Chapter 3
Methods

3.1 CASE DEFINITIONS

3.1.1 OVERALL CASE DEFINITION

The main definition for inclusion of a death in this study was the following:

'A person who suffered a non-suicide traumatic death, that occurred in Australia or to Australian-based workers, to which workplace exposures contributed as a necessary factor and which can be attributed, as an individual death, to those exposures.

Each of the components of this definition are addressed below:-

'A person who suffered'

The deceased person could be of any age, sex or nationality.

'a non-suicide'

Deaths due to suicide were not included in this study, even if there appeared to be some direct connection with work.

'traumatic'

This was defined as a cause of death that had been (or should have been) assigned an External Cause code (or E-code) of ICD-9[237] by the ABS (this was defined as an 'injury' for this study)[*]. Generally, this meant that the person died as a consequence of physical trauma or poisoning. The definition specifically excluded most disorders that would be seen as 'diseases', such as cancers, heart attacks and similar conditions. Note that if someone suffered a sudden, severe non-fatal adverse health event, such as a heart

[*] The small number of persons with unknown cause of death (ICD-9 code 799.9) were also included.

attack or a stroke, and as a result became involved in an incident that led to their death from injury, or they were involved in an incident that caused them to suffer a sudden severe adverse health event and die, then they would still be included under the study definitions.

'death,'

Non-fatal injuries were specifically excluded.

'that occurred in Australia or to Australian-based workers,'

All incidents that occurred in Australia or Australian territorial waters were included, regardless of the nationality of the injured person and the country of death. Also included were Australian-based workers injured overseas. Workers not based in Australia but who died in Australia as a result of injuries sustained overseas were excluded.

'to which workplace exposures contributed'

Generally there is a specific occurrence that leads to a fatal work-related injury. For example, a falling tree strikes a logger in the head, a tractor rolls over onto a farmer, a plumber is electrocuted while replacing a pipe, or a truck driver dies as a result of a head-on collision with another semi-trailer. To satisfy the definitions, the incident must have occurred, in part at least, because of exposure to some factor or situation that was present because of work. The definition of work and workplace was broad, and encompassed:

- all people working for pay, profit or payment-in-kind, including unpaid work in a family business or on a farm;
- full-time and part-time (>one hour per week) or ad-hoc work;

- all aspects of work (including road traffic incidents and other forms of transport), including commuting, during a recess period[†], at an employer-sponsored social function, during training or during a non-work period if the incident arose because of work (eg an employer murdered by an employee at home); and
- all persons killed directly as a result of someone else's work activity, whether or not the deceased was working at the time of the incident.

Therefore, there might not necessarily be anyone working at the time of the incident. For example, if a crane falls over on an idle construction site at night and kills a person walking past, that person would still be included as a bystander death because the exposure to a high energy impact from the crane occurred in part because of the work that was being done on the construction site.

'as a necessary factor'

If the incident/exposure had not occurred, then the person would not have received their fatal injury at the time.

'and which can be attributed, as an individual death, to those exposures;'

The deceased person must have died as a result of injuries that were directly related to an incident, and the incident must have been directly related to some workplace exposure. Note that the pathological process that led to death may not necessarily have been an external cause, as long as this process arose because of a preceding injury. For example, a farmer whose tractor rolled over and crushed his chest, who never recovered from his injuries and who died three months later of pneumonia, would be an eligible

[†] A recess period is a break from work during working hours (eg a meal break).

case. The same farmer, if he recovered and a year later died of a heart attack, would not be eligible.

3.1.2 OTHER CASE DEFINITIONS

In addition to the above work-related group, there were some other groups that were also included in the study because each had some sort of connection to work activity. These groups are addressed below.

Official volunteers

Anyone working in an official volunteer capacity was included, such as volunteer firefighters, salvation army workers, meals-on-wheels helpers and school tuck shop workers.

Students

Students of primary school age or older were included where the incident occurred during school time on school premises or while they were performing a task directly connected with their course. Commuting student deaths were excluded. For example, a veterinary student trampled by a horse she was examining would have been included, but a maths student killed while walking to the university would not.

Home duties

All persons performing home duties were included as long as the incident occurred in their own home or someone else's home. Home duties were defined as cleaning, cooking, laundry, maintenance and related activities, childcare, etc. For example, this included a person killed at home following a fall while cleaning out roof gutters, but excluded a person killed on the road while doing the shopping.

All deaths that occurred on a rural workplace

All traumatic deaths that occurred on rural workplaces were included regardless of their apparent connection to work. This was because it was often not clear where work exposures on farms ended and non-work exposures began.

3.1.3 DETAILED GUIDELINES FOR EACH WORK–RELATED CATEGORY

This section provides some elaboration on the categories used for the study.

1: Working for pay, profit or payment-in-kind or working without pay in a family business (not commuting)

This category comprised persons who worked 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 who worked without pay in a family business or on a farm. It specifically **excluded** commuting deaths (as defined below).

2: Commuting (but working as defined in Category 1)

This category comprised persons who satisfied the definition used for working in Category 1, but died as a result of an incident that occurred while travelling directly from work to home or home to work. A person was not considered to have traveled directly from work if they made an extended stop on the way home (such as stopping at gymnasium for exercise). In such cases, the trip prior to the stop would be considered commuting, but the trip afterwards would not. If the incident occurred while the person was travelling in the course of their work duties then they were **not** classified as commuting. Instead they were classified in the working category.

3: Volunteer

This category comprised anyone working in an **official** volunteer capacity for an organisation, excluding people just doing a favour for someone. As for 'home duties' cases, the intention was to cover persons performing duties that might conceivably be performed by someone in a paid capacity. In this category, the duties to be covered were generally those of persons who made an unpaid contribution to a sector of the community. The definitions of 'official' and 'organisation' are difficult to make precise. To be accepted as 'official' there had to be a clear indication that the person was engaged in some type of formal arrangement to act in the volunteer capacity. Most community groups, sporting clubs and fund-raising agencies would qualify as 'organisations'. Commuting deaths were specifically excluded, as were injuries that resulted from a road vehicle traffic incident on a public road or an incident that occurred while the person was a passenger on any form of public transport (unless this was directly part of the volunteer's duties).

Typical examples included lifesaving, volunteer firefighting, meals-on-wheels, school canteen work by parents and fund-raising for sporting clubs.

4: Student

This category comprised any person who was studying, from primary school and above, whose death was a result of an incident that occurred during school time on school premises or while they were performing a task directly connected with their course. This covered all primary, secondary and tertiary education, as well as all other formal courses that were vocationally related where there was a clear indication of the intention of the person to use this to begin, modify or further their career. The category specifically excluded persons taking courses primarily for recreational reasons.

Commuting deaths were specifically excluded, as were injuries that resulted from a road vehicle traffic incident on a public road or an incident that occurred while the person was a passenger on any form of public transport (unless this was directly related to school activities).

The intention was to include students if, at the time of the incident, they were doing tasks that were the equivalent of someone at work (being blown up in a chemistry experiment is an example). This was for two reasons. Firstly, because most of these incidents will have occurred in the workplace of someone else (eg teacher, hairdresser, pilot or builder) and such an incident shows a breakdown in the safety procedures in that workplace. Secondly, the student can be thought of as working, as per the approach now adopted in Sweden, where the 'laws governing the working environment in Sweden were amended in 1991 to include school children from the first grade[238], although the parallels between workers and students are clearly more easily appreciated in TAFE students than in primary school children. Note that apprentices attending TAFE courses were considered to be working and so travel to and from TAFE was considered to be commuting (if the travel was to or from home) or working (if the travel was to or from their usual workplace).

5: Home duties

This category comprised persons performing duties at home (or in someone else's home) that might conceivably be performed by someone in a paid capacity. Their inclusion in this study is consistent with the *'Better Health Outcomes for Australians'* publication by the then Commonwealth Department of Human Services and Health. This covered national goals and targets and was released during the planning stage of this study[239]. Two goals for work-related injury in this publication were to 'reduce the

number of work days lost due to home injury through the transfer of injury prevention skills from workplaces to residences' and to 'reduce the incidence of injury in paid and unpaid home-based caregivers' (pages 197 – 201). Without understanding the circumstances surrounding such deaths in the home, it is not possible to determine which workplace injury prevention measures might be appropriately implemented.

The working definition used here was based on that used in a recent survey by the ABS[240], but was not as broad as the ABS definition. Nevertheless, it was sometimes quite difficult to determine if the circumstances of the fatal incident met the study definitions for home duties and there was some unavoidable arbitrariness to the inclusions and exclusions.

6: Bystander - workplace

This category comprised any person fatally injured who did **not** satisfy any definitions of Categories 1 to 4 and:

- whose injuries resulted substantially/directly from an activity classifiable as 'work' according to the definitions of Categories 1 to 4; and
- whose injuries did **not** result from a road vehicle traffic incident on a public road or an incident that occurred while the person was a passenger on any form of land-based public transport (with the exceptions discussed below).

Note that persons who were working were not considered bystanders even if they were killed as a result of the activities of another worker. Instead, they were classed as working deaths. 'Passenger' included persons boarding and alighting from transport. It also included intending and recent travellers within precincts principally used to allow passengers access to the transport (eg railway platforms).

This category primarily covered bystanders fatally injured as a result of workplace activities not associated with public roads or public transport. Exceptions to this definition were:

- persons not working but fatally injured in a road vehicle traffic incident while travelling as passengers in the cabin (the working area) of a truck (including hitchhikers and family members of the driver);
- persons fatally injured while passengers on any form of public transport where the persons were travelling in the cabin or other working area of the vehicle (including aircraft); and
- persons fatally injured when struck by a vehicle being used for work in an area that could be deemed a defined workplace but still on a public road (eg a reversing garbage truck picking up rubbish).

The reason for this approach was to identify persons who were bystanders in or around vehicles but exposed to similar hazards to those faced by the working person controlling or working on the vehicle.

7: Bystander - road

This category comprised any person fatally injured who did **not** satisfy any definitions of Categories 1 to 4; and:

- whose injuries resulted substantially/directly from an activity classifiable as 'work' according to definitions of Categories 1 to 4; and
- whose injuries **did** result from a road vehicle traffic incident on a public road or a vehicle-related incident that occurred while the person was a passenger on any

form of public transport (with the exceptions noted above for the definition of 'bystander - workplace').

The intention was to include persons who died on the road as a result of other people's work. Examples included persons hit by a semi-trailer or struck by a police car involved in a chase or by the car being pursued. Persons who died as a result of exposure to working vehicles were included in this study as this is an area of health and safety not well covered and which is, in essence, no different to bystander deaths that occur in typical workplaces.

For the purposes of the study and this thesis, the primary focus in this category was on the true road bystanders where the working vehicle was 'at fault'. Other incidents were identified, but no detailed information on these was collected or coded. For this category, commuting vehicles were treated as any other working vehicle and classified accordingly. For example, if a night shift worker was commuting home in the early morning, fell asleep at the wheel and ran into another car and killed the occupant of the car, then the deceased occupant of the other vehicle would be included as a road bystander.

8: Rural workplace

This category comprised those persons involved in a non-suicide fatal incident on a rural workplace where the circumstances did not satisfy any definitions of Categories 1 to 7. A rural workplace was defined as 'a workplace predominantly engaged in the production of stock and/ or crops including any farm, orchard, vineyard, agricultural holding or pastoral holding'[241] (basically a 'farm'). This group was included because of the frequent difficulty in separating work exposures from non-work exposures on farms,

and because of a specific interest in farm deaths by the then Australian Agricultural Health Unit (now the Australian Centre for Agricultural Health and Safety).

9: Uncertain which category

This category consisted of all persons fatally injured in an incident known to satisfy at least one of the definitions of Category 1 to 8, where it was not clear which definition was best satisfied. This classification was only used during the collection process. At the time of final coding, all cases were allocated to one of Categories 1 to 8 or excluded as a non-case or as indeterminate.

3.1.4 CODING SYSTEM

Using the general coding definitions, each coronial file was classified at the time of data collection in order to identify work-relatedness and the category of work-relatedness. The classification was recorded using a three-digit code.

Case status

The first digit referred to whether or not the person should be included as a case, based on the circumstances of the death and the study definitions. Files were coded as:

0 definitely not a case;

1 definitely a case; or

2 indeterminate.

'Definitely a case' and 'definitely not a case' were used where the available evidence allowed the circumstances of the fatal incident to be confidently classified as meeting or not meeting the study definitions. 'Indeterminate' was used where the available evidence was such that classification could be little more than a guess.

Categorisation

The second digit referred to the category into which the case was placed, using the categories in the previous section on definitions. However, if the first digit was zero then other digits were not required. The categories were not mutually exclusive. If a case could have been classified into more than one category, the first category that the case satisfied was used. For example, a courier driver killed when his van collided with a semi-trailer, the driver of which had lost control, would be classified as working rather than as a road bystander. The categories were ranked as follows:

1 working for pay or working without pay in a family business (not commuting);

2 commuting to or from work (with work as defined in '1');

3 volunteer;

4 student;

5 home duties;

6 bystander - workplace;

7 bystander - road;

8 rural workplace;

9 uncertain which category; and

0 not work-related.

The third digit was either 0, 1 or 2, with the same meaning as for the case classification (0 = no, 1 = yes, and 2 = indeterminate). However, the interpretation of the third digit depended on the category of case. For working, commuting, volunteer, student, home duties and bystander - workplace cases, the third digit referred to whether the incident occurred on a farm or to someone employed in farm work. This allowed all cases related to farms to be easily identified. For bystander - road cases, the third digit was

used to differentiate between incidents where the deceased person's vehicle was 'at fault', where the working vehicle was 'at fault', and where the major contribution from the vehicles was not clear.

For example:

- "111" meant a definite working case for which the fatal injury occurred on a farm;
- "172" meant a road bystander death where it was not clear whether or not the working vehicle was at fault;
- "240" meant a fatal injury (that didn't occur on a farm) of someone who may or may not have been engaged in student activities; and
- "0" meant the death of someone who clearly did not satisfy any of the study definitions of a case.

3.1.5 GENERAL RULES USED FOR CASE CLASSIFICATION AND CODING

Criminal activity

Criminal activity was specifically excluded from inclusion as work activity, whether the person was injured as a result of their own activity or as a result of someone else's work connected with the criminal's illegal activity. However, someone engaged in criminal activity at the time they were injured as a bystander to a lawful work activity not connected to the criminal activity could have been included as a case.

For the purposes of this study, persons fatally injured, but otherwise not involved, in an incident involving both criminals and law enforcement officers, security officers, etc were included as bystanders.

Prostitution was not regarded as an illegal activity for the purposes of this study.

Murder/manslaughter

Murder victims were only included if the attack was directly connected to the victim's work (satisfying one of the definitions of Categories '1' to '5') or occurred on a rural workplace.

Age

There was no upper or lower age limit in any definition.

Time between incident and death

There was no upper limit for the delay between the occurrence of the incident and the death of the person, as long as the other aspects of the definition were satisfied.

Deaths due to 'disease'

If the deceased person suffered a heart attack or something similar close to the time of the incident, as a result of that incident, and subsequently died, then generally they were included, even though the study was only including 'traumatic' deaths. Theoretically, the coverage of interest was of all deaths where some aspect of work led directly to an incident that resulted in someone's traumatic death.

If the incident occurred first and as a result the person then suffered an acute adverse health event, such as a heart attack or stroke (for example, lack of oxygen leading to a fatal heart attack in an immersion incident), then they were included as a case, unless the Coroner indicated that there was no connection between the incident and the death.

If a non-fatal heart attack occurred first and caused the person to be involved in a fatal incident, then they were included as a case because it may have been possible to structure the work to prevent the incident occurring, such as with 'dead-man's' handles or higher railings following a non-fatal disease occurrence.

If there was no ‘incident’ but the heart attack occurred, then the person might still have met the definitions of a case if the heart attack arose from some work-related external cause, such as heat.

If the heart attack occurred first, the person died immediately and was **then** involved in an incident, then they were not included as a case. However, most of the time it was difficult to know whether the death occurred before or after such incidents, and often it was not known whether the heart attack occurred before or after the incident. To some extent, the decision had already been made by the ABS, because the ABS was the initial source of data on the potential deaths of interest (see Section 3.2.1). If the primary cause of death was coded by the ABS coders to heart attack or stroke, then the person would not have been included in the list provided by the ABS (which was only of persons with an External Cause code or unknown cause of death). However, some persons were identified in the coronial system who clearly died of an external cause, but whose name did not appear on the ABS Deaths Data List. If the external cause of death for these persons was related to work, then these people were included as cases.

In summary, if the person was included in the ABS list and the circumstances of the death satisfied the other criteria for inclusion, then the person was included as a case, even if there was a suggestion of an acute adverse health event having occurred near the time of the fatal incident. The only exception was if there was very strong evidence that the person did not die as a result of injuries received in the incident.

Skylarking

Injured persons were included if the circumstances involved skylarking or any other non-work activity that occurred at the workplace during working hours (including recesses) or during some social function sponsored by the employer.

Social events

Persons injured at work-related social events (including at conferences, meetings and sports days) were included if the even occurred:

- at the person's workplace and was at least partly sponsored by the employer; or
- elsewhere and was solely or almost solely sponsored by the employer.

'Employer' included the direct employer or the organiser of a work-related conference or meeting.

Domestic violence

Persons killed in incidents that occurred in their workplace but which arose from a domestic situation in which they were involved were excluded. Typical examples encountered during the study involved a person going to their spouse or defacto's workplace and shooting them. However, persons killed in their workplace as a result of a violent incident involving the domestic dispute of a colleague were included.

3.2 DATA SOURCES

3.2.1 DEATHS DATA

A list of all deaths due to external causes that occurred in Australia during the study period, excluding only those due to suicide, was obtained from the ABS. This list contained demographic details about each person, identified by a death registration

number but not a name. Since the coronial files were identified only by a name and not the death registration number, it was necessary to match the number to a name. Until recently, it has been necessary to perform such matching at the State and Territory Deaths Registry offices, sometimes using computers but usually manually. This matching can now be done by computer using the National Deaths Index (NDI) run by the Australian Institute of Health and Welfare (AIHW).

The AIHW was sent the list provided to the study team by the ABS, and AIHW officers computer-matched the death registration number to a name for each person. The resultant list formed the basis for the production of the List of Traumatic Deaths, which became the primary written record of the data collection phase of the study. Computer-matching was possible for all jurisdictions and all four years covered by the study, except for the Northern Territory for the years 1990 to 1992. The matching for these persons had to be done manually by one of the research officers in the Darwin office of the Northern Territory Registry of Births, Deaths and Marriages.

Names were identified using the NDI and NT Deaths Registry for 99.9% of the deaths on the ABS Deaths Data List. The remaining 18 deceased persons were identified as 'No Match' on the List of Traumatic Deaths. Of these 18, 15 names were later identified in the coronial system.

Cases certified by medical practitioners

Nearly all external cause deaths included on the ABS Deaths Data List are certified by a Coroner. However, external cause deaths of some persons, such as elderly persons in nursing homes who fracture a hip in a simple fall and later die of pneumonia, will have been certified by a medical practitioner. Few of these 'medically certified deaths' are the subject of a Coroner's inquiry and few, if any, would be likely to be work-related.

However, since there were coronial files for some medically certified deaths, coronial files were sought for all medically certified deaths. If the person did not appear on the Coroners' index, it was assumed that the death was not the subject of coronial investigation and no further action was taken. If the deaths had been the subject of a coronial inquiry, the file was treated in the same manner as any other coronial-investigated death.

Extras

In addition to the names that appeared on the List of Traumatic Deaths, that was based on the ABS Deaths Data List, there were a number of other sources of information used in an attempt to identify all persons who died of an external cause in Australia during the study period. These other sources were:

- the largely paper-based index of coronial files in each coronial jurisdiction (these were partly computerised in New South Wales, the Northern Territory and Victoria for deaths that occurred during the study period);
- coronial files of persons on the List of Traumatic Deaths who were involved in multiple fatality incidents;
- lists of deaths supplied by the various OHS and compensation agencies;
- the John Tonge Centre, which held records of nearly all post-mortems (and often associated brief descriptions of the fatal incident) performed for coronial cases in Queensland;
- the Queensland Department of Transport, which held the police reports (and sometimes associated documents) for all fatal motor vehicle incidents that occurred in Queensland;

- and the Rural Deaths List, a list of work-related deaths that occurred on Queensland farms, maintained informally by Mr Keith Ferguson of the Queensland Department of Work Health and Safety.

External cause deaths that did not appear on the List of Traumatic Deaths and which were identified only through one of these other information sources were described as 'Extras'.

3.2.2 DENOMINATOR

The denominators used for nearly all rates presented in this thesis were based on the relevant Labour Force Surveys conducted during 1989 to 1992 by the ABS[242]. Information on industry and occupation is collected on a quarterly basis in the February, May, August and November surveys. The denominators for this study were calculated by taking the average of the relevant surveys: 16 surveys for the entire four-year period of the study and four for each of the study years.

Population rates were calculated using data from annual ABS population surveys[242] and the 1991 National Census, also conducted by the ABS[243].

3.2.3 CONTENT OF CORONIAL FILES

Coronial files in different jurisdictions have the same general contents, but the specific file items vary considerably, both in the what is present and the quality of the information in the items. For example, during the period of the study, road traffic police completed a standard four-page form for road deaths in Queensland, whereas in South Australia there was usually a major Police Traffic Unit report (which comprised a detailed investigation of the incident, including witness statements) for all road deaths. Even within the same jurisdiction, there was variation between the contents, especially

for different circumstances of death. For example, the file of a vehicle-related construction site death nearly always contained a report by an OHS agency but rarely one by the road traffic police, whereas the file of a work vehicle-related death on a public road often contained a road traffic police report but rarely a report by an OHS agency. The main file items (with some associated comments) are shown in Table 3.1.

Table 3.1 Description of documents in coronial files

File document	Comments
Items from the Coroner	
Report of Coroner's findings/investigation	*Varied greatly in quality and detail.*
Coroner's recommendations	*Only in a minority of cases.*
Proceedings of inquest	*Inquests were not common; the information usually covered parts of other documents in the file; sometimes taped and not transcribed.*
Letters sent to interested parties	*eg attorney general; manufacturer.*
Police reports	
Initial police report/statement to Coroner	*Usually one page and on a standard form.*
Investigating Officer's statement	*Often detailed; often repetitive.*
Traffic incident/collision report	*Usually present in motor vehicle incidents; variable quality.*
Other police statements/affidavits	
Vehicle inspection reports	*Usually present in motor vehicle incidents.*
Forensic pathology reports	
Post-mortem/autopsy examination report	*Present in nearly all cases.*
Toxicology/alcohol analysis report	*Often present; sometimes included in the post-mortem report; varied screening in different jurisdictions.*
Witness statements/affidavits/depositions	*Often many; usually repetitive.*
Official reports	
OHS authority inspector's report	*In traditional industrial cases.*
Other official bodies	*BASI, maritime authorities, electricity authorities, mines department, company OHS unit.*
Other reports/items	
Manufacturers of equipment involved in the fatal incident	
Other statements from trained 'inspector'	
Drawings/maps/illustrations/photographs	
Letters to solicitors/compensation authorities/insurance companies	
Medical/hospital/ambulance reports	
Administrative items	
Notification of holding or of dispensing with Coroner's inquest	
Burial order	
Life extinct form	
Statement of identification	

3.3 DATA COLLECTION METHODS

3.3.1 RESEARCH OFFICERS

Eighteen research officers were initially engaged by the study team to participate in the data collection phase of the study. A further four officers were recruited during the data collection phase. These officers came from variety of educational, occupational and research backgrounds. They were engaged only for the data collection phase of the project and only for the time that data were being collected in their home jurisdiction.

The research officers worked at the coronial offices in their home jurisdiction, with two officers based in each jurisdiction except New South Wales, which had four. During the course of the study a third person began work in Queensland, a new officer replaced one of the South Australian officers who resigned early in the data collection phase, and four extra officers worked at various stages in Victoria (although no more than four at any one time).

The primary task of the research officers was to accurately describe the circumstances of death and to delineate cases from non-cases using the definitions of work-relatedness provided by the study coordinator (the author). This was a crucial aspect of the study because cases not identified by the research officers were not likely to be known about at all by the study coordinator, except through the description of circumstances.

Before the data collection began, the research officers attended a three–day training workshop in Sydney. They also returned to Sydney after the data collection for a one–day debriefing session. Two of the research officers later joined the study team but

there was no formal on-going involvement by any of the other research officers once the data collection phase was completed.

Data collection began late in January 1995 and finished in the first half of 1996.

3.3.2 COMPLETING THE LIST OF TRAUMATIC DEATHS

Once the ABS information was matched to a name using the National Death Index of the AIHW and the Northern Territory Death Registry data, a List of Traumatic Deaths was produced for each jurisdiction. This list contained the name, age and gender (and some other identifying information) of every person whose death;

- was due to external causes (except suicide) or of unknown cause;
- occurred on or between January 1st 1989 and December 31st 1992; and
- was registered in the State or Territory covered by the research officers.

This was the primary reference list for the study. Theoretically, all potential cases should have appeared on this list although, as explained later, there were some external cause deaths which for various reasons did not appear on this list. Research officers recorded the coronial file number, the person's age or date of birth, the case number (if the death was deemed to be work-related), the case code, the date of collection and a brief description of the circumstances of death. This description was a short paragraph that was supposed to record in a concise, unambiguous manner how, when, where and why the death occurred. This description was used later by the study team to review the appropriateness of the case classification and to gain a measure of the completeness of case ascertainment by the research officers. The description was intended to reflect why the research officer made the classification decision.

Typical comprehensive examples were:

The subject was a 23 year old teacher who died as a result of massive trauma which occurred when the car in which she was a passenger rolled down an embankment. The incident occurred during the day on a public road. Available information suggests but doesn't make clear that she was travelling from the school to a school sports carnival.

The subject was an 80 year old pensioner who died as a result of pneumonia three months after sustaining a fractured hip which occurred when he fell whilst getting out of bed to go to the toilet. The incident occurred at night in his home. No evidence at all that he was a case.

The subject was a thirteen month old baby who died as a result of drowning which occurred when she crawled into a dam. The incident occurred during a visit to her grandparents' farm. It appears the father was digging an irrigation ditch nearby and he momentarily forgot about the child.

Typical brief examples were:

'Drug overdose — out'

'Truck driver ran off road — definite case'

'Two car MVA. No idea what drivers were doing.'

3.3.3 FILE SELECTION

Files in each jurisdiction were inspected in random order (with some minor exceptions). This was done in an attempt to ensure that the data collection methods did not interfere with or bias the comparisons that were planned. These comparisons included between years, between jurisdictions and between studies (WRFS 1 and WRFS 2).

Randomisation would also increase the chance of representative results being obtained if the study was stopped before all planned work was completed. Initially it had been considered more practical to review files either on an alphabetical basis or by year of death, or alphabetically within each year. However, none of these methods are satisfactory because they are not random, and if techniques changed during the course of the data collection, by fatigue or learning, for example, then this may well have introduced some bias. The random approach to file inspection was therefore deemed essential. It was conducted in the following manner:

- The List of Traumatic Deaths was supplied to the research officers in alphabetical order within year (because this is the way most of the coronial file index systems were set up) for most jurisdictions. For the Northern Territory and Queensland, the list was supplied in alphabetical order spread over all four years of the study.
- This list was numbered from 1 to n, where n was the number of names in the jurisdiction.
- A list of n random numbers (ie numbers 1 to n arranged in random order) was supplied with the List of Traumatic Deaths.
- Research officers identified a coronial file number for each name on the list.
- Research officers then located and inspected each file, starting with the first number on the random number list.

The only exceptions to this random approach were:

- Victoria where, for logistical reasons specific to the Victorian system, all 1989 files were inspected (randomly) before files from 1990 to 1992 (also randomly);

- New South Wales, where files from country centres were inspected in groups, either as they were sent in from the country centres or when the research officers visited the country coronial courts.

3.3.4 COLLECTION OF CORONIAL FILE DATA

All research officers were provided with a folder containing the List of Traumatic Deaths for their jurisdiction. This list included the names of all persons who suffered a non-suicide traumatic death (or unknown cause death) in the years 1989 to 1992. Some other information about those persons (such as date of death) was also provided to aid in the identification of the correct Coroner's file numbers as there were instances where the names of two persons were identical. Also provided on this list was space to record the unique case identification number, the relevant data collector's three–letter identification code, the case classification code, the gender of the deceased, the age or date of birth of the deceased, a brief description of the death, the date of classification and an indicator of whether the classification was discussed with the study coordinators.

A case summary booklet was completed by the research officer for each case. This was intended to provide summary information on the data collection process. This information related to the identification and unique case number for each case, the type and detail of the information available to the research officer in the coronial file, the information actually collected, any difficulties that the research officer had in classifying or summarising the case and information regarding specific aspects of the case. This information was mainly used at the coding stage of the study and was designed to give the study team an insight into the confidence that they should have in the various reports that had been copied.

There were several steps in identifying and reviewing coronial files.

Firstly, the research officers went to the coronial alphabetical register/index of names and, using the deceased's name, date of death and any other identifying information from the List of Traumatic Deaths, identified the coronial file registration number that matched the first death registration name on the list. The coronial file number was then recorded on the List. This process was repeated until all relevant coronial file numbers had been identified and recorded on the list.

Secondly, the research officers used the random number list to determine the number of the first death to consider. The death corresponding to that number on the list was identified and the corresponding coronial file registration number used to find the appropriate Coroner's file.

Thirdly, the case definitions were used to assess whether the death described in the coronial file was work-related or not. Following this assessment of the work-relatedness of the death, a case code was assigned and recorded in the 'case code' column of the list. The list was used to record a brief description of the circumstances of the death, including an indication of why the deceased definitely did or did not satisfy the study definitions of a case, or why the assessment remained indeterminate.

If the death was assessed as definitely not a case, no further action was taken.

If the death was assessed as definitely or probably a case**,** relevant parts of the coronial file were identified and photocopied.

If the death was assessed as indeterminate, it was discussed with the co-research officer and sometimes by phone with a member of the study team. A final determination about whether to photocopy the relevant file information was then made.

3.3.5 DETERMINING WHICH FILES TO COPY

All deaths where the circumstances met the study definitions of work-relatedness were designated as cases. All relevant information in these files was photocopied, and the case was then described as having been collected.

All deaths where the circumstances clearly did not meet the study definitions of work-relatedness were designated as non-cases. No file information was photocopied for these deaths.

For some deaths (6.6%) the case status was indeterminate. This was because the circumstances were such that it was theoretically difficult to decide whether the circumstances met the study definitions, and/or there was insufficient information to decide whether the circumstances met the study definitions. For these indeterminate cases, the collection guidelines were not rigid and the deaths were dealt with on an individual basis. The general rule used was that if the research officer suspected that the circumstances did meet the study definition but remained undecided, then the file should be collected (eg someone doing home renovations where there was no specific information as to who the renovations were being done for and whether payment was involved). If the determination of case status could be little more than a guess, or the likelihood was that the circumstances did not meet the study definitions, then it was not collected (eg a teacher killed in a motor vehicle incident in the middle of the day and with no information as to the purpose of the journey). The final decision sometimes depended on a discussion between the collector and a member of the study team.

The research officers were instructed to collect most of the files which were difficult to classify, especially if the problem was one of a conceptual nature rather than a lack of information. This approach allowed a final decision on case status to be made later by the study team, which had the benefit of reviewing a lot of uncertain files and sometimes access to other information concerning the circumstances of the incident. An exception to this approach was for possible commuting cases, for which the research officers were instructed not to collect many files. This alternate approach was taken because potential cases that were indeterminate due to the purpose of the journey not being clear were thought likely to make up a large proportion of all indeterminate cases. Therefore, even if only a small proportion of these were collected, there would have been several hundred extra files to be copied, few of which might have had enough evidence to have been deemed to meet the study definitions of commuting. The accuracy of coding was checked for a sample of files for each research officer. This process is described in detail in Chapter 15.

3.3.6 MATERIAL COPIED FROM CORONIAL FILES

Once a case was identified, the research officer's task was to record all the information in the coronial file relevant to this case. Most information was recorded by photocopying the relevant parts of the file. Some written information was included in the case summary booklet. It was deemed not appropriate to copy the whole of the coronial file in most instances as there were documents that were not relevant to the study and documents that the Coroner or police did not want to be copied. Also, some files were many centimetres thick! Therefore, the research officers attempted to identify and copy the documents, and the information within those documents, which were most relevant for the purposes of this study. Guidelines on what to copy were given to research officers for particular types of incidents.

A review of a selection of coronial files during the planning stages of the study indicated that certain file documents were more likely than others to contain relevant information. Research officers were provided with a description of the documents that are found in some, most or all coronial files and with guidelines as to the frequency with which the documents were to be collected or were thought likely to contain useful information. In practice, the same sort of documents were in many files and, if present, were copied by the research officers. These documents are listed in Table 3.1 in Section 3.2.

Usually the whole of the relevant document was copied, but in certain instances, such as with some very detailed official reports or inquest transcripts, the report was so thick or repetitive of other documents that only the relevant parts were copied.

3.3.7 DEBRIEFING

Once data collection was completed in a jurisdiction, the research officers returned the photocopied material to Sydney and members of the study team conducted a debriefing with the officers. As part of this debriefing, members of the study team reviewed the entire List of Traumatic Deaths, including reading each description of the circumstances of death for every subject and comparing it with the allocated case code. Missing data (description, case code, case number) were also identified. Discrepancies were discussed with the research officers. Obvious errors were corrected at the time and files that needed reviewing or collecting were identified. The research officers then returned to their home jurisdiction and performed whatever work was required arising from the debriefing.

The debriefing also served as an opportunity to discuss with the research officers any personal difficulties that they experienced during the course of the data collection. The coronial files often contained graphic descriptions and photos of the injured person, as well as intimate personal details of the deceased person. A number of specific interventions were used during the course of data collection in an attempt to minimise any adverse effects that this material might have had on the research officers. Most of the research officers reported some occasions when they were particularly upset by the contents of a file, but that they were able to deal with this and avoid any prolonged effects through discussing it with another research officer and/or taking a few hours off. However, one research officer withdrew from the study at an early stage, in part because of psychological difficulties attributed to dealing with the information in the coronial files. The procedures used in an attempt to minimise adverse experiences for the research officers, and the experiences of the research officers, are documented elsewhere[244].

3.4 CODING

3.4.1 INTRODUCTION

The research officers allocated an initial category code to each death, but didn't do any other coding. The information photocopied by the research officers was subsequently coded by members of the study team at the NOHSC office in Sydney. Coding commenced once data collection had been finalised in June 1996 and was completed in February 1998. A total of six coders (but only five at any one time) entered information during the course of the coding.

Nearly all information used for the classification and coding of material into the computer database came from the photocopied coronial file material or associated

administrative data. Additional information for most cases came from the ABS Deaths Data List (death registration number, country of birth, period of residence in Australia, marital status, gender, External Cause code and aboriginality). For some cases, information was obtained from the OHS, compensation or rural deaths lists (circumstances, industry, occupation), the State or Territory electricity authorities (current voltage involved in electrocutions), mining departments and *WorkCover News* in New South Wales

The first stage of coding was to read the available photocopied material from the coronial file and to classify the circumstances of death using the study definitions. Difficult cases were discussed with other study team members as described below, but all cases were reviewed at varying times during the coding and analysis process. Cases which, on review, were deemed to not meet the study definitions were then excluded as non-cases or indeterminate cases. A brief text description of the circumstances of the fatal incident and the reasons for exclusion was made and kept on a computer file. All excluded cases were reviewed by at least one other coder before a final decision one exclusion was made. All confirmed cases were coded into the study database.

Information was coded directly into a database developed in Access[245] specifically for the study. This database contained a series of forms which covered areas relevant to most incidents and which were completed for every case. Other optional forms covered information relevant only to certain types of cases (eg falls, motor vehicle incidents, violence, and electrocution) and these forms were only completed where appropriate. One of the main forms consisted only of a narrative field. This was used to record in detail a semi-structured text description of the circumstances surrounding the fatal event and any associated factors of importance. This served to put the coded data into context

and sometimes provided additional information not covered adequately by the coding scheme. The forms and the main areas they covered are shown in Table 3.2.

Standard coding frames were used wherever possible, with associated small free text fields for key variables. Where more detail was required than was available from the standard coding frame, modifications were made in a manner that allowed the new choices to be collapsed into choices in the standard frame if desired. If a suitable coding frame was not available, then the study team developed one. The coding frames were designed to be comprehensive and to allow meaningful comparison with the data collected in WRFS1.

The main variables for which standard coding frames were used are shown in Table 3.3. All other variables were coded using frames developed by the study team.

Table 3.2 Coverage of main and specific database forms

Form	Areas covered
Main forms[1]	
Coronial administration	Collection details; main codes; coronial file contents; coronial process details.
Injured person	Demographic details.
Text description	Detailed narrative description of the circumstances surrounding the fatal incident.
Injuries	E-code; injuries; cause of death; alcohol and drug test results.
Physical environment/Personal protective equipment	Terrain; weather; variables related to the presence, use and function of personal protective equipment.
Injurious incident	Time, date and place of the incident and death; immediate response to the incident.
Organisation	Employment details; experience; training; general and safety procedures; evidence of OHS Committee, OHS agency or union safety activity preceding the incident.
Miscellaneous	Communication; clothing; role of mechanical equipment.
Agency/Mechanism/Activity	Agencies involved; mechanisms involved; activity of the injured person.
Contributing factors	Factors that contributed to the incident occurring or to the outcome being fatal.
Specific forms[2]	Confined spaces, construction, cranes, electricity, falls, farms, fire fighting, fishing and boating, forestry, forklifts, home duties, machine guarding, maintenance, mining, motor vehicle incidents, other involved person, shiftwork and violence.

1: Main forms were completed for every case.
2: Specific forms were only completed when relevant.

3.4.2 STANDARDISATION OF CODING

Cases were coded in random order across all jurisdictions. This was achieved by creating a list of all case numbers and randomising this list using the randomisation procedure in SAS[246]. The resultant randomised case number list was used by the coders to identify the next case to code.

Table 3.3 Standard coding frames used for coding

Area	Coding frame used
Industry	ASIC[247] using the ASIC computerised coder.
Occupation	ASCO[248] using the ASCO computerised coder.
Place of incident	National Data Standards for Injury Surveillance Place of Incident Levels 1 and 2 (with some additions)[249].
External Cause code	ICD-9[237].
Country of birth	ASCCSS[250].
Cause of death	Type of Occurrence (with some additions)[251].
Injuries	Type of Occurrence Nature and Location codes (with some additions)[251]; based on AIS body regions[252] to allow determination of an AIS and an ISS[253].
Mechanism	Type of Occurrence (with some additions)[251].
Agency	NSW WorkCover modification to Type of Occurrence[251].
Drugs	Federal Office of Road Safety[254].
Domestic activities	ABS[240].
Farm	Australian Agricultural Health Unit data set[255].
Mining	NSW Joint Coal Board[256].
Motor vehicle incidents	Federal Office of Road Safety (with some modification)[254].

The coding team met regularly (usually weekly, but sometimes more often) to discuss difficult coding decisions and to clarify approaches to coding. The resultant clarification of coding rules was recorded for reference during later coding. Most of the discussion at these meetings concerned whether the circumstances of the case met the case definitions and, if so, which was the most appropriate code. Usually a unanimous decision was reached. Where this was not possible, a final decision was based on the vote of the study team members. The basic approach used was to exclude deaths where the circumstances were particularly unclear or where, for theoretical reasons, it was difficult to determine whether or not the case definitions were met.

Prior to starting the formal coding process, the same group of 50 cases was coded independently by all coders. The results of this trial coding and the reasons for coding variability were discussed by the study team and clarification made of areas that appeared to be difficult to code in a standard manner. About a third of the way through the actual coding, the trial coding was repeated, with key variables from the same 50 cases again coded independently by each of the coders. The results were again discussed and problem areas identified.

Once all the cases had been coded, the data were checked for inconsistencies and errors. Cases which had been identified as being difficult to classify were reviewed, as were the descriptions of all collected cases which had subsequently been excluded and other cases which were highlighted during the checking process as possibly having been wrongly coded. Missing and duplicate cases were also sought and corrected as appropriate. The data for specific variables were checked in a number of ways, although safeguards had been incorporated into the database in an attempt to prevent out of range choices being entered in the first place. For the main variables, cases with unknown values and logical discrepancies on the basis of cross tabulations were checked and corrected as appropriate. Specific areas or variables which had been identified during the initial coding as being difficult to code accurately were also checked and corrected as appropriate. In addition, the variables for occupation and industry at the time of the incident were re-coded blindly for all cases at the end of the initial coding, using the relevant text variable and the text description where necessary. For those cases with differences between the first and second occupation and/or industry codes, the documentation was checked to establish the correct final code.

3.4.3 APPROACH TO CODING SPECIFIC VARIABLES

Occupation, industry and activity

The main focus of coding was on the occupation, industry and task (or activity) of the deceased person **at the time** of the fatal incident. A given occupation could involve a number of different tasks, but the appropriate coding of occupation was based on the position in which the deceased was employed rather than the task that happened to be being performed at the time of the incident. Thus, the **occupation** of a farmer killed in a plane crash while flying a plane to muster his cattle would have been coded as a farmer, not as a pilot. Similarly, his **industry** would have been coded as cattle grazing rather than air transport. However, his **activity** would have been coded as flying a plane (and mustering).

Employment status

Employment status was defined in two ways — on the practical basis of the employment arrangements and the legal basis of the employment arrangements. The main difference between these two definitions was that persons who acted as their own boss but who were legally employees of their own company were considered to be self-employed for practical purposes, but to be employees for legal purposes. Using this definition, any working person who appeared on a compensation list was considered to be legally an employee, regardless of their practical employment arrangements.

Industry

Results describing the 'forestry industry' cover forestry and logging. Similarly, unless specifically stated, results describing the 'fishing industry' cover fishing and hunting (on land). However, since there was only one death of a hunter during the study period, and the number of hunters working during the study period was very low, the presented

results are mainly relevant to the fishing industry. For some analyses, forestry and logging and fishing and hunting had to be combined because adequate separate denominator data were not available. For the same reason, the civilian defence force and public administration industries were combined for some analyses.

Agency

There were two main components to the coding of agency:

- **agency of injury** was defined as the object, substance or physical condition which made contact with the subject to **directly cause** the injury. This may or may not have been the agency most 'responsible' for the incident. Only one agency of injury was coded for each incident.
- **agency of incident** was defined as the object, substance or physical condition that was **most responsible** for the incident occurring or that was most intimately involved in the incident. Up to three such agencies were coded for each incident.

For example, if someone suffered a fatal head injury following a fall to the ground from a ladder, the agency of the injury would be the surface onto which they fell and the ladder would be an agency of the incident. Whether other agencies of the incident were coded would depend on the circumstances. If the fall was from two metres and the person landed on concrete, it is quite possible that the outcome might not have been fatal if the ground was made of something softer than concrete. In that circumstance, the concrete would be coded both as an agent of injury and as one of the agencies of the incident (along with the ladder). If the fall was from 20 metres, then the hardness of the ground would probably be irrelevant to the fatal outcome, so the concrete would only be coded as the agency of injury. If the person fell because they suffered a non-fatal

electric shock from a handtool they were using while on the ladder, the handtool (and the electricity) would have been coded as agents of the incident (in addition to the ladder). If there were more than three important agencies identified, then the three most important ones were coded and the remainder mentioned in the relevant text field.

The agency of the incident was considered more relevant for prevention purposes than the agency of injury, because the agency of injury may have been irrelevant to the fatal outcome of the incident. Most of the information about agencies presented in this thesis describes the agency of the incident.

Mechanism

Up to two mechanisms were coded for each incident. The mechanism described the physical event that best described the circumstances of the fatal incident. For example, in the scenario described above involving a fall from a ladder, the mechanism would be coded as 'fall from a height'. If the person fell because they suffered a non-fatal electric shock from a handtool they were using while on the ladder, the 'fall from a height' would be coded as the first mechanism and 'contact with electricity' as the second. If the person suffered a fatal electric shock and then fell from the ladder, the fall would not be a relevant mechanism and 'contact with electricity' would be coded as the sole mechanism.

Specific circumstances which were coded to mechanisms that might not seem obvious included:

- pedestrian incidents, which were coded to 'hit by moving objects' rather than 'motor vehicle incident', as per *Type of Occurrence Classification System*[251] coding instructions;

- assaults, which were coded to 'hit by person' (in the 'hit by moving object' broad category) if no weapon was involved, and to 'weapons' if a gun, knife or other weapon was involved;
- rollovers of mobile mechanical equipment (tractors, forklifts, earthmoving equipment, etc), which were coded to a specific rollover category; and
- being struck by a falling rock or rocks while mining was coded to 'hit by falling objects' (in the 'hit by moving objects' broad category) rather than to 'slide/cave-in', unless there was the collapse of a large section of a shaft.

Activity

Activity was divided into three conceptual areas and coded to the three levels that summarised these. The first level was based on the body position (eg sitting, walking or climbing). The second level described the specific task that the person was doing at the time of the incident (eg hammering). The third level was designed to describe the context in which the specific task (Activity 2) was being performed (eg renovating), although the degree of specificity in the context was somewhat arbitrary in certain cases.

Personal protective equipment (PPE)

PPE was defined as 'Any item of clothing or equipment **worn** by workers to limit their exposure to hazards'[257].

Cause of death

The cause of death was defined as the pathophysiological cause of death. In a minority of cases, the injured person died not directly from the injuries received, but from a pathological process that occurred as a result of the injuries. Pulmonary embolism, pneumonia and sepsis were examples. These cases had the cause of death coded to the pathological process, not the original injuries.

Injuries

The aim in coding injuries was to provide as much detail, within reason, of the injuries sustained in the fatal incident and to code the injuries in a way that would allow later calculation of an Abbreviated Injury Score, which in turn would allow calculation of an Injury Severity Score. (The Injury Severity Score is a scoring system that summarises the severity of one or more injuries and which is inversely correlated with probability of survival.)

Contributing factors

Contributing factors were defined as factors that contributed to the incident occurring or made its outcome more severe than it would otherwise have been. Various factors could be identified which contributed to the occurrence of a particular fatal incident. In the majority of incidents, it was possible to identify several factors that contributed to the fatal outcome, rather than the fatal event being attributed to a single factor.

The identification of contributing factors is often not a simple task. It is dependent on a number of elements including the type and quality of the data available and the training and philosophy of the data recorders, such as police, Coroners and OHS inspectors, and the data coders. In many instances, the identification of contributing factors was straightforward, but even in some of these instances the assessment of the factors was not easy. For example, a worker deliberately not following proper work practices might be labelled as performing an improper work practice. However, it is then important to examine why the system of work allowed such actions by the worker to occur and to have such drastic consequences. Similarly, for any one incident, there may be a number of preventive approaches that might be reasonable. For example, engineering solutions, changes in work procedures and better training of workers or management might all be reasonable options for dealing with the same situation. Nevertheless, an attempt was

made to identify the main contributing factors, without implying that they were the root cause, nor that they were the only factors that were operating.

3.5 COVERAGE BY STATE, TERRITORY AND COMMONWEALTH OHS AND COMPENSATION AGENCIES

3.5.1 REQUESTED DATA

The State, Territory and Commonwealth OHS and compensation agencies were approached and asked to supply to the fatalities study team unit record information for all deaths which were identified by the jurisdictions as being due to non-suicide traumatic causes and which were identified by them as being work-related, using whatever definitions the agencies were using at the relevant time. Some other agencies which covered specific sectors of the workforce were also approached. For most jurisdictions this encompassed two lists — one for deaths covered by the OHS agency or division and another for the compensation agency or division. It was expected that many of the names would be common to both lists, but that some names would appear on only one of the lists.

The relevant agencies in each jurisdiction were asked for a list of:

- all non-suicide external cause **deaths** that occurred on or between January 1st 1989 and December 31st 1992, rather than **claims, notifications** or **incidents** that occurred during this time period;
- all (and only) deaths that the relevant agency or division deemed work-related (if an OHS agency or division) or compensable (if a compensation agency or division), including deaths related to motor-vehicle incidents and commuting deaths;

- separate lists for deaths relevant to the OHS division or the compensation division if OHS and compensation matters were covered by the same agency; and
- any relevant information, such as industry, occupation, age and date of incident, that might aid in the matching process.

3.5.2 DATA RECEIVED

Separate OHS and compensation lists were received from New South Wales, Queensland, South Australia and Victoria. Combined OHS and compensation lists were provided by the Northern Territory and Tasmania. Western Australia provided a detailed OHS list and a limited compensation list through the OHS agency. The ACT was unable to supply any OHS or compensation information. Comcare Australia provided data on relevant deaths of Commonwealth employees covered by the Comcare Australia scheme during the relevant period. All lists included the name of the individuals, except for the compensation list supplied by Western Australia (for which no records had names) and the Queensland OHS list (for which most records had names). Of other known compensation bodies that covered some workers during the study period, access to relevant information was refused by Telstra (then Telecom) and was not available and/or not requested from Australia Post, the forerunner of Seacare (which covered merchant seaman), the forerunner of Defcare (which covered military personnel) and other small compensation bodies that covered workers during the study period but did not contribute information to a jurisdiction-based compensation list nor to NOHSC for incorporation into the NDS, which is compensation-based.

3.5.3 APPROACH TO MATCHING

Unit record data were matched by name, with cases identified using information obtained from the coronial files. Where names were not available from unit record data, records were matched with the coronial data using whatever information was available

from the list supplied (eg date and description of incident for the Queensland OHS list; date and description of incident, plus age and industry of deceased person, for the Western Australian compensation list). Where names were not available, matches were only accepted where the corresponding information made the match virtually certain or very likely. Duplicate records and records of compensation claims which were later denied by the relevant agency were excluded.

There were many instances where a name appeared on one of the lists but the person had not initially been included as a case using the coronial information. There were four main reasons for this. The person had:

(i) not died from a non-suicide external cause death during the study period (and so did not meet the study definitions of a case and usually did not have a coronial file);

(ii) died from a non-suicidal external cause but had not initially been included as a case using the coronial information because the coronial file contained insufficient information to appropriately classify the death as work-related;

(iii) died from a non-suicidal external cause but had not initially been included as a case using the coronial information because the relevant information had been missed or misinterpreted by the research officer who had consequently mis-classified the death; and

(iv) died from a non-suicidal external cause but the coronial file revealed unequivocally that the circumstances did not meet the study definitions of work-relatedness despite a successful compensation claim having been lodged.

All coronial files relevant to these deaths were reviewed and, where necessary and possible, information about the deaths was sought from other sources such as the relevant Registry of Births, Deaths and Marriages.

The most common reason for discrepancy was for reason (i). In these instances one or more of the following applied:

- the person had died of a natural cause;
- had committed suicide;
- had died outside the study period; or
- had not died at all.

These records were excluded from the comparison.

Discrepancies involving reason (ii) mostly involved persons on a compensation list who had been involved in a motor vehicle incident for which there was a lack of information in the relevant file on the purpose of the journey of the deceased (who had usually been commuting). All these persons were subsequently included as cases.

Discrepancies due to reason (iii) involved persons who should have been included as cases initially and all were subsequently included as cases.

Deaths satisfying reason (iv) almost all involved a successful compensation claim for a death while commuting, but where the journey did not meet the study definitions of work-related commuting because of a prolonged break in the journey (usually at a bar) on the way home from work. These deaths were not included as cases.

A summary of the data supplied by the OHS and compensation agencies is documented in Table 3.4. Specific qualifications with the data were as follows:

- for New South Wales compensation information, there was some concern by the agency that the list was not very specific (possible inclusion of non-fatal incidents), especially for 1989.
- For Victorian compensation information, there was some concern by the agency that the list was not very specific (possible inclusion of claims that had not been accepted).
- For Western Australia, access to compensation information was refused by the compensation agency. With the agreement of the compensation agency, de-identified data were made available by Worksafe Western Australia which, as the relevant OHS authority (then known as the Department of Occupational Health, Safety and Welfare of Western Australia), had supplied OHS data for Western Australia when first requested. However, there was some concern about the accuracy of the compensation data that had been made available to the agency, including about its sensitivity (whether it included all relevant compensated deaths) and about its specificity (whether all included cases had actually died).

The outcome of the initial matching process is shown for compensation lists in Table 3.5 and for OHS lists in Table 3.6.

Table 3.4 Summary of OHS and compensation agencies information received from jurisdictions and other relevant agencies

Jurisdiction	Name supplied	Date of incident	Date of death	Type of incident	Occupation	Industry	Description of incident	Claim status
ACT[1]	na	na	na	na	na	na	na	na
NSW OHS	Y	Y	-	-	Y	Y	Y	na
NSW comp	Y	Y	-	Y	Y	Y	-	-
NT	Y	Y	-	Y	Y	Y	Y	-
QLD OHS[2]	Y	Y	-	-	-	-	Y	na
QLD comp	Y	Y	-	Y	Y	Y	Y	Y
SA OHS	Y	Y	-	-	-	-	Y	na
SA comp	Y	Y	Y	-	-	-	Y	Y
TAS	Y	Y	-	Y	-	-	Y	-
VIC OHS	Y	Y	-	Y	-	Y	Y	na
VIC comp	Y	Y	Y	Y	-	Y	Y	-
WA OHS	Y	Y	Y	Y	Y	Y	Y	na
WA comp[3]	-	Y	-	Y	-	Y	-	-
Comcare Australia	Y	Y	-	Y	-	-	Y	-

- : No information
na : Not applicable
Y : Yes

1: No data were supplied by the Australian Capital Territory.
2: Some unit records on the Queensland OHS list did not have names.
3: Names were not supplied for Western Australian compensation unit records.

Table 3.5 Outcome of matching compensation agency information with study information by jurisdiction[1] Number. Australia (excluding ACT only) 1989 to 1992

	NSW	NT[2]	QLD	SA	TAS[2]	VIC	WA	Comcare	Total
Case[3]									
In jurisdiction of incident[4]	329	32	332	97	53	345	72	28	1,288
In other jurisdiction	15	1	17	8	0	27	2	0	70
Total cases	344	33	349	105	53	372	74	28	1,358
Not a case[5]									
Didn't meet study definitions	12	1	5	1	1	27	0	5	52
Natural Cause	47	8	176	43	3	465	4	10	756
Suicide	1	2	5	6	0	12	0	3	29
Didn't die	15	0	2	0	0	0	12	0	29
Not in study period	1	22	49	0	0	23	46	0	141
Incident occurred overseas	2	0	0	0	0	0	0	0	2
Repeat in same jurisdiction	10	1	13	1	1	1	0	5	32
Rejected by jurisdiction	0	1	46	9	0	3	1	0	60
Missing[6]	6	0	5	0	0	1	21	4	37
Total on compensation lists	**438**	**68**	**650**	**165**	**58**	**904**	**158**	**55**	**2,496**

1: Excluding the Australian Capital Territory and including Comcare. This table only includes persons recorded on one or more of the lists supplied by the agencies.
2: The Northern Territory and Tasmania provided single compensation and OHS lists, both of which are considered in this table.
3: Persons included as work-related cases in the overall study.
4: There were 10 duplications between jurisdictions (including five with Comcare). These have been allocated to the jurisdiction in which the incident occurred.
5: Persons not included as work-related cases in the overall study and reasons for exclusion.
6: Unable to match name on agency list with a name in the overall study and no other known reason for exclusion.

Table 3.6 Outcome of matching OHS agency information with study information by jurisdiction[1] Number. Australia (excluding ACT only) 1989 to 1992

	NSW	NT[2]	QLD	SA	TAS[2]	VIC	WA	Comcare	Total
Case[3]									
In jurisdiction of incident	228	-	101	44	-	166	111	-	650
In other jurisdiction	0	-	0	0	-	0	0	-	0
								-	
Not a case[4]									
Didn't meet study definitions	6	-	31	0	-	1	0	-	38
Natural Cause	5	-	24	1	-	2	0	-	32
Suicide	0	-	3	0	-	0	0	-	3
Didn't die	0	-	0	0	-	0	0	-	0
Not in study period	0	-	1	1	-	0	0	-	2
Incident occurred overseas	0	-	0	0	-	0	0	-	0
Repeat in same jurisdiction	0	-	0	0	-	0	0	-	0
Reject by jurisdiction	0	-	0	0	-	0	0	-	0
Missing[5]	0	-	0	0	-	0	0	-	0
									0
Total	**239**	**-**	**160**	**46**	**-**	**169**	**111**	**-**	**725**

1: Excluding the Australian Capital Territory. This table only includes persons recorded on one or more of the lists supplied by the agencies.
2: The Northern Territory and Tasmania provided single compensation and OHS lists, both of which are considered in this table.
3: Persons included as work-related cases in the overall study.
4: Persons not included as work-related cases in the overall study and reasons for exclusion.
5: Unable to match name on agency list with a name in the overall study and no other known reason for exclusion.

3.6 WRFS 1 INFORMATION

3.6.1 IDENTIFICATION OF CASES

The methodology used for the current study was similar to that used in WRFS 1. This was done in an attempt to make data from the two studies as comparable as possible and because the available data systems had not changed greatly between the two studies. However, there were important differences between the methodology used for the two studies which need to be kept in mind when interpreting the results of any comparisons between them. These differences, and the main possible implications, are discussed below.

3.6.2 DEFINITIONS

The definitions used for WRFS 2 were developed to be as consistent as possible with those used for WRFS 1. The definitions used for working, commuting and volunteer cases were the same. The definitions used for bystanders in the workplace were the same, except that deaths secondary to medical misadventure (where someone was fatally injured in a health care setting as a direct result of a inadequate or inappropriate procedures or through the actions of a health care worker not following clearly accepted good practice) were excluded from WRFS 1 but included in WRFS 2. Also, review of WRFS 1 study methodology information suggests it is likely that the application of the definitions for bystander cases was more assiduous in WRFS 2, especially for deaths on farms. Deaths of students and of persons conducting home duties were included in both studies, but the definitions were more comprehensive in WRFS 2 and data from these 'peripheral' categories are not appropriate for comparison between the two studies. The 'road bystander' and 'other farm' categories were not included in the first study (Table 3.7).

Table 3.7 Comparability of definitions used for WRFS 1 and WRFS 2

Category	Comparability of definitions
Working	Same
Commuting	Same
Volunteer	Same
Student	WRFS 2 more comprehensive
Home duties	WRFS 2 more comprehensive
Workplace bystander	Similar definition - probably applied more assiduously in WRFS 2
Road bystander	Not included in WRFS 1
Other farm	Not included in WRFS 1

3.6.3 MATCHING OF NAME TO DEATH REGISTRATION NUMBER

The matching of name to death registration number was done manually for WRFS 1, with cards created for each person on the ABS Deaths Data List. These cards were taken to the relevant State or Territory Death Registry, where the corresponding name was found for each number. For WRFS 2, this process was largely computerised through the use of the AIHW's National Deaths Index, with all matching done using the National Deaths Index except for some of the Northern Territory deaths, which were matched by hand at the Northern Territory Deaths Registry. It is unlikely that these different approaches would have any implications for comparisons between the two studies.

3.6.4 IDENTIFICATION OF RELEVANT CORONIAL FILES

Both studies used the ABS Deaths Data List as the main reference point for identifying which coronial files should be examined. The list supplied by the ABS for WRFS 2 included some ICD-9 codes which were not included in WRFS 1. The ICD-9 codes coverage by the two studies is shown in Table 3.8, but the most important differences were that deaths due to unknown cause (ICD-9 code 799) and deaths due to medical misadventure (ICD-9 code E870 – E876) were included in WRFS 2 but not WRFS 1. Only 28 (0.8%) of the total cases in WRFS 2, and only 14 (0.8%) of the 1,787 working

cases had ICD-9 codes not covered by WRFS 1. Therefore, differences in inclusion criteria should not significantly affect comparisons between the two studies.

Table 3.8 Inclusion criteria for consideration of deaths during the study period for WRFS 1 and WRFS 2

Criteria	ICD-9 code	WRFS 1	WRFS 2
Inclusion of medically certified deaths		No	Yes
Inclusion of ICD-9 categories			
Unknown	799	No	Yes
Transport	E800 – E848	Yes	Yes
Accidental poisoning	E850 – E869	Yes	Yes
Medical misadventure, etc	E870 – E879	No	Yes
Falls	E880 – E888	Yes	Yes
Fire/flames	E890 – E899	Yes	Yes
Environment	E900 – E909	Yes	Yes
Accidental submersion, etc	E910 – E915	Yes	Yes
Other accidents	E916 – E928	Yes	Yes
Late effects of accidents	E929	Yes	Yes
Adverse effects of therapeutics	E930 – E949	No	Yes
Suicide	E950 – E959	No	No
Assault	E960 – E969	Yes	Yes
Legal intervention	E970 – E978	Yes	Yes
Undetermined intent	E980 – E989	Yes	Yes
War	E990 – E999	Yes	Yes

Another subtle difference between WRFS 1 and WRFS 2 was that for WRFS 1 medically certified deaths were excluded prior to the matching of names at the Deaths Registry. They were therefore not considered as possible work-related cases and were not included in the published numbers of initial deaths to be reviewed for WRFS 1. In contrast, the total number of initial deaths to be reviewed for WRFS 2 includes all the medically certified deaths because these were searched for in the coronial system as part of the data collection process. Coronial files were identified for 3.2 % of the medically certified deaths (93 out of 2,940), two of which were included as cases (one as a workplace case and one as a road bystander). Another two medically certified deaths

were not in the coronial system but were included as workplace cases on the basis of compensation information.

It is not clear whether other approaches were used widely in WRFS 1, although it appears that there was some use of compensation information for some selected States which may have identified persons whose names were not on the original ABS list or not originally included as cases. In contrast, an exhaustive approach was used to identify relevant files for the current study. Although the ABS list remained the primary source of deaths information, other approaches used for this study included inspection of the Coroner's paper-based index in each jurisdiction, use of a computerised index in jurisdictions where these were available, and thorough searching for all names on OHS or compensation agencies lists. It is likely that case identification was more comprehensive for the current study than for WRFS 1, although identification of working cases was probably almost complete in the first study. The extent of any differences might be roughly gauged by the proportion of:-

- names on the ABS list for which coronial files were not found (WRFS 1: 4.8%, WRFS 2: 0.3%);
- cases that were not found through the ABS list (WRFS 1: 0%; WRFS 2: 1.4%); and
- cases probably identified primarily because they were on one of the OHS or compensation agencies' list (WRFS 1: not known for certain but probably zero, WRFS 2: 6.1%) (Table 3.9).

Table 3.9 Coronial file identification for WRFS 1 and WRFS 2

Aspect	WRFS 1	WRFS 2[1]
Missing coronial files		
Total coronial files	16,246	20,017
Total missing files	780	68
Percentage missing files	4.8	0.3
Files not on the ABS list		
Total files	16,246	20,017
Files not on ABS list	0	529
Percentage files not on ABS list	0	2.6
Cases[2] not on the ABS list		
Total cases	1,738	3,626
Cases not on the ABS list	0	52
Percentage total cases not on the ABS list	0	1.4
Cases[2] identified primarily through the OHS and/or compensation lists		
Total cases	1,738	3,626
Cases identified primarily through the OHS and/or compensation lists	0	221
Percentage total cases identified primarily through the OHS and/or compensation lists	0	6.1
Final classification of deaths		
Total coronial files	16,246	20,017
Total cases[2]	1,738	3,626
Percentage total cases	10.7	18.1
Total cases[2] excluding road bystanders	1,738	3,064
Percentage total cases	10.7	15.3
Total indeterminates[3]	5,632	1,509
Percentage indeterminates	34.7	7.5
Total excluded	8,876	14,882
Percentage excluded	54.6	74.3
Status of inspected files		
Total files available for inspection	15,466	19,049
Inspected files coded as indeterminate	4,852	1,4441
Percentage inspected files coded as indeterminate	31.4	7.6

1: The WRFS 2 data presented here do not include medically certified deaths because these were not included in WRFS 1. Therefore, the four medically certified deaths that were made cases (two of which were made cases only on the basis of compensation list information) have been excluded. The total of 20,017 coronial files is equal to the total number of coronial files (20,110) minus the number of medically certified deaths for which there was a coronial file (93).

2: Includes all categories, not just working and commuting.

3: For both studies the total indeterminates category includes coronial files inspected and classed as indeterminate as well as files. For WRFS 1 it also included four persons for whom a matching name could not be found at the Deaths Registry.

3.6.5 COLLECTION AND CODING OF INFORMATION

Unlike WRFS 2, for which information from files was photocopied and assembled at a central point for coding, all relevant file information for WRFS 1 was written down at the Coroners' offices. This transcribed information consisted of a half to two page semi-structured text description and a series of areas covered by brief text and/or coded information. Further coding of this information occurred later at a central point, but none of the original file information was available once the study team left the Coroner's office in each jurisdiction. The effect of this was that much more detailed information was available for WRFS 2, allowing more detailed coding, more assiduous checking of data coding, and the opportunity to review potential cases whose status was ambiguous. These differences are likely to have resulted in better quality data in WRFS 2, but are not likely to have any other significant implications for comparisons of results between the two studies.

3.6.6 RESEARCH OFFICERS

For WRFS 1, data were collected by a study team which travelled to each coronial office. There were at least nine members involved in data collection to varying extents (not including Queensland where data collection was required to be performed by consultants on a contract basis). Further coding was done by some members of this data collection team. In comparison, WRFS 2 involved different research officers in each jurisdiction for data collection, with 22 research officers in total involved at some stage. The initial training and on-going checking processes used in WRFS 2 were designed to minimise differential and non-differential errors between research officers and research officer teams. There are comparative advantages and disadvantages in each of these two approaches, but any differences are not likely to have any significant implications for comparisons of results between the two studies.

3.6.7 FILE DATA QUALITY

Based on discussions with coronial staff and inspection of files from the WRFS 1 period during data collection for WRFS 2, it is likely that there had been an improvement in the quality and comprehensiveness of data included in coronial files since the first study. Any such improvement is likely to have made it easier for a definitive decision to be made on the basis of the study definitions. This effect is likely to have been more pronounced for motor vehicle incidents, for which a lack of detail on the purpose of a journey often meant that the final classification of the death had to be indeterminate. This was especially so for commuting cases, for whom a chance comment on the purpose of the journey would often be the only indication of work-relatedness. Since indeterminate cases were excluded from detailed analysis in both studies, more definitive case coding is likely to have lead to a higher proportion of true cases being identified for WRFS 2, with this effect likely to be more pronounced for vehicle incidents and especially for commuting deaths. The extent of any differences in file quality (and to some extent in the application of definitions) is hard to judge, but might be roughly gauged by the proportion of **inspected** files for which an indeterminate code was applied (WRFS 1: 31.4%, WRFS 2: 7.6%) (Table 3.9).

For WRFS 1, the Queensland file inspection and data collection was required to be performed by consultants contracted to identify and collect information from appropriate files. Since the WRFS 1 study team was not allowed to be involved in this process, there is little detailed information available about the data collection process in Queensland. Nevertheless, the WRFS 1 study team was satisfied with the comprehensiveness of the Queensland data collection.

In summary, it is likely that case identification was more comprehensive in WRFS 2 than WRFS 1, especially for commuting cases, but the difference for working cases is not likely to have been great.

3.6.8 OCCUPATION

For the period covered by the first fatalities study, available denominator information from the ABS was coded using the occupational classification system *A Classification and Classified List of Occupations* (CCLO)[258]. Therefore, for cases included in WRFS 1, occupation was also coded using CCLO. In 1986, the ABS changed its occupation coding from CCLO to the *Australian Standard Classification of Occupations* (ASCO)[248]. For WRFS 2, denominator data were only available coded to ASCO, so occupation data for cases included in the current study were coded to ASCO.

In order to make comparisons between WRFS 1 and WRFS 2 on the basis of occupation, the occupational coding needed to be standardised to a single system. Unfortunately, there is not a one-to-one correspondence between CCLO and ASCO. However, a probability transformation between the two systems is possible because a sample of data from the 1986 National Census was separately coded by the ABS to both systems. Using this information, a series of concordance tables was produced by the ABS[259]. These tables provide information on the percentage of persons in a given CCLO group that correspond to each main ASCO group. By applying these percentages to the known CCLO-coded ABS denominators, new imputed denominator data coded to ASCO can be obtained.

Concordance data were available separately for males, females and persons. For this thesis, yearly averages of the four relevant Labour Force Surveys (LFS) were calculated for each of the years covered by WRFS 1. The concordance percentages were applied

to these yearly averages, separately for males, females and persons. The resultant ASCO-coded denominators were used in the calculation of rates from WRFS 1 presented in this thesis.

Since the transformation from CCLO to ASCO is based on probability, it is not appropriate to use the probabilities to translate occupation codes for individuals. Also, available information (from WRFS 1 files) on occupation for WRFS 1 cases was generally detailed enough to allow an ASCO code to be directly assigned using the same system as that used to code occupation for WRFS 2 cases. Therefore, all WRFS 1 cases were assigned an ASCO code that was based on the text description of their occupation, their original CCLO code and, where necessary, the full text description of the incident. This re-coding was done in random order and was performed by the same persons who coded the occupations for WRFS 2. The percentage of working and commuting cases with unknown occupation for both studies was low (WRFS 1: 2.1%, WRFS 2: 1.2%) and is unlikely to affect comparisons between the studies based on occupation.

In summary, the occupation–specific rates for WRFS 1 that are presented in this thesis are based on ASCO and were determined using the directly re-coded occupations of cases and the transformed ABS LFS data.

3.6.9 INDUSTRY

For the years covered by both WRFS 1 and WRFS 2, the ABS used the *Australian Standard Industry Classification* (ASIC) to classify industry[247]. Therefore, industry–specific rates presented in this thesis were determined in the same manner for both WRFS 1 and WRFS 2 without the need for transformation or re-coding of WRFS 1 industry data.

There was a much higher proportion of cases with unknown industry in WRFS 1 (13.5%) than WRFS 2 (2.9%), with work-road and commuting cases accounting for most of the difference (Table 3.10). The lower percentage of missing cases in the second study is almost certainly due to the better quality data available for WRFS 2 cases. Cases with unknown industry had to be excluded from industry–specific comparisons, leading to industry–specific fatality rate estimates which would have been slightly lower than the true rates. This will have affected the industry–specific rates from WRFS 1 more than those for WRFS 2, where the unknown proportion was much smaller. The exact effect of this is not known, although it is clearly much more of a problem for commuting cases in both studies than for workplace cases in either study, and a larger problem for WRFS 1 than for WRFS 2. If the true industries of the unknown cases were distributed in the same proportions as the cases with known industry, the rates for industries in WRFS 1 would be underestimated by about 13% for all rates based on all working and commuting cases and by about 11% for all working cases. For WRFS 2, the industry rates based on all working and commuting cases would be underestimated by about 3%, and by less than 1% for all working cases.

Table 3.10 Duty context for workplace, work-road, commuting and total deaths with unknown industry for WRFS 1 and WRFS 2 Number and percent

Duty context	WRFS 1		WRFS 2	
	Number	%[1]	Number	%[2]
Workplace cases with unknown industry	56	6.2	7	0.6
Work-road cases with unknown industry	79	21.5	2	0.4
All working cases with unknown industry	135	10.6	9	0.5
Commuting cases with unknown industry	73	27.4	62	9.9
All working and commuting cases with unknown industry	208	13.5	71	2.9

1: Percentage of total cases in each duty context category for WRFS 1.
2: Percentage of total cases in each duty context category for WRFS 2.

3.7 ETHICS APPROVALS AND AUTHORISATION FOR ACCESS TO DATA

The overall study was approved by the then Research Standing Committee of NOHSC. This approval was granted following ethical approval by the Ethics Committee of the University of Sydney. During the organisational phase of the study, the study team was required to seek, and received, ethical approval from the following ethics committees:

- the Joint Institutional Ethics Committee of the Royal Darwin Hospital and the Menzies School of Health Research;
- the Alice Springs Institutional Ethics Committee;
- the Ethics Committee of the National Deaths Index of the AIHW; and
- the John Tonge Centre for Forensic Sciences (Queensland) Institutional Ethics Committee.

In addition, approval was sought and received from the following authorities for access to relevant data:

- Registrars of Births, Deaths and Marriages for access to Deaths Data from the ABS and for other relevant State-based Death Registry data;
- State Coroners (or equivalent authorities) for access to coronial information;
- the Queensland Government Statistician;
- the Queensland Commissioner of Police for access to relevant police reports no longer held in the associated coronial files;
- the Information Management and Services Manager at the Queensland Department of Transport for access to relevant file data on fatal motor vehicle incidents for which data were no longer held in the associated coronial files;
- the heads of OHS and compensation agencies for access to unit record data for relevant work-related deaths that occurred during the study period;
- electrical authorities for information on relevant electrical deaths that occurred during the study period; and
- mines inspectorates for information on relevant mining deaths that occurred during the study period.

Approval was sought but not received from the following authorities for access to relevant data:

- Bureau of Air Safety Investigation (BASI) for information on relevant fatal aircraft incidents that occurred during the study period;
- ACT WorkCover for access to unit record data for relevant work-related deaths that occurred during the study period;
- WorkCover Western Australia for access to unit record data for relevant compensated deaths that occurred during the study period (permission was later

granted for access to some de-identified data through the then Department of Occupational Health, Safety and Welfare of Western Australia); and

- Telstra for access to unit record data for relevant compensated deaths that occurred during the study period.

3.8 ANALYSIS AND PRESENTATION OF RESULTS

3.8.1 WORKING AND COMMUTING DEATHS

Work-related deaths of workers were separated into five main categories based on the duty context. These categories were not mutually exclusive:

- **'Workplace deaths'** in which the incident involved fatal injury to a working person in the course of, or as a result of, their work duties in any situation other than in a motor vehicle incident (MVI) on a public road;
- **'Work-road deaths'** in which the incident involved fatal injury to a working person in the course of, or as a result of, their work duties and in an MVI on a public road;
- **'Commuting deaths'** in which the incident involved fatal injury to a working person who was travelling to or from work but not in the course of work;
- **'Working deaths'** in which the incident involved fatal injury to any working person in the course of, or as a result of, their work duties (thus the working deaths group was made up of the workplace and work-road deaths groups); and
- **'Working and commuting deaths'** in which the incident involved fatal injury to any working person in the course of, or as a result of, their work duties or travelling to or from work (thus the working and commuting deaths group was made up of the workplace, work-road and commuting deaths groups).

The results presented in this thesis cover all five groups, but concentrate on the workplace, work-road and working deaths categories.

3.8.2 RATES AND CONFIDENCE INTERVALS

Results presented as numbers of deaths of workers or commuters include all working persons identified as cases in this study. Results presented as rates of death of workers or commuters include only those deceased workers who were members of the Employed Civilian Labour Force (ECLF). This is because the ECLF was used as the denominator population for the rate calculations. The ECLF includes nearly all working persons aged 15 years or older, but specifically excludes members of the armed services. Ninety-six percent of the 1,787 working cases were in the ECLF. Rates were calculated as deaths per 100,000 person-years, which is equivalent to the number of persons who died in one year in a group of 100,000 persons. For ease of reading the rates are expressed as deaths per 100,000 persons per year.

The data on work-related traumatic death presented in this thesis represent a census of all relevant deaths that occurred during the study period. Therefore, they should not be affected by sampling variability. However, it is assumed that the actual number of deaths that occur in a given period would vary randomly, even with the same factors operating, and that this random variability is best described by the Poisson distribution. This random variability is proportionately greater for smaller numbers of deaths. If comparisons are to be made between groups, it is sensible to do this taking into account the extent of random effects (or variance) associated with the numbers or the rates based on them. Confidence intervals provide a guide to the extent of this variation. For this reason, 95% confidence intervals are included for most rates presented in this thesis.

Confidence intervals were based on the numerator data of the rates (ie the cases identified in the study), assuming a Poisson distribution and using the relationship between the Poisson distribution and the Chi-squared distribution. Confidence intervals were calculated using the exact method for numerators up to 100, and the normal approximation for numerators above 100 as described by Armitage and Berry[260]. Variability in the denominator (arising from the sampling variability in the Labour Force Survey) was not included in the calculations of the confidence intervals. Therefore, to the extent that significant variance exists in the Labour Force Survey estimates, the stated confidence intervals will be slightly narrower than the true values. Any significant variance in the stated rates is likely to arise largely from the numerator data, so the effect of this approach is not likely to affect the confidence intervals, nor the conclusions based on them, to any significant extent.

3.8.3 ANALYSIS AND GRAPHICS SOFTWARE

Analyses were conducted using the Statistical Analysis System[261] and Excel[262]. Figures were produced using SigmaPlot[263].

3.8.4 CONFOUNDING

Most of the outcomes examined in this thesis can be affected independently by more than one factor. For example, the risk of suffering a fatal work-related injury might be affected by the presence of faulty equipment, the occupation of the deceased, the age of the deceased, the suitability of established procedures and so on. If the association between a factor and an outcome is examined without taking other factors into account, apparent variations for one factor (eg occupation) may really be due to variations for another (eg faulty equipment) rather than to the first factor itself. That is, the measures associated with the first factor may be **confounded** by the effect of the second. This does not present a problem if the data are primarily used to identify factors which are

commonly (or not commonly) associated with fatal incidents. However, if it is necessary to examine the **independent** effect of a factor, any analysis must take account of the effect of other important factors. This can be accomplished in a number of different ways, such as stratification, standardisation or the use of multivariate methods. Most of this thesis is concerned with providing an overview of the type, number and circumstances of work-related traumatic deaths. It does not attempt to definitively identify the causes of the fatal incidents, taking into account the effect of other factors. Instead, it aims to identify factors which are commonly (or not commonly) associated with the fatal incident or the deceased. Therefore, most of the information presented in this thesis examines factors in isolation from each other (ie on a univariate basis). Interpretation of the results should be made keeping this in mind.

3.8.5 STANDARDISATION

Rates were standardised where appropriate for comparison purposes. Comparison between WRFS 1 and WRFS 2 included a comparison of standardised rates. Rates were standardised by industry and sometimes occupation. This section describes only the approach used for industry standardisation, but the standardisation for occupation was conducted in the same manner.

Rates from WRFS 2 were adjusted by multiplying the industry–specific rates from WRFS 2 by the industry–specific denominators from WRFS 1. The resultant industry–specific adjusted number of deaths for WRFS 2 was then divided by the total denominator for WRFS 1 to produce an adjusted rate for WRFS 2 that could be compared with WRFS 1. The standardisation was also done in reverse, adjusting the WRFS 1 rates using the WRFS 2 denominators. Both rates are presented, but the first approach, using WRFS 2 rates, is considered more accurate because WRFS 1 had a

larger proportion of cases with unknown industry which had to be proportionately distributed to calculate WRFS 1 rates.

The rates for each of the four years covered by the current study were standardised using the direct method[264] as described for WRFS 1 and WRFS 2 comparisons. Rates from each of the four years were standardised using the industry specific-denominators for 1989.

Comparisons between jurisdictions included calculation of rates standardised by industry. Both direct and indirect standardisation approaches were used. Direct standardisation was the preferred approach to avoid the problem of confounding (in this case due to industry) that can be introduced if multiple comparisons are made of indirectly standardised rates. However, the very low numbers of deaths in the smaller jurisdictions made it difficult to appropriately include them in the calculation of directly standardised rates. Indirect standardisation is less of a problem for the smaller jurisdictions, so this approach was also used. However, the problem of residual confounding must be kept in mind when interpreting the results from the indirect standardisation[264]. Direct standardisation was conducted by applying the industry–specific denominators for the whole of Australia to the industry–specific rates in each jurisdiction. Jurisdictions with too few numbers in the numerator or denominator were excluded from the directly standardised comparisons. Indirect standardisation was conducted by applying the industry–specific denominators for each jurisdiction to the industry–specific rates in the whole of Australia.

For all standardisation calculations, the cases with unknown industry were distributed to each of the industry categories on a proportional basis, using the industry proportions for those cases with known industry.

3.8.6 DENOMINATOR DATA

The Labour Force Survey provides information on both numbers of persons employed and hours worked. Rates calculated on the basis of persons employed do not take account of part–time workers. Clearly, for a given number of workers, the total time at risk is less if the workers are part-time rather than full–time. Therefore, if there is a major difference between the proportion of part-time workers in two groups, comparisons between the groups are usually better done on the basis of hours worked rather than persons employed. Although it was found that there was some seasonal variation in the proportion of part-time workers between and within industry groups, these differences were only minor when averaged out over the 16 surveys. Denominators based on persons were used for the calculation of rates in this study for consistency with previously published rates and for ease of interpretation. Rates based on the whole population were calculated using data from annual ABS populations surveys[242] and the 1991 National Census, also conducted by the ABS[243].

3.8.7 PERCENTAGES

In some tables, percentages do not add up exactly to 100 because of rounding. However, for ease of interpretation, 100 is used as the total in all these tables, regardless of the effect of rounding.

3.8.8 INCIDENTS VERSUS DEATHS

Some fatal incidents involved more than one death. Most sections of this thesis consider deaths rather than incidents. Where the number of incidents is used, this is clearly stated in the relevant section.

3.9 OUTCOME OF THE COMPLETED CASE IDENTIFICATION PROCEDURE

3.9.1 SUMMARY OF CASE IDENTIFICATION PROCEDURE

The original Deaths Data List supplied by the ABS contained 22,506 unit records covering the four years 1989 to 1992. Seventy–eight of these (0.3%) were excluded—72 were duplicates in the same jurisdiction, four deaths were registered in two jurisdictions and two deaths were of persons who died outside the study period. This left 22,428 unit records on the ABS Deaths Data List identified as persons who died of non-suicide external causes during the study period (plus persons with an ICD-9 code of 799.9, indicating an unknown cause of death).

Of the 22,428 deaths, 2,940 were medically certified (13.1%) and only 93 of these (3.2%) had files in the coronial system. The remaining 19,488 deaths were not medically certified and so should have had files in the coronial system. Another 529 persons (designated as 'Extras') whose deaths were not recorded on the list supplied by the ABS were identified in the coronial system as having died of a non-suicide external cause. There were thus 20,110 coronial files of relevance to the study that needed to be inspected.

Of the coronial files of relevance, 20,042 were found (99.7%). Other sources of information, such as OHS or compensation agency information, death certificate information, police reports and newspaper reports, were found for 16 of the remaining 68 persons for whom coronial files could not be located (24.6%). There were also two medically certified deaths not in the coronial system for whom information was obtained that showed that the deaths met the study definitions of a case.

Of the 20,060 deaths for which information was available, 4,169 were collected as probable cases (20.8%), 14,637 were excluded as non-work related (73.0%) and 1,254 were excluded as indeterminate (6.3%).

The probable cases that were collected were reviewed by the study team during the coding process and a final decision was made on the appropriate classification. Of the 4,169 probable cases that were collected, 3,630 were confirmed as meeting at least one of the study case definitions (87.0%). A further 323 were excluded as non-cases (7.8%) and 216 were excluded as indeterminate (5.2%).

Therefore, of the original 22,957 deaths identified as due to non-suicide external (or unknown) causes on the basis of the ABS Deaths Data List, or found as 'Extras' in the coronial system, 3,630 were confirmed as cases (15.8%), 17,805 were excluded as non-work related (77.6%) and 1,522 were excluded as indeterminate (6.6%) (Figure 3.1 and Table 3.11).

Figure 3.1 Summary of the completed case identification procedure

Table 3.11 Summary of the completed case identification procedure

Category	Number	%
Net deaths on ABS list	22,428	99.7
Excluded as duplicates, not in study period, etc	78	0.3
Deaths on ABS list	**22,506**	**100.0**
Medically certified deaths	2,940	13.1
Non-medically certified deaths	19,488	86.9
Total deaths on ABS list	**22,428**	**100.0**
Non-medically certified deaths	19,488	96.9
Medically certified deaths with coronial files	93	0.5
'Extras'	529	2.6
Total deaths in coronial system	**20,110**	**100.0**
Files found	20,042	99.7
Files not found	68	0.3
Total deaths in coronial system	**20,110**	**100.0**
Collected as potential cases	4,169	20.8
Excluded — non-case on basis of coronial file	14,637	73.0
Excluded — indeterminate on basis of coronial file	1,254	6.2
Total files found (plus 16 missing with extra information and two medically certified with extra information)	**20,060**	**100.0**
Confirmed cases	3,630	87.1
Excluded — non-case after review of collected information	323	7.7
Excluded — indeterminate after review of collected information	216	5.2
Total collected potential cases	**4,169**	**100.0**
Total confirmed cases	3,630	15.8
Total confirmed non-cases	17,805	77.6
Total confirmed indeterminates	1,522	6.6
Total net deaths on ABS list plus 'Extras'	**22,957**	**100.0**

3.9.2 DETAILS OF CASE IDENTIFICATION PROCEDURE

The rationale behind the methodology used for this study was that all work-related traumatic deaths should be able to be identified through the coronial system. This is because all such deaths are (by definition) due to external causes, all external cause deaths are allocated an External Cause code by the ABS, and all external cause deaths are (in theory) subject to coronial investigation. Therefore, by obtaining a list of external cause deaths from the ABS and reviewing all coronial files relevant to these deaths, all work-related traumatic deaths should be identified.

However, a number of practical issues provide some complications or alternatives to this ideal case identification approach. These include the following:

- not all external cause deaths are registered with the ABS within 18 months to two years of their occurrence;
- not all external cause deaths are given an appropriate External Cause code on the ABS Deaths Data List or are registered with the ABS;
- some external cause deaths are certified by a medical practitioner and then are not usually subject to coronial investigation;
- some coronial files are not able to be located; and
- there are some relevant information sources about work-related external cause deaths outside the coronial system.

Figure 3.2 describes the process of file identification, collection and coding in more detail than Figure 3.1. The levels and letters in brackets mentioned below correspond to the levels and letters shown on the Figure.

Level 1 — The true total number of deaths that occurred during the study period due to non-suicide external causes is not known (a). Note that deaths from unknown cause, given an ICD-9 code of 799.9, were also included on the ABS Deaths Data List supplied for the study. So, when comments are made about the list of non-suicide external cause deaths supplied by the ABS, they include the relatively small number of deaths from unknown causes (486 over four years). However, these deaths from unknown cause will usually not be specifically referred to in the rest of this section.

Level 2 — Those deaths registered with the ABS and given an appropriate External Cause code were on the ABS Deaths Data List supplied for the study and the total

number is known (b: 22,428). In contrast, the total number of those not on the ABS Deaths Data List (not registered with the ABS or registered but not given an appropriate External Cause code) is not known (c).

Level 3 — The number of ABS-identified external cause deaths that were certified by a medical practitioner (d: 2,940), and the number not certified by a medical practitioner (e: 19,488), is known (MC = medically certified). The number of external cause deaths that were not on the ABS Deaths Data List and that were not medically certified (f) is not known. Similarly, the number of external cause deaths that were not on the ABS Deaths Data List and that were medically certified (g) is not known.

Level 4 — The number of ABS-identified external cause deaths that were certified by a medical practitioner and that were (i: 93), or were not (h: 2,847), the subject of some sort of coronial investigation is known. All ABS-identified external cause deaths that were not certified by a medical practitioner were (by definition) the subject of a coronial investigation (e). The number of external cause deaths that were not on the ABS Deaths Data List and that were the subject of coronial investigation is known (n: 529), but not separately for medically certified (l) and non-medically certified (j) deaths. These 529 were the deaths identified as 'Extras' during the data collection process. The number of external cause deaths that were not on the ABS Deaths Data List and that were not the subject of coronial investigation is not known, either combined (p) or separately for medically certified (m) and non-medically certified deaths (k).

Level 5 — Therefore, the total number of external cause deaths that were the subject of coronial investigation (o: 20,110), or were on the ABS Deaths Data List, were medically certified and were not the subject of coronial investigation (h: 2,847), is known.

However, the total number of external cause deaths that were not on the ABS Deaths Data List and were not the subject of coronial investigation (p) is not known.

Level 6 — Nearly all coronial files of interest were found (q: 20,042). Of those files that were not found (r: 68), appropriate information was found from other sources to enable an assessment of the circumstances to be made for some deaths (s: 16) but not for others (t: 52). Of the medically certified deaths not in the coronial system, other information (from the compensation agencies) revealed that two deaths met the study definitions of a case (u: 2) and the remainder were excluded as non-cases (v: 2,845).

Level 7 — Of the deaths for which the coronial file was found or there was sufficient information from other sources, the deaths were either collected as a definite or probable case (x: 4,169), excluded as a non-case (w: 14,637) or excluded as an indeterminate (y: 1,254).

Level 8 — Each collected case was reviewed by one or more members of the study team and confirmed as a case (A: 3,630), excluded as a non-case (z: 323) or excluded as an indeterminate (zz: 216).

Level 9 — Therefore, the final total number of cases (A: 3,630), non-cases (B: 17,805) and indeterminate cases (C: 1,522) was known. The total of these three groups (A + B + C) was equal to the sum of the total number of deaths on the ABS Deaths Data List supplied to the study team plus the total number of 'Extras' (b + n). The only area of uncertainty in the case identification procedure is for external cause deaths which were not on the ABS Deaths Data List supplied to the study team and which were not the subject of coronial investigation. The number of such deaths is not known, but it is

likely that very few deaths were in this group and even less likely that any work-related deaths would be among this group. This is because almost all external cause deaths in Australia should come to the attention of either, or both, of the ABS and the coronial systems.

Examples that were encountered during the study of deaths where ABS registration did not occur were persons who went missing, were presumed dead, whose bodies were never recovered and for whom there was little information about the circumstances of their deaths. It appears that these people were classified as missing persons rather than deceased persons and so were not registered with the ABS. There were a number of instances of this, usually involving presumed drowning, in the Queensland coronial system.

Figure 3.2 Details of the completed case identification procedure

MC = medically certified
CS = coronial system

3.9.3 DISCUSSION OF CASE IDENTIFICATION PROCEDURE

Some information was available which assisted in assessing the potential effect of the various factors listed above which complicated the case identification procedure.

Late registration

Based on the Deaths Data List information supplied by the ABS for this study (excluding Northern Territory deaths, for whom some data on registration year were missing), 99.3% of 1989 deaths were registered by the end of the registration year following the death, and 99.9% by the end of the following year (Table 3.12). Only three deaths from 1989 were registered in the third and fourth registration years following the year of death. Results from deaths that occurred in the other three years of the data collection show a very similar pattern, with only four 1990 deaths registered in the third year after death and 13 deaths in 1991 registered in the second year after death. Similar patterns were seen in each of the jurisdictions. The ABS-supplied information was obtained in late 1994, on completion of data entry for the 1993 death registration year. So, even for 1992 deaths, it can be expected that over 99% of deaths would have been registered early enough for inclusion in the list supplied by the ABS. The deaths from the study period that were not registered by this time presumably account for some of the 'Extras' identified in the coronial system.

Table 3.12 Time to registration for non-suicide external cause deaths Number and percent. Australia (excluding NT), 1989 to 1992

Year of death	Years between death and registration[1]										Total	
	0		1		2		3		4			
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
1989	5,190	(85.2)	860	(14.1)	40	(0.7)	2	(0)	1	(0)	6,093	(100)
1990	4,821	(87.7)	653	(11.9)	19	(0.3)	4	(0.1)	na		5,497	(100)
1991	4,585	(88.1)	605	(11.6)	13	(0.2)	na		na		5,203	(100)
1992	4,561	(90.6)	472	(9.4)	na		na		na		5,033	(100)

1: Deaths data obtained from the ABS in late 1994

Deaths not assigned an External Cause code or not registered

The ABS coders rely on the cause of death information on the death certificate as the primary source of information used to allocate an ICD-9 code for the Deaths Data List. For coronial cases, ABS coders often use more detailed information obtained from the Coroners' offices. If this information is wrong, ambiguous or misleading, then the ABS coder might incorrectly apply a natural cause code rather than an External Cause code to an external cause death. Such persons would then not have appeared on the list of deaths supplied for the study by the ABS. Probably the most common cause of this occurrence is where a person dies months or years after a traumatic incident that caused injuries which eventually lead to their death. For example, someone suffering severe chest injuries in a tractor rollover who died months later of related pneumonia might have a death certificate which lists pneumonia as the cause of death and does not mention the preceding trauma.

The number of non-suicide external cause deaths that were registered but which were not assigned an External Cause code is not known. The 529 'Extras' identified in the coronial system were presumably not included in the information supplied by the ABS

because they were either registered after the end of data entry for the 1993 registration year, were not assigned a non-suicide External Cause code, or were never registered.

The extent of the first of these possibilities can be examined using the study data. If it is assumed that all deaths are registered within five years of the death occurring (a reasonable approach given the data supplied by the ABS), the 1989 proportions can be used to estimate the number of deaths which met the selection criteria for the study, and that were assigned an appropriate External Cause code, but that were not registered by the time the data were supplied by the ABS. On this basis, the number of additional deaths would be zero for 1989 (by definition), one for 1990 deaths, four for 1991 deaths and 26 for 1992 deaths. This gives a total of 31 additional deaths (0.14% of the total deaths). These calculations do not include the Northern Territory, for which data on registration year were not available for all deaths. Applying the overall percentage of 0.14% to the 602 deaths that occurred in the Northern Territory during the study period gives an estimate of another one death. Therefore, it would be expected that about 32 deaths which met the inclusion criteria would not have been registered in time for inclusion in the data supplied by the ABS. On the basis of the supplied ABS data, one of these deaths would be expected to have been assigned an unknown cause code and the remainder an External Cause code. This estimate of 32 would account for only 6.0% of the 529 'Extras' identified in the coronial system.

The number of 'Extras' registered but not assigned an appropriate External Cause code, and the codes which they were assigned, could be determined if necessary by searching for them in the appropriate Death Registry records, but this was not possible for this study. Since the number of 'Extras' whose death was never registered is likely to be very low (but probably not zero), it is likely that there were about 495 (529 minus 32)

non-suicide external cause deaths during the four year period of the study which were not assigned appropriate External Cause codes. This represents about 2.2% of all such deaths that occurred during the study period. Some characteristics of the 529 'Extras' compared with the ABS-identified deaths are shown in Table 3.13. The average age of the 'Extras' was very similar to the non–medically certified deaths (but note that age was missing for over half the 'Extras').

Medical certification

Of the 22,428 deaths identified as non-suicide external cause (and unknown cause) deaths by the ABS during the study period, 2,940 were certified by a medical practitioner (13.1%). Only 93 of the medically certified deaths (3.2%) had records in the coronial system, with one classified as a working death (1.1%) and one as a road bystander (1.1%). Two of the medically certified deaths without records in the coronial system were later found (through compensation agency information) to satisfy the study definitions of a work-related death and were therefore included as workplace cases. It is unlikely that any of the remaining medically certified deaths not in the coronial system were work-related. The available general characteristics of the medically certified group support this assumption, to the extent that the average age and assigned External Cause codes are very different from those of non-medically certified deaths and, to a lesser extent, from medically certified deaths with records in the coronial system. As expected, the medically certified deaths not in the coronial system are predominantly of elderly people who died as a result of a fall not related to ladders, scaffolding, buildings or other structures (Table 3.13).

Missing files

Since 99.7% of files were found, there would have been negligible bias due to missing records.

Table 3.13 Comparison of characteristics of medically certified deaths, non-medically certified deaths, 'Extras' and working cases Australia, 1989 to 1992

Characteristics	Medically certified – not in the coronial system	Medically certified – in the coronial system	Not medically certified	Extras	Working cases
Number	2,847	93	19,488	529	1,787
Age in years[1]					
Mean	79.1	65.1	39.2	39.4	38.9
(standard deviation)	16.1	23.8	23.9	21.9	14.7
ICD-9 E-codes (% in category)[2]					
Transport	1.1	18.3	54.4	na	48.2
Falls					
Ladder and scaffolding	0.1	-	0.4	na	2.0
Building	-	-	0.8	na	2.3
Other	74.7	33.3	8.1	na	2.2
Hit by falling object	0.1	1.1	1.1	na	7.3
Machinery related	-	-	1.6	na	14.3
Electrocution	-	-	1.1	na	6.5
Late effect of accidents	5.9	8.6	0.5	na	0.3
Other	18.1	39.7	32.0	na	16.5
Total	100.0	100.0	100.0	na	100.0
Percentage made cases[3]	**0.1**	**2.1**	**18.6**	**9.8**	**100.0**

1: Age was missing for 10 (0.1%) of the non–medically certified deaths and 341 (64.5%) of the 'Extras'.
2: E-codes were not available for 'Extras' as they were, by definition, not on the ABS Deaths Data List.
3: There were four medically certified deaths that were made cases. Two were not in the coronial system — both were made workplace cases. The other two were in the coronial system — one was made a workplace case and one a road bystander.

Other relevant information sources

Information from a number of sources, including OHS and compensation agencies, was used to supplement the data obtained from the coronial system if necessary and available.

Variation by year

There were no marked changes in the proportions of deaths classified as cases, non-cases and indeterminates over the four years of the study. Each year showed a small

drop in the proportion of deaths classified as cases (from 17.0% to 14.7%) and a small increase in the proportion of deaths classified as non-cases (from 75.1% to 79.1%). The proportion of indeterminates showed an inconsistent decrease (from 7.9% to 6.2%) (Table 3.14).

Table 3. 14 Overall case classification for external cause deaths Number and percent by year. Australia, 1989 to 1992

Classification	1989		1990		1991		1992		Total	
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
Case	1,096	(17.0)	917	(15.9)	839	(15.4)	778	(14.7)	3,630	(15.8)
Non–case	4,841	(75.1)	4,489	(77.8)	4,298	(78.7)	4,177	(79.1)	17,805	(77.6)
Indeterminate	509	(7.9)	361	(6.3)	325	(6.0)	327	(6.2)	1,522	(6.6)
Total	**6,446**	**(100.0)**	**5,767**	**(100.0)**	**5,462**	**(100.0)**	**5,282**	**(100.0)**	**22,957**	**(100.0)**