Occupational Injury Mortality Rates in the United States: Changes from 1980 to 1989

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ABSTRACT

Changes in occupational injury mortality rates over the 1980s were examined through analysis of the National Traumatic Occupational Fatalities surveillance system. The US occupational injury mortality rate decreased 37% over the decade, with decreases seen in nearly every demographic and employment sector. Greater declines were among men, Blacks, and younger workers, as well as among agricultural, trade, and service workers. Electrocutions, machine-related incidents, and homicides showed the greatest decreases. Changes in occupational mortality rates by demography, industry, and cause of death indicate the areas in which the most progress has been made and those that are prime targets for prevention efforts. (*Am J Public Health.* 1996;86:73–77)

Introduction

To identify worker groups that have experienced the greatest reduction in risk of death on the job and those for which occupational injury prevention efforts are most needed, this study examines changes in occupational injury mortality rates over the 1980s by demographic characteristics, industry, and cause of death.

Methods

The National Traumatic Occupational Fatalities surveillance system, a nationwide, death certificate–based census of deaths resulting from injuries at work, was the source of data for this study. Case subjects in the surveillance system meet the following criteria: 16 years of age or older, an external cause of death (*International Classification of Diseases* [ICD-9] code between E800 and E999),[1] and the injury-at-work item on the certificate marked "yes." Methods and details of this surveillance system have been well described.[2–4]

Because no single source of employment data provides information on demographic, geographic, and employment characteristics of workers, occupational mortality rates were computed with several different sources of denominator data. Rates for demographic characteristics (sex, race, age) were calculated with annual average employment data published by the Bureau of Labor Statistics from household surveys.[5] Rates for Standard Industrial Classification[6] industry sectors and cause-of-death groups[1,2] were computed with data from *County Business Patterns,*[7] supplemented with data from the Census of Agriculture for agricultural production[8] and from the Bureau of Labor Statistics household survey for public administration.[5] Military cases were excluded because comparable denominator data were lacking. All rates presented here are annual average rates per 100 000 civilian workers ([annual number of deaths/annual number employed] × 100 000). Percentage of change in rates from 1980 to 1989 are presented for demographic, employment, and cause-of-death groups. Rates for each characteristic by year are displayed in tables to facilitate assessment and interpretation of rate magnitude and differentials. Death certificates capture an average of 81% of fatal occupational injuries,[9] so both the numbers and the rates of deaths presented here are conservative.

Results

The number of fatal occupational injuries in the United States declined from about 7400 in 1980 to about 5700 in 1989—a 23% decrease (Figure 1). The fatality rate decreased 37%, from 8.9 in 1980 to 5.6 in 1989.

Throughout the decade, death rates for male, Black, and older workers were consistently higher than those for their counterparts. Rates decreased among all demographic groups, but they decreased more among Blacks, other races, and younger workers than among Whites and older workers (Table 1).

Rates in the four highest risk industries—mining (including oil and gas extraction); construction; transportation, communication, and public utilities; and agriculture, forestry, and fishing—were notably and consistently higher than rates in all other industries (Table 2). From 1980 to 1989, the rates declined in all industry sectors, with those in agriculture, forestry, and fishing; wholesale trade; retail trade; and services decreasing by more than the national average of 37%.

Six leading causes of death—motor vehicle incidents, machine-related injuries, homicides, falls, electrocutions, and being struck by falling objects—accounted for 72% of all occupational injury deaths. To better target injury prevention

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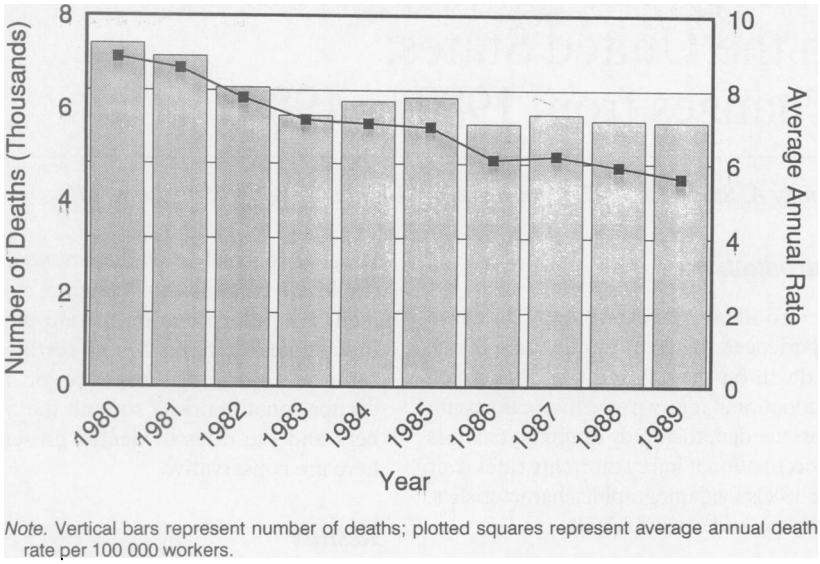
This paper was accepted May 9, 1995.



Note. Vertical bars represent number of deaths; plotted squares represent average annual death rate per 100 000 workers.

FIGURE 1—Number and rate of US occupational injury deaths, by year, 1980 through 1989.

efforts, we examined rate changes in the industry sectors with the highest rates for each of the leading causes of death. Table 3 shows the industry- and cause-specific fatality rates by year for the industry sectors that accounted for the greatest proportion of deaths within each of the six leading causes of death. Twenty-three percent of all fatal occupational injuries during the 1980s were the result of motor vehicle incidents, which also had the highest rates and the least decline during the 1980s.

Machines accounted for 13% of all work-related injury deaths during the 1980s, with 30% of these occurring in agriculture, forestry, and fishing. However, deaths due to machinery in this sector decreased 61% over the decade.

Homicide was the third leading cause of fatal occupational injuries, accounting for 12% of all work-related injury deaths. Two thirds of these homicides occurred in three industry sectors—retail trade, public administration (including law enforcement), and services. Retail trade, which accounted for more than one third of these deaths, experienced a 46% decrease in the rate of homicide over the decade.

Falls accounted for about 10% of fatal occupational injuries, and electrocutions accounted for 7%. Almost half of the falls and 40% of the electrocutions occurred in the construction industry. The rate of occupational electrocutions decreased more than that of any other leading cause of death.

More than 400 people were killed each year from being struck by falling objects at work. Most of these deaths (71%) were caused by trees, limbs, or logs falling and striking workers. About two thirds of these fatal injuries occurred in three industries: construction; agriculture, forestry, and fishing; and manufacturing (including logging and sawmill operations). The death rate for being struck by a falling object in the manufacturing industry is the only death rate among the leading causes and industries that increased during the decade.

Discussion

In nearly every demographic and employment sector of the US workforce, the rate at which workers were killed on the job decreased over the 1980s. Unfortunately, surveillance data cannot specify which of various factors contributed to this decline. Many changes have taken place in the workforce over the decade. In addition to changes in work practices and environments, including increased regulations and hazard awareness, other factors, such as new technology and mechanization, and changes in the economy, the industrial mix, and the distribution of the workforce, may also affect rates. For example, as employment shifts toward retail and service industries, which have inherently lower fatality rates, overall and demographic-specific fatality rates would be expected to decline. However, we also see declining industry-specific rates, which control for sectoral shifts, so it appears that workplaces are becoming safer, whether by design or by chance. Among the total US population, the rate of deaths from injury declined by 16% from 1980 to 1989,[10] compared with a 37% decrease in the work-related injury death rate. We must continue to monitor these trends and design studies that identify correlates and causal factors contributing to them.

This study provides data that are useful for the efficient targeting of prevention resources. Prevention of workplace injuries and deaths should capitalize on efforts both within and outside the occupational safety arena. For example, injury prevention measures that have been developed by public safety organizations are often applicable to, and have been implemented in, the workplace. Such measures include motor vehicle injury prevention efforts such as requiring seat belt use, providing vehicles with airbags and antilock brakes, and prohibiting alcohol or illicit drug use; educational campaigns designed to alert the public to safety hazards, such as efforts by power companies and other groups to warn the general population about the dangers of overhead power lines; and crime prevention efforts developed by the criminology community, which are applicable because the vast majority of workplace homicides are related to other crimes such as robbery. In fact, current studies of crime prevention through environmental design in retail settings show promise in the prevention of workplace homicide.[11–13] In short, efficientand successful occupational injury prevention programs should take advantage of prevention strategies developed for public safety.

At the same time, workplace deaths are often distinct from deaths from the same cause outside the workplace. In addition to obvious examples such as falls, machinery incidents, and electrocution hazards, work-related motor vehicle and homicide risks entail some distinct concerns. Issues specific to commercial vehicles, such as hours of operation, multiple-trailer rigs, and the effects of a universal commercial driver's license, are unique to work-related motor vehicle fatalities. Eighty-two percent of workplace homicides occur in conjunction with robberies or other crimes,[14] compared with only 13% of homicides in the general population.[15] Only 8% of the workplace homicide victims in 1992 were killed in a personal dispute that included co-workers, family members, or acquaintances,[14]

TABLE 1—US Occupational Injury Death Rates,[a] by Sex, Race, and Age, 1980 through 1989

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	% Change 1980–1989[b]
Sex											
Male	12.5	11.8	10.8	9.7	9.8	9.8	8.7	8.9	8.5	8.3	−33.6
Female	1.0	0.9	0.9	0.7	0.8	0.8	0.8	0.8	0.7	0.7	−30.0
Race											
White	7.4	7.0	6.4	5.7	5.8	5.7	5.1	5.1	4.9	4.8	−35.1
Black	9.3	8.0	7.3	6.4	6.2	6.7	5.7	6.1	5.1	5.4	−41.9
Other	7.0	6.0	5.7	5.5	5.0	5.7	4.0	4.4	4.1	3.9	−44.3
Age, y											
16–19	6.0	5.3	4.6	4.0	3.6	3.3	3.6	3.0	2.9	2.6	−56.7
20–24	7.9	7.3	6.3	5.4	5.7	5.3	4.5	4.7	4.4	4.0	−49.4
25–29	7.7	7.4	5.9	5.3	5.6	5.6	4.7	4.7	4.7	4.6	−40.3
30–34	6.6	6.8	6.0	5.2	5.3	5.3	4.9	4.8	4.6	4.6	−30.3
35–39	6.7	5.9	6.2	5.3	5.3	5.2	4.5	4.4	4.2	4.3	−35.8
40–44	6.7	6.2	5.4	5.7	5.2	5.7	4.9	4.7	4.6	4.3	−35.8
45–49	6.8	6.9	6.4	6.0	5.8	5.4	5.1	5.0	4.9	4.8	−29.4
50–54	7.7	7.7	7.0	6.0	6.2	6.1	5.8	5.5	5.3	5.3	−31.2
55–59	8.6	8.0	7.2	7.1	7.0	7.9	6.3	6.9	6.8	6.7	−22.1
60–64	9.7	9.5	8.2	7.2	7.7	7.7	6.9	8.4	7.2	6.9	−28.9
65+	17.4	16.2	15.7	13.7	14.6	14.1	13.3	15.2	13.7	12.7	−27.0

[a]Rates per 100 000 workers.
[b]For space consideration, rates are rounded to one decimal place; for accuracy, however, percentage of change was calculated from rates at two decimal places.

TABLE 2—US Occupational Injury Death Rates,[a] by Industry, 1980 through 1989

Industry	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	% Change 1980–1989[b]
Mining	41.4	44.4	28.8	27.0	37.7	29.9	26.0	26.2	23.9	27.0	−34.7
Construction	28.9	28.9	27.7	28.3	25.7	25.9	23.4	24.3	22.9	21.8	−24.8
Transportation/public utilities	29.3	27.8	25.0	22.6	24.7	24.6	21.1	19.8	20.3	19.3	−34.0
Agr/for/fish	26.9	25.1	21.9	19.1	19.2	19.3	15.8	15.5	13.9	13.3	−50.8
Public administration	7.7	7.5	6.9	7.6	6.9	6.4	6.2	6.8	6.1	5.3	−31.2
Manufacturing	4.8	4.6	4.5	4.3	4.5	4.3	4.2	4.4	4.2	4.1	−15.2
Retail trade	4.0	3.8	3.6	3.2	2.6	2.9	2.3	2.4	2.4	2.2	−43.8
Services	3.9	3.3	3.4	3.1	2.8	2.8	2.4	2.3	2.6	2.2	−42.5
Wholesale trade	3.2	3.0	2.5	2.7	2.2	2.2	2.0	2.1	2.3	1.7	−45.6
Finance/real estate	1.6	1.7	1.4	1.5	1.6	1.1	1.2	1.4	1.1	1.2	−25.2
All industries	8.9	8.6	7.8	7.2	7.1	7.0	6.1	6.2	5.9	5.6	−37.2

Note. Agr/for/fish = agriculture, forestry, and fishing.
[a]Rates per 100 000 workers.
[b]For space consideration, rates are rounded to one decimal place; for accuracy, however, percentage of change was calculated from rates at two decimal places.

whereas more than half of the homicide victims in the general population were killed by family members or acquaintances.[15]

The trends in fatality rates for these causes also differ between the general population and the workforce. In the general US population, the rate of motor vehicle deaths decreased about 17% to 18% from 1980 to 1989,[10,16] compared with a 28% decrease in work-related motor vehicle death rates. The rate of homicide among the general population decreased 13% from 1980 to 1989,[10] while the work-related homicide rate decreased 38%. However, homicide among the public has been increasing during the 1990s[10] and may be increasing in the workplace as well. Prevention of workplace deaths from these causes, which are often considered public safety concerns, must also consider the aspects unique to the workplace.

The workplace offers a valuable opportunity for implementing prevention efforts because it is a relatively controlled environment. Prevention efforts developed for and found to be effective in the workplace, such as rollover protective structures and machine guarding, may be applicable to other settings as well. The workplace can also serve as a controlled laboratory for assessing the effectiveness of injury prevention mechanisms.

For greatest effectiveness, occupational injury prevention programs should include a multifaceted approach, integrating education, enforcement, and engineering controls. Such an approach has been

TABLE 3—US Occupational Injury Death Rates,[a] by Cause of Death within Selected Industries, 1980 through 1989

Cause of Death/ Industry	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	% Change, 1980–1989[b]
Motor vehicles	2.0	1.9	1.6	1.7	1.8	1.6	1.4	1.4	1.5	1.4	−27.6
Transportation/public utilities	14.3	13.6	11.5	10.3	13.0	12.2	10.2	9.6	10.3	10.0	−30.3
Construction	3.8	3.8	3.0	4.7	4.6	3.5	3.2	3.6	3.6	3.6	−7.0
Agr/for/fish	3.6	3.5	3.4	2.9	3.1	3.2	2.6	2.6	2.3	2.3	−36.2
Manufacturing	0.7	0.6	0.5	0.6	0.7	0.6	0.5	0.6	0.7	0.7	−5.8
Machines	1.2	1.2	1.2	1.0	1.0	0.9	0.8	0.9	0.8	0.7	−38.1
Agr/for/fish	9.8	9.6	8.4	6.7	5.8	6.9	5.3	5.1	4.4	3.8	−61.4
Construction	3.6	4.1	3.9	4.0	3.4	3.6	3.2	3.5	2.9	3.1	−14.3
Manufacturing	0.9	0.8	0.9	0.9	0.8	0.7	0.9	0.9	0.8	0.9	−1.2
Homicides	1.1	1.1	1.0	0.9	0.8	0.8	0.7	0.7	0.7	0.7	−38.2
Retail trade	2.4	2.3	2.1	1.7	1.5	1.6	1.4	1.4	1.3	1.3	−45.6
Public administration	1.6	1.9	1.5	1.5	1.2	1.6	1.6	1.7	1.7	1.1	−31.1
Services	0.8	0.8	0.8	0.7	0.5	0.6	0.5	0.5	0.6	0.5	−42.9
Falls	0.9	0.8	0.7	0.7	0.7	0.7	0.6	0.6	0.6	0.5	−36.5
Construction	7.1	7.6	6.9	7.0	6.7	7.2	5.8	5.8	6.4	5.6	−21.1
Manufacturing	0.4	0.4	0.5	0.3	0.3	0.4	0.3	0.4	0.3	0.3	−33.3
Electrocutions	0.7	0.6	0.6	0.5	0.6	0.5	0.5	0.4	0.4	0.3	−54.3
Construction	4.8	4.6	4.9	4.5	4.3	3.4	4.1	3.5	3.4	2.9	−39.3
Agr/for/fish	2.4	1.7	1.4	1.4	1.5	1.1	1.0	1.0	0.8	0.5	−78.3
Transportation/public utilities	1.8	1.9	2.0	1.4	1.7	1.3	1.5	1.4	0.9	0.9	−51.4
Manufacturing	0.3	0.2	0.3	0.3	0.3	0.2	0.2	0.2	0.3	0.2	−41.9
Struck by object	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.4	−37.9
Construction	2.1	2.2	2.4	1.9	1.7	2.2	1.9	2.2	1.5	1.5	−27.4
Agr/for/fish	2.0	1.5	1.4	1.6	1.5	1.4	1.2	1.3	0.9	0.9	−57.6
Manufacturing	0.6	0.5	0.6	0.7	0.7	0.6	0.8	0.7	0.6	0.7	+13.8

Note. Agr/for/fish = agriculture, forestry, and fishing.
[a]Rates per 100 000 workers.
[b]For space consideration, rates are rounded to one decimal place; for accuracy, however, percentage of change was calculated from rates at two decimal places.

applied, for example, to the prevention of workplace electrocutions. During the 1980s, electrocutions became a primary emphasis of the National Institute for Occupational Safety and Health's injury prevention program, and changes to the National Electrical Code and to Occupational Safety and Health Administration regulations were implemented, as were public safety awareness campaigns by power companies and others. Deaths due to electrocution decreased more than any other cause of death to workers during this period. While it is unknown to what extent each of these and many other efforts and changes contributed to the decline in rates, the mix of education, enforcement, and engineering controls should be considered for effective injury prevention strategies.

Conclusions

Prior to the 1970s, the risk of death or serious injury was broadly tolerated and considered an acceptable risk of going to work. Today, however, workers are demanding safe and healthful working conditions, and employers are being held responsible for the safety of their employees. We must continue to challenge the common public perception that occupational injuries are random "accidents." Quite the contrary, most fatal occupational injuries are preventable. Employers and employees must take the responsibility of evaluating their workplaces and implementing appropriate measures to prevent injuries and deaths.

Although the rate of occupational fatalities decreased during the 1980s in nearly every demographic and employment sector of the US workforce, more than 5000 workers are still dying each year from work-related trauma. The data presented here provide a starting point for targeting prevention efforts toward the high-risk industries for the most prevalent causes of death. Effective occupational injury prevention programs will capitalize on efforts both within and outside the occupational safety arena, and will include an integrated approach of education, enforcement, and application of engineering controls. We must work together and continue to seek new approaches to protect American workers from injury and death at work. □

Acknowledgment

This paper was presented in part at the Annual Meeting of the American Public Health Association on October 27, 1993, in San Francisco, Calif.

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A Survey of Injuries among Broadway Performers

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ABSTRACT

To obtain more information about injuries of Broadway performers, 313 performers appearing in 23 Broadway companies were surveyed. The percentage of performers injured was 55.5%, with a mean of 1.08 injuries per performer. Lower extremity injuries were the most common. Sixty-two percent of performers believed that their injuries were preventable. As this study reports factors that significantly increase the risk of injury for dancers and actors, it may help to heighten concern with reducing the incidence of injuries to professional performers, theatrical students, and nonprofessionals worldwide. (*Am J Public Health.* 1996;86:77–80)

Introduction

To the audience, a Broadway production appears to be a perfectly fine-tuned exercise of precision performed eight times a week and always starting on time. However, the demands and pressures of performing on this level take their toll on actors, dancers, and singers on the Broadway stage, who frequently sustain a variety of injuries. Although surveys of injuries to professional theatrical and ballet dancers[1–3] and theatrical dance students[4] have been made, little information is available about injuries to Broadway dancers and actors. To better understand the prevalence and risk factors for theatrical injuries, we conducted a survey of performers in Broadway productions and touring companies.

Methods

Sampling

With the cooperation of the staff and members of Actors' Equity Association, performers in all Broadway productions current as of February 1993, including 10 productions in New York City and 13 on tour throughout the United States, were surveyed (Table 1). The productions were predominantly musicals with varying amounts of choreography and a few dramas.

The survey was administered by the stage manager of each company, who called a cast meeting on various dates in February 1993 without announcing the topic. An attached letter from the senior business representative of Actors' Equity Association introduced and endorsed the survey. After the questionnaires were completed by all performers who attended the company meeting, they were mailed by the stage managers to Actors' Equity Association's main office and then forwarded to the investigators. The total number of respondents was 313.

Sources of Error and Bias

Retrospective surveys present potential problems with the accuracy of the respondents' recollections. For performers, however, memories of injuries are likely to be particularly vivid since their livelihood is at stake. The assurance of confidentiality and anonymity may have also encouraged candor in this survey. Because performers who were disabled at the time of the survey were not included, the injury rate may actually be higher than described. Anecdotal information suggests that the overall number of such performers was low.

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This paper was accepted on August 16, 1995.