1 Introduction

1.1 Background

Socioeconomic differences in health (Acheson 1998; Turrell et al. 1999), and other manifestations of health inequality, such as those between men and women (Hunt & Annandale 1999; Annandale & Hunt 2000), urban and rural areas (Strong et al. 1998a; Wilkinson & Blue 2002; AIHW 2003), Indigenous and non-Indigenous peoples (ABS & AIHW 2001, 2003) and ethnic groups (Rice 1999; Bryan & Batch 2002) are seen by many health authorities as some of the major public health challenges facing developed societies such as Australia. While there have been significant improvements in life expectancy and other health outcomes for the Australian population as a whole in recent years (AIHW 2002), these gains have not been equally distributed across all sections of the population.

Turrell et al. (1999) identified in the report—*Socioeconomic Determinants of Health: Towards a National Research Program and a Policy and Intervention Agenda*—a number of barriers to overcome if we are to improve our understanding of health inequalities and how they might be addressed in this country. One of the most significant barriers is Australia's fragmented, underdeveloped, and poorly coordinated monitoring and research infrastructure in relation to health inequalities. In 2001, the School of Public Health at Queensland University of Technology (QUT) established the Australian Research Program on Health Inequalities (ARPHI) to improve our understanding of such inequalities. This research program has five closely interrelated components:

(i) *Monitoring and surveillance of health inequalities in Australia*. This component examines temporal trends and quantifies the magnitude and direction of mortality and morbidity inequalities, and differences in risk factor prevalence and health-related behaviours between social groups and geographic areas.

(ii) *Methods and measurement*. This involves the development and application of new measures of inequality and the refinement and improvement of existing measures (at the individual, household, and area levels).

(iii) *Improving knowledge and understanding of health inequalities.* This aspect of the research program involves researching the processes and mechanisms that constitute the intermediate links between social and economic factors and health.

(iv) *Policies and interventions to reduce health inequalities.* This focuses on identifying and critically evaluating the range of actions available to tackle health inequalities.

(v) *Strengthening Australia's research capacity and infrastructure as these relate to health inequalities.* This component focuses on identifying the necessary 'building blocks', networks, and inter-sectoral linkages that need to form the basis of a nationally coordinated and strategic approach to researching and reducing health inequalities.

Research and monitoring projects undertaken as part of this research program draw on theories and concepts from a range of intersecting disciplines—sociology, psychology, anthropology, politics, and economics—and combine these with information on disease causation from biology and medicine, and the analytic methods of epidemiology and bio-statistics. Increasingly, it is being recognised that a multi-disciplinary approach is necessary if we are to better understand social variation in disease, and develop policies and strategies to address this issue (Lynch 2000; Berkman & Kawachi 2000). Further, part of the approach underpinning this research program is informed by a conceptual framework first developed for the report by Turrell et al. (1999). The framework delineates many of the main determinants of health inequalities, assists with

identifying knowledge gaps, offers suggestions for future research, and helps identify possible entry points for policy and interventions. The framework has subsequently been published elsewhere (Turrell 2002c; Oldenburg et al. 2000a) and it is reproduced and discussed in more detail in Chapter 8.

This present report—*Health Inequalities in Australia: Mortality*—is published jointly by the Queensland University of Technology and the Australian Institute of Health and Welfare (AIHW), and is the first in a series. Subsequent reports will focus on health inequalities in morbidity, health-related behaviours, risk factor prevalence, and health service utilisation (Series Number 2), and on measuring socioeconomic position in population health monitoring and health research (Series Number 3).

Health Inequalities in Australia: Mortality represents the continuation of work that commenced nearly two decades ago. In 1987, the Australian Institute of Health published a report that documented the nature and extent of mortality inequalities among working-aged Australians during 1981 (Lee et al. 1987). This report was subsequently extended and updated by the AIHW in a series of publications that examined mortality inequalities among Australian children (0–14 years), young adults (15–24 years), working-aged adults (25–64 years) and older persons (aged 65 years or more) for the period 1985–1987 (Mathers 1994a, 1994b, 1995, 1996). The current report updates this series, and examines mortality inequalities in Australia for the period 1998–2000 by sex, geographic region, socioeconomic disadvantage, occupation, and country of birth. In keeping with the earlier work by the AIHW, this report examines mortality inequalities for males and females aged 0–14, 15–24, 25–64 and 65 years or older.

The current report however, extends the earlier AIHW analysis in a number of important respects:

- Mortality inequalities are documented for three additional age groups: those aged less than 1 year, 65–74 years, and 75 years or older.
- Occupation-based mortality inequalities among women aged 25–54 are reported. This was not possible in the earlier reports which, due to data limitations, only presented occupation findings for males.
- Where data collection and coding allow, this report also focuses on documenting changes in the size of mortality inequalities between the mid-1980s and the late 1990s.

1.2 Purpose

Health Inequalities in Australia: Mortality provides an important statistical reference source for mortality inequalities across the lifecourse, using as comprehensive an array of sociodemographic indicators as Australia's data allow. While comparisons of data published previously by the AIHW have been included, the report's primary purpose is to assess the nature and magnitude of mortality inequalities in Australia using data from 1998–2000. The report is intended to be a resource that focuses on describing patterns of association between each sociodemographic indicator and mortality. The report also includes the following:

- a brief overview of some of the main explanations for the observed patterns; and
- some discussion of public policy, health policy, health promotion, or other intervention strategies that might be relevant to reduce the identified health inequalities.

1.3 Indigenous mortality and inequality

It is now well established that Indigenous people experience much poorer health than the non-Indigenous population. As numerous reports have shown, Indigenous Australians have a substantially lower life expectancy (approximately 20 years lower than the non-Indigenous in 1998–2000), they are more likely to experience adverse birth outcomes such as low birth weight and premature birth, they have greater morbidity and disability, and they have higher rates of hospitalisation (ABS & AIHW 2003; AIHW 2002). Given that Indigenous health has been examined and discussed in detail elsewhere, we do not cover the topic directly in this report. We do, however, make use of data on Indigenous mortality when comparing the health profiles of different geographic areas (see the introduction of Chapter 4 for further details).

1.4 Structure of this report

The report is organised as follows:

Chapter 2 – Data issues and methods

Chapter 3 – Mortality differences by sex

Chapter 4 – Mortality differences by geographic region

Chapter 5 – Mortality differences by socioeconomic disadvantage

Chapter 6 – Mortality differences by occupation

Chapter 7 – Mortality differences by country of birth

Within each of these chapters, mortality inequalities for different age groups are examined using (where appropriate) up to six measures of mortality: life expectancy, potential years of life lost (PYLL), potentially avoidable deaths, sex-specific age-standardised death rates, mortality rate ratios, and excess mortality. In a final chapter (Chapter 8), we present a discussion of the findings of the report, propose some possible implications for policy and interventions, and suggest some directions for the future monitoring of mortality inequalities in Australia.

2 Data issues and methods

2.1 Data sources

Deaths registrations for the years 1998, 1999 and 2000 were the primary source of data used throughout this report. These datasets were provided by the ABS which compiles mortality statistics from information made available by the Registrars of Births, Deaths and Marriages in each state and territory. Information about the cause of death is recorded by medical practitioners and coroners, from which the ABS codes the underlying and multiple causes of death. Mortality statistics reported throughout this publication relate to year of registration, rather than the year of occurrence, and only the underlying cause of death is reported.

2.2 Causes of death examined

Only causes that provided a sufficient number of deaths to enable reliable comparisons between population subgroups were analysed. For each cause of death examined, we have reported the total number of deaths that occurred during the period 1998–2000 for males and females in each age group (Appendix A). For persons aged 25 years and over, and where the number of deaths was sufficient, we examined mortality inequalities by disease categories consistent with the National Health Priority Areas (NHPA). Further information on the NHPA can be obtained from the Department of Health and Ageing’s web site at <http://www.health.gov.au/pq/nhpa/>.

2.3 Mortality classifications and coding issues

Deaths registered in Australia from 1 January 1999 were coded to the 10th revision of the International Classification of Diseases (ICD-10). Data for 1998 were recoded from ICD-9 to ICD-10 by the ABS and as such this report uses ICD-10 for all causes of death.

Where possible, we compare the results of this present report with that documented by Mathers (1994a, 1994b, 1995, 1996); this earlier work was based on deaths that occurred in 1985–1987. Changes in cause of death coding from ICD-9 to ICD-10, however, have precluded a comprehensive analysis of trends in mortality rates over time, and only those causes which are fully compatible between the two revisions are reported. Data examining temporal trends were age-standardised to the total Australian population as at 30 June 1988. All other data presented throughout this report are age-standardised to the total Australian population as at 30 June 1991.

2.4 Population estimates

Age-specific death rates for each sociodemographic indicator (see below) were calculated by dividing the number of deaths occurring within each population subgroup in the calendar years 1998, 1999, and 2000 by the estimated resident population for these years. When comparing mortality indicators across geographic regions and socioeconomic areas, we used ABS estimated resident populations for Statistical Local Areas (SLAs) in 1999.

The ABS Labour Force Surveys (ABS 1997a) were used to estimate populations for each of the major occupation groupings comprising the Australian Standard Classification of Occupations (ABS 1997b). Estimates of Indigenous populations for SLAs and categories of the Accessibility/

Remoteness Index of Australia (ARIA) were based on data from the 1996 Census (Department of Health and Aged Care 2001).

2.5 Sociodemographic indicators

This report examines mortality differences in Australia by the following sociodemographic indicators:

- Sex
- Geographic region
- Area socioeconomic disadvantage
- Occupation
- Country of birth

These indicators are consistent with those presented in a series of earlier reports published by the AIHW (Mathers 1994a, 1994b, 1995, 1996). For details about the methods used to categorise each of the sociodemographic indicators, see the introduction section at the beginning of each respective chapter.

2.6 Mortality indicators

Life expectancy

Life expectancy is one of the most widely used measures of population health, and its calculation is based solely on mortality and population data. It is defined as the average number of years a person is expected to live if the age-specific death rates of the given period continue throughout a person's lifetime, and is commonly reported as life expectancy at birth. For this report, abridged life tables based on 5-year age groups were constructed to calculate life expectancies for persons by sex, geographic region and area socioeconomic disadvantage. Life expectancy is reported for males and females aged less than 1 year, and those aged 15 years, 25 years, and 65 years.

Age-standardised death rates

Mortality within a given population is strongly related to age. Thus, a population with a large proportion of older persons would experience higher mortality rates than populations with a younger age profile. In order to facilitate comparisons between populations which may have different age structures, all mortality rates within this report have been directly age-standardised (see Armitage et al. 2002) to the total Australian population as at 30 June 1991 using 5-year age groups (unless otherwise stated). The following method was employed:

$$SR = \Sigma (R_1 * P_1) / \Sigma P_1$$

Where SR = the age-standardised mortality rate

R_1 = the age-specific death rate for age group 1

P_1 = the standard population in age group 1

Population data by occupation is published by the ABS in 10-year age groups. Consequently, mortality differences based on occupation were age-standardised using 10-year age groups.

Deaths among those aged 0–14, 15–24, and 25–64 years are expressed as rates per 100,000 persons. Deaths among those aged 65 years and over are expressed as rates per 1,000 persons.

Mortality rate ratios

Relative mortality differences between population groups are expressed in terms of rate ratios, with the age-standardised rate for each population subgroup being expressed as a proportion of the age-standardised rate of a reference group. The reference group within this report is generally the population group with the lowest mortality rate. The only exception being the analysis based on country of birth, where the country of birth with the highest mortality rates (Australia) was the reference group. Rate ratios reported in the figures are presented with their associated 95% confidence intervals.

The rate ratio is an internationally accepted measure of inequality, and is widely used in health and epidemiological research. However, the reader needs to be aware that the measure must be interpreted carefully when making comparisons between groups or when measuring change over time in the differences between groups. It is usefully complemented by consideration of the absolute differences in death rates. These issues are discussed below using hypothetical examples in the following table.

Hypothetical example showing the relation between mortality rates and rate ratios under different time periods and comparative scenarios

	Time 1 Scenario A		Time 2 Scenario B		Time 3 Scenario C		Time 4 Scenario D	
Groups being compared	**Death rate**	**Rate ratio**	**Death rate**	**Rate ratio**	**Death rate**	**Rate ratio**	**Death rate**	**Rate ratio**
Group 1	100		50		25		10	
Group 2	150	1.5	100	2.0	50	2.0	30	3.0
Absolute difference in death rates	50		50		25		20	

First, as a measure of *relative* inequality, rate ratios can change in magnitude even though the *absolute* difference between groups remains unchanged. In Scenario A for example, the difference in death rates between Group 1 and Group 2 is 50, and the rate ratio is 1.5. In Scenario B, although death rates for both groups declined by the same amount between the two periods (i.e. 50), and the absolute difference between the groups remained the same (i.e. 50), the rate ratio actually widened to 2.0.

Second, differences between two groups in terms of death rates can narrow over time, yet the relative inequality between them can remain the same. In Scenario B for example, the difference in death rates between Group 1 and Group 2 is 50 and the rate ratio is 2.0. In contrast, for Scenario C, death rates for the two groups decline, and the rate-difference between them reduces in magnitude to 25, however the rate ratio remains at 2.0.

Third, as the absolute magnitude of death rates for each group gets smaller, and especially when the rates approach zero, rate ratios can become large, and they also become sensitive to small differences in absolute rates. In Scenario C for example, the difference in death rates between Group 1 and Group 2 is 25, and the rate ratio is 2.0. In Scenario D however, absolute death rates for both groups declined, the difference between the groups in absolute terms narrowed to 20, yet the rate ratio increased to 3.0.

Potential Years of Life Lost (PYLL)

Potential Years of Life Lost (PYLL) is an indicator of premature mortality that gives more importance to deaths that occur at a younger age than those that occur at an older age. The method adopted here calculates the number of years that would have been lived had a person survived to age 75. For example, if a person were to die at age 20, he or she would contribute 55 years of potential life lost. This figure is generally expressed as PYLL per 1,000 persons.

Potentially avoidable deaths

Within this report, potentially avoidable deaths are conditions that are determined to be preventable through any of the following:

- individual behaviour change or population-level interventions;
- early intervention or detection;
- adequate management or medical intervention

Potentially avoidable deaths are recorded for persons aged less than 75 years of age. Deaths deemed avoidable were based on causes identified by Tobias and Jackson (2001) and are presented as the number of avoidable deaths per 100,000 persons. Importantly, deaths classified as potentially avoidable does not imply that these deaths could have been avoided; rather they have the potential to be prevented through the type of actions outlined above. A detailed list of potentially avoidable causes of death and their corresponding ICD codes can be found in Appendix B.

Excess mortality

In this report, we used a measure of 'excess mortality' to provide an indication of the burden of mortality in the Australian population that was attributable to inequality based on sex, geographic remoteness, area-based socioeconomic disadvantage, and occupation. We used an excess mortality measure that estimated the number and percentage of deaths that would have been saved if mortality across one or more population subgroups was the same as that of a reference population. The reference population is generally the sociodemographic category with the lowest mortality rate, and this convention is followed in this report. The methods used to calculate excess mortality are based on those described by McCracken (2002) and it is a measure that is widely employed in studies of health inequality (Turrell & Mathers 2001).

2.7 Potential sources of error in the mortality analysis

There are numerous potential sources of error in the mortality analysis presented in this report. Details of those sources of error pertaining specifically to each sociodemographic indicator are provided in each of the chapters. Here we consider a more general source of error often known as numerator-denominator bias. The calculation of mortality rates (and other mortality outcomes) involves the use of two different data sources: data obtained from the mortality registration process (used for the numerator) and data collected as part of the Census or population surveys (used for the denominator). Each type of collection uses similar sociodemographic indicators (e.g. age, sex, occupation) to classify data; however, the indicators may not be exactly the same. Misclassification error occurs when a sociodemographic indicator used in one data source differs from that used in another and, generally, the size of the error is related to the discrepancy between indicators (i.e. large differences in how the numerator and denominator data are classified will tend to produce larger errors). Quantifying the magnitude of bias resulting from misclassification error is difficult, but is assumed to be small for sex, place of residence and birthplace, but larger for occupation.

2.8 Standard errors and statistical tests

Standard Errors (SE) and Confidence Intervals (CI) were calculated for all rates and rate ratios using the following formulas:

Mortality rates

SE = Age-standardised Mortality Rate/(sqrt total deaths)

CI = Age-standardised Mortality Rate $\pm$ (1.96*SE)

Rate ratios

SE = sqrt(1/p_1+1/p_2)

Where p_1 = total deaths within sub-population

p_2 = total deaths within reference group

CI = exp(lnRR $\pm$ 1.96 *SE(lnRR))

Significance levels for rate ratios were calculated using the following test statistic (assumed normally distributed around zero, under the null hypothesis that the rate ratio is 1.0) (Mathers 1994a):

$$z = \frac{\log 10(r_1 / r_2) * \ln(10)}{sqrt[se(r_1)^2 / r_1^2 + se(r_2)^2 / r_2^2)]}$$ (Where r_1 and r_2 are age-standardised rates)

A two-tailed p value was calculated from the z score. Significance levels for rate ratios are indicated as follows: *p<0.05, **p<0.01, ***p<0.001

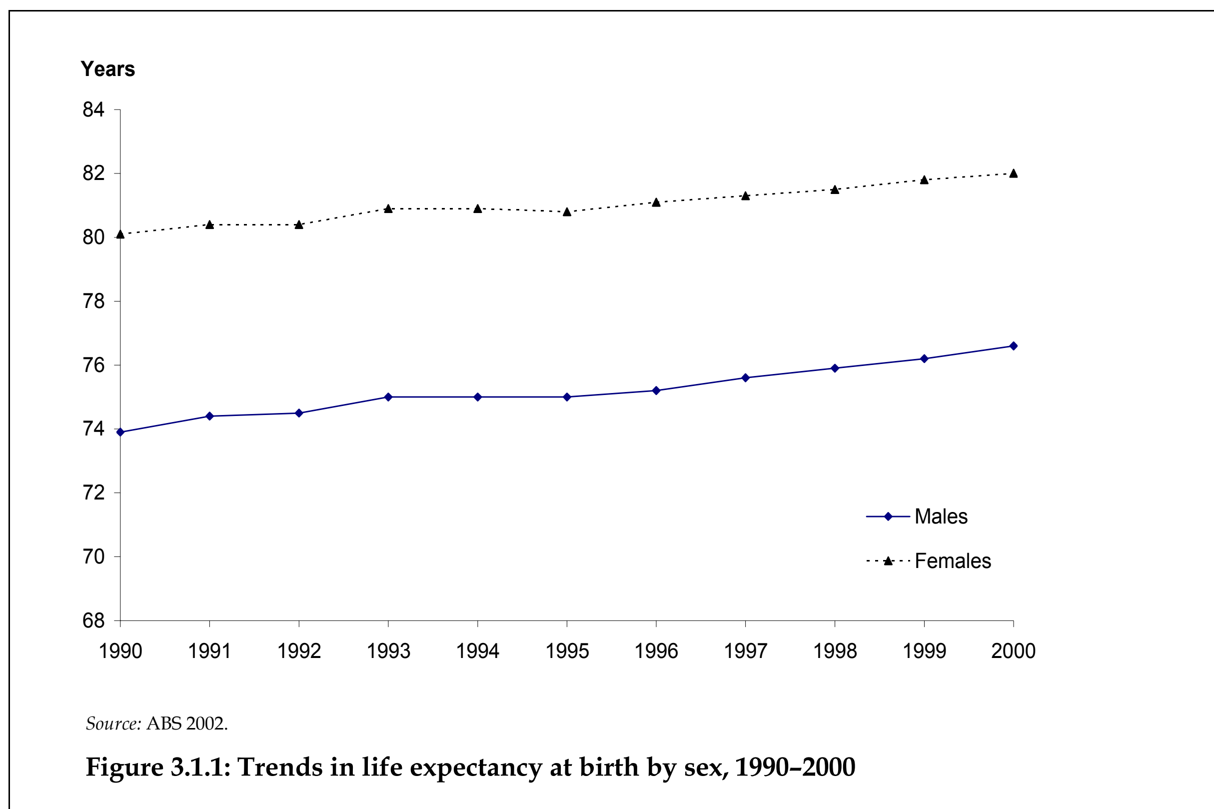
3 Mortality differences by sex

Males and females have very different mortality profiles (Hart 1989; Ory & Warner 1990; Kane 1994; Mathers 1994a, 1994b, 1995, 1996; Waldron 1995; Cameron & Bernades 1998; Annandale & Hunt 2000; Lawlor et al. 2001; Pampel 2003). Females live longer than males, and they experience lower mortality rates for almost all non-sex-specific causes of death, and this sex discrepancy is evident at every age.

This chapter examines the mortality experience of Australian males and females in 1998–2000. In addition, where data collection and coding permit, we compare the magnitude of sex differences in mortality for the years 1985–1987 and 1998–2000. As with all other chapters in this report, we examine the nature and extent of mortality inequalities at different stages of the lifecourse, from infancy and childhood, through to adolescence and adulthood, and among the elderly. In the final section of this chapter, we briefly discuss some of the suggested reasons for sex differences in mortality.

3.1 Persons aged 0–14 years

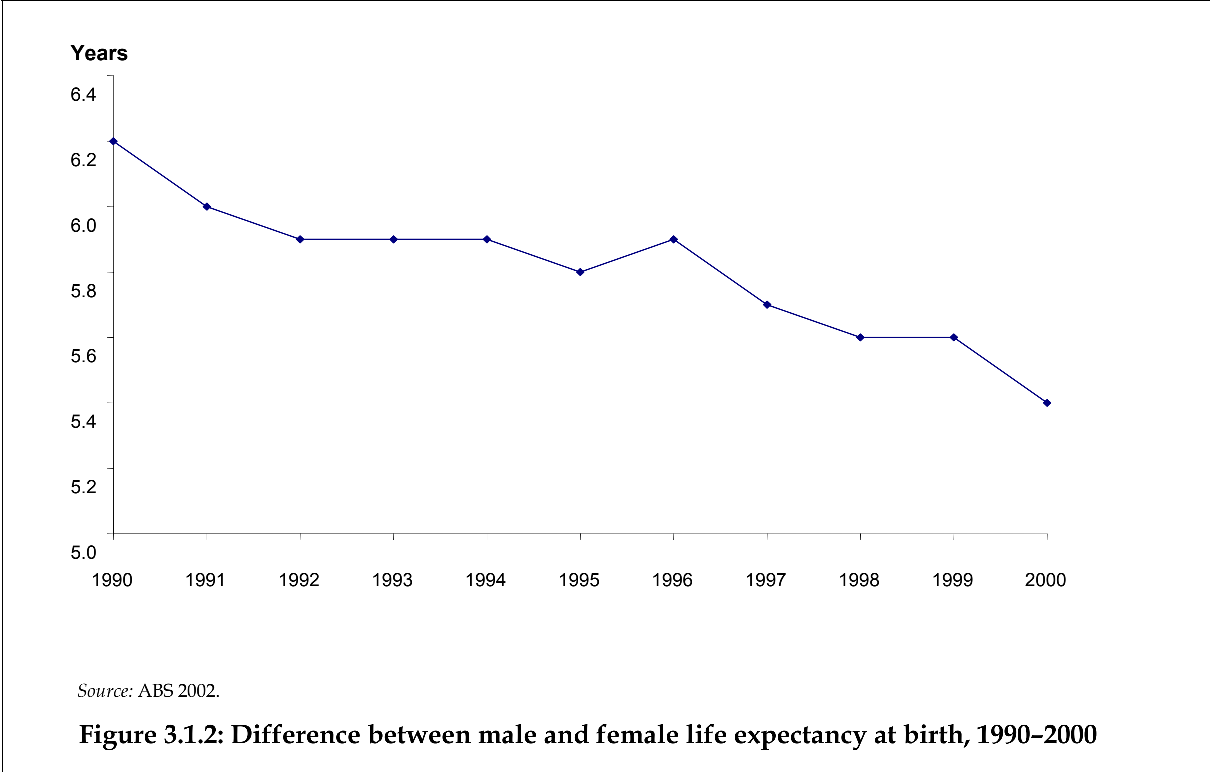
In 1998–2000, male life expectancy at birth was, on average, 76.8 years, while females could expect to live 82.4 years. Life expectancies for both males and females improved throughout the 1990s, increasing by around 2.7 years for males and 1.9 years for females (ABS 2002) (Figure 3.1.1).



Source: ABS 2002.

Figure 3.1.1: Trends in life expectancy at birth by sex, 1990–2000

In 1990, a new-born girl had a life expectancy 6.2 years greater than a new–born boy (Figure 3.1.2). In the early part of the 20th century, this gap was around 4 years, increasing to over 7 years by the beginning of the 1980s. Throughout the 1990s, the gap in life expectancy between males and females narrowed, reaching 5.4 years by 2000 (de Looper & Bhatia 2001; ABS 2002). Declining differences in life expectancy for males and females have also been observed in many other countries (Trovato & Lalu 1996).



Source: ABS 2002.

Figure 3.1.2: Difference between male and female life expectancy at birth, 1990–2000

Infants aged less than 1 year

Boys aged less than 1 year experienced significantly higher mortality rates than girls in 1998–2000. For all causes of death, boys recorded a mortality rate 25% higher than girls at 586 and 468 deaths per 100,000 persons respectively (Table 3.1.1). Similar results were recorded for a number of specific causes, with boys experiencing significantly higher mortality rates for:

- certain conditions originating in the perinatal period (26% higher, 58 more male deaths per 100,000)
- congenital malformations, deformations and chromosomal abnormalities (16% higher, 21 more male deaths per 100,000)
- Sudden Infant Death Syndrome (51% higher, 23 more male deaths per 100,000)
- accidents and injury (56% higher, 8 more male deaths per 100,000)

Table 3.1.1: Age-standardised mortality rates and rate ratios, children aged less than 1 year by sex, 1998–2000

Cause of death and ICD-10 codes	Rate[(a)]	Rate ratio
All causes		
Boys	586.5	1.25***
Girls	468.6	1.00
Certain conditions originating in the perinatal period (P00–P96)		
Boys	276.6	1.26***
Girls	218.8	1.00
Congenital malformations, deformations and chromosomal abnormalities (Q00–Q99)		
Boys	153.0	1.16*
Girls	131.8	1.00
Sudden Infant Death Syndrome (R95)		
Boys	67.2	1.51***
Girls	44.5	1.00
Accidents and injury (V01–Y98)		
Boys	22.8	1.56**
Girls	14.6	1.00

(a) Deaths per 100,000 persons.

Source: ABS mortality data.

*p<0.05, **p<0.01, ***p<0.001

Table 3.1.2 indicates that around 553 deaths could have been avoided in 1998–2000 if boys aged less than 1 year experienced the same mortality rate as girls; this corresponds to approximately 11.4% of all deaths within this age group.

Table 3.1.2: Excess mortality by sex, children aged less than 1 year, 1998–2000

Cause of death and ICD-10 codes	Number[(a)]	Per cent[(b)]
All causes	553	11.4
Certain conditions originating in the perinatal period (P00–P96)	224	12.0
Congenital malformations, deformations and chromosomal abnormalities (Q00–Q99)	95	8.1
Accidents and injury (V01–Y98)	102	19.8

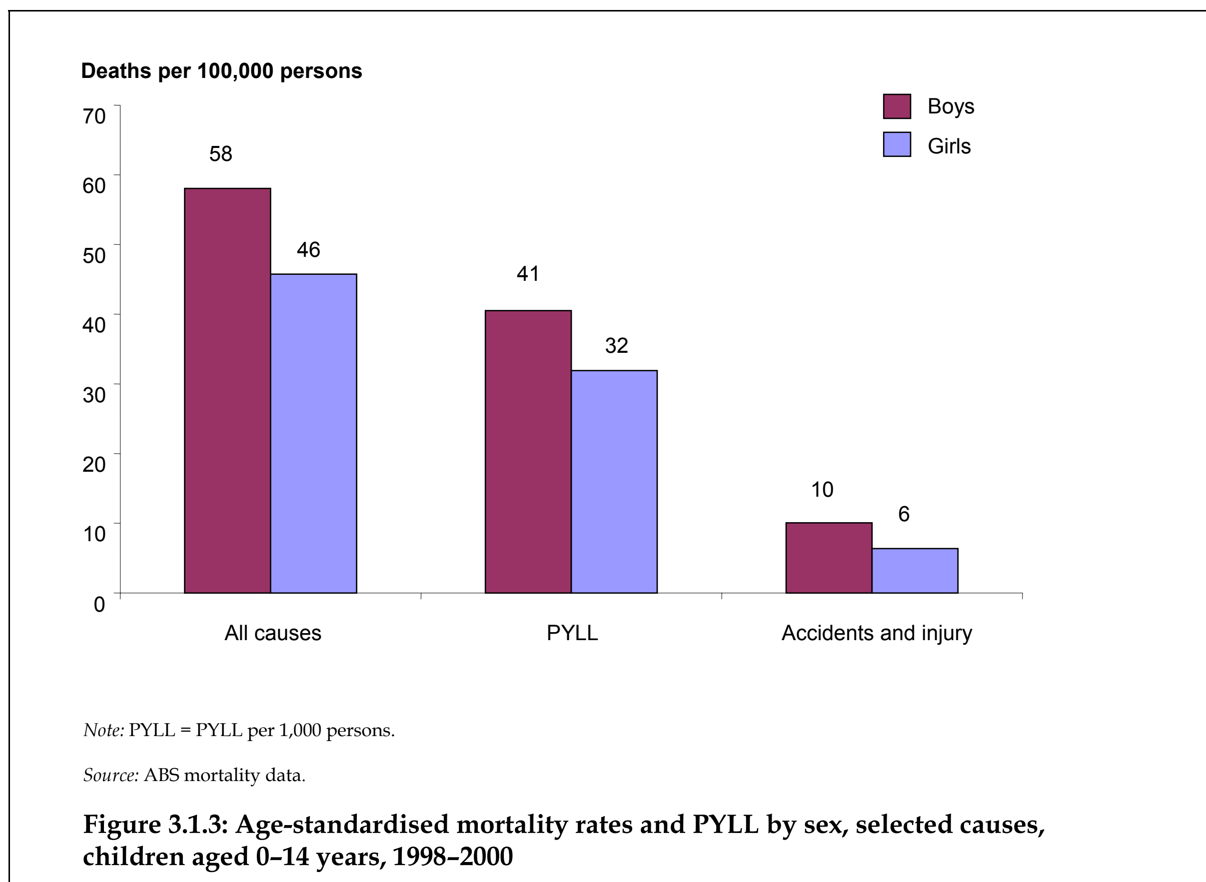
(a) Total number of deaths that would have been avoided if boys experienced the same mortality rates as girls.

(b) Percentage of deaths that would have been avoided if boys experienced the same mortality rates as girls.

Source: ABS mortality data.

Children aged 0–14 years

In 1998–2000, boys aged 0–14 years recorded significantly higher mortality rates than girls for a number of causes of death. For all-cause mortality, boys had an age-standardised mortality rate of 58 deaths per 100,000 persons, compared with around 46 deaths per 100,000 persons for girls (Figure 3.1.3; Table 3.1.3). Significant sex differences were also found for Potential Years of Life Lost (PYLL), potentially avoidable deaths, and accidents and injury.



Note: PYLL = PYLL per 1,000 persons.

Source: ABS mortality data.

Figure 3.1.3: Age-standardised mortality rates and PYLL by sex, selected causes, children aged 0–14 years, 1998–2000

In 1998–2000, mortality rate ratios for boys and girls aged 0–14 years were significantly different for each cause of death examined (Table 3.1.3; Figure 3.1.4). Overall, boys experienced mortality rates that were:

- 27% higher for all-cause mortality (12 more male deaths per 100,000); and
- 59% higher for accidents and injury (4 more male deaths per 100,000).

Table 3.1.3: Age-standardised mortality rates and rate ratios by sex, children aged 0–14 years, 1998–2000

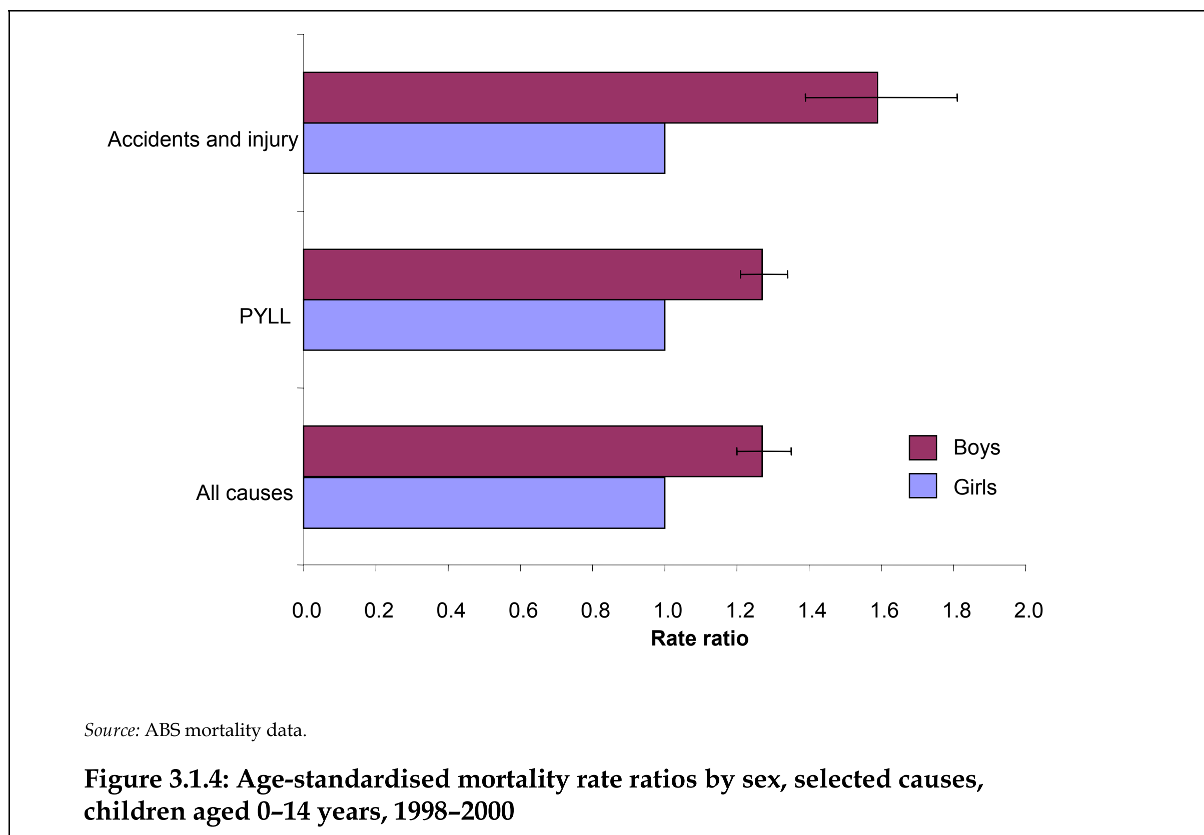
Cause of death and ICD-10 codes	Rate[(a)]	Rate ratio
All causes		
Boys	58.0	1.27***
Girls	45.8	1.00
PYLL[(b)]		
Boys	40.5	1.27***
Girls	31.9	1.00
Potentially avoidable deaths		
Boys	29.3	1.32***
Girls	22.2	1.00
Accidents and injury (V01–Y98)		
Boys	10.1	1.59***
Girls	6.4	1.00

(a) Deaths per 100,000 persons.

(b) PYLL per 1,000 persons.

Source: ABS mortality data.

*p<0.05, **p<0.01, ***p<0.001



Source: ABS mortality data.

Figure 3.1.4: Age-standardised mortality rate ratios by sex, selected causes, children aged 0–14 years, 1998–2000

Table 3.1.4 presents the excess mortality associated with differences in mortality between boys and girls aged 0–14 years. In 1998–2000, around 725 deaths could have been avoided if boys experienced the same mortality rate as girls. A substantial number of deaths could also have been avoided for accidents and injury (223 deaths).

Table 3.1.4: Excess mortality by sex, children aged 0–14 years, 1998–2000

Cause of death and ICD-10 codes	Number[(a)]	Per cent[(b)]
All causes	725	12.1
Accidents and injury (V01–Y98)	223	23.2

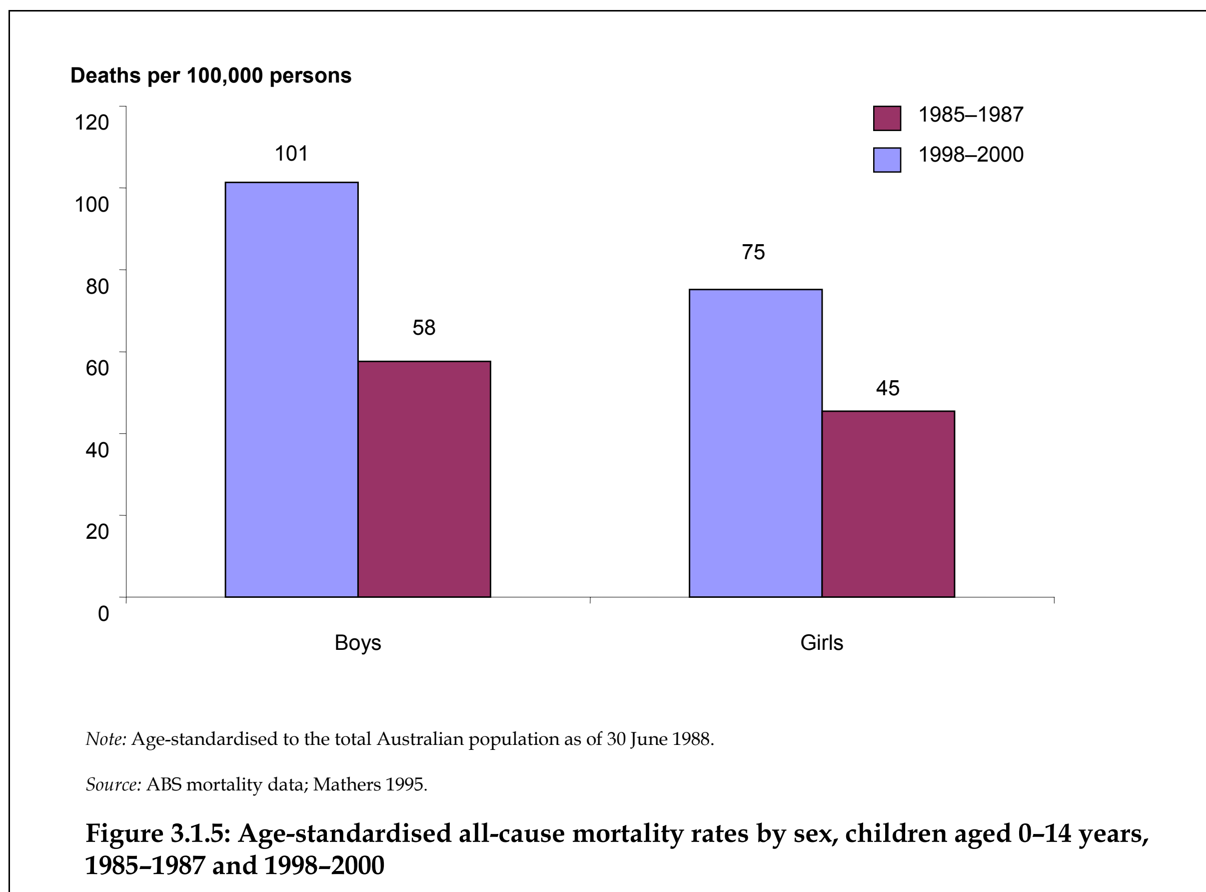
(a) Total number of deaths that would have been avoided if boys experienced the same mortality rates as girls.

(b) Percentage of deaths that would have been avoided if boys experienced the same mortality rates as girls.

Source: ABS mortality data.

Trends in mortality rates and mortality inequality

Substantial declines in total mortality were recorded for both boys and girls aged 0–14 years between 1985–1987 and 1998–2000, with boys recording a larger decline than girls. Over this period, age-standardised mortality rates for girls fell by around 30% from 75 to 45 deaths per 100,000 persons, whereas mortality rates for boys fell by about 42%, from 101 to 58 deaths per 100,000 persons (Figure 3.1.5). Overall, the sex difference in mortality for boys and girls declined from 35% in the mid-1980s to 27% by the end of the 1990s.



Note: Age-standardised to the total Australian population as of 30 June 1988.

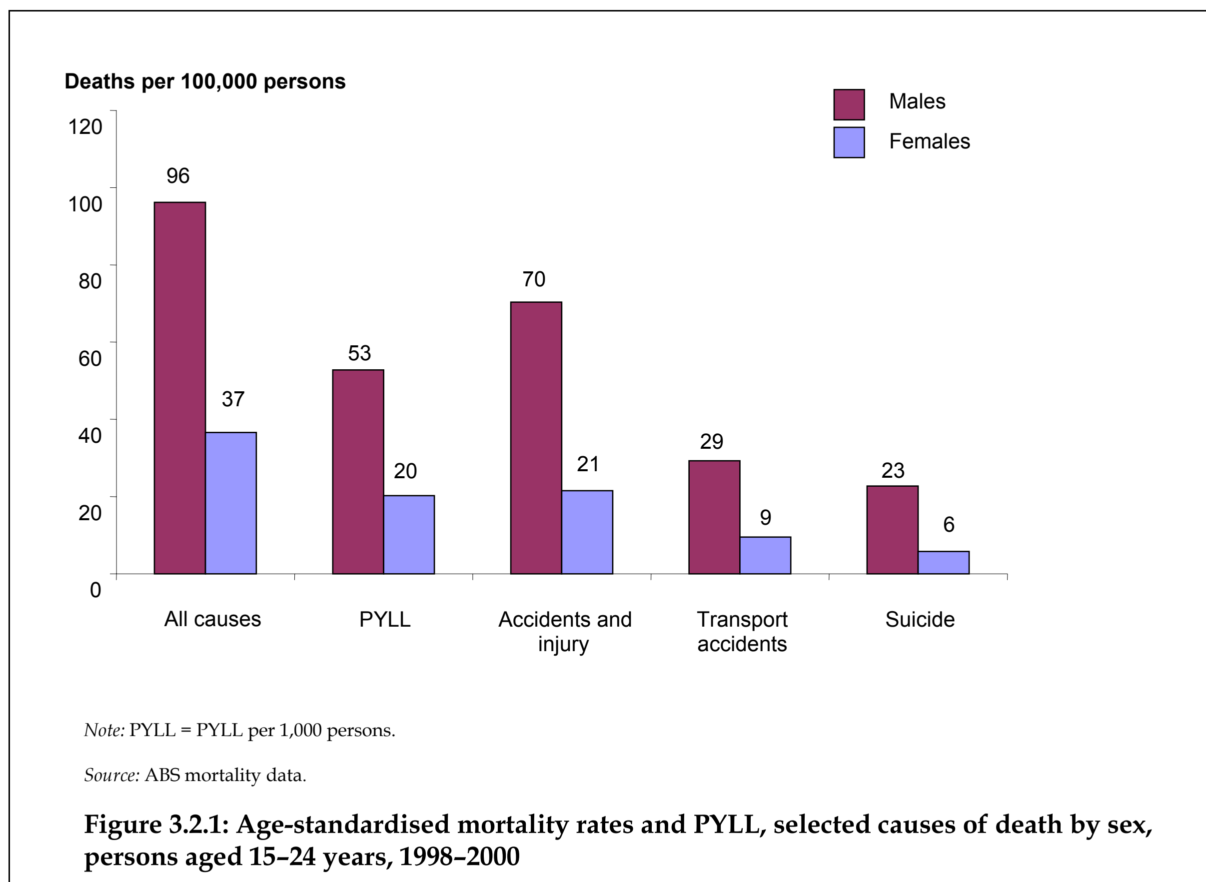
Source: ABS mortality data; Mathers 1995.

Figure 3.1.5: Age-standardised all-cause mortality rates by sex, children aged 0–14 years, 1985–1987 and 1998–2000

3.2 Persons aged 15–24 years

In 1998–2000, males aged 15 years recorded a life expectancy of 62.5 years. This was around 5.5 years less than for females of the same age, who recorded a life expectancy of 68.0 years. Males aged 15–24 years also experienced significantly higher mortality rates. For all-cause mortality, males and females recorded age-standardised rates of around 96 and 37 deaths per 100,000 persons respectively (Figure 3.2.1; Table 3.2.1). When expressed as rate ratios, male mortality rates were:

- 163% higher for all causes (60 more male deaths per 100,000);
- 227% higher for accidents and injury (49 more male deaths per 100,000);
- 208% higher for transport accidents (20 more male deaths per 100,000); and
- 293% higher for suicide (17 more male deaths per 100,000).



Note: PYLL = PYLL per 1,000 persons.

Source: ABS mortality data.

Figure 3.2.1: Age-standardised mortality rates and PYLL, selected causes of death by sex, persons aged 15–24 years, 1998–2000

Table 3.2.1: Age-standardised mortality rates and rate ratios by sex, persons aged 15–24 years, 1998–2000

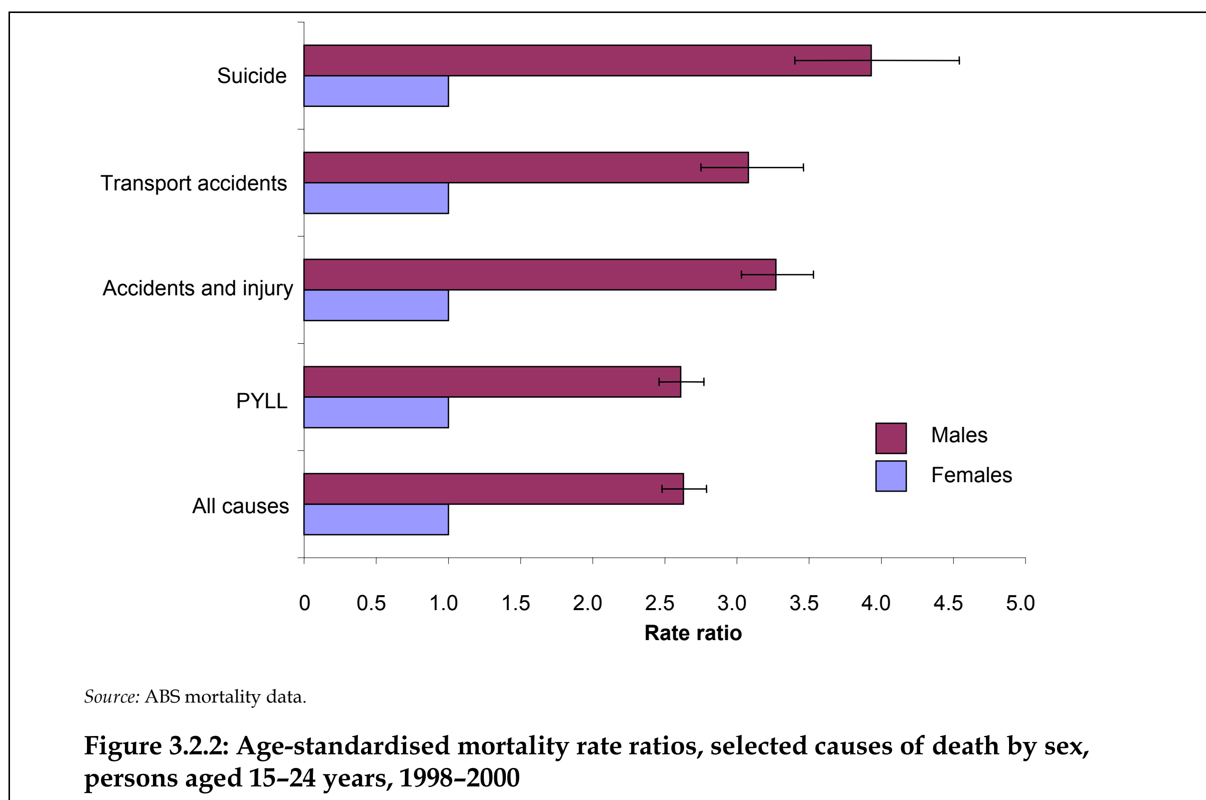
Cause of death and ICD-10 codes	Rate[(a)]	Rate ratio
All causes		
Males	96.2	2.63***
Females	36.6	1.00
PYLL[(b)]		
Males	52.8	2.61***
Females	20.2	1.00
Potentially avoidable deaths		
Males	58.8	2.85***
Females	20.6	1.00
Accidents and injury (V01–Y98)		
Males	70.3	3.27***
Females	21.5	1.00
Transport accidents (V01–V99)		
Males	29.3	3.08***
Females	9.5	1.00
Suicide (X60–X84)		
Males	22.7	3.93***
Females	5.8	1.00

(a) Deaths per 100,000 persons.

(b) PYLL per 1,000 persons.

Source: ABS mortality data.

*p<0.05, **p<0.01, ***p<0.001



Source: ABS mortality data.

Figure 3.2.2: Age-standardised mortality rate ratios, selected causes of death by sex, persons aged 15–24 years, 1998–2000

For males aged 15–24 years in 1998–2000, around 2,456 deaths could have been avoided if they had experienced the same all-cause mortality rate as females (Table 3.2.2). If cause-specific death rates for males in this age group were equivalent to those of females, a substantial number of male deaths could also have been avoided for:

- accidents and injury: 2,011 deaths (53.7% of total);
- transport accidents: 815 deaths (51.6% of total); and
- suicide: 697 deaths (59.9% of total).

Table 3.2.2: Excess mortality, selected causes of death by sex, persons aged 15–24 years, 1998–2000

Cause of death and ICD-10 codes	Number[(a)]	Per cent[(b)]
All causes	2,456	45.4
Accidents and injury (V01–Y98)	2,011	53.7
Transport accidents (V01–V99)	815	51.6
Suicide (X60–X84)	697	59.9

(a) Total number of deaths that would have been avoided if males had the same mortality rate as females.

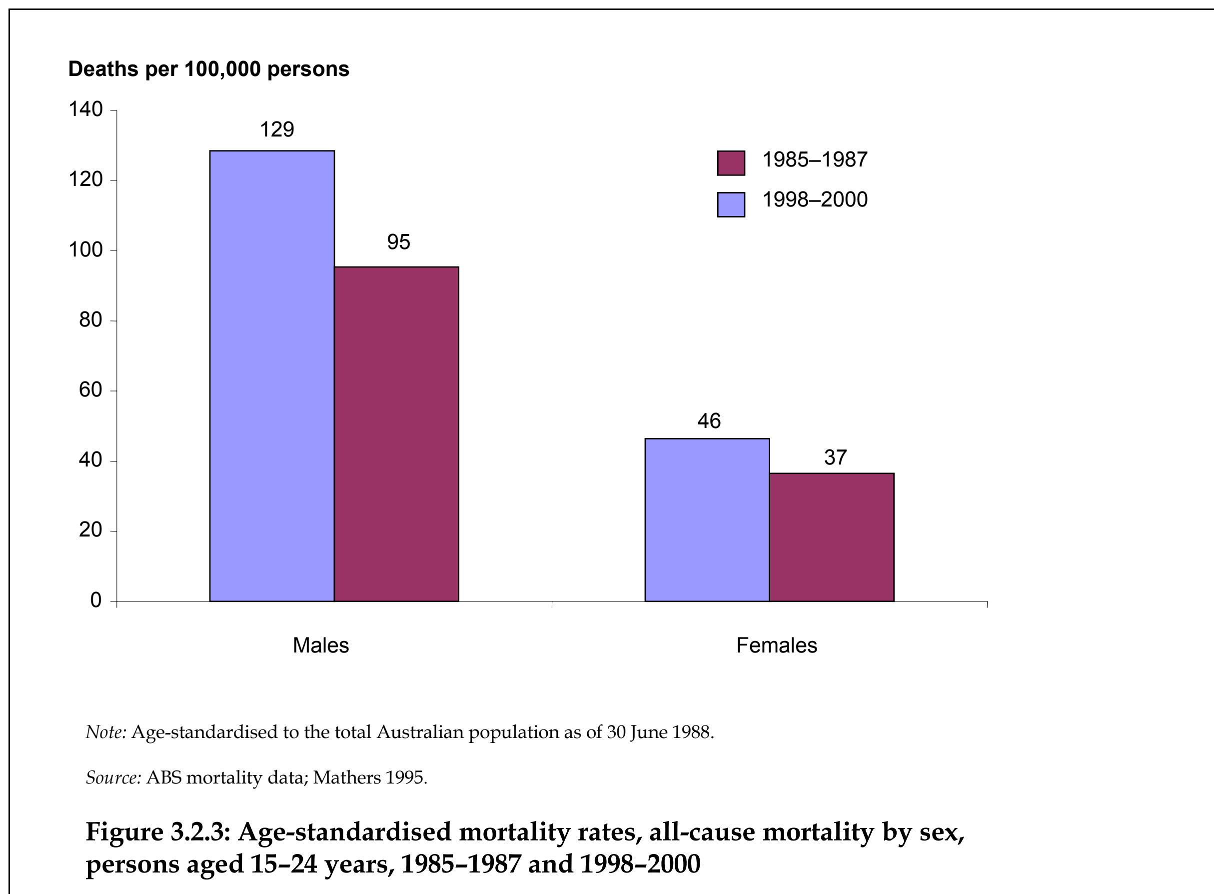
(b) Per cent of deaths that would have been avoided if males had the same mortality rate as females.

Source: ABS mortality data.

Trends in mortality rates and mortality inequality

Between 1985–1987 and 1998–2000, all-cause mortality rates fell for both males and females aged 15–24 years. Male rates fell by around 26% from 129 to 95 deaths per 100,000 persons, whereas female mortality fell by 21%, from 46 to 37 deaths per 100,000 persons (Figure 3.2.3).

The size of the mortality inequality between males and females aged 15–24 years also declined during the period 1985–1987 and 1998–2000. In the mid-1980s, male all-cause mortality rates were 177% higher than females (83 more male deaths per 100,000); by 1998–2000 the difference was 161% (58 more male deaths per 100,000).



Note: Age-standardised to the total Australian population as of 30 June 1988.

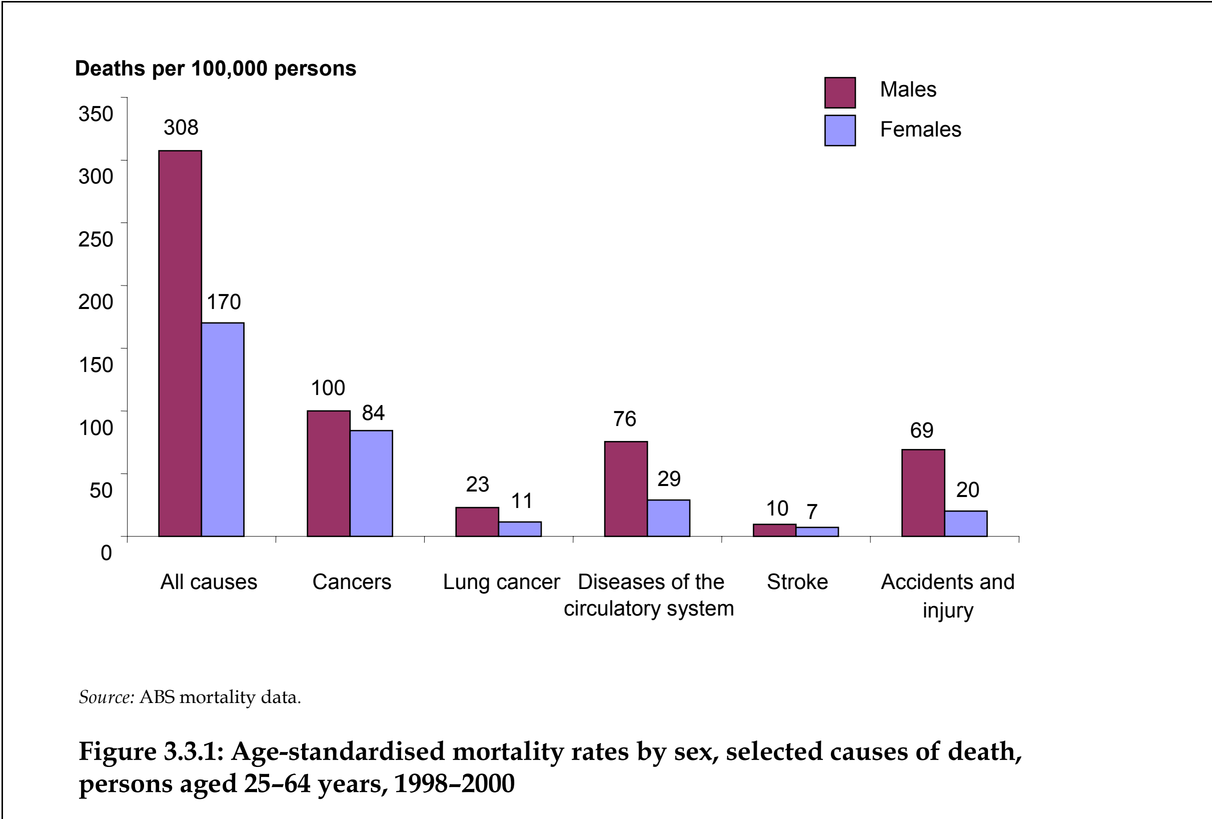
Source: ABS mortality data; Mathers 1995.

Figure 3.2.3: Age-standardised mortality rates, all-cause mortality by sex, persons aged 15–24 years, 1985–1987 and 1998–2000

3.3 Persons aged 25–64 years

In 1998–2000, males aged 25–64 experienced significantly higher mortality rates than females for each cause of death examined. All-cause mortality for males was 308 deaths per 100,000 persons, compared with 170 deaths per 100,000 persons for females (Figure 3.3.1; Table 3.3.1). Males also experienced higher mortality rates for a number of specific causes, including:

- all cancers: males, 100 deaths per 100,000 persons; females, 84 deaths per 100,000;
- lung cancer: males, 23 deaths per 100,000 persons; females, 11 deaths per 100,000; and
- accidents and injury: males, 69 deaths per 100,000 persons; females, 20 deaths per 100,000.

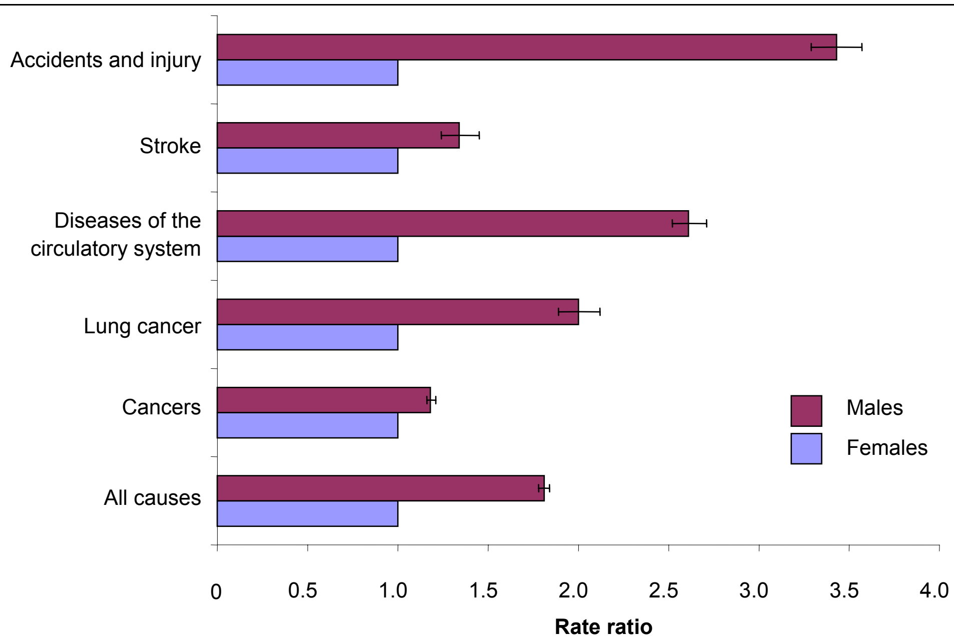


Source: ABS mortality data.

Figure 3.3.1: Age-standardised mortality rates by sex, selected causes of death, persons aged 25–64 years, 1998–2000

When expressed as rate ratios (Figure 3.3.2; Table 3.3.1), male mortality rates were higher by:

- 81% for all causes (138 more male deaths per 100,000);
- 18% for all cancers (16 more male deaths per 100,000);
- 161% for diseases of the circulatory system (47 more male deaths per 100,000);
- 122% for diseases of the digestive system (7 more male deaths per 100,000);
- 243% for accidents and injury (49 more male deaths per 100,000); and
- 300% for suicide (22 more male deaths per 100,000).



Source: ABS mortality data.

Figure 3.3.2: Age-standardised mortality rate ratios by sex, selected causes of death, persons aged 25–64 years, 1998–2000

Table 3.3.1: Age-standardised mortality rates and rate ratios by sex, persons aged 25–64 years, 1998–2000

Cause of death and ICD-10 codes	Rate[(a)]	Rate ratio
All causes		
Males	307.6	1.81***
Females	170.1	1.00
PYLL[(b)]		
Males	76.8	1.88***
Females	40.9	1.00
Potentially avoidable deaths		
Males	199.2	1.88***
Females	106.2	1.00
Cancers (C00–C97)		
Males	99.9	1.18***
Females	84.3	1.00
Cancer of the digestive organs (C15–C26)		
Males	30.9	1.72***
Females	18.0	1.00
Colon cancer (C18)		
Males	9.5	1.35***
Females	7.0	1.00
Melanoma of skin (C43)		
Males	4.8	1.71***
Females	2.8	1.00
Lung cancer (C33, C34)		
Males	23.0	2.00***
Females	11.5	1.00
Brain cancer (C71)		
Males	5.9	1.63***
Females	3.6	1.00
Cancer of the lymphoid, haematopoietic and related tissue (C81–C96)		
Males	10.6	1.42***
Females	7.4	1.00
Mental and behavioural disorders due to psychoactive substance use (F10–F19)		
Males	9.0	3.88***
Females	2.3	1.00
Diseases of the circulatory system (I00–I99)		
Males	75.5	2.61***
Females	28.9	1.00
Ischaemic heart disease (I20–I25)		
Males	52.1	3.83***
Females	13.6	1.00
Acute myocardial infarction (I21)		
Males	26.1	3.55***
Females	7.3	1.00
Stroke (I60–I69)		
Males	9.6	1.34***
Females	7.2	1.00
Diseases of the respiratory system (J00–99)		
Males	11.2	1.31***
Females	8.6	1.00

(continued)

Table 3.3.1 (continued): Age-standardised mortality rates and rate ratios by sex, persons aged 25–64 years, 1998–2000

Cause of death and ICD-10 codes	Rate[(a)]	Rate ratio
Chronic lower respiratory disease (J40–J47)		
Males	7.6	1.22***
Females	6.2	1.00
Diseases of the digestive system (K00–K93)		
Males	12.7	2.22***
Females	5.7	1.00
Diseases of the liver (K70–K77)		
Males	9.4	2.76***
Females	3.4	1.00
Accidents and injury (V01–Y98)		
Males	69.1	3.43***
Females	20.2	1.00
Transport accidents (V01–V99)		
Males	16.6	3.11***
Females	5.0	1.00
Suicide (X60–X84)		
Males	29.2	4.00***
Females	7.3	1.00

(a) Deaths per 100,000 persons.

(b) PYLL per 1,000 persons.

Source: ABS mortality data.

*p<0.05, **p<0.01, ***p<0.001

In 1998–2000, an estimated 20,700 male deaths could have been avoided if males aged 25–64 years experienced the same mortality rate as females (Table 3.3.2); this represented 28.3% of all deaths for persons within this age group. If cause-specific death rates for males in this age group were equivalent to those of females, a substantial number of male deaths could also have been avoided for:

- all cancers: 2,255 deaths;
- diseases of the circulatory system: 7,282 deaths;
- diseases of the digestive system:1,097 deaths; and
- accidents and injury: 7,184 deaths.

Table 3.3.2: Excess mortality by sex, persons aged 25–64 years, 1998–2000

Cause of death and ICD-10 codes	Number[(a)]	Per cent[(b)]
All causes	20,693	28.3
Cancers (C00–C97)	2,255	7.9
Lung cancer (C33, C34)	1,742	32.7
Diseases of the circulatory system (I00–I99)	7,282	45.2
Stroke (I60–I69)	369	14.3
Diseases of the digestive system (K00–K93)	1,097	38.1
Accidents and injury (V01–Y98)	7,184	54.4

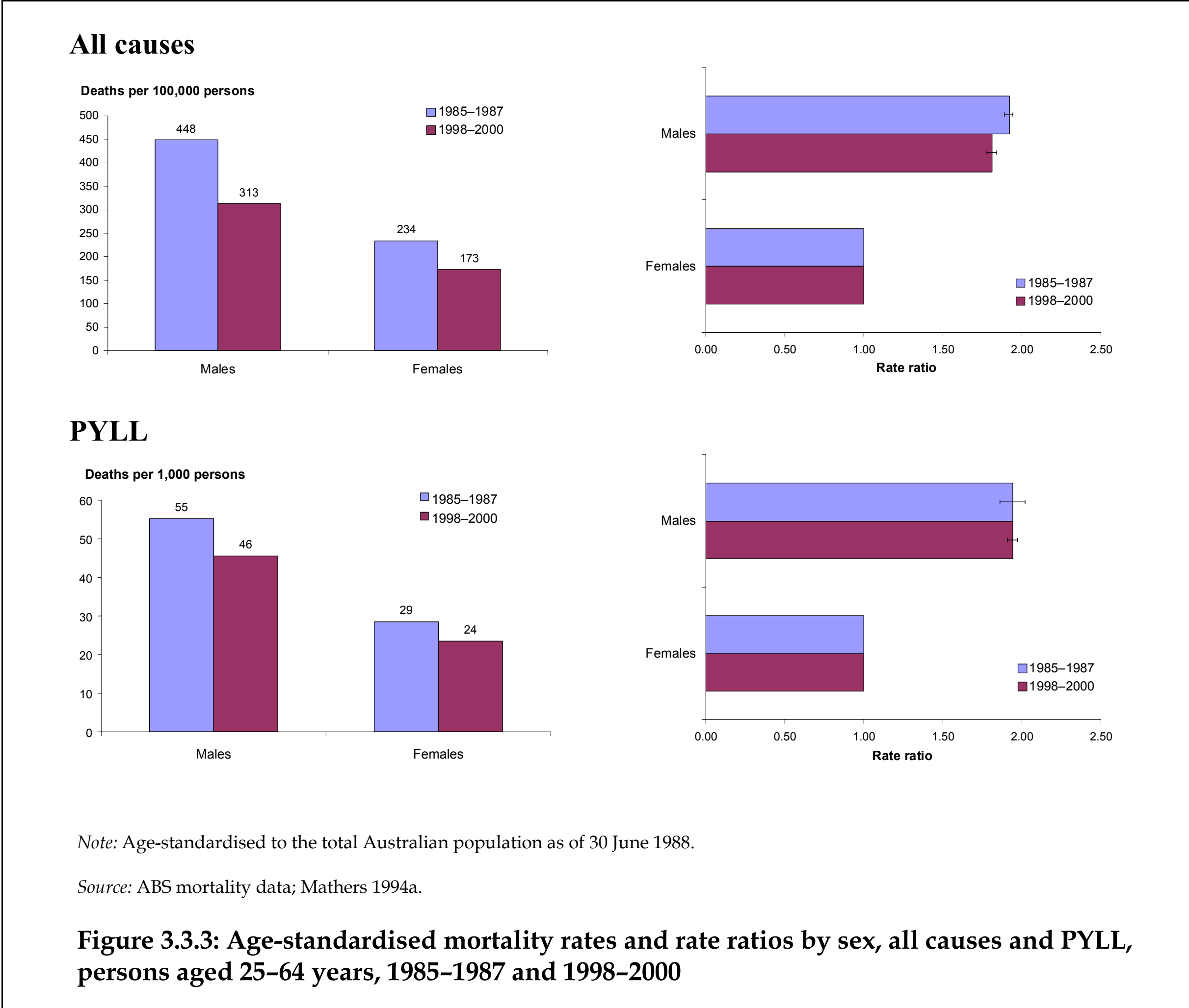
(a) Total number of deaths that would have been avoided if males had the same mortality rates as females.

(b) Percentage of deaths that would have been avoided if males had the same mortality rate as females.

Source: ABS mortality data.

Trends in mortality rates and mortality inequality

Between 1985–1987 and 1998–2000, all-cause mortality for males aged 25–64 fell by approximately 30%, from 448 to 313 deaths per 100,000 persons. The corresponding decline for females was 26%, from 234 to 173 deaths per 100,000 persons (Figure 3.3.3). The number of Potential Years of Life Lost (PYLL) also declined for males and females between the mid 1980s and the late 1990s.



Note: Age-standardised to the total Australian population as of 30 June 1988.

Source: ABS mortality data; Mathers 1994a.

Figure 3.3.3: Age-standardised mortality rates and rate ratios by sex, all causes and PYLL, persons aged 25–64 years, 1985–1987 and 1998–2000

While males aged 25–64 years continued to experience significantly higher mortality rates than females in 1998–2000, the sex difference was smaller than that observed in 1985–1987 (Table 3.3.3). Between the two periods, mortality inequality between males and females declined by approximately 6% for all causes, 5% for all cancers, and 3% for diseases of the circulatory system. Table 3.3.3 also shows that death rates for cancer among females aged 25–64 years declined from 106.4 deaths per 100,000 in 1985–1987 to 85.5 per 100,000 in 1998–2000.

Table 3.3.3: Age-standardised mortality rate ratios, selected causes of death by sex, persons aged 25–64, 1985–1987 and 1998–2000

	1985–1987		1998–2000	
Cause of death and ICD-10 codes	Rate[(a)]	Rate ratio	Rate[(a)]	Rate ratio
All causes				
Males	448.5	1.92***	312.6	1.81***
Females	234.0	1.00	172.5	1.00
Cancers (C00–C97)				
Males	134.5	1.26***	102.4	1.20***
Females	106.4	1.00	85.5	1.00
Disease of the circulatory system (I00–I99)				
Males	167.1	2.70***	77.1	2.61***
Females	61.9	1.00	29.5	1.00

Note: Age-standardised to the total Australian population as of 30 June 1988.

(a) Deaths per 100,000 persons.

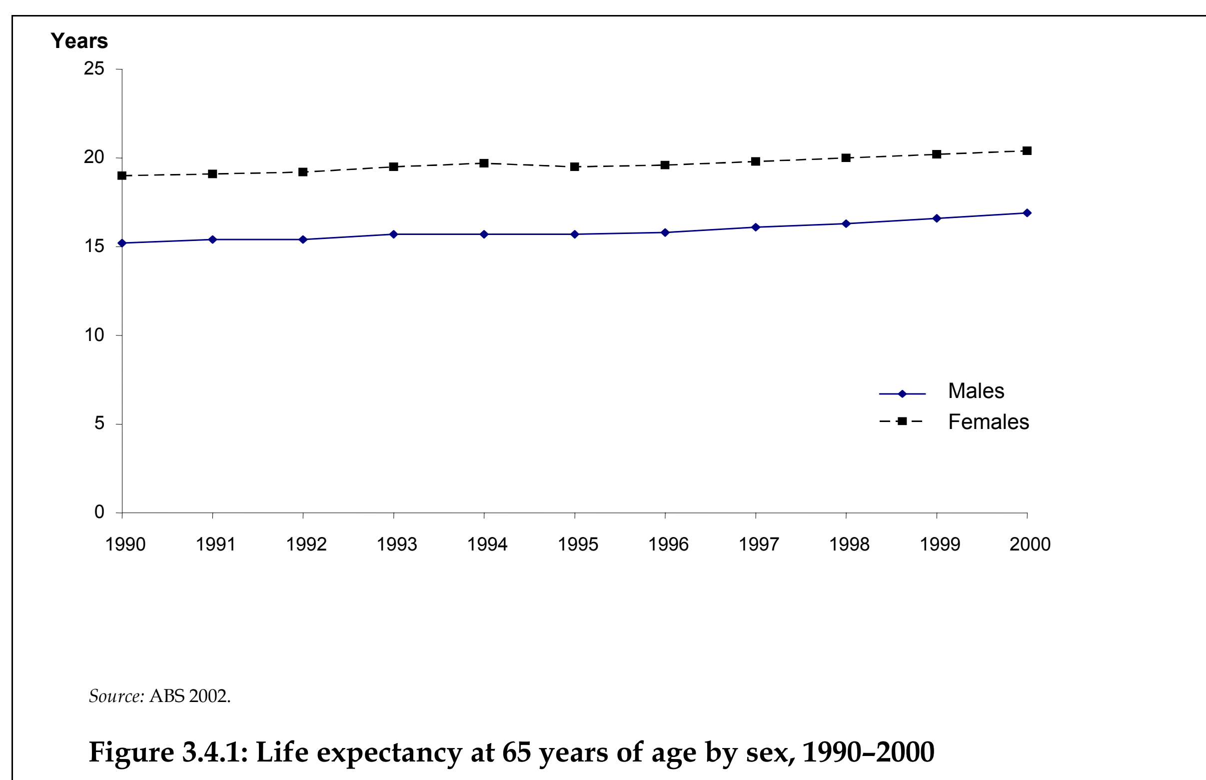
Source: ABS mortality data; Mathers 1994a.

*p<0.05, ** p<0.01, ***p<0.001

3.4 Persons aged 65 years and over

In this report, deaths among those aged 65 years and over are expressed as rates per 1,000 persons, which is consistent with the earlier (benchmark) work of Mathers (1994b).

Over the 10-year period from 1990 to 2000, life expectancy for persons at 65 years of age steadily improved. In 1990, life expectancy for a male at age 65 was around 15.2 years, and by the year 2000, this had increased to 16.9 years. Females experienced a similar change, with life expectancy at 65 increasing from 19.0 years in 1990 to 20.4 years in 2000 (Figure 3.4.1).



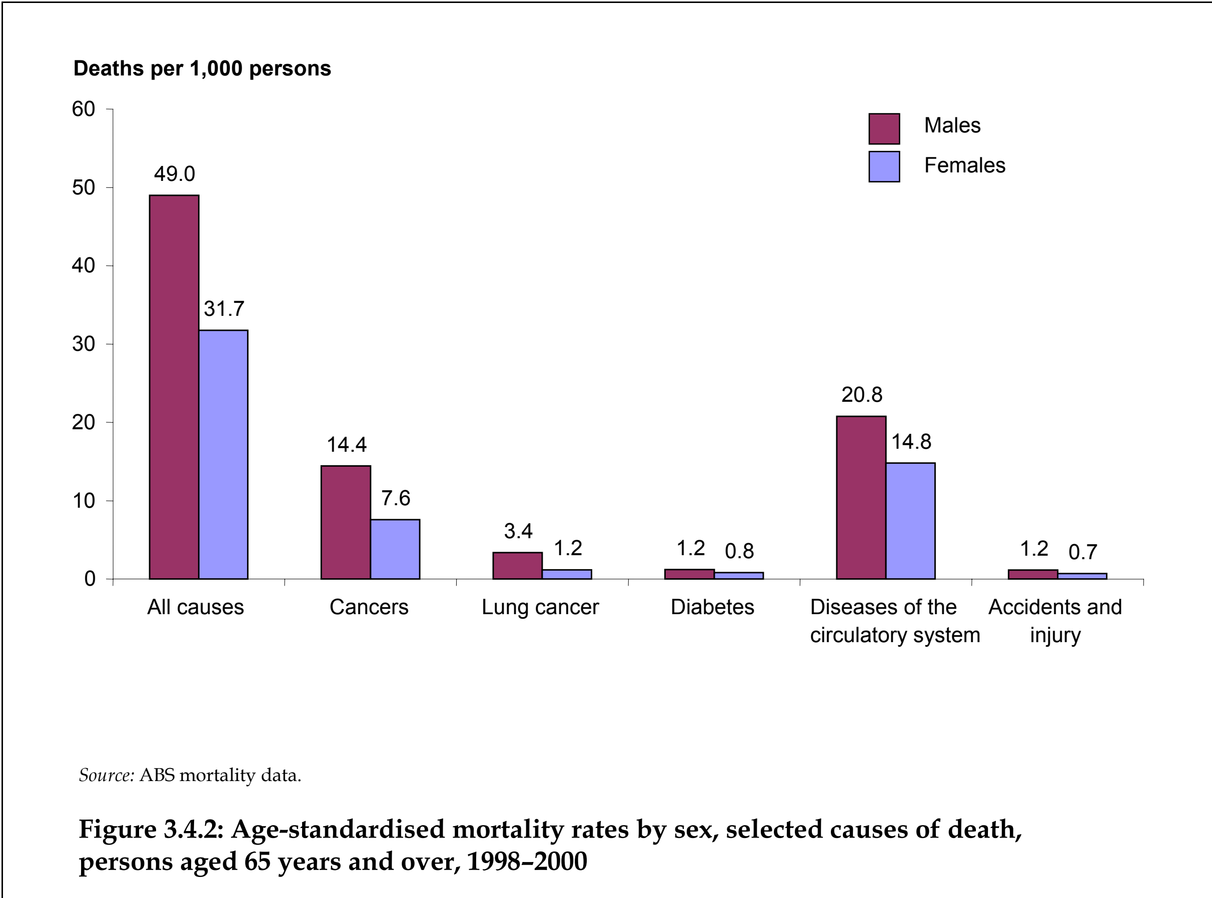
Source: ABS 2002.

Figure 3.4.1: Life expectancy at 65 years of age by sex, 1990–2000

In 1998–2000, males aged 65 years and over experienced higher mortality rates than females for a number of causes of death (Figure 3.4.2; Table 3.4.1). All-cause mortality among males was 49 deaths per 1,000 persons, and among females, 32 deaths per 1,000 persons: a difference of approximately 54%.

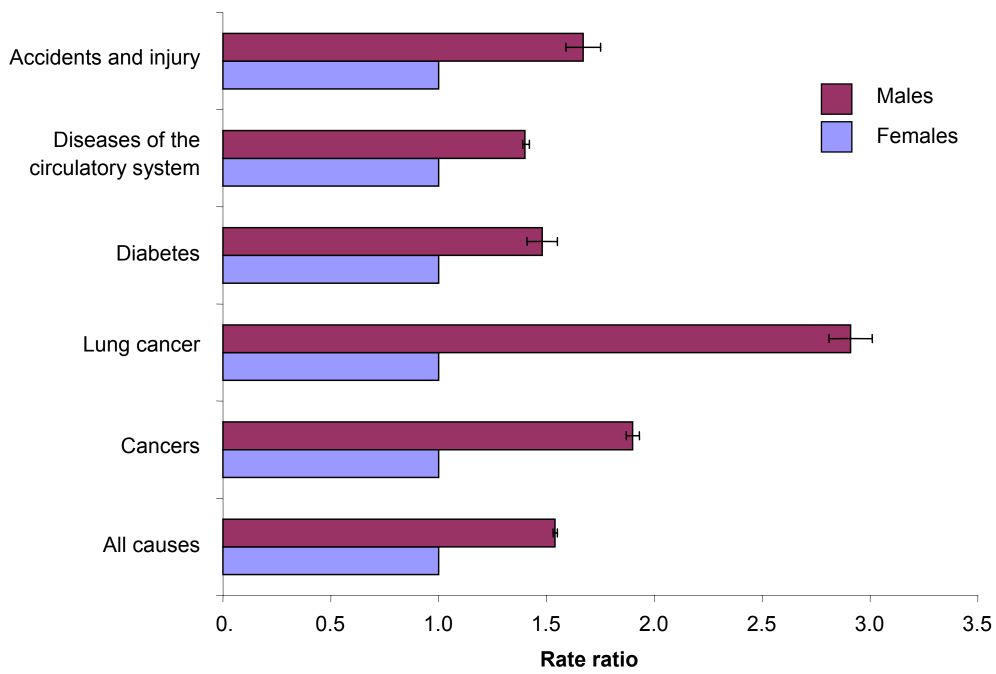
Sex differences in mortality among persons aged 65 years and older were also evident for many specific causes. When expressed as rate ratios (Figure 3.4.3; Table 3.4.1), male mortality rates were:

- 90% higher for all cancers (17 more male deaths per 1,000);
- 45% higher for diabetes mellitus (0.39 more male deaths per 1,000);
- 40% higher for diseases of the circulatory system (6 more male deaths per 1,000);
- 93% higher for diseases of the respiratory system ((2 more male deaths per 1,000); and
- 67% higher for accidents and injury (0.46 more male deaths per 1,000)



Source: ABS mortality data.

Figure 3.4.2: Age-standardised mortality rates by sex, selected causes of death, persons aged 65 years and over, 1998–2000



Source: ABS mortality data.

Figure 3.4.3: Age-standardised mortality rate ratios by sex, selected causes of death, persons aged 65 years and over, 1998–2000

Table 3.4.1: Age-standardised mortality rates and rate ratios by sex, persons aged 65 years and over, 1998–2000

Cause of death and ICD-10 codes	Rate[(a)]	Rate ratio
All causes		
Males	48.97	1.54***
Females	31.74	1.00
Cancers (C00–C97)		
Males	14.44	1.90***
Females	7.59	1.00
Cancer of the digestive organs (C15–C26)		
Males	3.90	1.66***
Females	2.35	1.00
Colon cancer (C18)		
Males	1.25	1.43***
Females	0.87	1.00
Cancer of the pancreas (C25)		
Males	0.59	1.23***
Females	0.48	1.00
Lung cancer (C33, C34)		
Males	3.39	2.91***
Females	1.17	1.00
Cancer of the lymphoid, haematopoietic and related tissue (C81–C96)		
Males	1.34	1.60***
Females	0.84	1.00
Endocrine, nutritional and metabolic diseases (E00–E90)		
Males	1.52	1.38***
Females	1.10	1.00
Diabetes mellitus (E10–E14)		
Males	1.20	1.48***
Females	0.81	1.00
Diseases of the nervous system (G00–G99)		
Males	1.35	1.25***
Females	1.08	1.00
Alzheimer's disease (G30)		
Males	0.48	0.83***
Females	0.58	1.00
Diseases of the circulatory system (I00–I99)		
Males	20.78	1.40***
Females	14.80	1.00
Ischaemic heart disease (I20–I25)		
Males	12.05	1.65***
Females	7.29	1.00
Acute myocardial infarction (I21)		
Males	6.71	1.61***
Females	4.16	1.00
Pulmonary heart disease of pulmonary circulation and other forms of heart disease (I26–I52)		
Males	2.46	1.20***
Females	2.05	1.00

(continued)

Table 3.4.1 (continued): Age-standardised mortality rates and rate ratios by sex, persons aged 65 years and over, 1998–2000

Cause of death and ICD-10 codes	Rate[(a)]	Rate ratio
Heart failure (I50)		
Males	1.01	1.09***
Females	0.93	1.00
Stroke (I60–I69)		
Males	4.47	1.09***
Females	4.11	1.00
Diseases of arteries, arterioles and capillaries (I70–I79)		
Males	1.27	1.68***
Females	0.75	1.00
Diseases of the respiratory system (J00–J99)		
Males	4.93	1.93***
Females	2.56	1.00
Influenza and pneumonia (J10–J18)		
Males	0.91	1.31***
Females	0.69	1.00
Chronic lower respiratory disease (J40–J47)		
Males	3.18	2.19***
Females	1.45	1.00
Diseases of the digestive system (K00–K93)		
Males	1.39	1.29***
Females	1.08	1.00
Diseases of the genitourinary system (N00–N99)		
Males	1.16	1.36***
Females	0.85	1.00
Renal failure (N17–N19)		
Males	0.80	1.56***
Females	0.51	1.00
Accidents and injury (V01–Y98)		
Males	1.15	1.67***
Females	0.69	1.00
Falls (W00–W19)		
Males	0.17	1.46***
Females	0.12	1.00

(a) Deaths per 1,000 persons.

Source: ABS mortality data.

*p<0.05, **p<0.01, ***p<0.001

Persons aged 65–74 years, and 75 years and over

In 1998–2000, mortality inequalities between males and females were found for those aged 65–74 years and 75 years and older. For the 'younger' of these age groups, all-cause mortality rates were 85% higher among males (11 more male deaths per 1,000), and for the oldest age group, male death rates were 44% higher (26 more male deaths per 1,000) (Table 3.4.2). For both age groups, males also experienced significantly higher death rates for diabetes mellitus, diseases of the circulatory system, and accidents and injury.

Table 3.4.2: Age-standardised mortality rates and rate ratios by sex, persons aged 65–74 years, and 75 years and over, 1998–2000

Cause of death and ICD-10 codes	65–74 years		75 years and older	
	Rate(a)	Rate ratio	Rate(a)	Rate ratio
All causes				
Males	24.73	1.85***	86.14	1.44***
Females	13.38	1.00	59.99	1.00
Cancers (C00–C97)				
Males	10.00	1.82***	21.26	1.96***
Females	5.49	1.00	10.83	1.00
Diabetes mellitus (E10–E14)				
Males	0.68	1.60***	1.99	1.42***
Females	0.43	1.00	1.40	1.00
Disease of the circulatory system (I00–I99)				
Males	8.81	2.07***	39.20	1.26***
Females	4.26	1.00	31.01	1.00
Accidents and injury (V01–Y98)				
Males	0.65	2.12***	1.92	1.51***
Females	0.30	1.00	1.28	1.00

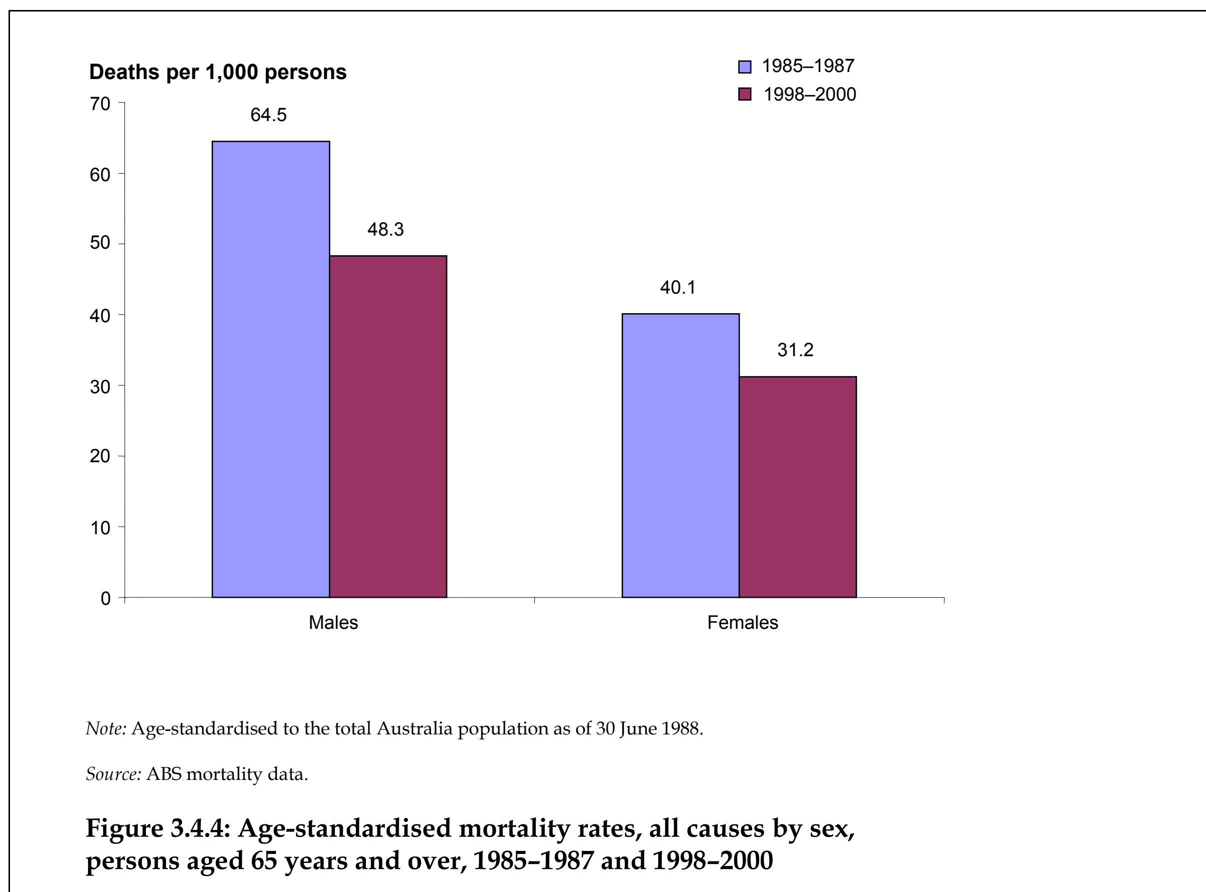
(a) Deaths per 1,000 persons.

Source: ABS mortality data.

*p<0.05, ** p<0.01, ***p<0.001

Trends in mortality rates and mortality inequality

Between 1985–1987 and 1998–2000, mortality rates fell for both males and females aged 65 years and over. Male all-cause mortality declined by around 25%, from 65 to 48 deaths per 1,000 persons, and female mortality fell by approximately 22%, from 40 to 31 deaths per 1,000 persons (Figure 3.4.4).



Note: Age-standardised to the total Australia population as of 30 June 1988.

Source: ABS mortality data.

Figure 3.4.4: Age-standardised mortality rates, all causes by sex, persons aged 65 years and over, 1985–1987 and 1998–2000

Between the mid-1980s and late 1990s, mortality inequality between males and females aged 65 years or more narrowed slightly: the sex difference in all-cause mortality was 61% in 1985–1987 (24 more male deaths per 1,000) and 55% in 1998–2000 (17 more males deaths per 1,000)(Table 3.4.3). Small declines in mortality inequality were also observed between males and females for all cancers, and diseases of the circulatory system.

Table 3.4.3: Age-standardised mortality rate ratios, by sex, persons aged 65 years and over, 1985–1987 and 1998–2000

	1985–1987		1998–2000	
Cause of death and ICD-10 codes	**Rate[(a)]**	**Rate ratio**	**Rate[(a)]**	**Rate ratio**
All causes				
Males	64.5	1.61***	48.3	1.55***
Females	40.1	1.00	31.3	1.00
Cancers (C00–C97)				
Males	15.3	1.96***	14.3	1.90***
Females	7.8	1.00	7.5	1.00
Disease of the circulatory system (I00–I99)				
Males	33.7	1.43***	20.5	1.41***
Females	23.6	1.00	14.5	1.00

Note: Age-standardised to the total Australian population as of 30 June 1988.

(a) Deaths per 1,000 persons.

Source: ABS mortality data; Mathers 1994b.

*p<0.05, ** p<0.01, ***p<0.001

3.5 Summary and discussion

Consistent with previous Australian and overseas research, this report has shown that males and females have very different mortality profiles. Girls born in 1998–2000 were expected to live an average of 5.6 years longer than boys born in the same period. From infancy to old age, females experienced lower rates of death for all causes combined, and for most of the specific causes that were examined. The largest all-cause mortality inequality between the sexes was observed among 15–24 year olds (163%, 59 more male deaths) and the smallest was found for those aged less than 1 year (25%, 118 more male deaths). During 1998–2000, an estimated 23,874 deaths among males aged 0–64 years could have been avoided if they had experienced the same mortality rate as females. Further, despite reductions in all-cause mortality for both males and females between 1985–1987 and 1998–2000, death rates remained relatively higher among males at each period, although for all age groups, the size of the sex difference in mortality narrowed.

What factors might account for sex differences in mortality? How, for example, might we explain greater longevity among females, or higher death rates among male infants for seemingly very different causes of death such as congenital malformations, deformations and chromosomal abnormalities, and accidents and injury (see Table 3.1.1)? Further, what factors might underpin higher male death rates for suicide among those aged 15–24 (see Table 3.2.1), or higher death rates for cardiovascular disease and diseases of the digestive system among working-aged males (see Table 3.3.1)? There is a long history of attempts to explain these (and other) types of sex differences in mortality, and over the years many varied reasons have been proffered. Given the complexity and volume of this work, only a brief overview is provided here.

The suggested reasons for mortality differences between males and females reduce to two broad categories of explanation: those that relate to the biological determinants of sex differentiation (genes, hormones, and physiology), and differentiation that is a product of historical, social, economic, and cultural factors. Importantly, interactions and interdependencies among biological and social factors (e.g. gene–environment interactions) are also likely to contribute to sex differences in mortality.

The mortality profile of males at the beginning of life provides some of the strongest evidence that females have an inherent biologic advantage that results in lower rates of death. Although more boys than girls are born (an average of 105 boys for every 100 girls), their death rate in the first year of life is significantly higher (25% higher in 1998–2000: see Table 3.1.1). Moreover, boys have a higher rate of early death for conditions that seemingly have a clear biological basis, such as conditions specific to the perinatal period (e.g. congenital infections, haemorrhagic and haematological disorders of the foetus) and congenital malformations and chromosomal abnormalities. Biologic factors are also believed to contribute to higher rates of male mortality for some conditions experienced in adulthood, particularly coronary heart disease (Waldron 1995; Weidner 2000).

While the role of biologic factors in explaining some of the sex differences in mortality is widely acknowledged, many researchers see the difference as being due primarily to social and environmental influences (Waldron 2000; Kane 1994; Lawlor et al. 2001; Pampel 2003). This conclusion is underscored by studies which show that sex differences in mortality vary in magnitude across different time-points within the same country and between different countries at any single time-point (Trovato and Lalu 1996, 1998; de Looper and Bhatia 2001). These temporal and cross-national variations make a strong case for the primacy of non-biologic factors in shaping and circumscribing mortality differences between the sexes.

The now extensive literature on sex differences in mortality, and health more generally (e.g. Kane 1994; Hart 1989; Verbrugge 1989; Waldron 1995; Annandale & Hunt 2000; Cameron & Bernardes 1998; Macintyre et al. 1996), suggests that the poorer mortality profile of males is due to a complex array of interacting social and environmental factors, including (but not limited to):

(i) *Health-related behaviours*: males are more likely than females to smoke cigarettes (Waldron 1986, 1991; Turrell et al. 2002b), consume alcohol at higher levels of risk (Ely et al. 1999; Green et al 2003; Persson et al. 1998), and have food and nutrient intakes that are less consistent with dietary guideline recommendations (Turrell 1997). These factors probably contribute to the significantly higher death rates among males for cardiovascular disease, lung cancer, diabetes, diseases of the digestive system, and diseases of the liver.

(ii) *Psychosocial response to illness*: males and females differ in terms of how they perceive symptoms and illness, how they define and monitor their psychobiological functioning, and their general attentiveness to changes in bodily states (Saltonstall 1993; Scott & Morgan 1993; Sabo & Gordon 1995).

(iii) *Help-seeking and health service use*: males are less likely to seek help in response to symptoms and illness and are more likely to delay help-seeking, thus reducing the probability that potentially fatal conditions are prevented or detected at an asymptomatic stage. Males are also less likely to engage in continued care: that is, show persistence in caring for their health problems by such things as attending follow-up appointments and compliance with medical advice.

(iv) *Exposure to environmental risks:* irrespective of age, males experience much higher death rates for accidents and injury. This presumably reflects men's greater exposure to employment-related hazards, their propensity to engage in leisure activities with higher levels of associated risk, and their greater risk-taking behaviour more generally (e.g. driving cars fast). Higher levels of mortality for accidents and injury among male children aged less than 1 year (see Table 3.1.1) also suggests that male and female infants are exposed to different types and levels of social and environmental risk.

(v) *Social relations:* males tend to have fewer intimate social networks and ties than females, and are less likely to have a close personal confidant other than their partner (Fuhrer et al. 1999). Males are also less likely to be active civic participants, as reflected in their lower levels of involvement in community organisations and rates of volunteerism. Arguably, the higher death rate for suicide among males (especially in adolescence and young adulthood) is partly due to their having fewer close ties and being less socially integrated. Also, dealing with such things as stress, anxiety, and feelings of hopelessness and low self-esteem is likely to be more difficult in the absence of social and personal supports, and this may partly underpin males' higher use of cigarettes and alcohol, and in turn, their poorer mortality profile for chronic degenerative conditions such as cardiovascular disease.

Importantly, it is also necessary to acknowledge that some of these social and environmental factors influencing health differences between males and females may themselves be the product of inherent (e.g. genetic) differences between the sexes.

In sum, this chapter has shown that irrespective of age, males and females exhibit a very different mortality pattern, and previous research suggests that this is due to both biologic and environmental factors. Moreover, sex differences in mortality are not constant, but rather change (widen and narrow) in response to concomitant social, economic, and cultural changes that occur in the wider society. This suggests that large sex inequalities in mortality are not inevitable (Lawlor et al. 2001), and that the inequalities are likely to be responsive to policies and interventions that encapsulate the social origins of sex differences in death.