Vital Signs: Health Burden and Medical Costs of Nonfatal Injuries to Motor Vehicle Occupants — United States, 2012

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Abstract

Background: Motor vehicle crashes are a leading cause of death and injury in the United States. The purpose of this study was to describe the current health burden and medical and work loss costs of nonfatal crash injuries among vehicle occupants in the United States.

Methods: CDC analyzed data on emergency department (ED) visits resulting from nonfatal crash injuries among vehicle occupants in 2012 using the National Electronic Injury Surveillance System – All Injury Program (NEISS-AIP) and the Healthcare Cost and Utilization Project National Inpatient Sample (HCUP-NIS). The number and rate of all ED visits for the treatment of crash injuries that resulted in the patient being released and the number and rate of hospitalizations for the treatment of crash injuries were estimated, as were the associated number of hospital days and lifetime medical and work loss costs.

Results: In 2012, an estimated 2,519,471 ED visits resulted from nonfatal crash injuries, with an estimated lifetime medical cost of $18.4 billion (2012 U.S. dollars). Approximately 7.5% of these visits resulted in hospitalizations that required an estimated 1,057,465 hospital days in 2012.

Conclusions: Nonfatal crash injuries occur frequently and result in substantial costs to individuals, employers, and society. For each motor vehicle crash death in 2012, eight persons were hospitalized, and 100 were treated and released from the ED.

Implications for Public Health: Public health practices and laws, such as primary seat belt laws, child passenger restraint laws, ignition interlocks to prevent alcohol impaired driving, sobriety checkpoints, and graduated driver licensing systems have demonstrated effectiveness for reducing motor vehicle crashes and injuries. They might also substantially reduce associated ED visits, hospitalizations, and medical costs.

Introduction

Motor vehicle crashes are a leading cause of injury and death. Previous research has shown that motor vehicle crashes result in substantial mortality, with 22,912 motor vehicle occupants killed in 2012 in the United States (1), and an estimated 265,000 years of potential life lost in 2011 (CDC’s Web-Based Injury Statistics Query and Reporting System [WISQARS], unpublished data, 2014). The estimated medical cost of such fatalities was $226 million (2). Because the burden of nonfatal injuries caused by motor vehicle crashes has been less well-documented, this report estimates the U.S. health burden and medical and work loss costs of nonfatal motor vehicle crash injuries; the most recent available data on emergency department (ED) visits and hospitalizations were examined.

Methods

Data from the 2012 National Electronic Injury Surveillance System – All Injury Program (NEISS-AIP), which is operated by the U.S. Consumer Product Safety Commission in collaboration with CDC, and data from the 2012 Healthcare Cost and Utilization Project National Inpatient Sample (HCUP-NIS) of the U.S. Agency for Healthcare Research and Quality were analyzed. NEISS-AIP is a nationally representative stratified probability sample of 63 U.S. hospitals (3). Detailed data on initial ED visits per injury per person are abstracted from medical records for all nonfatal injuries and poisonings. Patients who made more than one ED visit because of a crash injury in 2012 were counted separately for each visit. NEISS-AIP data are publicly available through CDC’s WISQARS (2). HCUP-NIS is based on a 20% stratified sample of inpatient hospital...
discharges at U.S. community hospitals. In 2012, 44 states participated in HCUP-NIS, and resulting data were weighted to provide national estimates (4). Data on work-related crash injuries were obtained from the NEISS-Work occupational supplement, which uses the same sample as NEISS-AIP. In all data sources, nonfatal occupant (driver or passenger) injuries from unintentional motor vehicle traffic crashes (hereafter called crash injuries) were defined consistent with the International Classification of Diseases, Ninth Revision, Clinical Modification external cause-of-injury codes E810–E819 with suffixes “.0” and “.1” (indicating injuries specific to motor vehicle occupants). Nature of injury categories (e.g., sprains/strains and fractures) were derived from the NEISS-AIP principal diagnosis codes. Rates of ED visits were calculated for all crash injuries using population estimates from the U.S. Bureau of the Census (http://www.census.gov/population/projections/data/national/2012.html), and for work-related crash injuries using estimates of full-time-equivalent (FTE) employees from the U.S. Bureau of Labor Statistics’ Current Population Survey (http://www.census.gov/cps/methodology).

Estimated counts, rates per 100,000 population, and 95% confidence intervals (CIs) for total, treated and released, and transferred or hospitalized (hereafter referred to as hospitalized) ED patients and the proportion of hospitalized ED patients were stratified by sex and age group. The age groups, selected to coincide with distinct crash risk and opportunities for intervention, were: 0–14 years, 15–29 years (further divided into 15–17 years, 18–20 years, 21–24 years, and 25–29 years), 30–39 years, 40–49 years, 50–59 years, 60–69 years, 70–79 years, and ≥80 years. Crude injury rates were presented for each age group, whereas overall and sex-specific injury rates were age-adjusted to the standard year 2000 population (2). For work-related crash injuries, the age group of 20–69 years was used to coincide with the ages of those most likely to drive for work. Differences in estimates were considered statistically significant (p<0.05) if their CIs did not overlap. The proportion of ED visits by nature of injury were calculated using 2010 data (the most recent data available). The annual estimated total number of hospital days was calculated by multiplying the total number of ED visits resulting in hospitalization from NEISS-AIP by the average length of stay from HCUP-NIS.

Methods for estimating lifetime medical and loss of work costs associated with crash injuries are described in detail elsewhere (5). The medical estimates included the cost of initial ED visits and hospitalizations for crash injuries, attributable lifetime medical costs (e.g., follow-up ED visits and hospitalizations, ambulance transportation, ambulatory care, prescription drugs, home health care, vision aids, dental visits, and medical devices), and nursing home and insurance claims administration costs. The loss of work estimates included lost expected employment earnings, lost fringe benefits, and lost value of household work. Costs beyond the first year after the crash injury were discounted at the recommended 3% (6). Medical costs were estimated from 2010 U.S. dollars (USD) data and inflated to 2012 USD using the Price Indexes for Personal Consumption Expenditures by Function from the U.S. Bureau of Economic Analysis (5). Work loss estimates are presented as 2012 USD based on the Employment Cost Index, Total Compensation, Civilian from the U.S. Bureau of Labor Statistics for productivity loss (5). Total lifetime medical costs were calculated by multiplying the number of treated and released ED patients or hospitalized patients by the corresponding average estimated lifetime medical cost for both sexes and each age group and summing the results.

Results

During 2012, an estimated 2,519,471 ED visits (CI = 2,041,225–2,997,717) for crash injuries occurred, corresponding to an estimated rate of 806 visits per 100,000 population (Table 1). Of these visits, 1%–2% were identified as work-related, with a rate of 25 visits per 100,000 FTE employees. Age-specific rates by disposition did not vary significantly by sex. Total visit rates varied significantly by age; children aged 0–14 years had the lowest rate (281 visits per 100,000 population [CI = 218–344]), teens and young adults aged 15–29 years the highest rate (1,448 visits per 100,000 population [CI = 1,165–1,742]), and adults aged 30–39 years the second highest rate (1,075 visits per 100,000 population [CI = 883–1,267]) (Table 1). Rates for work-related crashes did not vary significantly by age group, ranging from 23 to 29 visits per 100,000 FTE employees aged 20–69 years.

Approximately 7.5% (N = 188,833 [CI = 110,377–267,288]) of persons visiting EDs because of crash injuries were hospitalized. A similar proportion of persons with work-related crash injuries (8%) were hospitalized. Adults aged ≥80 years had a significantly higher hospitalization rate (33%) than other age groups except for adults aged 70–79 years (17%) (Figure 1). The average length of stay for hospitalization among all ages was 5.6 days for a total of 1,057,465 hospital days. Sprains/strains accounted for 55% of treated and released ED visits (Figure 2), although such injuries were the least likely to result in hospitalization, with 99.6% of patients with sprains/strains treated and released. Fractures accounted for just 4% of treated and released ED visits but resulted in hospitalization in 45% of cases.

The lifetime medical cost of crash injuries was estimated to be $18.4 billion: $7.7 billion for treated and released patients and $10.7 billion for hospitalized patients (Table 2). The average lifetime medical cost per hospitalized patient was $56,674 (Table 2). The average lifetime medical cost per treated and released patient was $3,362 (Table 2).
### TABLE 1. Number and rate* of emergency department visits for nonfatal crash injuries among motor vehicle occupants, by age group, sex, and disposition — National Electronic Injury Surveillance System, United States, 2012

| Age group and sex | No. of visits & No. per 100,000 & (95% CI) | No. of visits & No. per 100,000 & (95% CI) | No. of visits & No. per 100,000 & (95% CI) |
|-------------------|---------------------------------|---------------------------------|---------------------------------|
| **0–14 yrs**      |                                 |                                 |                                 |
| Total             | 171,954                         | 281.2**                         | 160,810                         | 263.0                          | 203.5–322.5                  |
| Female            | 94,152                          | 314.9                           | 88,790                          | 296.9                          | 228.8–365.1                  |
| Male              | 77,802                          | 249.0                           | 72,020                          | 230.5                          | 178.0–283.0                  |
| **15–29 yrs**     |                                 |                                 |                                 |
| Total             | 949,524                         | 1,447.6**                       | 877,366                         | 1,342.7                        | 1,074.5–1,611.0              |
| Female            | 535,478                         | 1,669.0                         | 504,770                         | 1,578.1                        | 1,250.4–1,905.9              |
| Male              | 414,022                         | 1,235.5                         | 372,572                         | 1,116.9                        | 900.0–1,333.9                |
| **30–39 yrs**     |                                 |                                 |                                 |
| Total             | 124,977                         | 993.1                           | 114,047                         | 906.3                          | 703.9–1,108.7                |
| Female            | 72,566                          | 812.9                           | 67,818                          | 1,051.0                        | 856.0–1,354.2                |
| Male              | 52,411                          | 812.9                           | 46,229                          | 717.0                          | 549.7–884.4                  |
| **40–49 yrs**     |                                 |                                 |                                 |
| Total             | 239,563                         | 1,798.0                         | 219,644                         | 1,648.9                        | 1,287.5–2,010.4              |
| Female            | 134,161                         | 2,074.0                         | 125,761                         | 1,943.8                        | 1,511.6–2,376.1              |
| Male              | 105,402                         | 1,539.0                         | 93,883                          | 1,116.9                        | 900.0–1,333.9                |
| **50–59 yrs**     |                                 |                                 |                                 |
| Total             | 292,060                         | 1,619.0                         | 269,885                         | 1,496.1                        | 1,186.3–1,805.9              |
| Female            | 166,130                         | 1,882.5                         | 156,774                         | 1,776.5                        | 1,385.8–2,184.4              |
| Male              | 124,930                         | 1,536.4                         | 113,087                         | 1,227.3                        | 997.8–1,456.8                |
| **60–69 yrs**     |                                 |                                 |                                 |
| Total             | 292,925                         | 1,368.9                         | 273,790                         | 1,279.5                        | 1,016.9–1,542.1              |
| Female            | 162,620                         | 1,540.9                         | 154,417                         | 1,463.2                        | 1,160.0–1,766.4              |
| Male              | 130,304                         | 1,201.5                         | 119,373                         | 1,007.0                        | 869.0–1,332.5                |
| **70–79 yrs**     |                                 |                                 |                                 |
| Total             | 434,428                         | 1,075.3                         | 407,260                         | 1,008.1                        | 817.7–1,198.5                |
| Female            | 242,198                         | 1,199.8                         | 229,945                         | 1,138.9                        | 926.2–1,351.5                |
| Male              | 192,230                         | 951.0                           | 177,315                         | 877.4                          | 696.1–1,058.8                |
| **80+ yrs**       |                                 |                                 |                                 |
| Total             | 368,556                         | 862.8                           | 341,140                         | 798.6                          | 621.0–976.2                  |
| Female            | 202,933                         | 942.5                           | 192,064                         | 892.0                          | 697.5–1,086.5                |
| Male              | 165,624                         | 781.8                           | 149,076                         | 703.7                          | 538.3–869.0                  |
| **All ages†‡**    |                                 |                                 |                                 |
| Total             | 2,519,471                       | 806.3                           | 2,302,207                       | 738.5                          | 692.2–784.7                  |
| Female            | 1,412,180                       | 901.5                           | 1,313,130                       | 841.2                          | 786.6–895.9                  |
| Male              | 1,107,288                       | 712.7                           | 989,053                         | 637.1                          | 596.6–677.6                  |

**Abbreviation:** CI = confidence interval.

* Per 100,000 population.
† Total estimates include patients with disposition coded as “observed,” “left against medical advice,” or “unknown.”
§ National estimates based on weighted data from the National Electronic Injury Surveillance System – All Injury Program.
‡ Totals include visits with unknown age and/or unknown sex. Estimates might not add up to total because of rounding.
** Rate is significantly different compared with other age groups within the same disposition category.
†† Estimates for all ages are age-adjusted.
lifetime cost of work loss because of crash injuries in 2012 was estimated to be $32.9 billion: $9.4 billion for treated and released patients, and $23.5 billion for hospitalized patients. Crash injuries declined in the past decade. Compared with 2002, an estimated 397,761 fewer ED visits and 5,771 fewer hospitalizations occurred in 2012. This reduction was associated with an averted $1.7 billion lifetime medical cost and $2.3 billion work loss costs.

Conclusions and Comment

The health burden and medical costs resulting from nonfatal crash injuries in the United States are substantial. In 2012, an estimated 2.5 million ED visits occurred because of such injuries, of which approximately 188,000 were serious enough to require hospitalization. This is equivalent to 6,902 ED visits and 517 hospitalizations every day. With U.S. households averaging 5.7 vehicle trips per day, the risk for these injuries is widespread (7).

Motor vehicle crashes result in substantial mortality and years of potential life lost. This study shows that the nonfatal injury burden is also high. For each motor vehicle occupant killed in a crash in 2012, eight were hospitalized, and 100 were treated and released from the ED. The estimated lifetime medical cost of nonfatal crash injuries is similar to other serious, but perhaps more well-known, public health problems. For example, the estimated lifetime medical cost of crash injuries is approximately 50% higher than the estimated $12.6 billion cost for human immunodeficiency virus (HIV) in the United States (8). On average, each crash-related ED visit costs $3,362, and each hospitalization costs $56,674. These nonfatal crash injury costs can create both an immediate and lifelong burden for individuals and their families, as well as employers, and public and private health care payers. Although these are lifetime medical costs, the majority of medical costs (approximately 75%–90%) are estimated to occur in the first 18 months after the crash (5). In addition to the burden of medical costs, crash injuries cause a substantial lost lifetime productivity valued at $32.9 billion.

Teens and young adults aged 15–29 years accounted for a disproportionate share of the burden, comprising 21% of the population but accounting for 38% of both the treated and released visits and costs in this analysis. Other studies have shown that this age group has a higher prevalence of risk factors for crash injuries. In 2012, teens and young adults aged 16–24 years had the lowest prevalence of observed restraint use (80%) compared with all other age groups (87%–88%) (9). In 2010, adults aged 21–24 years and 25–34 years had the highest self-reported prevalence of driving after having had...
too much to drink (3.6% and 2.6%, respectively) compared with adults aged 18–20 years (2.2%) and adults aged ≥35 years (0.8%–1.9%) (10).

Older adults in this study were more likely to be hospitalized for a crash injury compared with other age groups. Increased frailty, rather than increased risk for crash involvement, likely accounts for the majority of increased fatality risks for adults aged ≥60 years (11), and might explain the increased proportion of ED visits that result in hospitalization among this age group.

Analyses of risk factors such as nonuse of restraints, alcohol use, and geographic location were not possible in this study. Although the Fatality Analysis Reporting System (derived from police reports) has national and state-level information on motor vehicle crash fatalities, including factors contributing to the crash, no single data source exists for risk factors and associated medical outcomes for nonfatal crash injuries. Also, the completeness of external cause-of-injury coding in existing state-based hospital discharge and ED data systems varies, making it difficult to monitor and assess motor vehicle crash injuries treated in hospitals in some state and local jurisdictions (12,13).

The findings in this report are subject to at least four limitations. First, NEISS-AIP and HCUP-NIS use different data collection methods and thus report different estimates of the number of crash injuries. NEISS-AIP data were used to present national estimates of crash injury rates because this system focuses on injury-related visits to EDs, where most crash injuries are initially treated. Second, work-related crashes might not have been identified consistently and could be undercounted.

### TABLE 2. Average and total costs of emergency department visits for nonfatal crash injuries among motor vehicle occupants, by age group, sex, and disposition — National Electronic Injury Surveillance System, United States, 2012

| Age group and sex | Treated and released | Hospitalized |
|-------------------|----------------------|--------------|
|                   | No. of visits |
| 0–14 yrs | 160,810 | 8,315 |
| 15–29 yrs | 877,366 | 60,737 |
| 30–39 yrs | 407,260 | 23,556 |
| 40–49 yrs | 341,140 | 23,608 |
| 50–59 yrs | 275,930 | 25,548 |
| 60–69 yrs | 146,687 | 18,813 |
| 70–79 yrs | 63,970 | 13,515 |
| ≥80 yrs | 29,035 | 14,648 |
| All ages | 2,302,207 | 188,833 |
| No. of visits | Average cost ($) | Total cost ($) | No. of visits | Average cost ($) | Total cost ($) |
| Total | 3,370 | 541,913,000 | 8,315 | 529,983,000 |
| Female | 3,427 | 308,311,000 | 4,241 | 262,641,000 |
| Male | 3,244 | 233,602,000 | 4,074 | 267,342,000 |
| Total | 3,386 | 2,971,125,000 | 60,737 | 3,536,130,000 |
| Female | 3,278 | 1,654,612,000 | 25,042 | 1,222,416,000 |
| Male | 3,534 | 1,316,513,000 | 35,696 | 2,313,714,000 |
| Total | 3,339 | 1,319,055,000 | 23,556 | 1,335,693,000 |
| Female | 3,020 | 694,399,000 | 10,169 | 519,593,000 |
| Male | 3,523 | 624,656,000 | 13,387 | 816,100,000 |
| Total | 3,311 | 1,129,637,000 | 23,608 | 1,260,796,000 |
| Female | 3,106 | 596,617,000 | 9,628 | 510,886,000 |
| Male | 3,575 | 533,020,000 | 13,980 | 749,910,000 |
| Total | 3,315 | 914,703,000 | 25,548 | 1,370,351,000 |
| Female | 3,178 | 498,816,000 | 10,839 | 561,529,000 |
| Male | 3,495 | 415,887,000 | 14,710 | 808,822,000 |
| Total | 3,507 | 514,419,000 | 18,813 | 1,041,821,000 |
| Female | 3,593 | 306,085,000 | 9,170 | 441,218,000 |
| Male | 3,388 | 208,334,000 | 9,644 | 600,603,000 |
| Total | 3,783 | 241,970,000 | 13,515 | 797,531,000 |
| Female | 3,866 | 146,392,000 | 7,900 | 422,114,000 |
| Male | 3,661 | 95,578,000 | 5,615 | 375,417,000 |
| Total | 3,679 | 106,829,000 | 14,648 | 821,795,000 |
| Female | 3,754 | 65,924,000 | 8,783 | 458,391,000 |
| Male | 3,565 | 40,905,000 | 5,866 | 363,404,000 |
| Total | 3,626 | 7,739,677,000 | 188,833 | 10,701,947,000 |
| Female | 3,253 | 4,271,182,000 | 85,794 | 4,399,393,000 |
| Male | 3,507 | 3,468,495,000 | 103,039 | 6,302,554,000 |

* Costs are in 2012 U.S. dollars.
† National estimates based on weighted data from the National Electronic Injury Surveillance System – All Injury Program.
§ Totals include visits with unknown age and/or unknown sex. Estimates might not add up to total because of rounding.
Third, the lifetime medical cost estimates presented in this report did not include medical costs among patients that left against medical advice or were kept for observation without hospital admission; however, only 1% of the NEISS-AIP sample fell into this category. Finally, the cost estimates represent less than the full identifiable economic burden because this report does not include costs such as property damage.

This analysis suggests that states, employers, and individuals can avert substantial medical costs by adopting safety practices and policies shown to protect motor vehicle occupants. Primary seatbelt laws, child passenger restraint laws, ignition interlocks to prevent alcohol impaired driving, publicized sobriety checkpoints, and graduated driver licensing systems for teens all have shown effectiveness to reduce crash injuries and fatalities. To date, no state has implemented all of these safety measures in accordance with evidence and expert recommendation.

- **Additional information is available at [http://www.cdc.gov/vitalsigns](http://www.cdc.gov/vitalsigns).**

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