THE EPIDEMIOLOGY OF WORK-RELATED FATALITIES IN AUSTRALIA

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ABSTRACT

Background: There is no on-going information on the number, rate or circumstances of work-related fatal injury in Australia. This thesis reports on a study aimed to identify and describe all work-related fatalities that occurred in Australia during the four-year period 1989 to 1992, in order to make a significant contribution to the effectiveness of activity designed to prevent work-related traumatic death.

Methods: A broad definition of work was used, with particular focus on workers and bystanders. The study also included the injury-related deaths of volunteers, students, persons performing home duties and persons fatally injured on farms but not due to obvious farm work. The data were obtained primarily from coronial files. Files were found for 99.7% of the deaths of interest. Detailed results are presented on the work-related deaths of workers, bystanders and persons fatally injured while engaged in home duties. The results for workers are also compared with those from an earlier study of work-related fatalities in Australia, which covered the years 1982 to 1984 inclusive. Other aspects of work-related deaths are considered in detail, including the effect of employment arrangements; their coverage by occupational health and safety and compensation agencies; their handling by the coronial system; the role of External Cause codes in identifying and monitoring work-related injury deaths; and the reliability and validity of the definitions used to classify work-related injury deaths.

Results: There were 2,413 persons fatally injured while working or commuting during the study period (1,787 working; 626 commuting), with a rate of death for working persons of 5.5 per 100,000 persons per year. This compared to the rate of 6.7 for working deaths during 1982 to 1984, with just under half of the decline probably due to changes in the industry distribution of the workforce. Another 802 persons were fatally injured as a result of someone else's work activity, and 296 persons aged 15 years and

over were fatally injured while undertaking active tasks in an unpaid and informal capacity in their own home or in someone else's home. Thirty-four percent of working deaths were not covered by either occupational health and safety (OHS) or compensation agencies. A consideration of External Cause codes for the period 1979 to 1997 inclusive suggested there was a yearly decrease in the rate of workplace deaths of 2.6% per year, with less than half of this change due to industry changes in the workforce. Deaths occurring in a small number of particular circumstances were found to pose classification problems.

Conclusion: Fatal work-related trauma remains an important problem for the Australian community. By understanding how and why these deaths occur, appropriate steps can be taken to prevent similar incidents recurring. It is expected that the results reported here, and other information that has arisen from the study, will make an important contribution to developing this understanding and preventing the occurrence of work-related traumatic death in Australia.

DEDICATION

This PhD describes the terrible tale of lost life resulting from injuries associated with work. To read literally thousands of coroners' files was to read the life stories of thousands of people, always knowing that none of the stories would have a happy ending. I hope the work presented in this thesis can make some contribution to lowering the serious and fatal injury still associated with work in Australia.

The pain, suffering and loss I read of during this study have emphasised to me the importance of making the most of whatever time is available to each of us, and of valuing the family and friends I have. I wish my father were here to guide me when I need it and to help me celebrate finally finishing the project. I miss him. However, I am very fortunate to have a mother and step-father who are always positive and give wise counsel when I need it; a wonderful wife who is unfailing in the support she provides and sacrifices she makes for me to pursue my many interests; and three beautiful children who help to make each day worth living.

To Denis, Judy, Ron, Felicity, Elizabeth, Matthew and Thomas, this thesis is dedicated to you.

STATEMENT OF INVOLVEMENT

The study described in this thesis, and much of the analysis presented here, was conducted while the author was a member of the Epidemiology Unit of the National Occupational Health and Safety Commission (NOHSC). The author planned the entire study, led the study team, and was the key participant in all aspects of the study, but all team members made an important contribution to the successful outcome of the study.

The author wrote all the content of this thesis and conducted all analyses presented here. Some of the analyses had initially been conducted by other team members, but all of these were re-done by the author for this thesis. All figures were produced by the author, although the template for many had been produced by Mr Leigh Hendrie for the initial NOHSC report describing the main findings of the study.

Data were collected from the coroners' offices by a team of research officers, under the supervision of the author. Coding of raw data was conducted by all team members, including the author. Checking, correction and analysis of data for the original NOHSC report, and subsequent analyses for more detailed, specific reports, were conducted by all team members, again under the direction of the author.

The main team members were Tim Driscoll, Rebecca Mitchell, John Mandryk, Sandra Healey and Leigh Hendrie.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

The following papers arising from this study have been published or are in press.

First authored

1 Driscoll T, Feyer A-M, Stout N, Williamson A. Assessing the classification of work-relatedness of fatal incidents: a comparison between Australia, New Zealand and the United States. *Injury Control and Safety Promotion* 2002;**9**(1):32-39.

2 Driscoll T, Healey S, Mitchell R, Mandryk J, Hendrie A, Hull B. Are the self-employed at higher risk of fatal work-related injury? *Safety Science* 2003. In press.

3 Driscoll T, Hull B, Mandryk J, Mitchell R, Howland A. Minimising the personal cost of involvement in research into traumatic death. *Safety Science* 1997;**25**(1-3):45-53.

4 Driscoll T, Mitchell R. Fatal work injuries in New South Wales. NSW Health Public Health Bulletin 2002;**13**(5):95-99.

5 Driscoll TR, Mitchell RJ, Hendrie AL, Healey S, Mandryk JA, Hull BP. Unintentional fatal injuries arising from unpaid work at home. *Injury Prevention* 2003. In press.

6 Driscoll T, Mitchell R, Mandryk, J, Healey S, Hendrie A, Hull B. Work-related fatalities in Australia, 1989 to 1992: an overview. *Journal of Occupational Health and Safety - Australia New Zealand* 2001;**17**(1):45-66.

7 Driscoll T, Mitchell R, Mandryk J, Healey S, Hendrie A, Hull B. Trends in work-related fatalities in Australia, 1982 to 1992. *Journal of Occupational Health and Safety - Australia New Zealand* 2002;**18**(1):21-33.

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Other papers

1 Franklin R, Mitchell R, Driscoll T, Fragar L. Agricultural work–related fatalities in Australia, 1989–1992. *Journal of Agricultural Safety and Health* 2001;**7**(4): 213-227.

2 Franklin R, Mitchell R, Driscoll T, Fragar L. Non-work–related farm fatalities in Australia, 1989–1992. *Journal of Agricultural Safety and Health* 2001;**7**(4): 229-239.

3 Mitchell R, Driscoll T, Healey S. Work-related road fatalities in Australia. *Accident Analysis and Prevention* 2003. In press.

4 Mitchell R, Driscoll T, Healey S, Hull B, Mandryk J, Hendrie L. Work-related fatal injuries in the fishing industry in Australia, 1989 to 1992. *Journal of Occupational Health and Safety - Australia New Zealand* 2001;**17**(4):375-386).

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6 Mitchell R, Driscoll T, Healey S, Mandryk J, Hendrie L, Hull B. Work-related fatalities involving construction activities in Australia, 1982-1984 to 1989-1992. *Journal of Occupational Health and Safety - Australia New Zealand* 2003. In press.

7 Mitchell R, Franklin R, Driscoll T, Fragar L. Farm-related fatalities involving children in Australia, 1989–1992. *Australian and New Zealand Journal of Pubic Health* 2001;**25**(4):307-314.

8 Mitchell RJ, Franklin RC, Driscoll TR, Fragar LJ. Farm-related fatal injury of young and older adults in Australia, 1989-1992. Australian Journal of Rural Health 2002;**10**(4): 209-219.

The following papers arising directly from an international comparison of work-related fatalities which relied on data from this study for the Australian component of the comparison, and on which the author worked, have been published:

1 Feyer A-M, Williamson A, Stout N, Driscoll T, Usher H, Langley J. Comparison of work-related fatal injuries in the United States, Australia and New Zealand: method and overall findings. *Injury Prevention* 2001;**7**(1):22-28.

2 Williamson A, Feyer A-M, Stout N, Driscoll T, Usher H. Use of narrative analysis for comparisons of the causes of fatal accidents in three countries: New Zealand, Australia, and the United States. *Injury Prevention* 2001;**7**(Suppl I):15-20.

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The study was a massive exercise, requiring detailed planning, meticulous attention to detail, and tremendous cooperation of many people in the public sector in Australia, That the study proved so successful is a testament to the positive contribution made by the scores of people involved.

Of particular importance was the contribution made by the main other study team members - Rebecca Mitchell, John Mandryk, Sandra Healey and Leigh Hendrie. We worked extremely well as a team throughout the study and became good friends, which improved the quality and efficiency of our work and made the work more enjoyable. Most importantly, we remain good friends even though we all now work in different areas.

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ABBREVIATIONS

AAHU	Australian Agricultural Health Unit
ACT	Australian Capital Territory
ABS	Australian Bureau of Statistics
AIHW	Australian Institute of Health and Welfare
ASCCSS	Australian Standard Classification of Countries for Social Statistics
ASCO	Australian Standard Classification of Occupations
ASIC	Australian Standard Industry Classification
AUST	Australia
BASI	Bureau of Air Safety Investigation
CASA	Civil Aviation Safety Authority (Formerly CAA: Civil Aviation Authority)
CCLO	A Classification and Classified List of Occupations
CFOI	Census of Fatal Occupational Injuries
CI	Confidence Interval
E-CODE	External Cause of Death Code
ECLF	Employed Civilian Labour Force
FORS	Federal Office of Road Safety
ICD-9	International Classification of Diseases, 9th Revision
LFS	Labour Force Survey
MCD	Medically certified death
MVA	Motor vehicle accident (term used in some text descriptions)
MVI	Motor vehicle incident
NCIS	National Coroners Information System
NDI	National Deaths Index
NDS	National Data Set for Compensation-based Statistics
NDSIS	National Data Standards for Injury Surveillance
NEC	Not elsewhere classified

NISU	National Injury Surveillance Unit
NIOSH	National Institute of Occupational Safety and Health
NOHSC	National Occupational Health and Safety Commission
NSW	New South Wales
NT	Northern Territory
OHS	Occupational Health and Safety
PPE	Personal protective equipment
QLD	Queensland
SA	South Australia
TAFE	Technical and Further Education facility
TAS	Tasmania
VIC	Victoria
WA	Western Australia
WHO	World Health Organisation
WRFS 1	The first work-related fatality study (covering the years 1982 to 1984)
WRFS 2	The second work-related fatality study (covering the years 1989 to 1992)

Introduction

This thesis provides an overview of the key results from a study of work-related fatal injuries (fatalities) that occurred in Australia in the four-year period 1989 to 1992 (WRFS 2). The data were obtained primarily from coronial files. The information is also compared to a similar study of work-related fatalities that covered the three-year period 1982 to 1984 (WRFS 1).

Aim

The study aimed to identify and describe all work-related fatalities that occurred in Australia during the study period in order to make a significant contribution to the effectiveness of activity designed to prevent work-related traumatic death.

Methods

This study included all people who died as a result of work-related trauma that occurred anywhere in Australia in the four-year period 1989 to 1992.

The study excluded persons who died of diseases such as cancers, heart attacks and other serious medical conditions; committed suicide, even if there appeared to be some direct connection with work; or received non-fatal injuries.

A broad definition of work was used and the cases of interest were divided into two main groups, workers and bystanders:

- **"Workers"** were persons fatally injured whilst performing some kind of activity for pay, profit or kind;

- **"Bystanders"** were persons not working but who were fatally injured directly as a result of someone else's work activity.

The study also included a number of smaller groups whose death was related to work in a more indirect way. These groups were volunteers, students, persons performing unpaid home duties and persons fatally injured on farms but not due to obvious farm work.

Files were found for 99.7% of deaths. Of the original 22,957 deaths of potential interest, 3,630 were confirmed as deaths related to work (15.8%); 17,805 were excluded as non-work related (77.6%); and 1,522 were excluded as indeterminate (6.6%).

Results

The study examined a number of groups of persons whose deaths were related to work. The results presented in the thesis focus particularly on the deaths of working persons, (excluding people commuting either to or from work), but detailed considerations of fatally injured bystanders and of home duties deaths are also presented.

Working deaths and commuting deaths

There were 2,413 persons fatally injured whilst working or commuting during the four-year period 1989 to 1992. That is, an average of 603 deaths each year (or 12 deaths each week). Of these 2,413 persons:

- 1,787 were injured whilst working (447 deaths per year):
  - 1,244 were injured in a workplace (workplace deaths) (311 per year); and
  - 543 were injured in motor vehicle incidents on public roads (work-road deaths) (136 per year); and

- 626 were injured commuting to or from work (157 per year).

The overall rates of work-related death per 100,000 persons per year were:

- 7.5 for workers and commuters combined. The year-specific rate decreased for each year of the study; and
- 5.5 for working deaths (3.8 for workplace deaths; 1.7 for work-road deaths). The year-specific rates decreased for the first three years of the study and then remained steady for the final year.

When changes in the industry distribution of the workforce were adjusted for the results were similar, although the decrease over time was not as large.

The majority of deaths were of males and the rates of death were approximately ten times higher for males compared with females in all categories of working except commuting, for which the rate was approximately 2.5 times higher in males.

There was a gradual rise in the death rate of working cases from the 15 – 19 year group until the 60 – 64 year group, after which there was a dramatic increase.

The industries with the highest rates of death (per 100,000 persons per year) were forestry (97), fishing (93), mining (36), transport and storage (23), agriculture (21), and construction (10).

Some specific occupations found to have high rates (per 100,000 persons per year) included commercial pilots (197), fishermen/women (132), forestry labourers (119), drilling plant operators (72), mining labourers (65), ship's pilots / deck officers (58),

structural steel labourers (43), truck drivers (42), and excavation and earthmoving machinery operators (38).

The numbers and rates of death differed considerably between States and Territories (jurisdictions), although when changes in the industry distribution of the workforce were adjusted for, the differences between the jurisdictions decreased.

The main agencies involved in the incidents were motor vehicles; environmental agencies; materials, substances and chemicals; and machinery and fixed plant.

The main mechanisms involved in the incidents were vehicle incidents (mainly motor vehicles but also aircraft); being hit by moving objects; falls; contact with electricity; and drowning. Falls, falling objects and contact with electricity were common mechanisms across a number of different occupation and industry groups.

Common places for the fatal incidents were public roads (33%); farms or other rural workplaces (20%); industrial or construction areas (13%); mines or quarries (7%); and trade or service areas (7%).

The most common pathophysiological causes death were multiple injuries; head injuries; injuries to the trunk; electrocution; drowning; and mechanical asphyxia.

Blood alcohol measurements were available for 70% of working deaths. Raised blood alcohol appeared to contribute to at least 4% of all working deaths and the alcohol had been consumed in connection with work in 44% of these alcohol-related deaths. Drugs appeared to contribute to 2% to 3% of the working deaths but information on drug

levels was available only in about one third of cases. Types of drugs found included amphetamines, cannabis, barbiturates and narcotics.

The 1,787 deaths of working persons resulted from 1,657 incidents. Eighty-five of these incidents involved more than one working person being killed. The number of working persons killed in the multiple incidents ranged from two to eleven.

Comparison with WRFS 1

Compared with WRFS 1 (deaths occurring in 1982 to 1984), the current study showed a similar number of deaths per year but a decrease in overall rates of death for working persons for Australia and for each State and Territory. The rates in Australia dropped from 6.7 per 100,000 persons per year to 5.5 per 100,000, a decline of 16.8%, but the decline was about 10% when changes in industry distribution of the workforce were adjusted for.

The rates of death in the industries with significant numbers of deaths increased considerably for mining; and moderately for transport and storage and for agriculture; decreased considerably for manufacturing, construction and for wholesale and retail trade; and changed little for other industries.

Within each jurisdiction the rate went up for some industries and down for others, even though the overall rate decreased.

Bystanders

In addition to the 2,413 persons killed whilst working or commuting, another 802 persons were fatally injured as a result of someone else's work activity (200 deaths per year or almost four deaths each week).

There were 325 workplace bystander deaths (81 deaths per year), almost half of whom were children less than 15 years. About one-third of the incidents involved farms or farm work.

There were 532 road bystanders deaths (133 deaths per year - some of these were also classified as workplace bystanders). Most of the working persons operating the working vehicle were truck drivers working in the transport industry. Blood alcohol levels were available for 49% of the working or commuting persons involved in bystander deaths. Raised blood alcohol levels of the working person were known to be a factor in at least 3% of the road bystander deaths.

Patterns of fatal incidents

There were a number of examples of similar combinations of circumstances that led to work-related injury deaths. These should help inform specific prevention strategies. Examples included:

- working alone under a raised vehicle that was not adequately secured and/or supported;
- working on a roof without a safety harness and falling through a skylight not properly signposted, with similar colouring to the roof material and without underlying protective mesh;

- performing maintenance or installation work and coming into contact with live wires on a circuit not protected by a residual current device, often when the electricity should have been disconnected;
- a combination of a steep slope and a tractor without a rollover protective device and/or seat belts;
- a combination of high speed, lack of sleep, night driving and sometimes alcohol and/or drugs in long distance truck drivers involved in motor vehicle incidents on public roads;
- construction and mining labourers on worksites being run over by reversing vehicles from which the driver's vision was restricted because of blind spots;
- falls from ladders that were not secured;
- children (especially those under five) on farms drowning in dams when they wandered away from their parents, often climbing through inadequate fencing and/or following a pet to a small dam into which they fall due to the steep slopes; and
- members of the public being killed when their vehicle was struck by a semi–trailer whose driver had lost control of the truck

Home duties deaths

Home duties deaths were persons who were fatally injured undertaking active tasks in an unpaid and informal capacity in or around their own home or someone else's home. There were 296 persons aged 15 years and over who were fatally injured while undertaking active tasks in an unpaid and informal capacity in their own home or in someone else's home (74 per year). This was a rate of about five per million persons per year.

Males had both a higher number of deaths, and a higher rate of death, compared to women. When the time spent on various activities was taken into account, men had four times the risk of being killed while undertaking housework, four times the risk while gardening, and ten times the risk while involved in maintenance.

Rates were reasonably steady in younger ages, but increased from age 55 years onwards, especially for women.

The most common activities at the time of the fatal incidents were home repairs and maintenance (26%); gardening and lawn care (19%); car care (11%); food and drink preparation (10%); home improvements (9%); and cleaning grounds (6%).

The most common locations of the fatal incidents were the garden (26%); kitchen (8%); paddock or field (7%); garage or carport (7%); roof (6%);and shed (6%).

The most common mechanisms of the fatal incidents were falls from a height (28%); contact with electricity (19%); being hit by falling objects (12%); and contact with heat (12%).

Common specific agencies involved in the fatal incidents were ladders (18%); roofs (7%); manual lifting equipment (mainly car jacks – 7%); tractors (5%); and portable electric cables (5%).

The most common pathophysiological causes of death were head injuries (23%); electrocutions (19%); and mechanical asphyxia (10%).

Alcohol probably contributed to between 9% and 10% of home duties deaths.

Common scenarios involved in the fatal incidents were falling from unsecured ladders whilst performing maintenance; being crushed while working under a vehicle that had not been properly supported or chocked; being electrocuted whilst working with faulty equipment or on live circuits; and being burned in fires resulting from stoves being left on and unattended.

Employment arrangements

Of the 1,787 workers fatally injured as a result of work, about one fifth to one quarter were self-employed and around two thirds were employees.

On a crude basis, the rate of death was about 70% higher in self-employed workers compared to employees but, once standardised by differences in industry distribution, the rates for self-employed workers and employees were very similar.

Comparison with OHS and compensation agency information

The working and commuting deaths identified in this study were compared with working and commuting deaths recorded by OHS and compensation agencies in most States and Territories.

This comparison revealed that 65% of working deaths were not covered (captured) by OHS agencies; 43% of working deaths were not covered by compensation agencies; and 34% of working deaths were not covered by either OHS or compensation agencies.

There was considerable variation in coverage between jurisdictions, and of fatal incidents involving different industries, occupations, mechanisms and agencies.

Coronial and other agency information

Inquests were held in 56% of all incidents involving the deaths of working persons, but there was considerable variation in the proportion of inquests for different industries, occupations and mechanisms involved in the fatal incidents.

Recommendations were made by the coroner in 15% of all working cases and by an OHS agency for 14% of all working cases and for 40% of the deaths of working cases for which there was an OHS report in the coronial file. Other specialist authorities made recommendations in 7% of all working cases.

External Cause codes

The single biggest External Cause code category was "Motor vehicle traffic accidents" (MVTAs), which accounted for 31% of the working deaths and, as expected, virtually all the work-road deaths. External Cause code categories covering machinery, falling objects, aircraft crashes, falls and electricity each accounted for more than six percent of working deaths and ten percent of workplace deaths, with machinery accounting for 20% of the workplace deaths.

Some External Causes are only relevant to work-related deaths of workers, and others can be expected to have a high proportion of deaths that are work-related. This was confirmed separately with the data from the current study and from WRFS 1. Based on this finding, External Cause codes were used to track the work-related deaths of workers in Australia for the period 1979 to 1997 inclusive. This analysis indicated that

there was a steady decline in the rate of work-related fatal injury in workplaces in Australia from 1979 to 1997 inclusive, with the only exception being an increase around 1988. The decrease was about 2.6% per year. Industry changes in the workforce appeared to account for less than half of this change.

Reliability and validity

A series of analyses considering the reliability and validity of case classification and the utility of the definitions used in the study showed that:

- there was a high level of agreement between the true classification (as determined by the author) and the classification assigned by the research officers for all categories, except for the *Work Bystander* and *Uncertain Case* categories, whether using brief scenarios or full Coroners' files;
- the coding agreement between officers from WRFS 1 and WRFS 2 for WRFS 1 deaths was very high, especially when considering the allocation of deaths as either working cases or not;
- Australia, New Zealand and the United States have a similar understanding of what constitutes work and work-relatedness, and that valid comparisons of work-related death data that were collected using different definitions or philosophies are possible when the data sets can be modified on the basis of common inclusion criteria; and
- deaths occurring in particular circumstances can cause classification problems. These include domestic violence; business trips; work-related social functions; travel on public roads for work versus commuting; apprentices or other workers involved in training; hobby farmers; "fringe" forms of work (such as collecting cans); bystanders, whether in a workplace or on public roads; volunteers; and deaths on farms of non-workers.

Future directions

Future surveillance of work-related traumatic death should be conducted largely through the National Coroners Information System, which is currently being established by the Australian Coroners' Society.

Conclusions

The overall rate of work-related traumatic death in Australia decreased over the 11-year period 1982 to 1992. Some industries have experienced considerable improvement, but for other industries there was no change or a worsening of the rate of death. The rate of death varied widely for different workforce groups, and for some occupations the rate of death was 10, 20 or 30 times greater than the workforce average. A number of different patterns were evident in the study findings, with similar groups of factors associated with many of the fatal incidents.

Fatal work-related trauma therefore remains an important problem for the Australian community. By understanding how and why these deaths occur, appropriate steps can be taken to prevent similar incidents recurring. It is expected that the results reported here will make an important contribution to developing this understanding and preventing the occurrence of work-related traumatic death in Australia.