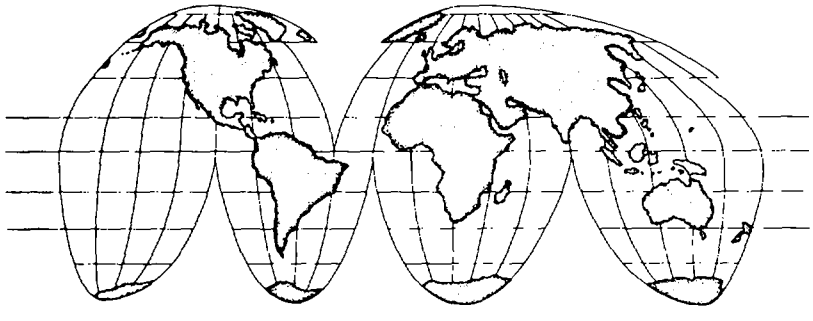
Levels and Trends in Injury Mortality and Morbidity in Selected Participating Countries



Australian Injury Morbidity and Mortality Data:
Issues for Comparability

by James E. Harrison, M.B., B.S., M.P.H.

Thank you for the opportunity to participate in this ground–breaking international meeting. The goal of the International Collaborative Effort on Injury Statistics is to improve "the quality, reliability, and comparability of international statistics on injuries." Achievement of this goal will have both direct and indirect value for Australia.

Attempts are made quite frequently to compare Australian experience of injury occurrence and control with experience elsewhere. More often than not, comparisons are difficult to make. Sometimes this is because data are not available. Often, however, the difficulty is that data are available for Australia and another country, but their trustworthiness and comparability are uncertain. A direct benefit of the ICE to Australia is that it should assist us in making valid international comparisons, just as it will assist others.

Achievement of the goal will bring other, more important benefits. Many of the problems which must be confronted when using and comparing injury data internationally are the same as those which arise in the course of national or regional injury surveillance and control. This is, I suspect, particularly true in the case of countries (such as Australia), which have a federal structure. Federal agencies confront problems of "the quality, reliability, and comparability of inter***state*** statistics on injuries", and lessons learned at the international level are likely to have application at national level.

I have two aims in presenting this paper: to provide a brief picture of injury in Australia, and to relate this illustration of injury in a particular country to the objectives of the symposium.

I shall begin by presenting a definition of injury: "Disruption of the structure or function of the human organism, resulting from exposure to excessive or deficient energy." Typically, both the exposure to energy, and the onset of disruption, are acute. Often the energy is kinetic, but it may be another type (thermal, chemical, etc.).

I do not present this definition (which is based on definitions presented by others) to suggest that it is the last word on the matter but, rather, to underscore the need for clear definitions as the basis for our work in injury statistics. Something close to this definition is, I think, widely accepted in public health circles in Australia, and the following statistical sketch of injury in Australia is based on it. It should be noted that this definition includes injuries irrespective of the role of human intent.

The injury experience of a population is often presented as a pyramid. The apex represents the relatively small number of fatal injury cases, and the broader, lower parts of the pyramid represent the more numerous injuries of lesser severity. Figure 1 is an injury pyramid based on recent Australian data. I introduce the injury pyramid here to make two points about injury data in Australia (and, I think, elsewhere) which are pertinent to international comparability.

First, injury data availability is in direct proportion to case *severity*, and in inverse proportion to case *frequency*. We know quite a lot about the relatively small number of injury deaths, less about hospital inpatient cases, and still less about cases resulting in neither death nor hospital admission. The priorities implied by this hierarchy of information availability may be correct, though the present situation certainly did not result from careful planning of injury data systems. We should be careful not to under–rate the importance, in human and economic terms, of 'less severe' injuries.

Second, constructing the pyramid reminds me of the rough–and–ready nature of many injury case categories used in Australia and elsewhere. For want of more direct measures, we tend to use hospital admission, or attendance at a hospital emergency department, as a proxy for case severity. We do this despite knowing that clinical criteria for admission may vary considerably, that economic and other factors do much to determine which cases will go to

which service, and that these factors vary with time and place. Improving our ability to measure the severity of injury (particularly injury that is not life threatening) rigorously and practicably is a challenge for injury researchers, and is important for international comparability of injury data.

Figure 2 shows incidence rates for injury deaths registered in Australia in 1992, by 5–year age groups, and sex. I would like to draw your attention to three points revealed by these data. First, male rates were higher than female – this is so for nearly all classes of injury for which data are available. Second, rates were highest in old age. Third, rates were relatively high for young adult males.

This figure can also be used as a reminder of several technical aspects of injury data that should be specified when reporting data, and kept in mind when comparing them.

The *event being reported* Note that I have reported cases by year of registration, not year of death. At present, about 12% of injury deaths in Australia are registered during a year later than the year of occurrence – nearly all in the following year. Improved death data collection is likely to facilitate early reporting of injury mortality by year of occurrence. This is a worthwhile improvement, particularly for classes of deaths whose rates vary substantially over short periods of time, and enables close monitoring of high priority types of injury.

Denominators In calculating rates, I have used age and sex specific estimates of the Australian population at the mid–point of the period covered by the figure. These estimates, published by the Australian Bureau of Statistics, are based on a national census each five years (most recently in 1991), with estimates for intercensal years being adjusted using birth, death, immigration, and emigration data. Usually (as in this figure) the population estimates used are on the basis of 'place of usual residence'.

Figure 3 is the same as Figure 2, except that the vertical axis shows numbers of injury deaths rather than incidence rates. The salient point is that most injury deaths involve young adult males. Note, also, the small peak in cases in young childhood (this has diminished in recent years).

The prominence of injury mortality in early adult life is still more evident in terms of the age–specific proportions of all deaths which are injury deaths (Figure 4). For males, injury accounted for more than half of all deaths from early childhood until the end of the fourth decade of life. The proportions of female deaths were smaller but were, nonetheless, substantial.

While mortality rates show injury to be an important cause of death, particularly in the first half of life, it is even more prominent in terms of some other measures of ill health. Years of Potential Life Lost ('YPLL'; here measured to age 65 years) due to injury is high because of the early ages at which most injury deaths occur. (Aspects of the method used to calculate YPLL, such as the choice of age thresholds, may warrant consideration by the ICE).

Injury is a frequent reason for admission to hospital, accounting for about one in ten cases in Australia. Surveys of reasons for visiting a doctor, and of self–reported recent illness also reveal the prominence of injury as a source of morbidity.

Surveillance of injury experience in Australia is, as elsewhere, restricted by data limitations (some attempts to overcome the limitations are mentioned at the end of this paper). At present, long term injury data are available, at national level, only for deaths. Figure 6 shows injury death rates since 1921. The main point to note is that both male and female injury rates have tended to decline since the late 1960s, and are now at historically low levels. Since 1968, male rates have declined by about 2.4% per year, and female rates have declined by about 3.1% per year. Note the continuing male excess.

On a technical note again, the rates in this figure have been standardised, by the direct method, to the Australian population in 1988. The use of standardisation as an aid to comparison of injury data is another matter which the ICE may care to consider.

While the recent decline in injury mortality has been considerable, and welcome, it should not be overstated. Other causes of death have declined at about the same rate, and so the proportion of all deaths which are injury deaths has changed less than the rate of injury deaths (Figure 7). Indeed, injury has accounted for a relatively high proportion of male deaths in Australia in recent years.

"Injury" is, of course, a mixed bag of conditions, occurring in diverse circumstances, and involving a wide range of causal factors. Figure 8 shows male rates since 1968 for three major categories of injury deaths, distinguished according to 'external cause': motor vehicle crashes; suicides; and falls. Motor vehicle crash death rates have dropped by more than half during this period – a dramatic decline, which accounts for much of the total decline in injury mortality during the period. Overall, suicide rates changed little during the period (as we shall see, some age–specific rates have risen). Suicide is now more common as a cause of male death than road crashes. Mortality attributed to falls declined gradually.

Figure 9 presents equivalent data for females, which tell a somewhat different story. Female rates were lower than male rates for road deaths and suicides, but similar for falls (falls death *case counts* are higher for females than males, reflecting the sex–distribution of the elderly population at risk). Rates for all three categories showed noticeable decline during the period.

Australian injury mortality data are coded according to the 'External Causes' classification of the 9th revision of the International Classification of Diseases (ICD9). Only one 'E–code' is provided per case, and 'injury and poisoning' codes (from Chapter 17 of ICD9) are not provided. A single E–code is useful, but provides limited insight into the circumstances of injury occurrence, and no direct information on the nature of the trauma sustained.

The data items and classifications used in injury statistics do much to determine what is – and can be – revealed. For example, alcohol is known to be an important factor in the occurrence of many types of injury, yet routine injury data collections generally do not record information on alcohol involvement (greater efforts have been made for road injury). Many significant categories of injury cannot be distinguished easily in Australian mortality and hospital admission data – occupational injuries and sports–related injuries for example. To a large extent, these defects reflect national reliance on ICD9. The National Injury Surveillance Unit (NISU) and others involved on injury surveillance and prevention are seeking to extend the information available about injury deaths in Australia, by co–operating with coroners to develop a national coroner case data system.

Geographic, social, economic and demographic factors contribute to injury risk. Groups attracting particular interest and concern differ between countries and with time. I have chosen to present the injury mortality experience of Aboriginal Australians as an example of the impact of these types of factors. The health disadvantage of Aboriginal Australians is becoming well known. Figure 10 shows a comparison of the injury mortality of Aborigines with that of all other Australians, during the three year period 1990 to 1992. The Aboriginal rates were much higher than those for the rest of the population.

This figure provides a good opportunity to mention another technical aspect of comparison of injury data, which might well be considered by the ICE: assessment of the significance of apparent differences between rates, particularly when case numbers (or populations) are small. For example, the rate shown in Figure 10 for Aboriginal Australians aged 75 years and above is derived from 12 deaths over three years, in a population whose mid–point size was 1583 persons.

The data source on which case counts in this figure are based – routine mortality data – is supposed to contain a record for every death registered. As such, it can be seen as a census of deaths, and case counts derived from this data collection are not subject to sampling error. The population estimate is also from a census. Where a rate is calculated on the basis of a large numbers of cases, it can be regarded, more or less, as an absolute value. If the number of cases is small, however, it should be recognised that the rate estimate is subject to chance variation in the precise number of cases that occurred in the period under consideration (e.g., two cases rather than one in a category would double the rate estimate).

A method used to take chance variation into account assumes that the number of injuries occurring in any time period is an independent variable which tends to follow a Poisson probability distribution (the National Center for Health Statistics presents formulae for calculating approximate confidence intervals based on this assumption in a technical appendix to many of its publications). Application of this approach to the data in Figure 10 confirms that the Aboriginal rates are significantly higher than non–Aboriginal rates overall, and for most of the age groups shown. For the age groups 10–14 years, and 75 years and over, however, the Aboriginal rate excess was not significant at the p=0.05 level.

Note that one Australian state (Queensland) did not supply information on Aboriginality for deaths registered during this period. This can serve as a reminder of the many situations in which data on a subject of interest are incomplete. The incomplete data on Aboriginal mortality are a lot better than no data – the situation that prevailed until a few years ago.

Routine injury data can be used in a number of ways. Analysis of historical data reveals events which may be important for the future control of injury. For example, the change from coal gas to petroleum gas for domestic purposes appears to have been associated in Australia (as it was in Britain and elsewhere) with a decline in suicide by this means (Figure 11). A more dramatic example is the rise and fall in suicide using pharmaceutical substances that coincided with the widespread use, then restriction, of barbiturates in Australia (Figure 12). The significance of such examples for the present is that awareness of historical trends is helping to ensure that environmental factors are taken into account in current attempts to develop strategies for suicide control in Australia.

Injury data can also lead to new recognition of problems, and may prompt causal hypotheses. For example, initial analysis of the Aboriginal injury mortality data mentioned a moment ago reveals striking differences between Aboriginal and non–Aboriginal suicide patterns (Figure 13). Is the peak in Aboriginal rates in early adulthood seen here a data artifact, or a stable pattern, or is this a breaking wave of suicide beginning with recent birth cohorts? While these data alone don't provide an answer, they can prompt us to ask the questions.

Increasingly, the available data are being used for priority setting in injury control, and for setting quantitative injury control targets. Figure 14 concerns one of a set of draft national targets which is presently out for public comment prior to refinement and anticipated adoption by Australia's governments. The aim is to achieve a year 2000 'All injury' mortality rate 20 percent lower than the rate in 1992.

An issue for the ICE raised by this Figure is the definition of 'all injury'. In the proposed Australian target, injury is defined as all deaths receiving an ICD 'External Cause' code except those attributed to medical and surgical complications and misadventures (i.e. E870–879), or to adverse effects of medications in therapeutic use (i.e. E930–949). These groups, account for only a small proportion of E–coded deaths, but about one–quarter of injury hospital admissions receive an E–code in these ranges. They have been excluded on the basis of a view that these cases are part of a rather different issue from that represented by other 'E–codes', and require different responses.

Another proposed injury control target is for drowning at ages 0 to 4 years (Figure 15). Drowning accounted for more than one–third of all 'External Causes' deaths in this age group in Australia in 1992. More than half of the drowning deaths occurred when a child fell or wandered into a private swimming pool.

We know this latter point because a special classification is being applied to drowning deaths in Australia. The International Classification of Diseases (9th revision), used to classify 'causes of death', treats drowning in a way that is not sufficient for current circumstances in Australia. Responding to the lack of necessary detail on circumstances of drownings, special supplementary classifications were developed in several states. Beginning with 1992 death registrations, one of these classifications is being applied nation–wide. This provides an example of a general challenge to classification of injury: information requirements change over time, and differ between settings, suggesting a need to try to design systems that can accommodate changes, and to allow for special local or regional requirements.

Rates of non–intentional drowning, and of most other categories of non–intentional injury in Australia, are declining or steady. The same cannot be said for intentional injury. While still low by world standards, homicide rates are tending to rise (Figure 16 shows rates for males and females aged 20 to 39 years).

More dramatic is the thirty–year rise in suicide rates amongst young adult males (Figure 17). Male suicide rates at older ages declined a little during the same period. A proposed year 2000 target appears optimistic, in the light of the historic trends. Reversals in Australian suicide rates almost as dramatic as the one implied by the target have occurred (see Figure 12), when a specific environmental factor changed. While a number of suicide control measures are being proposed now, I know of none for which there is substantial evidence that would warrant prediction of a turnaround of the magnitude implied by this target, and I suspect that these trend data were not taken into account in framing the draft target.

Proposed Australian injury control goals and targets address a number of other topics which have also been identified as warranting special attention. A problem for target–setting is the lack of adequate baseline data for many topics on which we might wish to set targets. Data are imperfect for mortality, scantier for injury morbidity than mortality, and very limited for exposure to risk factors.

The need to improve injury data is recognised, and the National Injury Surveillance Unit has a key role in bringing about the necessary changes. Here is a list of my priorities for improving injury data in Australia. In the light of these priorities, my interest in the ICE should come as no surprise.

Issue	Developments	Expected Benefits
• Data standards	• National Health Data Dictionary • National Minimum Dataset for Injury Surveillance	• better comparability • efficiency
• Injury mortality	• coroner data system	• timeliness • detailed information
• In–patient injury morbidity	• national morbidity collection	• comparability • accessibility
• Ambulatory injury morbidity	• integrated special purpose emergency department collection	• quantitative rigour • efficient collection
• Special purpose injury surveillance	• trauma service information systems • rare injury registers (e.g., spinal injury) • sector–specific information system (e.g., sports injury; farm injury	• various benefits

At national level, a key task is the first—standard setting. In collaboration with several injury surveillance and control groups, NISU has developed a National Minimum Data Set for Injury Surveillance (NMDS–IS). The principles which have guided its design are public health usefulness; ease of data collection; capacity for integration in general purpose data systems; and compatibility, with the ICD, and with the Australian National Health Data

Dictionary (a developing standard for national reporting of hospital admission data). An outline of the core data items in the NMDS–IS is shown in Figure 18.

Apart from the narrative injury description item (which is of crucial importance), the NMDS–IS maps very closely onto both the 9th and 10th revisions of the International Classification of Diseases. The minimum data set is in use in a number of emergency departments, and is being assessed for inclusion in the National Health Data Dictionary, and by groups developing ambulatory services data systems at state and regional level. We expect that further development of data standards, together with projects to improve national aggregation of data on injury admissions, and the collection of enhanced injury mortality data by coroners, will result in further improvement of injury surveillance and control in Australia over the next few years. These developments will improve "the quality, reliability, and comparability" of Australian statistics on injuries. In undertaking this work, we will try to learn from experience gained in other countries, and will be pleased if others find worthwhile lessons in the Australian experience.

Thank you for your attention. I hope I have achieved my twin aims of introducing Australian injury data to you, while also raising some of the issues which we'll be considering during the rest of this Symposium, and afterwards, during the very welcome International Collaborative Effort on Injury Statistics. I trust that some fruit of the Effort will be on display at the 3rd International Conference on Injury Prevention and Control, in Melbourne, Australia in February 1996.

Note on data: Unless stated otherwise, data in this paper were analysed by NISU using mortality and population data supplied by the Australian Bureau of Statistics.

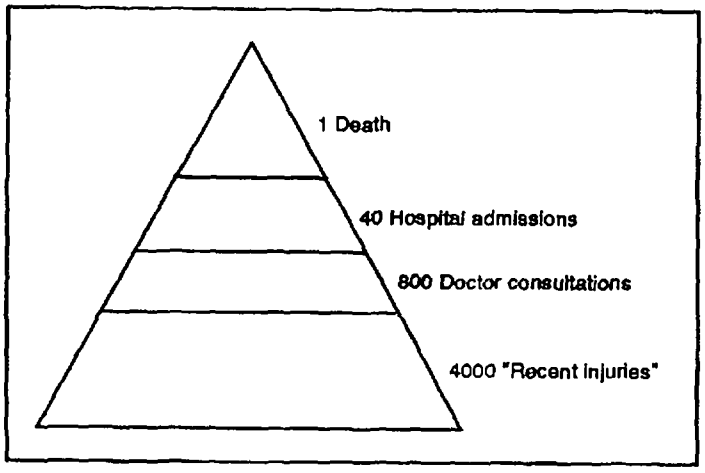


Figure 1. Australian "Injury Pyramid" (approximate values)

Figure 2: Injury deaths Australia, 1992: Incidence rates by age group and sex.

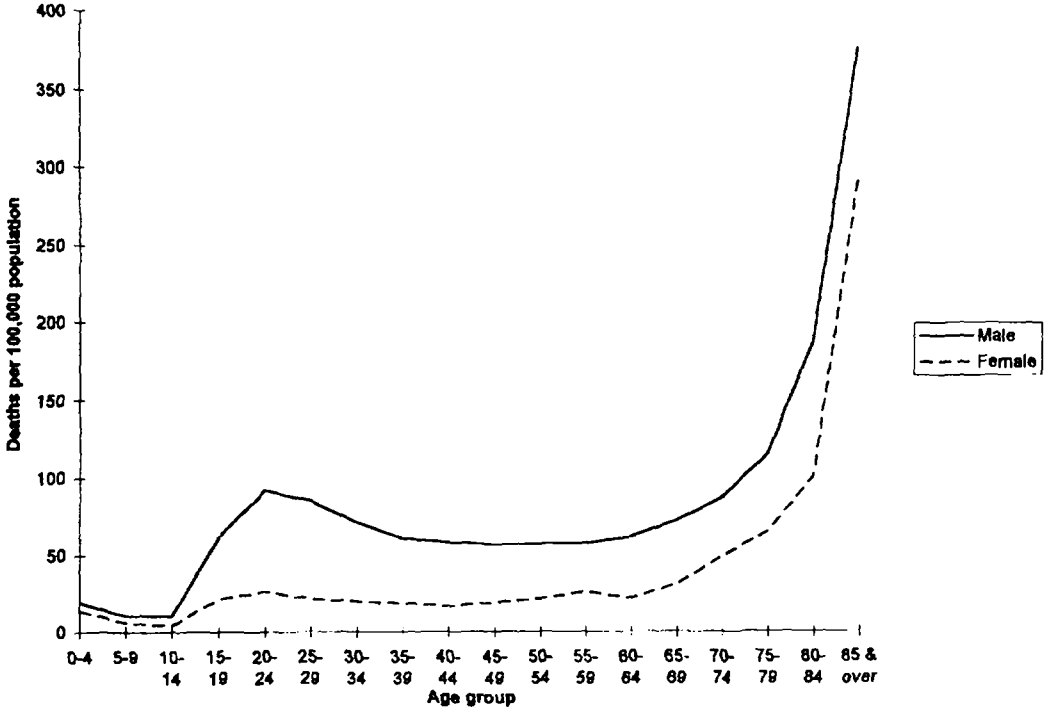


Figure 3: Injury deaths Australia, 1992: case counts by age group and sex.

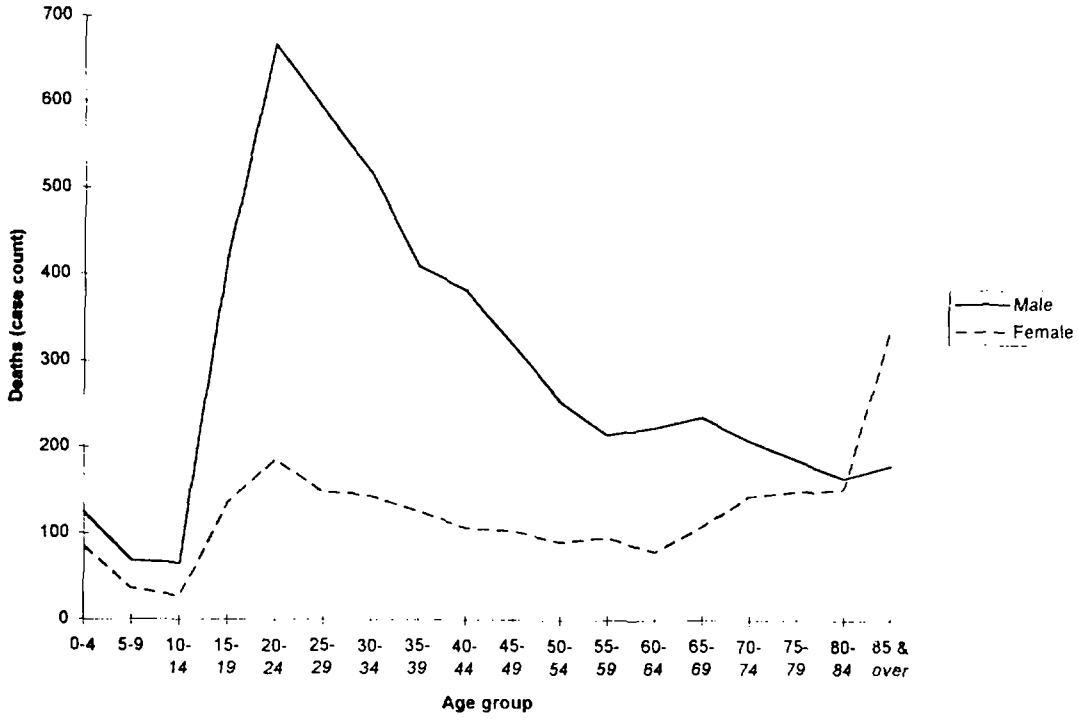


Figure 4: Injury as a proportion of all deaths, Australia 1992: by age and sex.

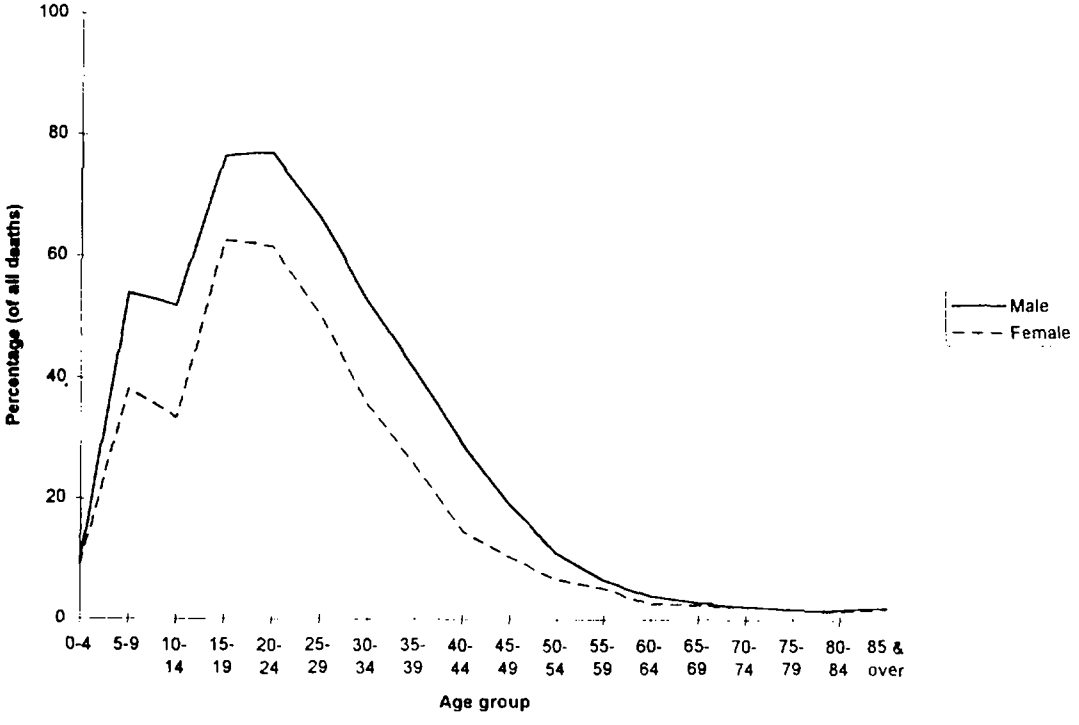


Figure 5: Rank of injury and other causes of ill-health, Australia 1990/91 (or closest available year)

Rank	Mortality	YPLL (<65)	Admissions	Bed-days	Doctor visits	Recent illness
1	*circulatory*	*other*	other	other	other	other
2	neoplasm	**INJURY**	**INJURY**	circulatory	respiratory	respiratory
3	other	neoplasm	circulatory	**INJURY**	circulatory	circulatory
4	respiratory	circulatory	respiratory	neoplasm	**INJURY**	**INJURY**
5	**INJURY**		neoplasm	respiratory	infectious	infectious
6	infectious		infectious	infectious	neoplasm	neoplasm

YPLL(<65)=Years of Potential Life Lost before age 65 years. Recent Illness=episodes reported at interview.

Figure 6: Injury mortality, Australia 1921-1992: age standardised rates, by sex.

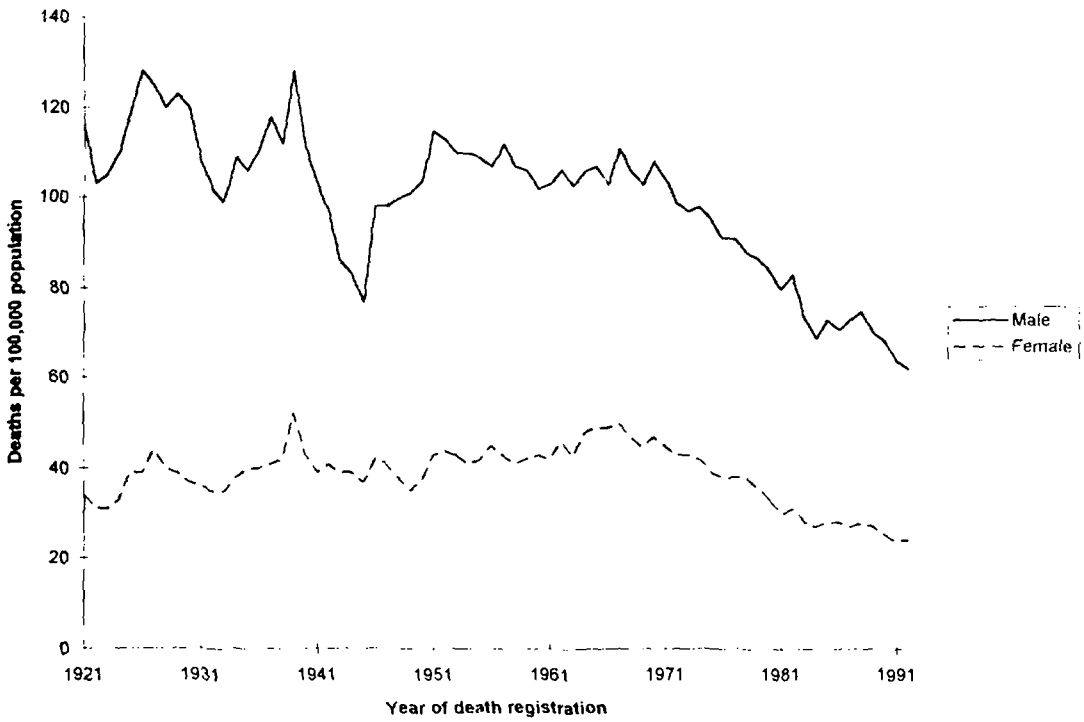


Figure 7: Injury deaths as a proportion of all deaths, Australia 1921-1992: by sex.

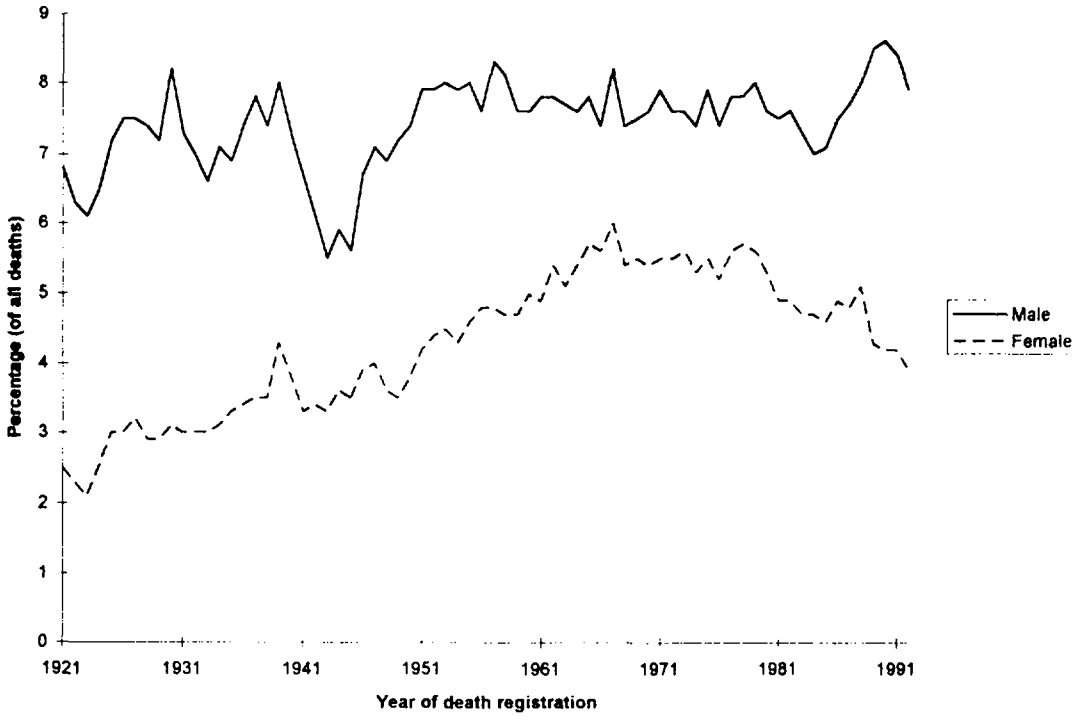


Figure 8: Mortality from three major types of injury, Australia 1964-92: males, age standardised rates.

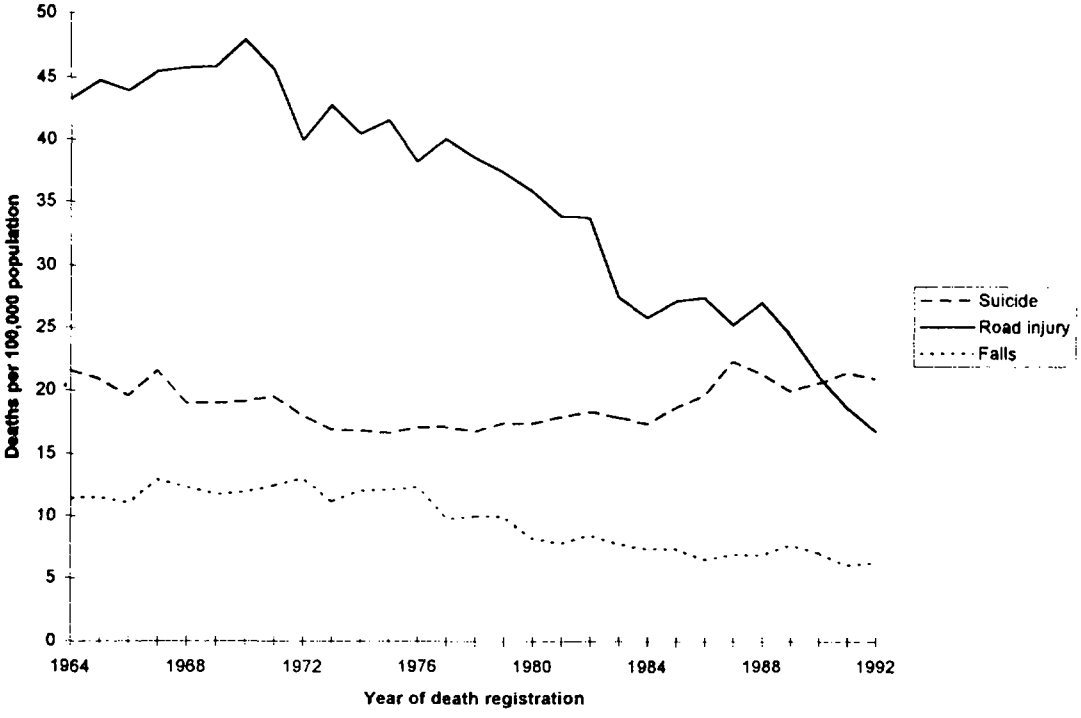


Figure 9: Mortality from three major types of injury, Australia 1964-92: females, age standardised rates.

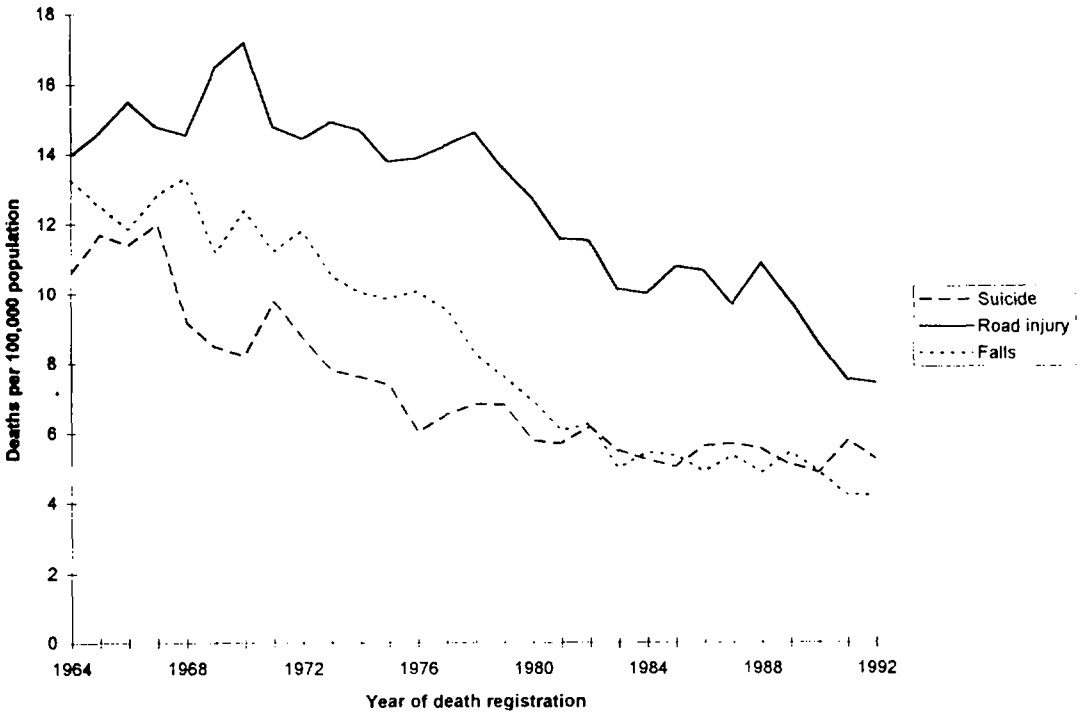


Figure 10: Aboriginal and non-Aboriginal injury mortality, 1990-92: Australia (except Queensland)

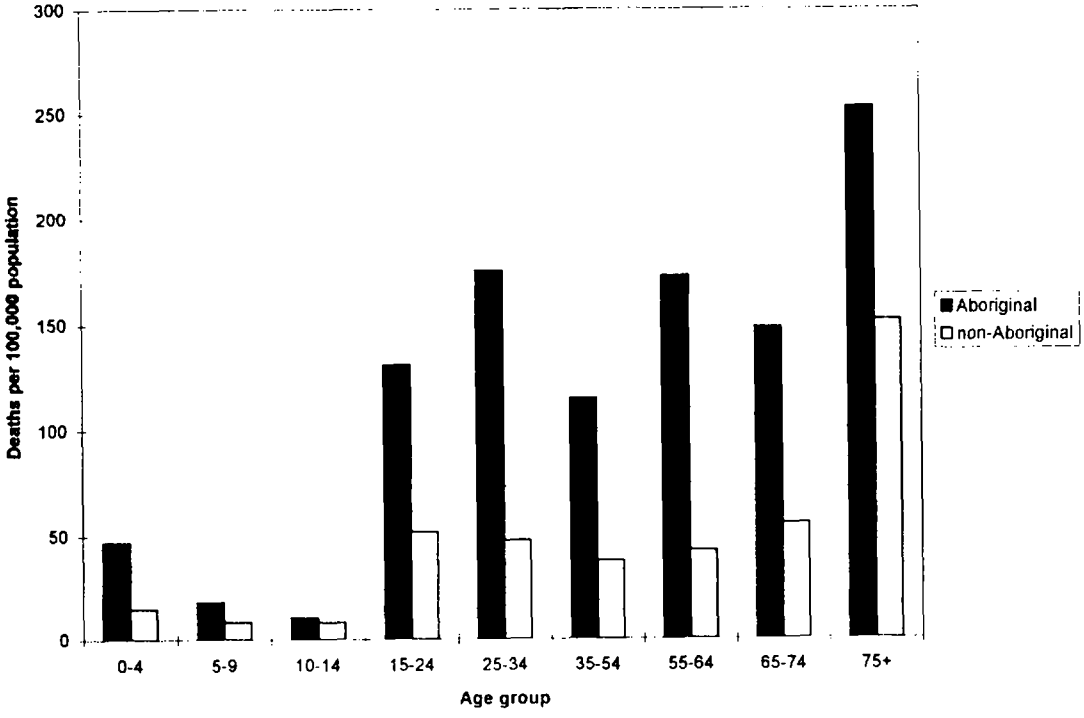


Figure 11: Suicide by gas, Australia 1922-92: females.

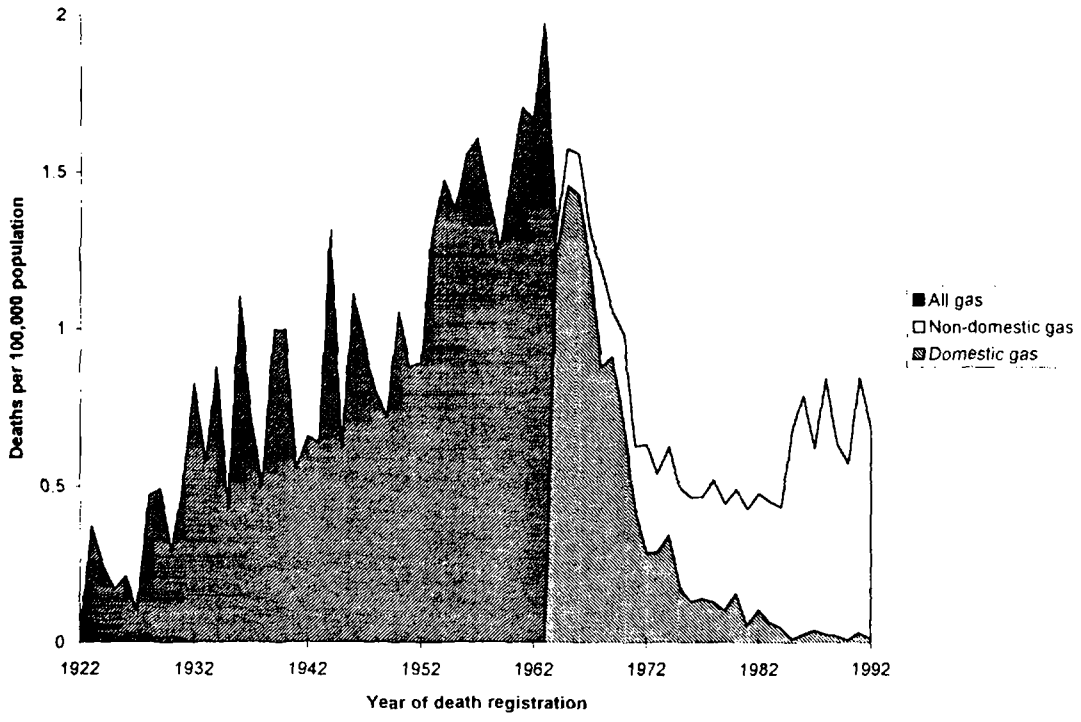


Figure 12: Common methods of suicide Australia 1922-92: female, age standardised rates.

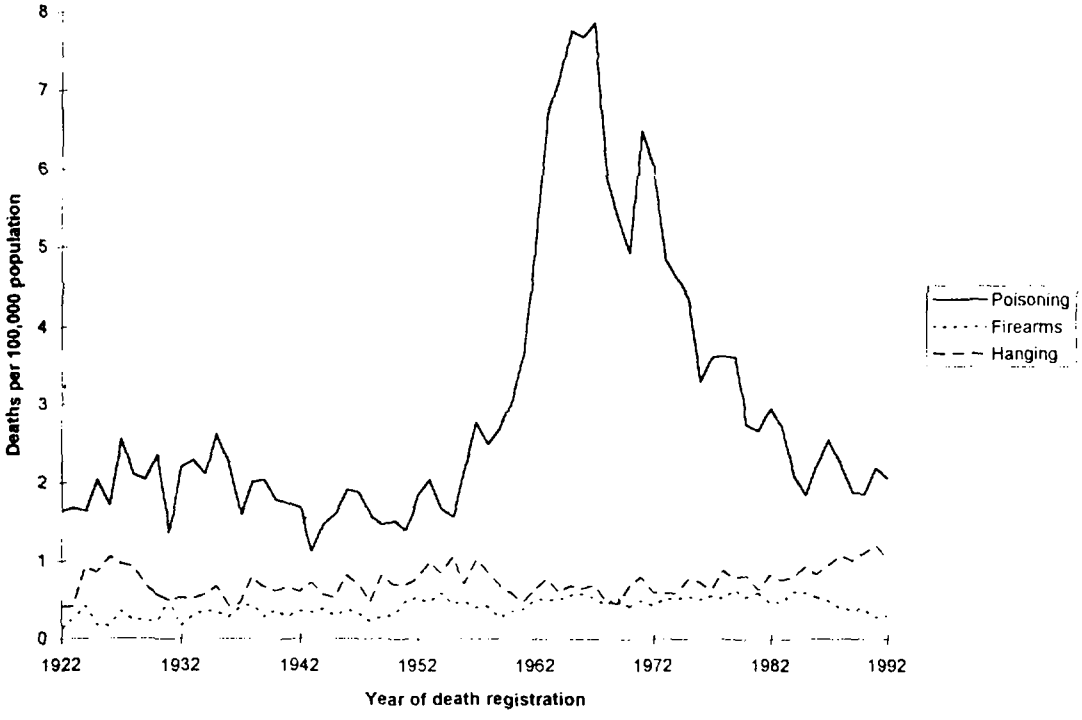


Figure 13: Suicide mortality, Aboriginal and other persons, Australia (except Queensland) 1990-92

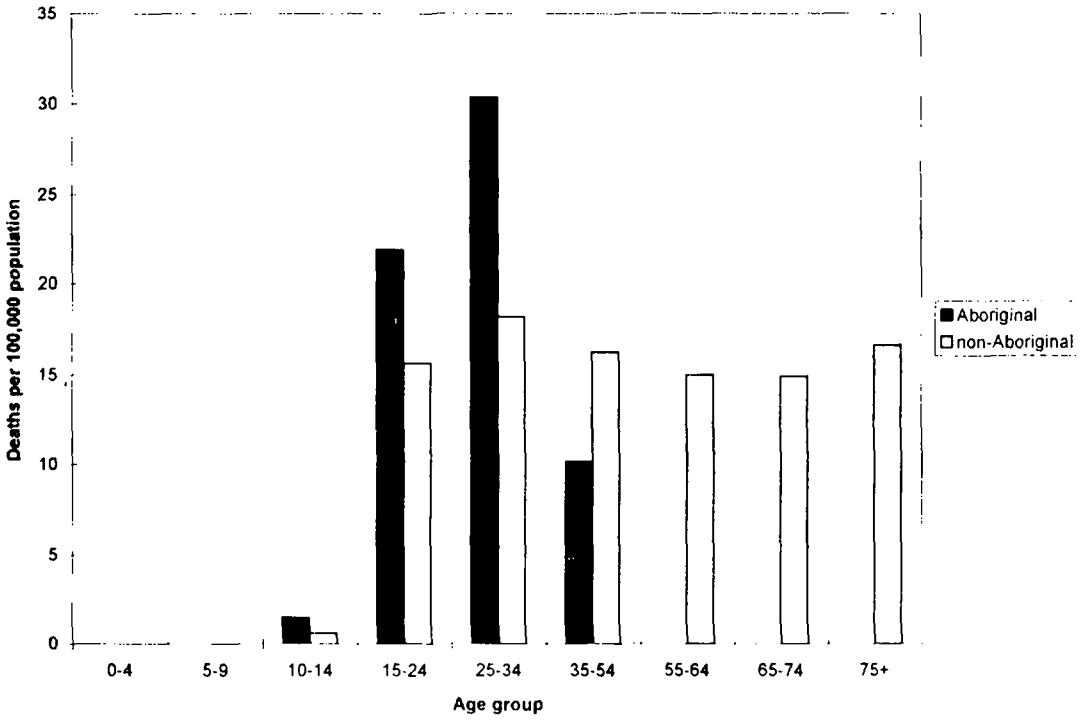


Figure 14: Injury mortality Australia, 1968-92: age standardised rates, by sex

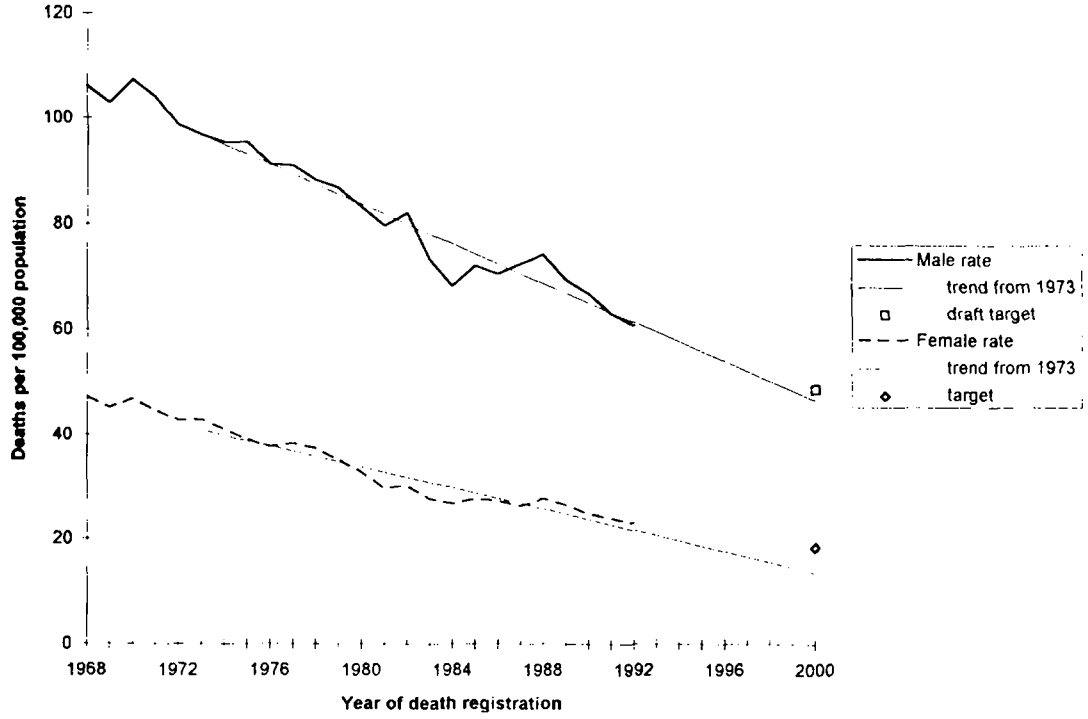


Figure 15: Australian injury trends and targets: drowning, 0-4 years, 1964-92.

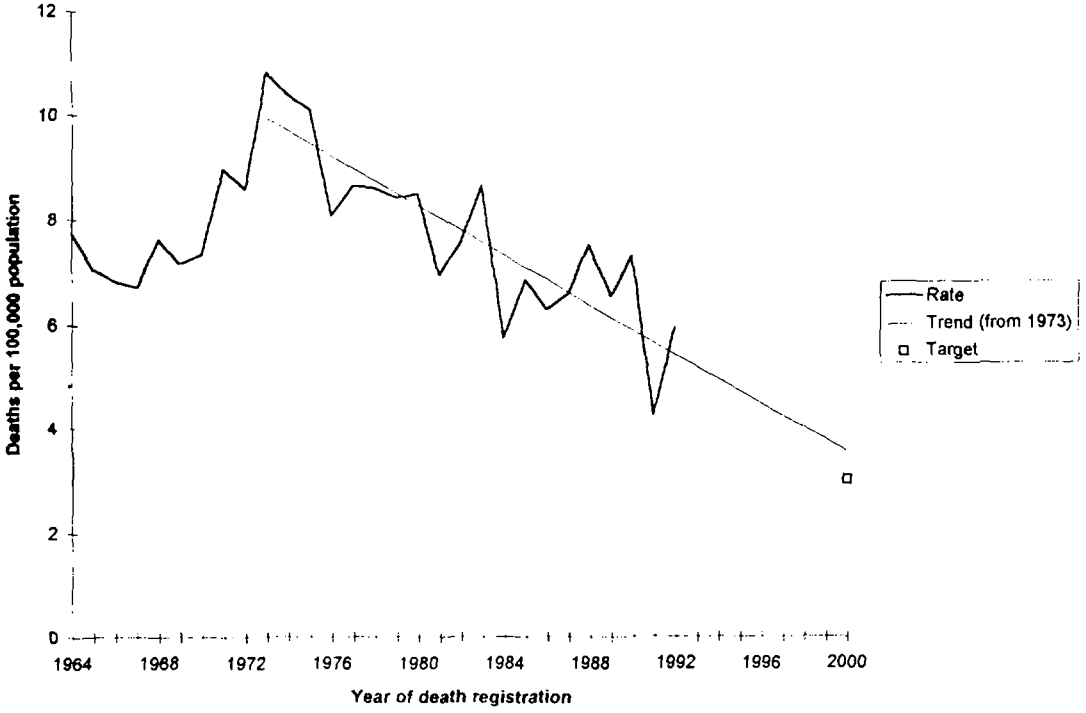


Figure 16: Australian injury trends and targets: homicide, 20-39 years, 1964-92

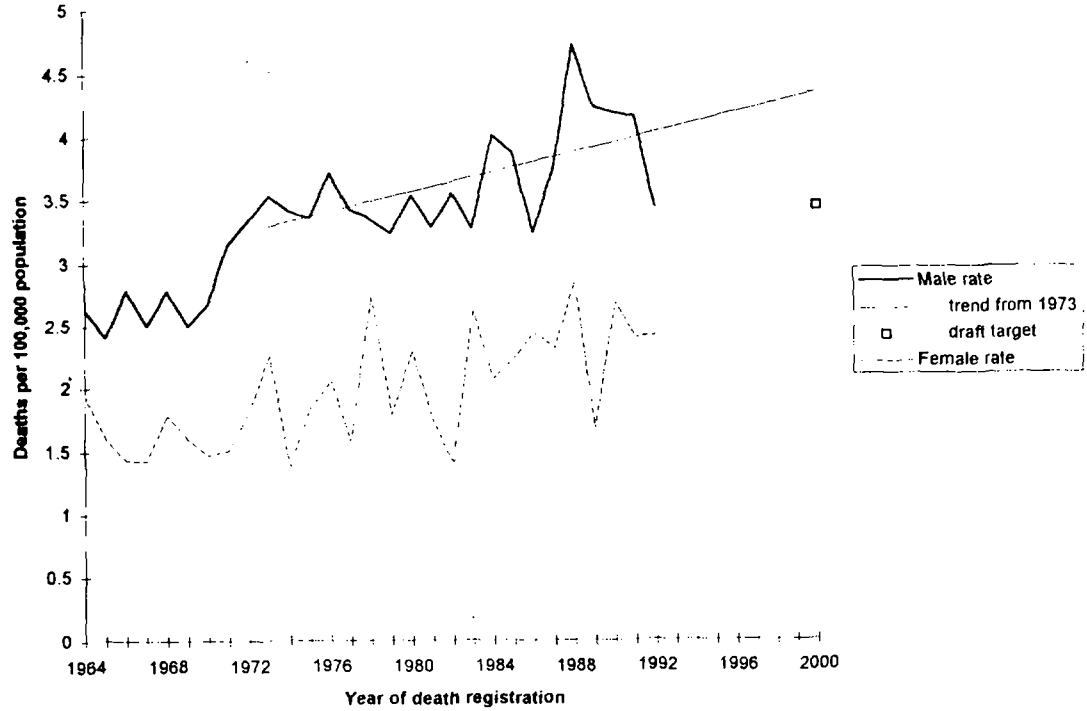


Figure 17: Australian injury trends and targets: suicide, males 20-24 years, 1964-92

Figure 18: National Minimum Data Set for Injury Surveillance

	Minimum	Extended
Narrative description of injury event	<=100 characters	unlimited
Main 'external cause'	29 'cause' groups 11 'intent' groups	full ICD9 E-codes
Type of place of occurrence	13 categories	
Type of activity	9 categories	
Trauma	30 'nature' groups 22 'body part' groups	full ICD9 Chapter 17 codes