



Human and Ecological Risk Assessment: An International Journal

Publication details, including instructions for authors and subscription information:

<http://www.tandfonline.com/loi/bher20>

Work-Related and Non-Work-Related Injury Deaths in the U.S.: A Comparative Study

Guang-Xiang Chen ^a , E. Lynn Jenkins ^a , Suzanne M. Marsh ^a & Janet J. Johnston ^a

^a National Institute for Occupational Safety and Health, Division of Safety Research, 1095 Willowdale Road, MS/H-1811, Morgan town, West Virginia 26505; Tel (voice): 304-285-5995, Tel(fax): 304-285-6235; gchen@cdc.gov

Published online: 03 Jun 2010.

To cite this article: Guang-Xiang Chen , E. Lynn Jenkins , Suzanne M. Marsh & Janet J. Johnston (2001) Work-Related and Non-Work-Related Injury Deaths in the U.S.: A Comparative Study, Human and Ecological Risk Assessment: An International Journal, 7:7, 1859-1868, DOI: [10.1080/20018091095447](https://doi.org/10.1080/20018091095447)

To link to this article: <http://dx.doi.org/10.1080/20018091095447>

PLEASE SCROLL DOWN FOR ARTICLE

Taylor & Francis makes every effort to ensure the accuracy of all the information (the "Content") contained in the publications on our platform. However, Taylor & Francis, our agents, and our licensors make no representations or warranties whatsoever as to the accuracy, completeness, or suitability for any purpose of the Content. Any opinions and views expressed in this publication are the opinions and views of the authors, and are not the views of or endorsed by Taylor & Francis. The accuracy of the Content should not be relied upon and should be independently verified with primary sources of information. Taylor and Francis shall not be liable for any losses, actions, claims, proceedings, demands, costs, expenses, damages, and other liabilities whatsoever or howsoever caused arising directly or indirectly in connection with, in relation to or arising out of the use of the Content.

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden. Terms & Conditions of access and use can be found at <http://www.tandfonline.com/page/terms-and-conditions>

Work-Related and Non-Work-Related Injury Deaths in the U.S.: A Comparative Study

Guang-Xiang Chen,^{1,2} E. Lynn Jenkins, Suzanne M. Marsh, and Janet J. Johnston
National Institute for Occupational Safety and Health, Division of Safety Research, 1095 Willowdale Road, MS/H-1811, Morgantown, West Virginia 26505; Tel(voice): 304-285-5995, Tel(fax): 304-285-6235; gchen@cdc.gov

ABSTRACT

This study assesses the percentage of traumatic fatalities attributable to work-related causes in the US, by cause of death and population demographics. The 1993-1998 Vital Statistics Mortality data from the National Center for Health Statistics were used. There were 848,945 traumatic fatalities (E800-E999) among the general population 16 years or older in the US during this time; of these, 32,044 were work-related accounting for 3.8% of all the fatalities. The work-related percentage varied from 62.7% for machine-related deaths to 0.7% for suicides, from 4.9% for males to 1.0% for females, from 9.8% in Alaska to 1.5% in Arizona, from 4.2% for decedents with 1 to 4 year college educations to 2.9% for decedents with high school or less, from 4.4% for races other than white and black to 2.6% for black. Mean age-at-death was 42 years for work-related vs. 48 years for non-work-related fatalities. This difference is more pronounced for deaths from falls (45 years vs. 78 years). Conversely, victims of work-related homicide were older than non-work-related (41 years vs. 33 years). A more complete understanding of the burden of traumatic fatalities attributable to work-related causes requires consideration of the total work-related percentage, causes of death, and population demographics.

Key Words: injury mortality, fatality, occupational injury mortality, mortality surveillance, etiologic fraction.

INTRODUCTION

Work-related diseases and injuries have killed people from the beginning of history, although few studies have assessed the work-related share of disease and injury mortality at a national level. Hernberg (2001) stated, "This deficiency is understandable, since the task is heroic. Very often crucial data are lacking, either because work-related mortality has not been studied at all or because the quality of the studies available is poor." This

1 Corresponding author.

2 This manuscript is considered a work of the U.S. Government and is therefore not copyrighted.

question is so important that the *Scandinavian Journal of Work, Environment, and Health* devoted an entire issue to a study (Nurminen and Karjalainen 2001) that tried to assess the work-related percentage of disease and injury mortality in Finland in 1996. While it is difficult to assess work-related shares of disease mortality, it is relatively easier to assess work-related shares of injury mortality. Such opportunity exists in the United States. In the US, there are three national surveillance data sets that contain information on work-related injury deaths. These are the Census of Fatal Occupational Injury (CFOI) (Toscano and Windau 1998; BLS 2001), the National Traumatic Occupational Fatalities (NTOF) surveillance system (Bell *et al.* 1990; Jenkins *et al.* 1993), and the Vital Statistics Mortality (VSM) data (NCHS 2001). VSM contains all reported deaths in the US, including all disease and injury deaths. Differences and similarities between CFOI and NTOF were well discussed in previous studies (Marsh and Layne 2001; CDC 1998; Myers *et al.* 1998; Chen and Fosbroke 1998). Both NTOF and VSM are death certificate-based data systems. However, NTOF is unique in that the data contain narrative information from death certificates for the injury descriptions and the immediate, underlying, and contributory causes of death. NTOF also contains codes for industry and occupation (Fosbroke *et al.* 1997), but only work-related deaths are included. For the purpose of identifying both work-related and non-work-related injury deaths, this study used VSM data to assess work-related percentages of all traumatic fatalities in the United States during a six-year period from 1993 to 1998.

METHODS

In this study, injury deaths were drawn from the National Center for Health Statistics (NCHS) Vital Statistics Mortality data from all 50 states, the District of Columbia, and New York City. Decedents aged 16 years or older who died in the US from 1993 to 1998 with the "underlying cause of death" coded as "external" were included in the study. The "external" causes are defined based on the International Classification of Diseases, Ninth Revision, External Causes of Injury and Poisoning codes (ICD-9 E-codes, from E800 to E999) (WHO 1977). Work-related injury deaths in this study were identified by the "injury at work?" item on the death certificate. The Operational Guidelines for Determination of Injury at Work were developed jointly by the Association for Vital Records and Health Statistics, the National Institute for Occupational Safety and Health (NIOSH), the National Center for Health Statistics, and the National Center for Environmental Health and Injury Control (Jenkins *et al.* 1993). In general, a work-related injury death was defined as any injury death sustained while: (1) performing work for compensation, (2) performing volunteer work for an organized group, or (3) performing work on a farm. Injuries during commuting to or from a work site are not counted as work related.

The work-related percentage of all injury deaths is calculated as the number of work-related injury deaths over the number of all injury deaths (includes both work and non-work-related deaths) $\times 100\%$. Work-related percentages were calculated by cause of death, gender, sex, race, education, and state.

RESULTS

Overall, 3.8% of all traumatic fatalities among the general population 16 years or older in the US were attributed to injuries at work. But work-related percentages

Work-Related and Non-Work-Related U.S. Fatal Injuries

varied: (1) by cause of death from 62.7% of machine-related deaths to 0.7% suicides and intent undetermined (see Table 1); (2) by state from 9.8% in Alaska to 1.5% in Arizona (see Table 2.); (3) by county population size from 4.7% (county of population less than 100,000) to 3.4% (county population of 100,000 and more) (see Table 3.); (4) by gender from 4.9% in male to 1.0% in female; (5) by education level from 4.2% (1 to 4 year college education) to 2.9% (high school or less); (6) by age-group from 6.4% among decedents 46 to 65 years old to 1.1% among decedents more than 65 years old; and (7) by race from 4.4% (races other than white and black) to 2.6% (black). In general, mean age-at-death was younger in work-related than non-work-related traumatic fatalities (42 years for work-related deaths vs. 48 years for non-work-related deaths) (see Table 4.). This difference is more pronounced for deaths from falls, suffocation, natural/environmental exposure, and machine-related injuries; for example, 78.6% of non-work-related fall deaths occurred to persons aged 70 years or older, while only 7.4% of work-related fall deaths occurred to persons in that age group. Conversely, for homicide deaths, work-related cases were older than non-work-related. Decedents 16 to 19 years of age accounted for 49.3% of non-work-related homicide deaths, while decedents of the same age group accounted for 22.9% of work-related homicide deaths.

Table 1. Work-related and non-work-related injury deaths by cause of death.

| Cause of death categories (ICD-9) | Non-work-related | | Work-related | | Work-related percentage ^a |
|--|------------------|-------|--------------|-------|--------------------------------------|
| | N | % | N | % | |
| Machine (E919) | 2118 | 0.3 | 3558 | 11.1 | 62.7 |
| Electrocution (E925) | 1370 | 0.2 | 1644 | 5.1 | 54.5 |
| Explosion (E921, E923) | 502 | 0.1 | 591 | 1.8 | 54.1 |
| Struck by falling objects (E916) | 2148 | 0.3 | 1793 | 5.6 | 45.5 |
| Struck by flying objects/caught in (E917-E918) | 1017 | 0.1 | 629 | 2.0 | 38.2 |
| Air transport (E840-E845) | 4053 | 0.5 | 1267 | 4.0 | 23.8 |
| Water transport (E830-E838) | 3731 | 0.5 | 449 | 1.4 | 10.7 |
| Railway transport (E800-E807) | 3074 | 0.4 | 216 | 0.7 | 6.6 |
| Homicide (E960-E969) | 116391 | 14.2 | 5016 | 15.7 | 4.1 |
| Falls (E880-E888) | 83140 | 10.2 | 3468 | 10.8 | 4.0 |
| Nature/Environment (E900-E909, E928) | 24066 | 2.9 | 991 | 3.1 | 4.0 |
| Motor vehicles (E810-E829, E846-E848) | 231924 | 28.4 | 8353 | 26.1 | 3.5 |
| Drowning (E910) | 15488 | 1.9 | 479 | 1.5 | 3.0 |
| Suffocation (E911-E913) | 21286 | 2.6 | 544 | 1.7 | 2.5 |
| Fire (E890-E899) | 16741 | 2.0 | 396 | 1.2 | 2.3 |
| Other incidents | 33049 | 4.0 | 657 | 2.1 | 1.9 |
| Poisoning (E850-E869) | 55982 | 6.9 | 496 | 1.5 | 0.9 |
| Suicide (E950-E959) | 181113 | 22.2 | 1366 | 4.3 | 0.7 |
| Intent undetermined (E980-E989) | 19708 | 2.4 | 131 | 0.4 | 0.7 |
| All causes of injury (E800-E999) | 816901 | 100.0 | 32044 | 100.0 | 3.8 |

^a Work-related percentage=(Number of work-related injury deaths/number of all injury deaths) X 100%.

Table 2. Work-related and non-work-related injury deaths by state.

| State | Non-work-related | | Work-related | | Work-related percentage ^a |
|---------------|------------------|------|--------------|------|--------------------------------------|
| | N | % | N | % | |
| Alabama | 17974 | 2.2 | 684 | 2.1 | 3.7 |
| Alaska | 2505 | 0.3 | 271 | 0.8 | 9.8 |
| Arizona | 18687 | 2.3 | 283 | 0.9 | 1.5 |
| Arkansas | 9792 | 1.2 | 498 | 1.6 | 4.8 |
| California | 89298 | 10.9 | 3352 | 10.5 | 3.6 |
| Colorado | 12759 | 1.6 | 508 | 1.6 | 3.8 |
| Connecticut | 8335 | 1.0 | 174 | 0.5 | 2.0 |
| D.C. | 3847 | 0.5 | 109 | 0.3 | 2.8 |
| Delaware | 2153 | 0.3 | 74 | 0.2 | 3.3 |
| Florida | 49174 | 6.0 | 2028 | 6.3 | 4.0 |
| Georgia | 24721 | 3.0 | 1230 | 3.8 | 4.7 |
| Hawaii | 3223 | 0.4 | 96 | 0.3 | 2.9 |
| Idaho | 3997 | 0.5 | 302 | 0.9 | 7.0 |
| Illinois | 32282 | 4.0 | 1153 | 3.6 | 3.4 |
| Indiana | 17679 | 2.2 | 712 | 2.2 | 3.9 |
| Iowa | 7891 | 1.0 | 400 | 1.2 | 4.8 |
| Kansas | 7822 | 1.0 | 407 | 1.3 | 4.9 |
| Kentucky | 13350 | 1.6 | 697 | 2.2 | 5.0 |
| Louisiana | 17278 | 2.1 | 979 | 3.1 | 5.4 |
| Maine | 3466 | 0.4 | 99 | 0.3 | 2.8 |
| Maryland | 16114 | 2.0 | 408 | 1.3 | 2.5 |
| Massachusetts | 13195 | 1.6 | 310 | 1.0 | 2.3 |
| Michigan | 27175 | 3.3 | 849 | 2.6 | 3.0 |
| Minnesota | 12610 | 1.5 | 428 | 1.3 | 3.3 |
| Mississippi | 12209 | 1.5 | 617 | 1.9 | 4.8 |
| Missouri | 20259 | 2.5 | 777 | 2.4 | 3.7 |
| Montana | 3551 | 0.4 | 214 | 0.7 | 5.7 |
| Nebraska | 4715 | 0.6 | 329 | 1.0 | 6.5 |
| Nevada | 7212 | 0.9 | 319 | 1.0 | 4.2 |
| New Jersey | 17829 | 2.2 | 560 | 1.7 | 3.0 |
| New York | 43486 | 5.3 | 1633 | 5.1 | 3.6 |
| New Mexico | 8112 | 1.0 | 312 | 1.0 | 3.7 |
| New Hampshire | 2659 | 0.3 | 91 | 0.3 | 3.3 |
| North Dakota | 1898 | 0.2 | 136 | 0.4 | 6.7 |

Work-Related and Non-Work-Related U.S. Fatal Injuries

Table 2. (continued)

| | | | | | |
|----------------|-------|-----|------|-----|-----|
| North Carolina | 25888 | 3.2 | 1051 | 3.3 | 3.9 |
| Ohio | 27055 | 3.3 | 823 | 2.6 | 3.0 |
| Oklahoma | 12203 | 1.5 | 526 | 1.6 | 4.1 |
| Oregon | 11189 | 1.4 | 462 | 1.4 | 4.0 |
| Pennsylvania | 37510 | 4.6 | 1323 | 4.1 | 3.4 |
| Rhode Island | 2226 | 0.3 | 69 | 0.2 | 3.0 |
| South Dakota | 2428 | 0.3 | 160 | 0.5 | 6.2 |
| South Carolina | 13496 | 1.7 | 581 | 1.8 | 4.1 |
| Tennessee | 22474 | 2.8 | 734 | 2.3 | 3.2 |
| Texas | 58958 | 7.2 | 2690 | 8.4 | 4.4 |
| Utah | 5965 | 0.7 | 359 | 1.1 | 5.7 |
| Vermont | 1689 | 0.2 | 55 | 0.2 | 3.2 |
| Virginia | 19538 | 2.4 | 635 | 2.0 | 3.1 |
| Washington | 15984 | 2.0 | 610 | 1.9 | 3.7 |
| West Virginia | 6449 | 0.8 | 339 | 1.1 | 5.0 |
| Wisconsin | 14629 | 1.8 | 426 | 1.3 | 2.8 |
| Wyoming | 1966 | 0.2 | 162 | 0.5 | 7.6 |

^a Work-related percentage=(Number of work-related injury deaths/number of all injury deaths) X 100%.

Leading causes of death for non-work-related fatalities were motor vehicle crashes, suicides, homicides, and falls. Leading causes of death for work-related fatalities were motor vehicle crashes, homicides, machinery-related incidents, and falls. Injury events and sources of work-related fatalities differed from overall fatalities within the same cause of death. Motor vehicle crashes in the workplace were more likely to be non-traffic related and more likely to involve pedestrians, compared with those outside the workplace. The major cause of poisoning deaths outside the workplace was drug related, while the major cause of poisoning in the workplace was other substance related. The common causes of falls in the workplace were falls from ladders or scaffolding and falls from buildings or other structures, while the common causes of falls outside the workplace were falls from stairs or steps and other falls from one level to another (mostly falls from chair and bed—E884.2).

DISCUSSION

This is the first report on work-related percentages of all injury mortality by cause of death and population demographics at the national level in the United States. The overall work-related share of all injury mortality—3.8%, which is reported in this study, likely understates the significance and important impact of work-related injury mortality. There are several important issues relevant to the interpretation of these findings. Death certificates under-report work-related injury deaths. Death certificates capture an average of 81% of all work-related injuries (Stout and Bell 1991; Russell and Conroy 1991). Work-related percentages were higher than the overall 3.8% in certain population demographics, such as those 26 to 65 years of age, males, whites, and people of races other than white and black. Work-related percent-

Table 3. Work-related and non-work-related injury deaths by year, county population size, gender, race, and age group.

| Population demographics | Non-work-related | | Work-related | | Work-related percentage ^a |
|-------------------------|------------------|------|--------------|------|--------------------------------------|
| | N | % | N | % | |
| Year | | | | | |
| 1993 | 135854 | 16.6 | 5385 | 16.8 | 3.8 |
| 1994 | 135683 | 16.6 | 5542 | 17.3 | 3.9 |
| 1995 | 136063 | 16.7 | 5396 | 16.8 | 3.8 |
| 1996 | 136068 | 16.7 | 5381 | 16.8 | 3.8 |
| 1997 | 136072 | 16.7 | 5243 | 16.4 | 3.7 |
| 1998 | 137161 | 16.8 | 5097 | 15.9 | 3.6 |
| County Population Size | | | | | |
| less than 100,000 | 240899 | 29.5 | 11887 | 37.1 | 4.7 |
| 100,000 or more | 576002 | 70.5 | 20157 | 62.9 | 3.4 |
| Gender | | | | | |
| Male | 573595 | 70.2 | 29510 | 92.1 | 4.9 |
| Female | 243306 | 29.8 | 2534 | 7.9 | 1.0 |
| Race | | | | | |
| White | 654081 | 80.1 | 27280 | 85.1 | 4.0 |
| Black | 138905 | 17.0 | 3676 | 11.5 | 2.6 |
| Others | 23915 | 2.9 | 1088 | 3.4 | 4.4 |
| Age group (in years) | | | | | |
| 16-19 | 61676 | 7.5 | 863 | 2.7 | 1.4 |
| 20-29 | 154176 | 18.9 | 5936 | 18.5 | 3.7 |
| 30-39 | 154226 | 18.9 | 8017 | 25.0 | 4.9 |
| 40-49 | 124214 | 15.2 | 7522 | 23.5 | 5.7 |
| 50-59 | 71160 | 8.7 | 5248 | 16.4 | 6.9 |
| 60-69 | 62272 | 7.6 | 2863 | 8.9 | 4.4 |
| 70-75 | 79923 | 9.8 | 1243 | 3.9 | 1.5 |
| 76+ | 109254 | 13.4 | 352 | 1.1 | 0.3 |
| Education | | | | | |
| High school or less | 232302 | 28.4 | 6839 | 21.3 | 2.9 |
| 1-4 year college | 476989 | 58.4 | 21123 | 65.9 | 4.2 |
| Graduate school | 30255 | 3.7 | 1025 | 3.2 | 3.3 |
| Not recorded | 77355 | 9.5 | 3057 | 9.5 | 3.8 |

^a Work-related percentage=(Number of work-related injury deaths/number of all injury deaths) X 100%.

ages were also higher than 3.8% in half of the 50 states. The mean age-at-death is younger in work-related injury deaths than in non-work-related injury deaths, so on average more potential years of life lost result from a work-related fatality than from a non-work-related fatality (Gilbert *et al.* 1998), demonstrating a disproportionate impact on people of working age who are the nation's productive work force and income earners for their families. Some injury deaths in non-workplace settings may also have been influenced by work-related factors, such as suicides and injuries occurring during commuting to or from a work site. The percentages presented

Table 4. Mean age-at-death for work-related and non work-related injury death by cause of death.

| Cause of death categories (ICD-9) | Mean age-at-death (in years) | |
|--|------------------------------|--------------|
| | Non-work-related | Work-related |
| Machine (E919) | 60 | 48 |
| Electrocution (E925) | 42 | 34 |
| Explosion (E921, E923) | 50 | 37 |
| Struck by falling objects (E916) | 51 | 43 |
| Struck by flying objects/caught in (E917-E918) | 50 | 42 |
| Air transport (E840-E845) | 45 | 39 |
| Water transport (E830-E838) | 41 | 38 |
| Railway transport (E800-E807) | 38 | 47 |
| Homicide (E960-E969) | 33 | 41 |
| Falls (E880-E888) | 78 | 45 |
| Nature/Environment (E900-E909, E928) | 66 | 44 |
| Motor vehicles (E810-E829, E846-E848) | 43 | 43 |
| Drowning (E910) | 41 | 38 |
| Suffocation (E911-E913) | 70 | 41 |
| Fire (E890-E899) | 57 | 43 |
| Other incidents | 59 | 47 |
| Poisoning (E850-E869) | 41 | 40 |
| Suicide (E950-E959) | 45 | 43 |
| Intent undetermined (E980-E989) | 41 | 40 |
| All causes of injury (E800-E999) | 48 | 42 |

here are for injury mortality only. The percentage might be different for injury morbidity (McCaig *et al.* 1998). Finally, it is worth noting that the 3.8% identified in this study is close to the 3% identified in the Finnish Study (Nurminen and Karjalainen 2001). The United States and Finland are well-developed countries; the percentage would likely be much higher in less developed countries (Stout *et al.* 1990; Leigh *et al.* 1999).

Assessments of the burden of traumatic fatalities attributable to work-related causes are needed to plan the allocation of resources for injury research and prevention (Coggon 2001). But the most appropriate way to allocate resources may not be simply based on the total percentage of work-related versus non-work-related deaths. A more complete understanding of the role of work-related issues in injury deaths requires consideration of specific factors, such as, causes of death, population demographics (age, race, location, etc.), and social and economic impacts (Leigh *et al.* 1997).

Opportunities for prevention are an important reason for examining the work-related percentage of all injury deaths. Modern workplace safety legislation and resulting changes in safety management practices have demonstrated that workplaces are relatively more controllable than non-work environments. Safety hazards are relatively easier to predict and control in the workplace than in non-work environments. The preventability has been supported by the encouraging fact that

during the past two decades (from 1980 to 1998), the number of work-related injuries decreased (CDC 1998), while the number of non-work-related injury fatalities did not change much (NCHS 2001). Although the number of work-related injury deaths in 1998 was lower than it had been 20 years ago, at least 5097 workers were killed on the job that year. Thus, the modern workplace still poses a number of challenges in the area of occupational safety.

Fatalities may be grouped into three general categories: (1) fatalities that are common both in the workplace and non-workplace (*i.e.*, motor-vehicle crashes, homicides, and falls); (2) fatalities that are unique to the workplace (*i.e.*, machine-related deaths and electrocutions); and (3) fatalities that are common in non-workplace settings but not so common in the workplace (*i.e.*, suicides and poisonings). For fatalities common in both work and non-work places, prevention can be achieved through exchange of information about prevention strategies between workplace and non-workplace. For example, the policy of non-resistance during a robbery, which has been developed and used in the convenience store industry, is also applicable to the non-workplace (Faulkner *et al.* 1998). Workplaces provide unique opportunities to study injuries and prevention strategies in relatively controlled environments (CDC 1994). For example, collision warning system technologies, which are designed to help drivers avoid forward-moving collisions, are now being tested in the trucking industry (Woll 1998; NHTSA 1999). If demonstrated to be effective, such technologies could be introduced to passenger cars. For fatalities that are unique to the workplace, the Occupational Safety and Health Administration and NIOSH have developed regulations or recommendations for prevention (Pratt *et al.* 2001; NIOSH 2000; OSHA 2001). The National Center for Injury Prevention and Control (NCIPC) plays an important role in research and prevention of fatalities that are common in non-workplace settings (NCIPC 2001). NCIPC conducts research on a range of non-occupational injury issues and funds a network of academic-based injury prevention and control research centers.

This paper describes work-related fractions of overall traumatic fatalities: the number of work-related injury deaths divided by the number of work-related and non-work-related injury deaths. The percentage is an etiologic fraction or attributable risk (Kleinbaum *et al.* 1982). It is different from the proportionate mortality ratio (Chen *et al.* 2000). The work-related percentage was higher for persons with a college education than for persons with less than a college education. This suggests that persons with a college education who died from an injury were more likely to have died at work than less educated persons. This could be a reflection that persons with a college education had a higher prevalence of employment than less educated persons. It could also be a reflection of higher educated persons living in safer communities, having safer overall life styles, and thus having fewer non-work-related injury deaths. This study did not have information on employment, life style or community of the decedents.

A more complete understanding of the burden of traumatic fatalities attributable to work-related causes requires consideration of the total work-related percentage as well as specific factors, such as, causes of death, population demographics (age, race, location, etc.), and social and economic impacts. This study was unable to assess the burden by occupation and industry because the VSM data do not include this information for all states. This study also did not calculate rates for work-related

Work-Related and Non-Work-Related U.S. Fatal Injuries

and non-work-related fatal injuries. Such analyses would be useful to identify potential risk factors and populations at differential risk of work-related or non-work-related fatal injuries.

ACKNOWLEDGMENTS

We are grateful to Pat Cutlip for her assistance in preparing the VSM data and to Dr. Terry Wassell for his valuable comments.

REFERENCES

Bell CA, Stout NA, Bender TR, *et al.* 1990. Fatal occupational injuries in the United States, 1980 through 1985. *J Am Med Assoc* 236:3047-50

BLS (Bureau of Labor Statistics). 2001. Resources for information on Census of Fatal Occupational Injuries. Available at <http://www.bls.gov/oshcfo1.htm?H6>

CDC (Centers for Disease Control and Prevention). 1994. Occupational injury deaths — United States, 1980-1989. *MMWR* 43:262-4

CDC (Centers for Disease Control and Prevention). 1998. Fatal occupational injuries — United States, 1980-1994. *MMWR* 47:297-302

Chen GX and Fosbroke DE. 1998. Work-related fatal injury risk of construction workers by occupation and cause of death. *Human and Ecological Risk Assessment* 4(6):1371-90

Chen GX, Johnston JJ, Alterman T, *et al.* 2000. Expanded analysis of injury mortality among unionized construction workers. *Am J Industrial Medicine* 37:364-73

Coggon D. 2001. Mortality attributable to work. *Scand J Work Environ Health* 27:214-5

Faulkner KA, Landsittel DP, and Hendricks SA. 1998. Robbery-related injuries in convenience stores: Estimating lifetime risk and identifying high-risk populations. *Human Ecol Risk Assess* 4(6):1391-408

Fosbroke DE, Kisner SM, and Myers JR. 1997. Working lifetime risk of occupational fatal injury. *Am J Indust Med* 31:459-67

Gilbert SJ, Bailer AJ, and Stayner LT. 1998. Years of potential life lost due to occupational fatal injury in the United States. *Human and Ecological Risk Assessment* 4(6):1321-35

Hernberg S. 2001. Work-related factors and mortality— what is the burden?. *Scand J Work Environ Health* 27:157-160

Kleinbaum DG, Kupper LL, and Morgenstern H. 1982. Epidemiologic Research, pp 159-64. Lifetime Learning Publication, Belmont, CA, USA

Jenkins EL, Kisner SM, Fosbroke DE, *et al.* 1993. Fatal Injuries to Workers in the United States, 1980-1989: A Decade of Surveillance: National Profile. DHHS (NIOSH) Publication No. 93-108S. U.S. Government Printing Office, Washington, DC, USA

Leigh JP, Markowitz SB, Fahs M, *et al.* 1997. Occupational injury and illness in the United States. Estimate of cost, morbidity, and mortality. *Arch Intern Med* 157:1557-68

Leigh J, Macaskill P, Kuosma E, *et al.* 1999. Global burden of disease and injury due to occupational factors. *Epidemiology* 10:626-31

Marsh SM and, Layne LA. 2001. Fatal Injuries to Civilian Workers in the United States, 1980-1995 (National Profile). DHHS (NIOSH) Publication No. 2001-129,. U.S. Government Printing Office, Washington, DC, USA

McCaig LF, Burt CW, and Stussman BJ. 1998. A comparison of work-related injury visits and other injury visits to emergency departments in the United States, 1995-1996. *J Occup Environ Med* 40(10):870-5

Myers JR, Kisner SM, and Fosbroke DE. 1998. Lifetime risk of fatal occupational injuries within industries, by occupation, gender, and race. *Human Ecol Risk Assess* 4(6):1291-307

NCHS (National Center for Health Statistics). 2001. Resources for Information on Vital Statistics Mortality data. Available at <http://www.cdc.gov/nchs/about/major/dvs/mortdata.htm>

NCIPC (National Center for Injury Prevention and Control). 2001. Resources for Information on Prevention of Non-Work-Related Injuries. Available at <http://www.cdc.gov/ncipc/ncipchm.htm>

NHTSA (National Highway Traffic Safety Administration). 1999. Evaluation of the Intelligent Cruise Control System Volume1– Study Results. DOT-VNTSC-NHTSA-98-3, DOT-HS 808 969. Springfield, VA, USA

NIOSH (National Institute for Occupational Safety and Health). 2000. NIOSH Alert: Preventing Needlestick Injuries in Health Care Settings. DHHS (NIOSH) Publication No. 2000-108. Cincinnati, OH, USA

Nurminen M, Karjalainen A. 2001. Epidemiologic estimation of the proportion of fatalities related to occupational factors in Finland. *Scand J Work Environ Health* 27:161-213

OSHA (Occupational Safety and Health Administration). 2001. Resources on Information on Regulations on Preventing Occupational Injuries. Available at <http://www.osha.gov/comp-links.html>

Pratt SG, Fosbroke DE, and Marsh SM. 2001. Building Safer Highway Work Zones: Measures to Prevent Worker Injuries from Vehicles and Environment. DHHS (NIOSH) Publication No. 2001-128. Cincinnati, OH, USA

Russell J and Conroy C. 1991. Representativeness of deaths identified through the injury-at-work item on the death certificate: implication for surveillance. *Am J Public Health* 81:1613-8

Stout NA and Bell CA. 1991. Effectiveness of source documents for identifying fatal occupational injuries: A synthesis of studies. *Am J Public Health* 81:725-8

Stout NA, Frommer MS, and Harrison J. 1990. Comparison of work-related fatality surveillance in the USA and Australia. *J Occup Accidents* 13:195-211

Toscano GA and Windau JA. 1998. Profile of Fatal Work Injury in 1996. Compensation and Working Conditions. Spring 1998:37-45. Available at <http://www.bls.gov/special.requests/ocwc/oshwc/cfar0024.pdf>

WHO (World Health Organization). 1977. International Classification of Diseases: Manual on the International Statistical Classification of Diseases, Injuries, and Causes of Death. Ninth Revision. Geneva, Switzerland

Woll JD. 1998. Radar-based adaptive cruise control for trucks. *Automotive Engineering International* 106 (11):130-2