

Homicide While at Work: Persons, Industries, and Occupations at High Risk

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Abstract: The purpose of this study is to identify and describe, epidemiologically, work-related homicides in California from 1979 through 1981. Using the California State Computer Mortality File, an algorithm was developed and a search of the death certificates was made using three factors: "injury at work," injury at a work location, and pertinent external-cause-of-death codes. Only 30 per cent of the 466 homicide deaths identified were also found in the logs of the state Occupational Safety and Health agency. The average annual rate of

work-related homicides was 1.5 per 100,000 workers. The male-to-female-rate ratio was 4.2:1. Police and security guards and persons in occupations having frequent public contact involving exchange of money, particularly in late afternoon or evening hours, were at highest risk. Controlling exposures of high-risk individuals and developing strict standards for reducing such exposures might greatly reduce assaults and thus prevent senseless loss of life in the workplace. (*Am J Public Health* 1987; 77:1285-1289.)

Introduction

The goal of the US Occupational Safety and Health Act of 1970 is ". . . to ensure, so far as possible, every working man and woman in the nation safe and healthful working conditions. . . ." Persons who are at risk of being murdered while involved in work-related activities are not excluded by any language of the OSH Act, yet no standards have been developed to assure safety from this hazard. Part of the problem of federal or state inactivity on the hazard of homicide while at work is the very limited information on this problem.

The US Bureau of Labor Statistics¹ has reported that for 1983-84, 4 per cent of the documented 6,840 occupational fatalities were from assaults. Furthermore, this cause of death accounted for 33 per cent of all injury fatalities in the wholesale and retail trade industries and 35 per cent of injury fatalities in the services industry. In addition, the National Institute for Occupational Safety and Health (NIOSH) reports that gunshots accounted for 4.5 per cent of all at-work injury deaths in the US in 1980-81.² Aside from the above two sources, very little information is available for the US on this subject.

Studies from Maryland,³ British Columbia,⁴ Oklahoma,⁵ Texas⁶ and California⁷ have reported work-related homicide in from 7 to 30 per cent of work injury deaths, but the published literature on the subject is mostly incomplete or limited in scope.

There are two major ways in which persons who die from work-related activities, including homicide, might be identified in California (and many other states): reports from employers to the state Occupational Safety and Health (OSH) agency, and death certificates.

In California and most other states, employers are required to report all fatal injuries except an *accident* on a public street or highway.⁸ Also, not all workers have an employer, for example, self-employed persons or domestics. The lack of uniformity in reporting criteria in the US (and California) led to the recent conclusion by the US House of Representatives Committee on Government⁹ that the information systems on occupational disease (and injury) are

fragmented, resulting in inaccurate and unreliable data. Hence, reliance on existing California state OSH records was judged, *a priori*, to be potentially erroneous for homicide-at-work case-finding purposes.

Reliance on death certificates as a source for identifying work-related injury deaths is problematic as well, because external cause-of-death codes (E-codes) are often not work-specific and the description of how the fatal injury occurred is not entered into the computer beyond the E-code rubric.

To overcome the potential problem of underreporting of homicide to the state OSH agency or reliance on the coded portions of the death certificate to identify and describe occupations or industries involved, a different system of identifying work-related homicide deaths was developed. The details of the resulting algorithm are described below.

Methods

Case-Finding and Study Parameters

All homicide death certificates are located on the California Master Mortality File, a computerized listing of death certificate information for all California residents (plus those nonresidents dying in California). The algorithm for identifying work-related homicide deaths (Figure 1) involved four steps. The first step required a search of the file for all homicide deaths to California residents from 1979 through 1981. This three-year period was chosen for three reasons:

- availability of 1980 US census denominator information on occupation and industry for California residents;
- availability of death-certificate-coded occupation and industry for all persons aged 16-64; and
- sufficient time lapse for all pertinent cases to have been determined and to come to the attention of, or be incorporated into, official California statistics.

For this three-year period, 8,687 homicides (International Classification of Diseases, 9th Revision (ICD-9), external cause codes 960-969)¹⁰ among persons aged 16 through 64 were identified. Homicides from legal intervention or from "undetermined" causes were not included in this subset.

The second step involved finding which homicides among the thousands occurring annually in California were possibly work-related. For this purpose, two variable fields on each death certificate were examined in succession: "injury at work"; and homicide at an industrial, office, or farm location.

For those homicides with a positive indication in either one of the two variable fields, the third step involved examination of the hard copy of the death certificate for

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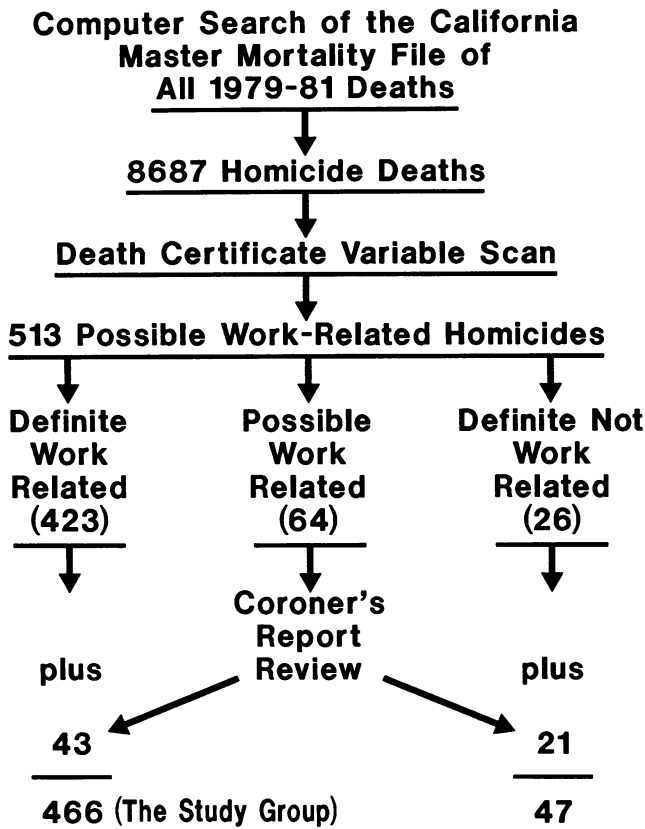


FIGURE 1—Case-finding Algorithm for Murders While at Work

written evidence of a work-related activity. This information is often recorded in the section of the certificate that asks how the injury occurred. For some of the certificates examined, it was not clear whether or not the homicide was work-related, hence, the final step involved obtaining and reading the pertinent coroner's report. All homicides (and other injury deaths) are coroners' cases by law in California. A review of the narrative description of the circumstances of death in these reports confirmed or rejected all doubtful work-related associations. Occupation and industry information recorded on the death certificate are not coded in California, but a special project was undertaken in 1982 to code these factors for the years 1979-81.

The primary occupation recorded on the death certificate (e.g., carpenter) sometimes differed from the work activity and location of the victim at the time of the homicide (e.g., bartender) noted on the coroner's report or described in the death certificate. In such cases, occupation and industry were recorded using the same system used by the State of California Center for Health Statistics staff who coded the death certificates originally for these two variables. The system for occupation or industry coding used in California was the same as that of the US Bureau of the Census¹¹ for the 1980 census in California.

Population counts, by occupation and industry, were obtained from the 1980 report for California from the US Bureau of the Census.¹² For comparison, the number of work-related homicides for 1979-81 reported to the state OSH agency and recorded on log sheets was compared to the number derived from the new case-finding technique.

TABLE 1—Agreement of Work-Related Homicides from Algorithm Search with Officially Reported Cases

		ALGORITHM		
		Homicide at Work	Homicide Not at Work	Total
OFFICIAL LOG SHEETS	Homicide at work	141	1	142
	Homicide not logged	325	46	371
	Total	466	47	513

Results

The computer search of the 1979-81 California Master Mortality File of all 8,687 homicides (ICD, 9th rev., Codes 960-969)¹⁰ among California residents age 16-64 yielded 513 deaths that were possibly work-related. Examination of the actual death certificate on file in the Office of the State Registrar of California could not confirm 26 cases. For another 64 homicides, it was not possible to determine from the narrative if the death was work-related or not, hence the pertinent coroner's record was obtained and examined. Forty-three of these homicides were confirmed as work-related. The yield of 466 at-work homicides was 91 per cent of the total identified using the algorithm outlined in Figure 1.

Of the 466 definite at-work homicides, only 141 (30 per cent) were located also in the log sheets of the state OSH agency. Agreement between the homicides identified by algorithm and those found in the agency log sheets is seen in Table 1. Only one homicide reported to the OSH agency was not found by the computer search. For this particular case, the death certificate was not marked "at work," the death did not occur at a work location, and the narrative description on the certificate of how the injury occurred was vague. Three hundred twenty-five at-work homicides during 1979-81 were not located on any of the log sheets on file in the OSH agency from 1979-85. All logs sheets over this six-year period were searched, since official "at-work deaths" are reported by year of official determination and not the year of death or injury.

The 1980 US census for California reported a total employed population of 10,358,781 persons aged 16-64 years. The 466 deaths for 1979-81 represent an average annual work-related homicide rate of 1.5 per 100,000 workers (Table 2). The homicide rate was 2.23 per 100,000 for males and 0.53 per 100,000 for females, a male-to-female rate ratio of 4.2:1 (Table 2).

The percentage distribution of homicides by year did not differ significantly over the three-year period.

TABLE 2—Number and Average Annual Work-Related Homicide Rates per 100,000 Workers, by Gender and Age, California, 1979-81

Age (years)	Males			Females		
	Number Workers	Number Killed	Rate per 100,000	Number Workers	Number Killed	Rate per 100,000
16-19	383,603	23	2.0	353,430	6	0.6
20-29	1,729,560	98	1.9	1,408,601	20	0.5
30-44	2,100,890	150	2.4	1,535,805	27	0.6
45-64	1,697,709	124	2.4	1,144,966	18	0.5
All Ages	5,911,762	395	2.2	4,442,802	71	0.5

TABLE 3—Number and Average Annual Industry-Specific Work-Related Homicide Rates per 100,000 Workers Aged 16–64, by Gender, California 1979–81

Industry	Males			Females		
	Number Workers	Number Killed*	Rate per 100,000	Number Workers	Number Killed	Rate per 100,000
Agriculture, Fisheries, Mining, Forestry	281,418	10	1.2	71,499	1	0.5
Construction	532,497	18	1.1	58,332	2	1.1
Manufacturing	1,432,950	40	0.9	690,644	3	0.1
Transportation, Communication, Public Utility	523,636	30	1.9	224,012	2	0.3
Wholesale Trade	315,220	15	1.6	134,501	3	0.7
Retail Trade	893,123	141	5.3	815,011	28	1.1
Finance, Insurance, Real Estate	293,215	9	1.0	437,734	7	0.5
Business/Repair	364,131	41	3.8	192,091	3	0.5
Personal Services	106,433	13	4.1	219,200	10	1.5
Entertainment, Recreation	105,644	5	1.6	63,753	0	0
Professional/Related	738,779	25	1.1	1,326,941	9	0.2
Public Administration	324,716	44	4.5	209,084	3	0.5
Total	5,911,762	391	2.2	4,442,802	71	0.5

*Excludes four persons without information on industry.

TABLE 4—Number and Average Annual Work-Related Homicide Rates for General Occupational Categories per 100,000 Workers Aged 16–64, by Gender, California, 1979–81

Occupation	Males			Female		
	Number Workers	Number Killed*	Rate per 100,000	Number Workers	Number Killed	Rate per 100,000
Managerial/ Professional	1,568,079	87	1.8	1,023,842	15	0.5
Technical/ Sales/ Administrative	1,236,935	90	2.4	2,137,796	24	0.4
Service	581,840	94	5.4	712,769	22	1.0
Farm/Forest/ Fishing	236,032	8	1.1	48,448	2	1.4
Precision Production/ Craft	1,159,457	42	1.2	129,174	2	0.5
Operators/ Fabricators/ Laborers	1,129,419	69	2.0	390,773	6	0.5
Total	5,911,762	395	2.2	4,442,802	71	0.5

*Excludes five persons with unknown information on occupation.

Age-specific homicide rates by gender are also given in Table 2. The rates do not appear to vary much over the four age groups, with slightly higher rates for males at ages 30–64 compared to younger ages. There is no age-specific pattern in the rates for females, with rates about the same for each of the age groups.

Major industrial-category homicide rates for males and females are given in Table 3. The rates were not age-adjusted since there were only small differences in the proportionate distributions over the major industrial categories. Rates per million male workers are highest in the retail trade, business and repair, personal service, and public administration industries. For females, homicide rates are highest in the retail trade and personal services industries.

The specific industries with the highest homicide rates (per 100,000 male workers) were: gas stations (14.4), other

retail stores (9.0), food and dairy stores (7.2), and eating and drinking places (6.7). For females, the homicide rates were highest in food and dairy stores (2.7) and eating and drinking places (1.6).

Major occupational-category homicide rates for males and females are given in Table 4. Service occupations have the highest rates for males and females but these classifications are too vague to be descriptively meaningful. Hence, rates for nine of the most common high-risk occupations for males with sufficient numbers for analysis are presented in Table 5. Rates of homicide are highest among police—10 times higher than the overall rate for males. Homicide rates are also high for taxi drivers, private security guards, and supervisors or proprietors of eating or drinking places, convenience stores, liquor stores, etc.

Homicide rates for females were highest among service

TABLE 5—Number and Average Annual Occupation-Specific Work-Related Homicide Rates per 100,000 Male Workers Aged 16–64, California, 1979–81

Specific Occupation	Number Workers	Number Killed	Rate per 100,000
Police	36,847	23	20.8
Taxi Driver	22,801	13	19.0
Security Guard	46,543	23	16.5
Supervisor/Proprietor	120,061	35	9.7
Sales/Personnel	208,896	29	4.6
Waiter/Bartender	204,692	23	3.7
Bus Driver	20,999	2	3.2
Janitor	170,929	14	2.7
Truck Driver	208,061	15	2.4

occupations (waitress in eating/drinking places, etc.). There were too few cases to derive valid rates for most of the occupation-specific categories for females.

Hour-of-injury information was recorded on the death certificate for 339 of the 466 homicide cases (72.7 per cent). Instances when the only time recorded was when the victim was "found" were not included in the analyses. Peak hour of fatal assaultive injury was 11:00 pm to midnight (9 per cent of all cases). About two-thirds of all homicides with known injury times occurred from 3:00 pm to 3:00 am. Twenty-three per cent of homicides with known injury times were among five occupations having frequent public contact: supervisors or proprietors; waiters, bartenders, waitresses; sales clerks; taxi drivers; and police. Seventy per cent of these homicides occurred from 3:00 pm to 3:00 am.

Firearms accounted for 77 per cent of all work-related homicides. The proportion was higher for males (80 per cent) than for females (62 per cent). A higher percentage of females (23 per cent) were killed by cutting or stabbing instruments than were males (12 per cent). This pattern was generally similar for each of the four age groups for each gender. The proportion of firearm homicides varied by occupational group. Over 92 per cent of supervisors or proprietors (mostly of food or dairy stores, convenience stores, liquor stores, or eating and drinking places) died from gunshot wounds, as did three-fourths of police or security guards, waiters, waitresses, or bartenders, janitors or maids, or truck/bus drivers. Sixty-one per cent of murdered taxi drivers were shot.

Finally, of the 466 death certificates or coroners' records reviewed, the usual occupation and industry recorded (and coded) on the certificate was not related to the exposure (occupation) at the time of the homicide for 98 persons (21 per cent). Most typically the usual occupation was a skilled craft, but employment at time of death was in a second occupation (e.g., taxi driver).

Discussion

One of the major findings from this research relates to the difficulty in readily identifying work-related homicide deaths in California (and possibly other states). In California, the definition of "work-related fatality" depends upon an administrative or judicial analysis and often has little bearing on the nature of the exposure. This often results in several years delay between the notification by the employer and official determination of a work-related fatality. These deaths are then incorporated into official published statistics according to year of determination, not year of occurrence. Even so, only 141 of 466 homicides occurring in 1979–81 were identified from the log sheets of the state OSH agency for the years 1979–85 (allowing for a four-to-six-year lag). During the

period 1979–81, California reported 241 shootings, stabbings, or assaults.¹³ The reason for the discrepancy is not known unless sources other than log sheets are used for tabulations or the larger figure includes homicides for years prior to 1979–81.

Although this report does not condemn the current administrative definition of a work injury in California, it does suggest the need to establish epidemiologic definitions of homicide and a quicker system of complete reporting of work-related homicide. The magnitude of homicide under-reporting to, or underacknowledgment by, the California state agency is severe. The reasons are unclear, but on reading the circumstances of the homicides, there appears to be a large number among self-employed persons or persons in small-industry occupations, the latter of which are also required to report all fatal-injury cases. In addition, it is important to note that 21 per cent of occupational and industrial codes for 466 victims of homicide had no bearing, by way of exposure, to the hazard that resulted in a homicide. More typically, such persons were killed during work activities associated with a second, temporary, or nonusual occupation. A system that would identify and record the particular exposure (occupation/industry) for such acute deaths would provide meaningful information useful for epidemiologic analysis and, hopefully, Occupational Safety and Health Administration (OSHA) standards development.

The actual number of annual homicide deaths to persons engaged in work-related activities in the US is not known, but if the rate derived from this current report (1.5 per 100,000 working population) is applied to the total US working population of about 107 million in 1985, aged 16–64, about 1,600 work-related murders occur yearly in the country.

In California, the proportions of work-related deaths in 1983–84 from highway crashes and falls are similar to the US for the same years, but about 11 per cent are from shootings, stabbings, and assaults.¹³ Considering the underreporting found in this current study of at least 50 per cent, the actual proportion of work-related homicide in California (and the US) may be closer to 25 per cent, similar to the proportion of work-related highway-crash fatalities, assuming all other types are accurately reported.

Homicide rates are highest for males, as in almost all other fatal-injury causes in the United States. The age range chosen for the analyses (16–64) was reasonable but it did not include persons outside that age range who may have been murdered at work. One of the reasons is the difficulty in assigning an occupation or industry for these persons. Persons under the age of 16 have no "usual" occupation and are almost always coded as "student." For those over the age of 64, their usual occupation may be "retired". A careful review of homicides and other possible work-related deaths for those less than age 16 and over age 64 should be undertaken for obvious reasons.

In 1982, Baker and colleagues³ called for standards requiring protection of workers from assaultive injury, yet no OSHA standards to address this problem have been implemented. Findings from this present study suggest that workers in occupations or industries having frequent public contact involving the exchange of money, particularly during evening hours, are at highest risk of homicide. Bullet-proof partitions or vests and limiting hours of public contact might be useful strategies to protect these high-risk workers who handle money.

There appears to be a large underestimation of officially recognized work-related deaths from assaultive causes. This

finding in itself has implications for estimating the entire national burden from work-related homicides. A careful study of these assaults, including the gathering of explicit, pertinent information from coroners' and/or police reports, would enable much-needed definition and quantification of high-risk exposures.

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Symposium Scheduled on Transplacental Effects on Fetal Health

A symposium, entitled "Transplacental Effects on Fetal Health," will be held at the National Institutes of Health, Bethesda, Maryland on November 5–6, 1987. The purpose of this symposium is to present the current understanding of the mechanisms of action of biologic agents, the effects of disturbed maternal metabolism, and drug and chemical abuse on the developing fetus of humans and animals. Four major topics are:

- Congenital Viral Infections
- Congenital Bacterial and Other Infections
- Metabolic, Drug and Chemical Teratogens
- Genetic Engineering

The symposium will be open and free-of-charge, and places will be reserved for at least 100 participants. Invitations will be given on a first-come basis. For further information, contact: George Migaki, DVM, Registry of Comparative Pathology, Armed Forces Institute of Pathology, Washington, DC 20306-6000; phone (202) 576-2452.