

## Comparison of work-related fatality surveillance in the U.S.A. and Australia\*

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### ABSTRACT

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Recently conducted studies of traumatic work-related fatalities in the U.S.A. and Australia were compared and analyzed in order to identify ways of improving the quality and utility of fatal occupational injury surveillance data at national level. Methodological differences between the two studies are examined, and comparative data are presented. Despite differences in data acquisition methods and in the structure of the labor and work environment, the results of the two studies were remarkably similar. The mean annual rates of fatal injury while working, for persons in the employed civilian labor force during the period 1982-1984, were 5.9/100 000 in the U.S.A. and 6.7/100 000 in Australia. Because the U.S. data collection method is likely to have underestimated the occurrence of work-related fatalities, the difference between U.S. and Australian rates is probably over-estimated by these figures. The fatality rates for age, sex and employment groups were also similar. Considerations necessary for meaningful comparison of surveillance data from different sources are discussed.

### INTRODUCTION

National studies of traumatic occupational fatalities have recently been reported in New Zealand (Cryer and Fleming, 1987), the U.S.A. (Stout-Wiegand, 1988a,b) and Australia (Harrison et al., 1989). The main aim of each study was to enumerate and characterize deaths attributable to work-related injuries as a basis for planning prevention. Reliable national epidemiologic data on deaths from work injuries in these nations have not been previously

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available because no routine reporting exists in either country that captures all the deaths. The surveillance of work-related injuries, including fatalities, poses major methodologic difficulties which have recently been reviewed in the U.S.A. by the National Academy of Sciences (Pollack and Keimig, 1987).

The comparative analysis presented in this paper results from a collaborative project undertaken in Australia by investigators from the U.S. National Institute for Occupational Safety and Health and the Australian National Institute of Occupational Health and Safety, who conducted the studies which are compared (the U.S. National Traumatic Occupational Fatality [NTOF] project and the Australian Work-Related Fatalities Study [WRFS]). The purpose of the comparison was twofold. First, it explored methodologic differences between the two studies, examining the definitions and methods used as well as indicative results, in order to identify ways of improving the quality of fatal occupational injury surveillance on a national level. Second, it examined difficulties of comparing surveillance data from different sources, leading to a discussion of preconditions for meaningful comparison. It is hoped that these analyses will assist in the development of a more comprehensive method for accurate reporting of occupational injuries.

#### COMPARATIVE METHODOLOGY

Despite differences in case selection criteria and data acquisition methods, the U.S. and Australian studies were similar in two important respects. First, each study was designed as a nationwide census, attempting to enumerate all traumatic occupational fatalities occurring within a specified time period. Second, both studies were designed to identify work-related fatalities retrospectively among all registered deaths attributed to injury.

The interpretation of epidemiologic studies of traumatic work-related fatalities depends upon definitions of "work" and "work-relatedness". The concepts represented by these terms may seem clear at first sight, but their practical application in data acquisition is often difficult. While reference may be made to definitions reached by the International Conference of Labour Statisticians for the International Labour Organisation [ILO], there are no universally accepted definitions. Even the ILO definitions rely on an intuitive understanding of terms such as "accident" ("fatal occupational injury" is defined as "a death within 365 days of any injury resulting from an accident at work"), and no formal distinction is made between injuries and acute diseases (International Labour Organisation, 1982b).

In the U.S. study, definitions were implicit in the data source. U.S. death certificates include an item enquiring "Injury at Work?", and identification of work-related cases depended entirely upon a positive response to this item. Certifiers require little formal training in filling out death certificates, and there is no national guideline for the completion of the injury at work item. In

the absence of a standard definition of injury at work, variation in the accuracy and consistency of data is to be expected.

Data were collected from death certificates purchased from the 50 states and the District of Columbia. In addition to a positive response to the "Injury at Work?" item, criteria for selection were age at death in excess of 15 years, and cause of death assigned any "external causes" code of the International Classification of Diseases, 9th Revision [ICD9] (U.S. Department of Health and Human Services, 1980), i.e. codes E800–E999. Collection was restricted to persons aged 16 years or older for consistency with U.S. labor force data, which were used as denominators in calculating rates.

Fatal injuries which occurred on the way to or from work (commuting cases) were not included in the U.S. data. While international recommendations suggest that commuting cases be included in work injury reporting, these cases cannot be identified on U.S. death certificates. Further, commuting cases are not regarded legislatively as work-related in the U.S., being excluded from the coverage of both workers' compensation plans, and national occupational safety regulations.

In most states, cases meeting these criteria could be identified electronically. Copies of the corresponding death certificates were then mailed to NIOSH. However, in some states manual searches of death certificates were necessary, particularly for deaths resulting from intentional injuries (homicides and suicides), to locate those attributed to injury at work. Intentional fatal injury data were not available from three states in which the "Injury at work?" item was routinely not completed for intentional cases.

Information on the death certificates received by NIOSH was transferred onto computer tape. Most variables were coded by NIOSH, while some information was transcribed literally from the death certificates. The current data set contains cases for the years 1980–1986 and the project is scheduled to continue through 1990 data collection.

National fatality rates for the U.S.A. were computed using Bureau of Labor Statistics Annual Household Survey data to estimate persons at risk (Bureau of Labor Statistics, 1981–1986). Fatally injured military personnel were excluded when calculating rates because the denominator data included only the civilian labor force. Cases of suicide at work were also excluded, to increase comparability of U.S. and Australian data.

Australian death registration data do not indicate whether or not a fatal injury occurred at work. The Australian study was based on the legal requirement that deaths from traumatic causes (with the exception of certain deaths of elderly persons, mostly following falls) must be reported to a coroner, who enquires into the pathophysiological cause of death and the surrounding circumstances. In the course of these enquiries the coroner compiles a file on each case. The use of coroners' files in the Australian study entailed three steps. First, the Australian Bureau of Statistics [ABS] provided a list of all deaths which had occurred in the years 1982–1984 and which were attributed to trauma or poisoning, excluding those due to suicide or medical misadventure (i.e.,

deaths assigned ICD9 codes in the ranges E800–E869, E880–E929 and E960–E999 were listed). These lists included death registration numbers but not decedents' names. Because coroners' files are indexed by name, the second step entailed matching death registration numbers with names using death registers in each of the eight Australian states and territories. Third, coroners' files were located for the identified traumatic deaths. Each file was examined by a member of the study team, who applied a predetermined set of criteria to assign the case to one of three classes: work-related, not work-related, or indeterminate. Information from the coroner's file, death register and ABS list were recorded on a detailed data form for each work-related case. Coded data and some text from the forms were transcribed onto microcomputer files for analysis (Harrison et al., 1989).

The core definition of "work" in the Australian study was chosen to match the best available denominator, which was derived from the ABS Monthly Labour Force Survey (Australian Bureau of Statistics, 1982–1984). Accordingly, "work" was defined as participation in the employed civilian labor force. This comprises people working for pay, profit or payment-in-kind, in a job or business or on a farm (including employees, employers and self-employed persons), and persons working without pay in a family business or on a farm. It excludes persons aged less than 15 years and members of the permanent armed forces. Separate data were collected on four groups outside the core definition: persons working for pay but not in the employed civilian labor force as defined (such as armed forces personnel and persons aged under 15); unpaid workers (e.g., home-makers and voluntary community service workers); students aged 15-plus engaged in activities required by an educational institution; and bystanders, fatally injured as a direct consequence of the work of another person. However, rates were calculated only for persons in the employed civilian labor force, as suitable denominators were not available for the other groups.

A fatality was considered to be work-related if the deceased was injured on the job, during a lunch break or other recess period, or while commuting between home and work. Commuting cases were included because they were covered by Australian workers' compensation schemes, but have been segregated for analysis. The issue of work-relatedness required a judgment to be made by the member of the study team examining the coroner's file; in the great majority of cases the decision was straightforward. Blind re-classification of samples of files by a second team member demonstrated a high degree of concordance between observers in classification of work-related cases (the kappa statistic for agreement was 0.78 [95% confidence limits, 0.68–0.88]). Most disagreement between observers was in cases regarded by both as being borderline between positive and indeterminate, on the basis of information available in coroners' files. Where the coroner's file contained insufficient information to resolve work-relatedness, the case was designated indeterminate and, for the purpose of analysis, treated as not work-related.

Table 1 summarises the case selection criteria of the two studies. The sensitivity and specificity of both studies depended on the quality of coding of cause of death to the ICD9 classification, and on the accuracy of attribution to work. In both countries ICD coding of deaths is done by experienced coders (Australian coders are not formally trained), and has been found to be accurate for trauma deaths (Kircher et al., 1985; Nairn et al., 1985).

It is likely that work-related fatalities were defined less consistently in the U.S. study than in the Australian study, because the U.S. system depended upon the practices of the innumerable people completing death certificates. Under-enumeration of work-related fatalities due to incorrect marking of the "Injury at Work?" box on U.S. death certificates has been estimated for several states. The reported estimates were 12% (Massachusetts Department of Health,

TABLE 1

Case selection criteria in the NTOF (U.S.A.)<sup>a</sup> and WRFS (Australia)<sup>b</sup>

Groups	NTOF (U.S.A.)	WRFS (Australia)	
		Civilian labor force	Other groups
Civilian labor force, > 15y	Y	Y	—
Civilian labor force, = 15y	N	Y	—
Military personnel	Y	N	Y
Working for pay, < 15y	N	N	Y
Unpaid community & domestic work	N	N	Y
Unpaid student/trainee work	N	N	Y
Labor Force, commuting to/from work	N	Y	N
Bystanders to work	N	N	Y
Suicides at work	Y	N	N

<sup>a</sup>National Traumatic Occupational Fatalities study (United States).

<sup>b</sup>Work-Related Fatalities Study (Australia).

Definitions:

"*Traumatic Fatality*": For the purposes of the studies, a traumatic fatality was any death attributed an ICD9 External Causes code in the following ranges:

NTOF (U.S.A.): E800–E999

WRFS (Aust.): E800–E869, E880–E929, E960–E999

(i.e., Australian study excluded suicide and medical misadventure)

"*Work-related*": traumatic fatalities were those resulting from injury in the course of activities as a member of specified groups within the national population. The WRFS (Aust.) focused on injury deaths in the employed civilian labor force. Only for this group were suitable denominator data available. The WRFS also surveyed work-related deaths in several other groups, as indicated in the column headed 'Other groups'.

1989), 15% (Colorado Department of Health, 1988), 24% (Karlson and Baker, 1978) and at least 33% (Baker et al., 1982). The validity of responses to this item varies substantially between states, and the degree of under-enumeration nationwide is not known. Data from one U.S. state indicated few if any false positives among deaths coded as "Injury at Work" (Colorado Department of Health, 1988), but national data are not available. However, the extent of misclassification is always affected by the criterion used to assess the correctness of responses.

The Australian study utilized a small, trained research team to make the decision according to study criteria. While this required judgments on work-relatedness, explicit criteria were available to research officers.

Limited comparison of data in the WRFS with other sources has revealed a small number of cases missed due to non-availability of coroners' files (less than 1%). About 1.3% of coroners' files sought could not be found because they were on loan or were lost. If the proportion of work-related cases was the same for missing coroners' files as it was for the files that were not missing (10%) then the true number of work-related fatalities would have been about 1.6% more than were identified in the WRFS.

Work-relatedness was not deducible from the coroner's file in a large number of road deaths, particularly those involving vehicles that were not obviously commercial. About 85% of files which were classified as indeterminate dealt with road injuries. It is likely that a small proportion of these fatal injuries occurred while working. The size of this probable under-enumeration of road deaths is uncertain.

False positive cases were screened from the Australian study by a series of systematic checks of data, and are likely to be few.

While the Australian approach to defining work-relatedness provided more detailed and more consistent information, it would not have been feasible at the national level in the U.S., with a population approximately 15 times that of Australia. Even with the smaller population the Australian method would require modification if it were to form the basis of an ongoing surveillance system.

## COMPARISON OF RESULTS

Comparisons of data from the two studies are presented largely to exemplify methodological issues discussed in the text. While international comparisons attract considerable attention, we are acutely aware of their limitations, as considered in the discussion, below. Comparability of data from the two studies was maximised by deriving conceptually similar subsets from each. However, exactly equivalent subsets of data could not be derived. Denominator data used in each study were available only in the form of summary tables, in which occupations and industries were aggregated into particular classes; differences

in these aggregations between the two countries constrained the extraction of comparable subsets of data. Comparison was restricted to the three calendar years for which both studies could provide data (1 January 1982–31 December 1984).

Both studies included as cases persons fatally injured in the course of paid employment. While the Australian study also collected data on persons injured while travelling between home and work, unpaid workers, students and bystanders to work, these categories were excluded from comparison (Table 2).

The U.S. study included persons aged 16 years or older, while the Australian study also included 15 year-olds. Employment data were not available for persons aged 15 or less in the U.S., so fatality data were not collected for this age group. While 15 year-olds could be distinguished and excluded from numerator data in the Australian study, excluding them from the denominator data presented difficulties. Fifteen year-olds comprised only 0.5% of cases in the Australian data used in making comparisons, and 10.3% of the 15–19 year age group. Failure to exclude them had little effect on rates for all ages, and none on age-specific rates other than for the youngest group.

TABLE 2

Subsets of data from NTOF (U.S.A.) and WRFS (Australia) studies on which comparisons were based

Criteria for inclusion <sup>a</sup>	NTOF (U.S.A.)	WRFS (Aust.)
Data source	Death Certificates	Coroners' records
Date of death	1/1/82 to 31/12/84	1/1/82 to 31/12/84
ICD9 "cause of death" codes	E800–E949, E960–E999	E800–E869, E880–E929, E960–E999
Age at death	16 years +	15 years +
"Work-relatedness"	"Injury at work" according to death certificate	"work-related" according to study personnel (excluding injuries while commuting)
Reference population	Civilian labor force	Civilian labor force

<sup>a</sup>Fulfilment of all criteria was necessary for inclusion of a case.

Deaths coded to medical misadventure were included in the U.S. study but excluded from the Australian study. Less than one percent of U.S. deaths involving "Injury at Work" were ICD-coded to medical misadventure. These deaths remain in the U.S. dataset used in comparisons.

The employment data used in each study to calculate rates included the civilian labour force and excluded employees of the armed services. Consequently, military cases were excluded from the U.S. and Australian data used in comparisons. The U.S. study had included suicides at work, while the Australian study had not. Hence, cases in the U.S. dataset where the "type of injury" was recorded as suicide were excluded for the purposes of comparison with Australian data.

The employment data were estimates of the mean number of persons employed in the civilian labor force in the study period, rather than person-time estimates. A preferable denominator unit may have been person-years of employment, as this would have taken account of variations in duration of exposure to the risks of work. Such data, however, were not available for the present comparison.

Considering only the relatively comparable sets of data as described, from 1982 through 1984 about 18 000 fatal work-related injuries occurred in the U.S. and nearly 1 300 in Australia. Based on these subsets, the overall mean annual fatality rates for this period were similar: 5.9/100 000 in the U.S. and 6.7/100 000 in Australia. The annual rate of fatal work injuries recorded by the studies decreased significantly in both nations during the period of comparison (Table 3).

The distributions of fatalities by sex for the two countries were also very similar in these datasets, both showing a very marked male preponderance (Table 4).

TABLE 3

Distribution of fatal occupational injuries in the NTOF (U.S.A.) and WRFS (Australia), 1982-1984: by year of death

Year	NTOF (U.S.A.)		WRFS (Australia)	
	<i>N</i>	Rate <sup>a</sup>	<i>N</i>	Rate <sup>a</sup>
1982	6 322	6.4	478	7.5
1983	5 739	5.7	407	6.5
1984	6 029	5.7	392	6.1
<b>Total</b>	<b>18 090</b>	<b>5.9</b>	<b>1 277</b>	<b>6.7</b>

<sup>a</sup>Per 100 000 workers.

Note: Chi-square tests of trend: U.S.A.:  $P < 0.001$ , Australia:  $P < 0.005$ .

TABLE 4

Distribution of fatal occupational injuries in the NTOF (U.S.A.) and WRFS (Australia), 1982-1984: by sex

Sex	NTOF (U.S.A.)		WRFS (Australia)	
	%	Rate <sup>a</sup>	%	Rate <sup>a</sup>
Male	94	9.9	96	10.2
Female	6	0.8	4	0.7
<b>Total</b>	<b>100</b>	<b>5.9</b>	<b>100</b>	<b>6.7</b>

<sup>a</sup>Per 100 000 male or female workers.

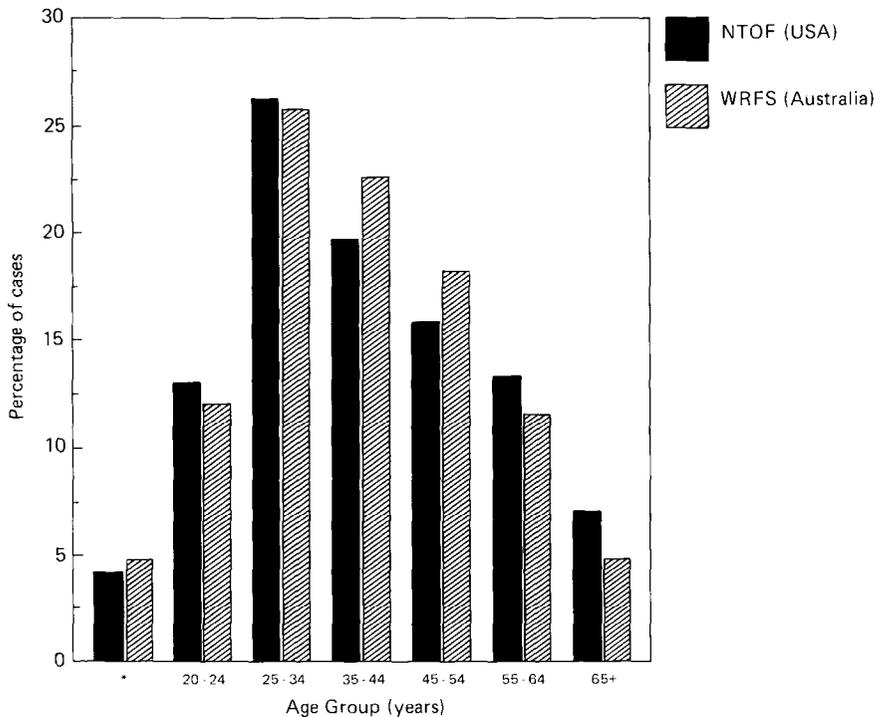


Fig. 1. Age distribution of work-related fatalities, NTOF (U.S.A.) and WRFS (Australia), 1982-1984. \*: age group NTOF 16-19 years, WRFS 15-19 years.

In both studies the rates of fatalities were lowest in the youngest groups, remained fairly constant from 20 to 44 years, and rose markedly with age. Figure 1 shows, for each study, the percentage of cases in each age group. Figure 2 shows age-specific rates.

Comparisons by occupation and industry group posed greater difficulties.

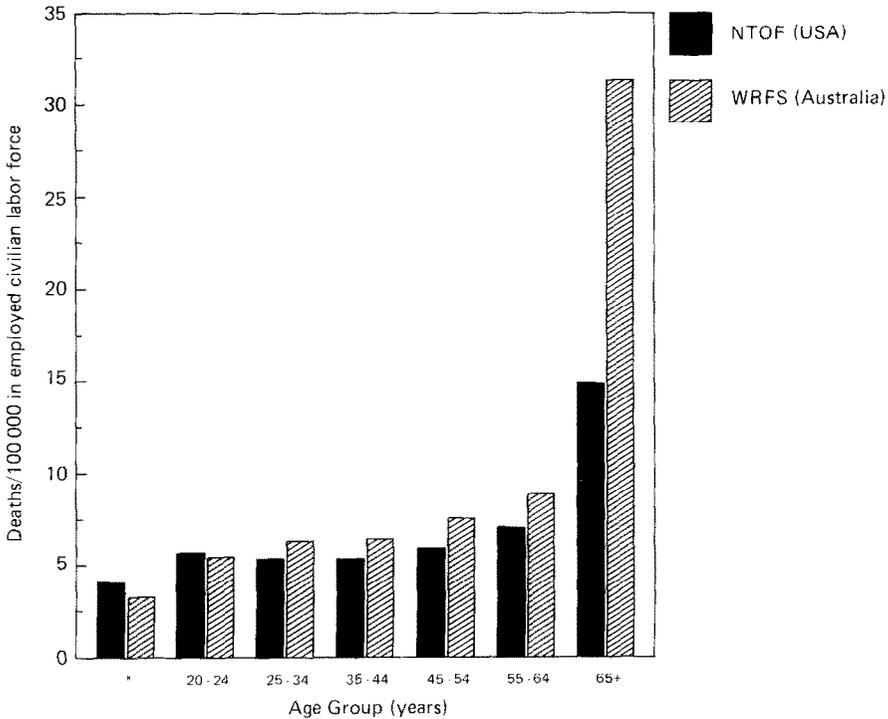


Fig. 2. Work related fatality rates by age group, NTOF (U.S.A.) and WRFS (Australia), 1982-1984. \*: age group NTOF 16-19 years, WRFS 15-19 years.

Problems included differences in classifications and in definitions of the data items coded to the classifications, as well as missing data.

In both studies, industry and occupation of cases were coded according to the classifications used in the denominators. There were similarities in the U.S. and Australian denominator classification systems. Both were compatible with the International Standard Industrial Classification of All Economic Activities (ISIC) (United Nations, 1968), and the International Standard Classification of Occupations (ISCO) (International Labour Organisation, 1968). Some broad comparisons of occupation and industry rates were possible, but differences in the aggregation of individual occupations and industries into the classes used in the denominators were a constraint.

In the U.S. study, occupation and industry referred to the *usual* activities of the injured person. In the Australian study, industry was that in which the person was engaged when injured (*current* industry, whether in a usual, new, or second job), and both usual and current occupation were collected. Australian data for current occupation were used in comparisons, as this data item was more complete than usual occupation. While usual occupation differed

from current occupation in many individual cases, the overall distribution by occupation class was very similar, and the ranking of rates was identical.

The impact of comparing U.S. data representing usual industry with Australian data for current industry is not known. However, if the distributions of usual and current industry of cases in the WRFS were as similar as the distributions of usual and current occupation, then the difference probably has little effect on the comparisons made.

Even when occupation or industry titles are technically equivalent, the meaning of comparisons may be affected by differences in work methods, tasks, environmental conditions and other factors. Examples of such factors are the degree of mechanisation of an industry, and cultural traditions affecting assessment of how safe is "safe enough". Collectively, such factors may be referred to as contextual (International Labour Organisation, 1982a). Contextual factors are particularly difficult to account for in comparisons, as they are bound up with cultural and economic traditions and circumstances, and are implicit rather than explicit characteristics of the data. They were not formally considered in this project.

In the U.S. study 12.4% of the cases and 10.6% in the Australian study could not be classified by industry group due to limitations of data sources. Similarly,

TABLE 5

Distribution of fatal occupational injuries in the NTOF (U.S.A.) and WRFS (Australia), 1982-1984: by industry division

Industry division	NTOF (U.S.A.)		WRFS (Australia)	
	%	Rate <sup>a</sup>	%	Rate <sup>a</sup>
Agriculture/Forestry/Fishing	13.0	21.6	25.6	26.6
Mining	5.6	32.5	6.0	26.2
Construction	17.5	26.8	16.2	15.9
Manufacturing	15.2	4.8	11.0	4.0
Transportation/ Communication/ Public utilities	20.3	26.5	21.7	14.5
Wholesale/Retail trade	7.9	2.3	7.0	2.4
Finance/Insurance/ Real estate	1.2	1.3	2.9	2.1
Services	12.3	3.9	6.5	1.9
Public administration	6.9	8.4	3.2	4.4
<b>Total</b>	<b>99.9</b>	<b>5.9</b>	<b>100</b>	<b>6.7</b>

<sup>a</sup>Per 100 000 workers in the industry division.

Note: Cases not classifiable by industry (12.4% of the U.S. fatalities and 10.7% of Australian fatalities) were proportionately redistributed among industry divisions in the calculation of rates presented in this table.

TABLE 6

Distribution of fatal occupational injuries in the NTOF (U.S.A.) and WRFS (Australia), 1982-1984: by occupation class

Occupation class	NTOF (U.S.A.)		WRFS (Australia)	
	%	Rate <sup>a</sup>	%	Rate <sup>a</sup>
Professional/Technical	7.1	2.7	2.9	1.3
Executive/Admin/Manager	7.4	4.1	1.2	1.2
Clerical	1.7	0.6	0.3	0.1
Sales	3.8	1.9	2.5	1.8
Farm/Forestry/Fishing	14.4	23.5	22.1	20.8
Service	5.5	2.4	5.4	3.7
Transportation/Craftsmen/ Operatives/Laborers/Miners	60.1	12.5	65.7	12.7
Transportation operatives	(19.1)	(26.8)		
Transport/Communication			(28.4)	(36.1)
Craftsmen/Operatives/ Laborers	(41.0)	(10.1)		
Tradesmen/Laborers			(32.2)	(7.5)
Miners/Quarrymen			(5.2)	(62.3)
<b>Total</b>	<b>100</b>	<b>5.9</b>	<b>100</b>	<b>6.7</b>

<sup>a</sup>Per 100 000 workers in the occupation class.

Notes: 1. Cases not classifiable by occupation (17.7% of U.S. data; 1.5% of Australian data) were proportionately redistributed among occupation categories in the calculation of the rates presented in this table.

2. Data in parentheses are for occupation groups which were not comparable between Australia and the U.S.A.

17.7% of U.S. cases and 1.5% of Australian cases could not be ascribed to an occupation group. For the purposes of comparison, unclassified cases were redistributed among industry and occupation groups in proportion to the number of cases classified to each group. This adjustment assumed that the likelihood of a case remaining unclassified did not vary with industry or occupation. While the validity of this assumption could not be tested directly, it was possible to determine, in the Australian study, that the proportion of cases not classified to an industry group was evenly distributed among occupation groups.

Discrepancies between the sets of data for the two countries — particularly denominator data — precluded detailed industry- and occupation-specific analyses, and exemplify the difficulties of making meaningful international comparisons of employment characteristics.

However, comparisons were possible at the level of broad industry and occupation divisions. Greater discrepancies appeared between U.S. and Australian data for industry divisions than were seen with other variables (Table 5).

Both absolute rates, and rankings of industry divisions by rate and proportion of cases, differ somewhat between studies. Nevertheless, both datasets identified the same four high risk industry divisions (agriculture, mining, construction and transportation) and five much lower risk divisions (manufacturing, trade, finance, service, and public administration).

Distributions of fatal work injuries by occupation category were surprisingly similar in the two sets of data (Table 6). Fatality rates for the occupation groups including farmers, foresters and fishers were about twice those of any other comparable groups. The occupation group with the second highest rate in each study was an aggregation including transport workers, craftsmen, operatives, labourers and miners. The smaller constituent groups in this aggregation were not comparable in the U.S. and Australian datasets. When aggregated into the larger, more comparable group, rates for the two studies were very similar.

## DISCUSSION

Comparisons of work injury surveillance data from different sources representing the same population can provide useful data for validity and reliability assessments (Karlson et al., 1978; Baker et al., 1982; Colorado Department of Health, 1988; Stout-Wiegand, 1988a,b; Suruda and Emmett, 1988; Massachusetts Department of Public Health, 1989). Comparisons between geographic or economic sectors afford the opportunity to share experience and information which can be used to monitor policies and programs and to co-ordinate interstate or international efforts (International Labour Organisation, 1982a).

Although fatalities are not necessarily representative of the total work injury picture, fatality surveillance is an important component of work injury surveillance. The incidence of fatalities is a marker of a population's occupational health and safety performance. Fatalities are tragic and potentially preventable events, and working communities require information on their occurrence; hazards which cause death deserve concentrated control efforts.

Compared with non-fatal injury, death is relatively easy to enumerate. Despite this, studies of work fatalities have encountered major difficulties, and estimates of the occurrence of fatalities have been highly discrepant. For example, the number of work-related fatalities in the U.S.A. in 1984 has been variously estimated as 3750 by the Bureau of Labor Statistics (Bureau of Labor Statistics, 1986), 4960 by the National Center for Health Statistics<sup>1</sup> and 11 500 by the National Safety Council (National Safety Council, 1986). These discrepancies can be attributed in part to differences in definitions and methods of estimation, and their existence underlines the importance of detailed specification of such definitions and methods. Without it, interpretation of

<sup>1</sup>Jeffery Maurer: National Center for Health Statistics, personal communication, 16 April, 1987.

fatality data is difficult, time trends cannot be assessed, and the data have little operational value in occupational health and safety surveillance.

Comparability of definitions and methods (a prerequisite for valid comparisons) is often overlooked when national fatality data are compared. For example, the ILO publishes national estimates of occupational fatalities in a form that invites international comparisons. Although the ILO requests that national statistics supplied to it conform to recommended standards, concepts, methods and definitions vary so widely between nations that the validity of comparisons is questionable. An explanatory note cautions that the published data in the table "should be used with extreme care" (International Labour Organisation, 1987). Moreover, insufficient detail is provided to evaluate the degree of comparability between nations.

Many of the conditions required for valid comparison were satisfied by the U.S. and Australian studies of fatal work-related injuries. The two studies had the same objectives, and their definitions of fatal work-related injuries (implied or stated) were similar. Different case selection criteria were applied, but these could be rendered reasonably compatible by segregating particular types of cases. In both studies the national employed civilian labor force was the basis for generating fatality rates.

On the other hand, available evidence suggests that the U.S. study probably missed more cases than the Australian study, because of unreliability in completion of the "Injury at Work" item on U.S. death certificates. If this is so, the difference between the overall U.S. and Australian fatality rates is likely to be less than that described here, i.e., less than the difference between 5.9 and 6.7 deaths per 100 000 workers.

Because the parameters of each study were clearly specified or could be delineated by the authors, it was feasible and valid to compare corresponding subsets of the U.S. and Australian data. The comparison incorporated both an examination of documented parameters and the authors' detailed knowledge of data sources in their respective countries.

The results were remarkably similar, despite differences in data acquisition methods and in the structure of labor and the environment of work in the two countries. The similarities invite sharing in the development of preventive measures.

The comparison has provided insights into the operation and utility of fatality data collection systems, highlighting the following points.

1. Valid fatality surveillance requires that all relevant cases are detected, and that all cases included in the collection comply with the stipulated definition of "work-related fatality". Population-based fatality surveillance programs should seek either to ascertain all work fatalities in the population, or all work fatalities occurring in a representative sample of the population. The relatively low frequency of work-related fatalities limits the potential for the use of population sampling.

2. Definitions, coding systems and data acquisition methods should be documented in detail for all published fatal injury data. Departures from standard definitions and coding schemes should be specified. Knowledge of the parameters of surveillance data is necessary for accurate interpretation of results and for assessment of the comparability of the data with other sources and with published statistics.

3. Comprehensive case ascertainment generally depends upon the participation of a large number of people in identifying cases (persons completing death registration forms in the U.S.A., for example), but this creates difficulties in maintaining uniform compliance with definitions. The validity of surveillance data may be promoted by simplifying the definition as much as possible, by careful and clear wording of questions on forms (preferably evaluated for their reliability in the field), by minimising the number of persons required to apply the definition and the number of data collection points (e.g., restricting case ascertainment to coroners' staff, if all relevant deaths come to their attention), and by provision of appropriate guidance or assistance to such persons.

In Australia, minor changes to existing methods of processing of information on deaths by coroners' offices and the Australian Bureau of Statistics could greatly facilitate surveillance of work-related fatalities, and other injury deaths. A proposal to achieve the changes is being discussed with the agencies involved. Computerisation of coroners' indexes or files (innovations being considered in some jurisdictions), and the inclusion of a nationally consistent data item flagging work-related deaths, would simplify surveillance.

4. Wherever possible, fatality data should be expressed in the form of rates. Denominators should preferably be in units of person-time. In order to obtain the required consistency between numerator and denominator, the denominator source must be identified early in the planning stage. When two or more sources of employment data are available as potential denominator sources, factors for consideration in selection should include the manner in which employment is defined, the demographic and employment variables available, and the classification schemes used for these variables.

5. While fatality surveillance usually concentrates on the employed labor force, it is advantageous to obtain data on other identifiable worker groups, such as volunteer workers. Some such groups may be at special risk (e.g., volunteer rural firefighters), and may share risks with employed persons doing similar work. Others have an ambiguous or changing status in relation to the employed labor force (e.g., unpaid domestic workers), and therefore should not be omitted from surveillance. However, workers outside the employed labor force should be distinguishable for the purposes of computing fatality rates and comparisons with other data sources.

6. Definitions, coding schemes and data acquisition methods tend to be influenced by the characteristics of the data available locally for the population

under study, particularly the available denominator source. Compatibility with other populations is likely to be of secondary concern. Locally derived definitions and classifications may conflict with those used elsewhere, or with standard definitions and classifications derived in the future. Two partial solutions can be considered for the purpose of comparison. First, available standard parameters should be incorporated wherever possible in the development of local definitions and classifications. Second, in some instances it may be worth collecting surveillance data according to more than one set of definitions and classifications.

Meaningful comparisons require agreement on the units to be compared and are more likely to be achievable if they are considered in the planning of surveillance systems. Thorough documentation of surveillance parameters is essential for this. But even the most complete documentation can provide only limited insights into the traditions and practices involved in data collection, and into contextual factors characteristic of particular cultures, economies and time periods. Direct consultation between investigators can be of great value in maximising technical comparability. Meaningful contextual interpretation requires, in addition, considerable familiarity with the communities under surveillance.

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