A Relative Risk Analysis of Workplace Fatalities

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The Census of Fatal Occupational Injuries (CFOI) collects information on the number of fatalities sustained by different types of workers. Using multiple data sources, such as death certificates, workers' compensation reports and claims, Occupational Safety and Health Administration reports, and other Federal and State records, CFOI attempts to collect information on all fatal occupational injuries that occur each year. CFOI analysts verify the work relationship for each fatality using at least two independent sources. In 1992, an average of 3 documents was collected for each fatality. For a fatality to be considered within the scope of the CFOI, the decedent must have been employed at the time of the event, and engaged in a legal work activity or present, as a requirement of employment, at the site of the incident. Besides private wage and salary workers, the annual census includes fatalities of public sector employees—both civilian and military—and the self-employed. For the present study, military fatalities were excluded from the analysis.

Although CFOI counts are informative in identifying worker groups that experience large numbers of fatalities, they do not by themselves measure risk. To quantify risk, the data on workplace fatalities must be associated with a measure of worker exposure to risk, such as employment or hours worked. The number of hours worked is preferable because different workers spend variable hours on the job in a given time period (e.g. year), and therefore have different lengths of exposure to workplace hazards.

Two related measures of risk can be calculated with data on fatalities and hours worked. The rate of workplace fatal injuries (or injury mortality rate) is calculated by dividing the number of fatalities in a given time period by the number of hours worked in that same period. This equation yields the number of fatalities occurring per hour worked.

$$\text{Rate} = \frac{\text{Fatalities}}{\text{Hours worked}} \text{ during same time period}$$

Alternatively, an index of relative risk can be calculated for a group of workers as the ratio of the rate for that group to the rate for all workers.

$$\text{Index of relative risk} = \frac{\text{Mortality rate for a given group}}{\text{Mortality rate for all workers}}$$

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This second statistic measures how much the mortality risk of the group differs from that of all workers.[1]

In this article, indexes of the relative risk of injury fatalities are calculated for different groups of workers to identify those at greatest risk. The fatality data come from the 1992 and 1993 CFOIs and measure the number of workers who died in 1992 or 1993 as the result of a workplace injury that occurred in 1992.[2] Estimates of annual hours worked were calculated using microdata from the 1992 Current Population Surveys.

Fatal injury risk by major occupational group and sex

Table 1 presents data by sex on the relative risk of death for all civilian workers in different occupational groups. The indexes are expressed in relation to the index of relative risk for all civilian occupations, with the given value of 1.0. All indexes within the table can be compared.The rate of fatalities for all occupations is about 5.2 deaths per 100,000 workers.

Women have a low relative risk of workplace fatalities. Men are about eight times more likely than women to be killed by a workplace injury ($1.6 \div 0.2 = 7$). Further, whereas in some occupational groups, women are more likely than men to sustain a nonfatal injury or illness, this is never the case for fatalities.[3] Even within detailed occupations, women generally have lower fatality risks than men. Because there are relatively few fatalities reported for women in the CFOI data base, some of the analyses in the following pages do not present fatality risks separately for women and men.

As expected, white-collar occupations have relative risks below 1, meaning these occupations are safer than average.

[1] For an example of a previous use of this index see Shail J. Butani, "Relative Risk Analysis of Injuries in Coal Mining by Age and Experience at Present Company," *Journal of Occupational Accidents* 10 (1988).

[2] A small number of injuries that occurred in 1992 will give rise to fatalities in 1994 and future years that are not yet known and cannot be included in the analysis. The 1992 CFOI data also include some fatalities that resulted from injuries occurring in previous years. These fatalities are not included in the analysis because measures of relative risk are constructed by using hours of exposure to risk that are contemporaneous with the occurrence of injuries. Hours of exposure for 1992 should be compared to counts of fatalities that were due to injuries that occurred in 1992.

[3] For information about the relative risks for nonfatal injuries and illnesses, see U.S. Department of Labor, *Report on the American Workforce*, Washington, DC (1994).

Table 1. Index of relative risk for occupational fatalities resulting from 1992 injuries, by occupation and sex, all civilian workers 15 years and over.

Occupation	Index of relative risk		
	Total	Men	Women
All civilian occupations	1.0	1.6	0.2
Managerial and professional specialty	.4	.6	.1
Executive, administrative and managerial	.5	.7	.2
Professional specialty	.3	.5	.1
Technical, sales and administrative support	.5	.9	.1
Technicians and related support	.9	1.6	.1
Sales occupations	.7	1.0	.3
Administrative support, including clerical	.1	.3	.1
Service occupations	.8	1.4	.2
Protective service	2.4	2.7	.8
Service occupations, except protective service	.4	.8	.2
Farming, forestry and fishing occupations	4.7	5.4	.5
Farming and related agricultural occupations	3.6	4.2	.5
Forestry, logging, fishing, and hunting	28.1	29.3	2.6
Precision production, craft and repair	1.5	1.6	.2
Mechanics and repairers	1.1	1.1	.7
Construction trades	2.4	2.4	1.3
Extractive occupations	10.3	10.2	-
Precision production occupations	.6	.8	0
Operators, fabricators, and laborers	2.2	2.7	.3
Machine operators, assemblers, and inspectors	.6	.9	.1
Transportation and material moving occupations	4.1	4.3	1.6
Handlers, equipment cleaners, helpers and laborers	2.6	3.1	.5

NOTE: Dashes indicate that data do not meet publication guidelines.

SOURCE: BLS Census of Fatal Occupational Injuries, 1992 and 1993, and Current Population Survey, 1992.

The safest occupational classification is administrative support occupations, including clerical, with a fatality risk only one-tenth of the overall average. Blue-collar and service workers have relative risks that vary widely. Workers in the forestry, logging, fishing, and hunting occupations have relative risks that are about 28 times higher than for the typical worker. Another high risk occupational group is the extractive occupations, such as oil drilling and coal mining. Blue-collar occupations, such as precision production workers, and machine operators, assemblers and inspectors, have fatality risks below the overall average.

Fatal injury risk for detailed occupations

The table in the previous section presents data only at a highly aggregated level, masking the identity of specific high risk occupations. Table 2 identifies 13 detailed occupations that had indexes of relative risk of fatality greater than or equal to 4.0. Because of the small number of fatalities to women, the data are not separated by sex. In order to isolate occupations that are relatively large or have relatively large numbers of fatalities, the table is limited to those occupations with annual average employment in excess of 100,000 or with more than 50 fatalities.

Table 2. Index of relative risk and number of occupational fatalities resulting from 1992 injuries, selected high risk occupations, all civilian workers 15 years and over (Index for all workers = 1.0)

Occupation	Index of relative risk	Number of fatalities	Major deadly event
Timber cutting and logging	36.5	131	struck by falling tree
Civilian airline pilots and navigators	24.1	120	airplane crash
Fishers	23.7	71	drowning
Supervisors, farm workers	20.3	55	tractor accident
Taxicab drivers and chauffeurs	9.4	105	homicide
Managers, farms, except horticultural	7.8	68	varied
Construction laborers	7.2	225	varied
Electrical power installers and repairers	6.1	36	electrocution
Roofers	5.9	49	fall
Sheriffs, bailiffs, and other law enforcement officers[1]	5.7	34	homicide, highway accident
Truck drivers	4.5	691	highway accident
Driver-sales workers	4.2	46	highway accident
Farm workers	4.0	195	varied

[1] Police officers and detectives are a separate occupation category and, as such, are not included here.

NOTE: Included in this list are occupations that meet the following criteria: employment of at least 100,000 or 50 or more fatalities; an index of relative risk 4.0 or above; and not designated as "not specified" or "not elsewhere classified."

SOURCE: BLS Census of Fatal Occupational Injuries, 1992 and 1993, and Current Population Survey, 1992.

The occupations in table 2 appear to be dispersed among widely varying occupational groups. However, they have a common element: these are jobs where people work outdoors, rather than on factory floors. Manufacturing sites, in fact, have relatively low rates of fatal work injuries, in contrast to relatively high rates for nonfatal injuries and illnesses.

The occupation with the highest index of relative risk is timber cutting and logging. These workers, who are over 36 times more likely to be killed on the job than the average worker, are typically killed by falling trees. Truck drivers, however, have the largest number of fatalities, most of these arising from highway accidents.

Three agricultural occupations appear in table 2 and a fourth fell just short of inclusion. Fatalities in farming occupations are not the result of one kind of incident; work-

ers are fatally injured in a number of ways including tractor rollovers and collisions, and being caught in farm machinery.

Age and workplace fatalities

The risk of a fatal occupational injury is far greater for employees over the age of 64 than it is for younger workers (see table 3). A man 65 or older is nearly four times more likely to die of a workplace injury than a man between the ages of 25 and 34. Similarly, a woman over 64 is much more likely to be killed than her 25 to 34 year old colleague.

Table 3. Index of relative risk for occupational fatalities resulting from 1992 injuries by age and sex, all civilian workers

Age group	Total	Men	Women
All ages, 15 years and over	1.0	1.6	0.2
15 to 19	.8	1.4	.1
20 to 24	.9	1.4	.2
25 to 34	.9	1.4	.2
35 to 44	.9	1.4	.2
45 to 54	1.0	1.6	.2
55 to 64	1.4	2.1	.2
65 and over	3.5	5.3	.5

SOURCE: BLS Census of Fatal Occupational Injuries, 1992 and 1993, and Current Population Survey, 1992.

A study of the events leading to fatalities suggests that the relative risks of many types of events jump for the oldest group of workers. Compared to men between 25 and 34 years of age, men over 64 are about 5 times more likely to have a fatal transportation accident, over 4.5 times more likely to die from a fall, 3.8 times more likely to die from contact with objects and equipment, and 3.4 times more likely to die from assault. Thus, no single event is responsible for the increased risk for those over 64. Older workers also seem to have an elevated risk of death from injury within detailed occupations. Differences in the occupations of the young and old do not seem to explain the finding. One possible explanation is that older workers simply are less likely to survive when they are severely injured.

Compared to the jump in fatality risk for those over 64, other variations in risk with age are either relatively small or essentially non-existent. The fatality risk does not vary with age for women younger than 65, and the risk is only slightly higher for men 55 to 64 years of age than it is for younger men.

Events leading to fatal occupational injuries

In 1992, transportation accidents were the event most often associated with fatal occupational injuries to men, accounting for 39 percent of their workplace deaths. (See table 4.) The second leading event for men was assaults and other violent acts. For women, assaults were the leading event associated with fatal occupational injuries (45 percent), followed closely by transportation-related events (38 percent). This section examines more closely these two events.

Table 4. Events in 1992 leading to fatal occupational injuries by sex, all civilian workers

Event	Total	Men	Women
Total	5,993	5,560	433
Transportation accidents[1]	2,347	2,183	164
Assaults and violent acts	1,264	1,070	194
Contact with objects and equipment	981	964	17
Exposure to harmful substances or environments	593	577	16
Falls	574	546	28
All other events	234	220	14

[1] Includes highway, nonhighway, air, water, rail and pedestrian accidents.

SOURCE: BLS Census of Fatal Occupational Injuries, 1992 and 1993.

Transportation accidents. Highway accidents in 1992 accounted for almost half of all transportation accidents leading to fatal work injuries for all civilian workers. (See table 5.) There were also a significant number of transportation accidents that occurred at industrial sites and farms. Further, a significant number of pedestrians were struck by vehicles and other mobile equipment.

Table 5. Transportation accidents in 1992 causing fatal occupational injuries, all civilian workers

Transportation accidents	Number	Percent
Total	2,347	100
Highway accidents	1,133	48
Nonhighway accidents, exc. rail, air, and water	425	18
Pedestrian struck by vehicle or mobile equipment	344	15
Aircraft accidents		
Water vehicle accidents	103	4

SOURCE: BLS Census of Fatal Occupational Injuries, 1992 and 1993.

Indexes of relative risk can be calculated by occupation for each type of accident. For example, if the risk of a fatal highway accident for the average worker is 1.0, then, it is possible to calculate the index of relative risk of a highway accident for a truck driver or for a worker of any other occupation. The index would give the relative risk per an hour worked, not per an hour in a vehicle. Because some workers spend more of their time engaged in transportation activities, they are more likely to be killed in transportation accidents.

Table 6 lists the 10 occupations with annual employment in excess of 100,000 that had the highest risk of a 1992 work-related highway fatality. Not surprisingly, three

of the four riskiest occupations are in the group entitled "motor vehicle operators." Truck drivers had, by far, the largest number of highway-related fatalities. Law enforcement and farming occupations also appear in the list. Additionally, occupations that have employment in excess of 100,000 and are not designated "not elsewhere classified" or "not specified" are included as well.

Table 6. Large occupational groups with the highest risk of fatal work-related highway accidents, all civilian workers 15 years and over, in 1992

Occupation	Index of relative risk	Number of fatalities
All civilian workers	1.0	1,131
Driver-sales worker	15.5	32
Truck drivers	13.7	396
Sheriffs, bailiffs and other law enforcement officers	8.9	10
Taxicab drivers and chauffeurs	7.1	15
Messengers	6.9	8
News vendors	6.9	5
Police and detectives, public service	5.0	25
Managers, farms, excl. horticultural	4.9	8
Farm workers	3.2	29
Operating engineers	3.1	6

NOTE: Included in this list are occupations that meet the following criteria: employment of at least 100,000 or 50 or more fatalities; an index of relative risk 4.0 or above; and not designated as "not specified" or "not elsewhere classified."

SOURCE: BLS Census of Fatal Occupational Injuries, 1992 and 1993, and Current Population Survey, 1992.

Similarly, table 7 shows large occupational groups with the highest risk of a work-related nonhighway transportation fatality, excluding air, rail, or water transportation accidents, and those involving pedestrians. The occupations

Table 7. Large occupational groups with the highest risk of fatal work-related nonhighway transportation accidents, excluding air, rail, water and pedestrian accidents, all civilian workers 15 years and over, in 1992

Occupation	Index of relative risk	Number of fatalities
All civilian workers	1.0	421
Managers, farms, excl. horticultural	31.1	19
Farmers, excl. horticultural	20.6	103
Farm workers	17.3	59
Excavating and loading machine operators	9.4	4
Industrial truck and tractor equipment operators	8.6	14
Operating engineers	8.4	6
Truck drivers	4.3	46
Laborers, except construction	4.1	17

NOTE: Included in this list are occupations that meet the following criteria: employment of at least 100,000 or 50 or more fatalities; an index of relative risk 4.0 or above; and not designated as "not specified" or "not elsewhere classified."

SOURCE: BLS Census of Fatal Occupational Injuries, 1992 and1993, and Current Population Survey, 1992,

with the highest incidences of workplace fatalities, accounting for 43 percent of all fatalities in this category, were farming occupations. These workers were often killed whileoperating tractors. The next three occupations in the table are engaged in operating material moving equipment, such as forklifts and excavating equipment.

In addition to occupation, age is often associated with the risk of work-related highway fatalities. Using the age of all workers killed in traffic incidents distorts the analysis, because some workers who die are passengers. When studying the effect of o=-age on highway fatality, it is more appropriate to use the of vehicle operators. However, CFOI routinely collects age data only for the deceased. Also, data may not be available on the proportion of a worker's time that is spent operating a vehicle. However, these data problems can be minimized to a large extent by focusing only on motor vehicle operators. The CFOI data indicate that, for highway accidents in this occupational group, the deceased was operating the vehicle over 94 percent of the time. Further, workers in this group tend to spend most of their working hours driving.

Table 8 shows how the relative risk of a work-related highway fatality varies by age for motor vehicle operators age 16 and over. Motor vehicle operators have a risk of a highway fatality that is nearly 12 times that of the average civilian worker. Motor vehicle operators age 65 and older are three times more likely to die from a highway accident than the average motor vehicle operator. The fatality risk for a motor vehicle operator between 16 and 19 years old is about the same as that of those 55 to 64 years old.

Assaults and violent acts. The large majority, 82 percent, of all assaults and violent acts are homicides.[5] While workplace homicides caused by disputes between clients, coworkers and spouses often make the news, research indicates that they only account for about 13 percent of all workplace homicides. In contrast, robberies and miscellaneous

Table 8. Index of relative risk and number of work-related highway fatalities for motor vehicle operators 16 years and over, by age, 1992

Age group	Index of relative risk	Number of fatalities
All civilian workers	1.0	1,128
Motor vehicle operators	11.7	453
16 to 19	15.1	9
20 to 24	8.8	25
25 to 34	9.0	101
35 to 44	12.4	135
45 to 54	11.9	93
55 to 64	16.0	62
65 and older	36.4	28

SOURCE: BLS Census of Fatal Occupational Injuries, 1992 and 1993, and Current Population Survey, 1992.

[5] The assaults and violent acts category also includes self-inflicted fatalities and those caused by animals.

crimes are responsible for over 80 percent of workplace homicides.[6]

Taxicab drivers have the highest risk of a workplace homicide (per hour worked), with an index of relative risk of homicide that is over 44 times higher than for the average worker. (See table 9.) Law enforcement occupations and workers engaged in retail sales also have especially high risks of workplace homicide.

Conclusions

Combining CFOI data with data from other sources helps to identify those who are at the highest risk of workplace fatality. The occupational group that includes loggers and fishers has a very high fatality risk, followed by employees in the extractive occupations. A characteristic of many of the high fatality risk jobs is that much of the work is performed outside.

Workers over the age of 64 have an especially elevated risk of death as compared to younger workers. This is true in the aggregate and also within detailed occupations. There is no single type of fatality that an older worker is more likely to suffer. Rather, workers over 64 are more likely to have a transportation accident and to die from a fall, assault, or contact with an object. An explanation for older workers' higher incidence of workplace fatalities is that they are less likely to survive severe injuries.

Transportation accidents are by far the most common event leading to a fatal occupational injury for men and the second leading factor for women. Not surprisingly, driver-sales workers and truck drivers have the highest risk of suffering a fatal accident on the highway. Farmers have the highest risk of a fatal transportation accident off the highway, often in accidents involving tractors. Motor vehicle operators over 64 are three times more likely to die from a highway accident than the average motor vehicle operator.

Assaults and violent acts are the leading event associated with workplace fatalities for women and the second leading event for men. Over 80 percent of workplace homicides occur during robberies or other crimes, while only about 13 percent arise from disputes between coworkers, clients, and spouses.

Table 9. Occupations with the highest risk of work-related homicide in 1992, all civilian workers 15 years and over.

Occupation	Index of relative risk	Number of fatalities
All civilian employees	1.0	1034
Taxicab drivers and chauffeurs	44.6	86
Sheriffs, bailiffs, and other law enforcement officers	18.4	19
Garage and service station related occupations	10.8	18
Sales counter clerks	9.2	14
Guards and police, excl. public service	8.4	53
Police and detectives, public service	7.4	34
Driver-sales workers	6.3	12
Food counter, fountain, and related occupations	5.6	10
Managers, food serving and lodging establishments	4.8	61
Cashiers	4.6	77

NOTE; Included in this list are occupations that meet the following criteria: employment of at least 100,000 .

SOURCE: BLS Census of Fatal Occupational Injuries, 1992 and 1993, and Current Population Survey, 1992.

[6] Janice Windau and Guy Toscano, "Workplace Homicides in 1992," in *Fatal Workplace Injuries in 1992: A Collection of Data and Analysis*, BLS Report 870, May 1994.