unspecified transportation events (Row %) |
| 010-990                   | All industries/occupations                          | 57                        | 22                           | 20                           | 2   |
| Industries                |   |                           |                              |                              |   |
| 402                       | Taxicab service                                     | 94                        | NR <sup>b</sup>              | NR                           | NR  |
| 471                       | Sanitary services                                   | 63                        | NR                           | NR                           | NR  |
| 910                       | Justice, public order, and safety                   | 74                        | 16                           | NR                           | NR  |
| 010                       | Agriculture production, crops                       | NR                        | 53                           | 26                           | NR  |
| 410                       | Trucking service                                    | 78                        | NR                           | 10                           | NR  |
| 901                       | General government, n.e.c.                          | 59                        | 31                           | NR                           | NR  |
| 810                       | Miscellaneous entertainment and recreation services | NR                        | 55                           | NR                           | NR  |
| 060                       | Construction  | 46                        | NR                           | 31                           | NR  |
| 842                       | Elementary and secondary schools                    | 65                        | NR                           | NR                           | NR  |
| Occupations               |   |                           |                              |                              |   |
| 418                       | Police and detectives, public service               | 80                        | 13                           | NR                           | NR  |
| 809                       | Taxicab drivers and chauffeurs                      | 94                        | NR                           | NR                           | NR  |
| 804                       | Truck drivers                                       | 81                        | 13                           | NR                           | NR  |
| 889                       | Laborers, except construction                       | NR                        | 30                           | 51                           | NR  |
| 869                       | Construction laborers                               | 34                        | NR                           | 44                           | NR  |
| 473                       | Farmers, except horticultural                       | NR                        | 70                           | 24                           | NR  |
| 208                       | Health technologists and technicians, n.e.c.        | 82                        | NR                           | NR                           | NR  |

NEISS-Work, National Electronic Injury Surveillance System Work-related injuries/illnesses program; n.e.c., not elsewhere classified.

<sup>a</sup>The 1990 Census Industrial and Occupational Classification Codes.

<sup>b</sup>NR, Not reported because of small number. According to CPSC recommendations, any estimate with coefficient of variation greater than 33% is considered unstable, hence not reported.

six of the nine industries. Nonhighway incidents accounted for more than 50% of all motor vehicle injuries in the agriculture production, crops, and the miscellaneous entertainment and recreation services industries. Pedestrian/nonpassenger struck by vehicle/mobile equipment accounted for a large portion of the motor vehicle injuries in the agriculture production, crops and the construction industries. Highway incident was the primary event in four of the seven W2 occupations. Nonhighway incident was the primary event for farmers, except horticulture occupation. Pedestrian/nonpassenger struck by vehicle/mobile equipment was the primary event for laborers, except construction and construction laborers.

Table IV compares the 2002 national estimates and rates of nonfatal work-related motor vehicle injuries between NEISS-Work and SOII [BLS, 2004]. SOII is maintained by BLS and collects data on nonfatal work-related injuries and illnesses that private industry employers record in accordance with the U.S. Department of Labor reporting protocol. SOII is the most frequently used source for national estimates of nonfatal work-related injuries in the United

States. In 2002, NEISS-Work estimated 96,700 nonfatal work-related motor vehicle injuries, compared to 61,700 estimated by SOII. NEISS-Work collected more pedestrian/nonpassenger struck by vehicle/mobile equipment incidents and SOII collected more highway incidents; 21% of cases in NEISS-Work were pedestrian/nonpassenger struck by vehicle/mobile equipment incidents compared to 16% in SOII, 63% of cases in SOII were highway incidents compared to 59% in NEISS-Work. However, the injury rates and injury distributions by age group and event were similar between the two systems.

## DISCUSSION

### Limitations and Strengths

Among the limitations that are commonly associated with NEISS-Work [Layne et al., 1994; Layne and Landen, 1997; Chen and Hendricks, 2001; Jackson, 2001; Layne and Pollack, 2004; Chen and Jenkins, 2007a,b], the large standard errors that are associated with the small sample of

**TABLE IV.** Comparison\* of National Estimates of Nonfatal Work-Related Motor Vehicle Injuries Between NEISS-Work and SOII in 2002

| Demographics and events                             | NEISS-Work                      |                    | SOII               |       |
|---|---------------------------------|--------------------|--------------------|-------|
|   | National estimates <sup>a</sup> | Rates <sup>b</sup> | National estimates | Rates |
| Total   | 96,700                          | 7.7                | 61,731             | 7.1   |
| Demographics  |                                 |                    |                    |       |
| Gender  |                                 |                    |                    |       |
| Female  | 20,400                          | 3.8                | 14,601             | NA    |
| Male  | 76,400                          | 10.6               | 46,738             | NA    |
| Age groups (years)                                  |                                 |                    |                    |       |
| Under 20  | 4,700                           | 12.0               | 1,259              | NA    |
| 20–24   | 10,900                          | 9.5                | 7,150              | NA    |
| 25–34   | 25,600                          | 9.1                | 15,829             | NA    |
| 35–44   | 26,600                          | 7.7                | 17,653             | NA    |
| 45–54   | 18,800                          | 6.2                | 11,907             | NA    |
| 55–64   | 7,300                           | 5.1                | 6,348              | NA    |
| 65 and over   | 3,300                           | 10.7               | 1,481              | NA    |
| Injury events                                       |                                 |                    |                    |       |
| Highway incidents (OIICS code 41xx)                 | 57,000                          | 4.5                | 39,149             | 4.4   |
| Nonhighway incidents (OIICS code 42xx)              | 17,400                          | 1.4                | 10,679             | 1.2   |
| Pedestrian incidents (OIICS code 43xx)              | 20,200                          | 1.6                | 10,038             | 1.1   |
| Unspecified transportation events (OIICS code 40xx) | 2,200                           | 0.2                | 1,865              | 0.2   |

NEISS-Work, National Electronic Injury Surveillance System Work-related injuries/illnesses program; SOII, Survey of Occupational Injury and Illness; OIICS, Occupational Injury and Illness Classification System; NA, data not available.

\*SOII covers only the private sector, and NEISS-Work covers the public and private sectors, and the self-employed.

<sup>a</sup>NEISS-Work national estimates are rounded to the nearest 100.

<sup>b</sup>Number of injuries per 10,000 full-time equivalents.

67 hospitals could most reduce the utility of NEISS-Work to tracking nonfatal work-related MV injuries. The large standard errors could limit the ability to detect the differences in numbers of injuries among demographic groups or to track injury trends over the years. This study also suffers two additional limitations. First, 7% of motor vehicle injury cases were coded as unspecified industry and 27% of motor vehicle injury cases were coded as unspecified occupation. The large percentage of unspecified cases could obscure or alter the actual injury distribution by industry and occupation. Second, there is no information on self-reported alcohol use or data on blood alcohol concentration within NEISS-Work data.

NEISS-Work is a national probability sample from which national estimates can be generated. NEISS-Work includes all nonfatal work-related motor vehicle injuries that are treated in emergency departments regardless of the payment methods (e.g., paid by auto insurance, workers' compensation, medical insurance, the injured worker). NEISS-Work data include injuries from all industries and occupations, regardless of size or ownership of a business.

The two NEISS adjunct programs, NEISS-AIP and NEISS-Work, provide a unique opportunity for researchers to compare work-related and nonwork-related nonfatal motor vehicle injuries.

### Fatal Versus Nonfatal Work-Related Motor Vehicle Injuries

NEISS-Work estimated 3,574,900 nonfatal work-related injuries in 2002, with motor vehicle incidents accounting for 2.7% of these injuries (96,700/3,574,900). This result is consistent with the 2002 SOII result of 2.5% (61,700 motor vehicle injuries vs. 2,494,300 total lost workday injuries) [BLS, 2004]. According to the 2002 CFOI, there were 5,524 work-related fatalities. Of these fatalities, 2,178 were motor vehicle incidents accounting for 39% of the total fatalities. For every work-related motor vehicle fatality, there were approximately 50 nonfatal work-related motor vehicle injuries that were treated in emergency departments (2,178/96,700) in 2002. For every work-related fatality, there were approximately 650 work-

related nonfatal injuries that were treated in emergency departments (5,524/3,574,900). This result suggests that motor vehicle incidents are far more deadly than other injury incidents.

### **NEISS Versus SOII Estimates**

Three factors may contribute to the difference in the estimated numbers of nonfatal work-related motor vehicle injuries between NEISS-Work and SOII. First, SOII is based on employer reports, but NEISS is based on reports from injured workers who are treated in emergency departments. Second, SOII records injuries that result in lost work days, but NEISS-Work captures injuries that require emergency department treatment. Finally, SOII excludes government workers, self-employed workers, and workers on farms with fewer than 11 employees, but NEISS-Work includes all of these categories. These workers may account for a significant portion of the additional injuries reported in NEISS-Work. This may appear to explain why the estimated number of motor vehicle injuries was 57% more in NEISS than in SOII, but the rates were actually similar between the two systems. Rates by gender and age could not be obtained from SOII in 2002.

### **Motor Vehicle Injuries and Fatalities Among Police Officers**

NEISS-Work suggests that justice, public order, and safety had the largest number of nonfatal work-related motor vehicle injuries of all industries. Among occupations, police and detectives, public service workers had the highest motor vehicle injury rate—by far more than double the rate for the next highest occupation, taxicab drivers and chauffeurs. A recent study [Kyriacou et al., 2005] found motor vehicle crashes to be the leading cause (47.5%) of occupational deaths among police officers in London and the third leading cause (25%) of occupational deaths among police officers in New York City. A South African study also identified motor vehicle crashes as the second leading cause of on-duty police deaths and injuries in Johannesburg [Plani et al., 2003]. These large motor vehicle injury and fatality rates among police officers warrant further research.

### **Motor Vehicle Injuries Among Workers Driving Light Motor Vehicles at Work**

NEISS-Work suggests that trucking service (1990 Census code 410), and bus service and urban transit (401) industries accounted for 19% of all nonfatal work-related motor vehicle injuries. Truck (1990 Census code 804) and bus (808) driver occupations accounted for 25% of all nonfatal work-related motor vehicle injuries. So, the majority of nonfatal work-related motor vehicle injuries

occurred to workers who drove light motor vehicles on the job. Current government regulations are focused on commercial trucks and buses. Few regulations address light motor vehicles in the workplace. In the United States, truck and bus safety is monitored and regulated by the Federal Motor Carrier Safety Administration (FMCSA). The NHTSA is responsible for highway traffic safety in general, but it does not differentiate work-relatedness. Although Occupational Safety and Health Administration (OSHA) regulations primarily address safe operation of mobile machinery off the highway, they do not monitor or regulate light motor vehicles in the workplace.

Workers driving light motor vehicles at work are an overlooked group that deserves more attention. No reports are available on how many workers drive light motor vehicles at work, who those workers are, and how many hours or miles they drive each day at work. Workers who are occupationally exposed to the hazard of motor vehicle crashes can be categorized as (1) those who drive commercial vehicles (e.g., heavy trucks and buses) and those who drive light motor vehicles (e.g., cars, station wagons, vans, pickup trucks, and utility vehicles) on the job under a variety of ownerships (e.g., company-owned or private vehicles); (2) those whose primary job is to operate a motor vehicle (e.g., commercial truck/bus and taxicab drivers) and those who occasionally drive a motor vehicle as part of their job (e.g., home healthcare providers, salespersons, marketing staff); and (3) those who are motor vehicle operators and who are occupationally exposed to traffic as pedestrians or nonpassengers (e.g., construction laborers working in a highway work zone).

According to the 2001 National Household Travel Survey [BTS, 2003], an estimated 26 million workers, or 22% of the labor force in the United States, had a job that required driving a motor vehicle at work (unpublished result based on an analysis of 2001 NHTS data). This is similar to Europe, where one out of four employees reported driving motor vehicles as a part of their job [Salminen, 2000]. According to the BLS [2007b], there were 2.9 million truck drivers and 653,000 bus drivers. It might be reasonable to assume that most of the rest of the 22.4 million workers (26 million workers, minus 2.9 million truck drivers, minus 700,000 bus drivers) were driving light motor vehicles on the job.

The large number of workers who drove light motor vehicles at work and the large number of motor vehicle injuries these workers encountered demand that the occupational health and safety practice should expand its current focus on truck and bus safety to include light motor vehicle safety. Researchers in Australia started to address this issue and proposed a conceptual model and a legislative framework to address work-related light motor vehicle safety [Stuckey and LaMontagne, 2005; Stuckey et al., 2007]. There are a few studies [Adams-Guppy and Guppy,

1995; Salminen, 2000, 2003; Horsburgh et al., 2001; Stuckey et al., 2007] addressing the safe operation of light motor vehicles at work. A European study suggested that haste, tiredness, thinking about work while driving, and traffic jams are risk factors of motor vehicle crashes among salespersons, marketing staff, and construction workers [Salminen and Lähdeniemi, 2002]. The use of a car as a mobile office has increased, and the use of cell phones while driving has become more of a risk factor when driving at work than driving during leisure time [Hunton and Rose, 2005; Eby et al., 2006]. Zaloshnja and Miller [2006] and Zaloshnja et al. [2007] suggested alcohol was involved in 9.1% of occupational motor vehicle fatalities.

Driving light motor vehicles on the job is under the employers' management along with being subjected to public highway traffic regulations. For example, several U.S. pharmaceutical companies ban cell phone use in their company-owned cars (personal communication). Company rules provide an opportunity for research communities, governments, and industries to work together to improve roadway safety at work.

## CONCLUSIONS

The study underlines the need for better surveillance data on nonfatal work-related motor vehicle injuries. Without a system tracking and monitoring all nonfatal work-related motor vehicle injuries, the United States remains unable to mount effective efforts for preventing motor vehicle injuries in the workplace. NEISS complements SOII by providing data on government employees, workers on farms with fewer than 11 employees, and self-employed workers. NEISS is useful but does have limitations mainly because of its small sample size. There are other complementary data systems that could potentially be used for nonfatal work-related motor vehicle injuries if data on patients' occupation, industry, and injury work-relatedness could be collected. These data systems include state-based hospital discharge data and emergency department reporting systems, which are population-based rather than sample-based.

Because the majority of nonfatal work-related motor vehicle injuries occurred to workers who drove light motor vehicles on the job, future efforts need to address both truck/bus safety and light motor vehicle safety at work in a wide range of industries, occupations, and work situations. NIOSH [2003] has developed measures for preventing work-related roadway crashes that are applicable to both employers and employees in various industries and occupations.

## ACKNOWLEDGMENTS

The author gratefully acknowledges the following NIOSH employees for their assistance with this manuscript:

Tim Pizatella for his initiation of the project; Harlan Amandus for his technical contribution; Larry Jackson, Suzanne M. Marsh, and Susan Derk for their assistance on the NEISS-Work data; and CDC editors Nicholas Lawryk and John Lechliter for editorial assistance. The findings and conclusions in this report are those of the author and do not necessarily represent the views of the National Institute for Occupational Safety and Health.

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