

# **Epidemic of coronary heart disease and its treatment in Australia**

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# **Epidemic of coronary heart disease and its treatment in Australia**

**Sushma Mathur**

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## Preface

The epidemic of coronary heart disease remains one of Australia's greatest health problems. It is the leading cause of premature death and disability despite major falls in coronary heart disease death rates over the past 30 years. The prevention and control of coronary heart disease remains a significant challenge not only in Australia but also in other developed countries. Recognising the importance of this disease, the Organisation for Economic Co-operation and Development (OECD) compared treatments, costs and outcomes related to coronary heart disease across 16 OECD countries, including Australia. The Australian data used in this international study form the basis of this report.

There is continuing need to inform the public, researchers, health professionals and policy makers on the importance of the disease, the large scope for prevention, patterns in treatment and care, and economic aspects.

This report aims to help achieve this, as the first Australian Institute of Health and Welfare (AIHW) report focusing exclusively on the national epidemic of coronary heart disease. Although some of the information in the report has been published previously in AIHW reports, it also contains a wealth of new information. This includes new information examining recent trends and patterns in:

- multiple risk factors
- cardiac procedures for people who have suffered a heart attack
- outcomes such as in-hospital case-fatality and long-term survival for people who have had a coronary event
- economic aspects of treatment for coronary heart disease.

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Richard Madden  
Director

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The report was refereed by Professor Andrew Tonkin (National Heart Foundation of Australia), Professor Annette Dobson (University of Queensland) and Associate Professor Michael Hobbs (University of Western Australia).

# Summary

This report highlights the considerable progress that has been made in addressing the epidemic of coronary heart disease (CHD) in Australia among 40–90 year-olds.

## Some major gains include:

- falling death rates for CHD: by over 30% between 1993–94 and 1999–00;
- falling onset of major coronary events: 20% decline in incidence rates between 1993–94 and 1999–00;
- better overall survival from major coronary events: 12–16% decline in case-fatality rates between 1993–94 and 1999–00;
- fewer hospital admissions for heart attack (a major component of CHD): 12% decline in acute myocardial infarction (AMI) admission rates between 1993–94 and 1999–00;
- better in-hospital survival for AMI: 17–19% decline in in-hospital case-fatality rates for AMI between 1993–94 and 1999–00;
- some lower risk factor levels: large declines in tobacco smoking and blood pressure levels since 1980.

## Associated large trends:

- large increases in the prescription of lipid lowering drugs, ACE inhibitors and calcium channel blockers between 1990 and 1998;
- rapid increase in revascularisation procedures, percutaneous coronary intervention (PCI) and coronary artery bypass grafting (CABG), for the treatment of AMI during acute admissions between 1993–94 and 1999–00.

## Some unwelcome statistics:

- rapid increase in prevalence of overweight and obesity and diabetes since 1980;
- increase in physical inactivity levels since 1997;
- no change in high blood cholesterol levels since 1980.

## Current patterns (in 1999–00):

- four in ten adult Australians have two or more major modifiable risk factors for CHD;
- 48,313 major coronary events, or 132 per day;
- 50% of these coronary events are fatal; and one in eight AMI patients die in hospital (3,258 patients);
- 28,002 hospital admissions for AMI. Of these:
  - one in four have cardiac catheterisation;
  - at least one in eight have PCI;
  - one in twenty have CABG;

- in-hospital case-fatality rates for AMI patients undergoing PCI is 3.5% and CABG 5.4% during acute admissions. This contrasts with overall PCI mortality of 0.8% and overall CABG mortality of 2.1%.

**Men and the elderly are most affected (in 1999–00):**

- compared with women, men are:
  - more likely to have multiple risk factors, such as tobacco smoking, physical inactivity, overweight and diabetes;
  - twice as likely to have CHD and die from it;
  - twice as likely to be hospitalised for heart attack;
  - more likely to receive cardiac catheterisation and revascularisation procedures;
- on the other hand, women are more likely to die during acute hospital admissions for AMI and following CABG and cardiac catheterisation;
- compared with younger age groups (40–64 year-olds), the elderly (75–90 year-olds) have:
  - worse risk factor levels;
  - substantially higher death rates and incidence rates from CHD;
  - higher admission rates for AMI, but lower rates of revascularisation procedures and cardiac catheterisations;
  - poorer survival after a coronary event.

# 1 Introduction

## 1.1 Background

Coronary heart disease (CHD) is the leading cause of death in Australia, claiming 26,521 lives in 2000. It contributes to significant illness, disability, poor quality of life and premature mortality, and the associated direct healthcare costs in Australia exceed those of any other disease. CHD was by far the greatest epidemic in Australia during the twentieth century. The level of CHD deaths peaked in the late 1960s and has since fallen by over 60%, but it remains a significant health problem not only in Australia but also in other developed countries. CHD kills 6.9 million people each year worldwide and is the leading cause of premature death and disability in developed countries. Due to the increasing rates of CHD in developing countries, it is predicted that by 2020 it will become the single leading public health problem for the world (Murray & Lopez 1996).

## 1.2 What is coronary heart disease?

CHD is the most common form of heart disease in Australia. Its primary feature is insufficient blood supply to the heart itself. The two major clinical forms of CHD are heart attack and angina. In a heart attack the insufficient blood flow is sudden and extreme. In angina the episodes of restricted flow are temporary and usually much less dangerous.

The common underlying problem in the various forms of CHD is atherosclerosis, a complex process that affects the vessels supplying blood to the heart, the coronary arteries. In atherosclerosis, build-ups called plaques form on the inside surface of the artery. When advanced, plaques can narrow the channel through which the blood flows. Plaques can be single or multiple and can affect one or more of the heart's three main arteries.

A heart attack occurs when a coronary plaque suddenly breaks open. This brings on a blood clot that completely blocks blood flow to the part of the heart muscle downstream. This is a life-threatening emergency that causes severe chest pain, and often collapse and sudden death. Apart from other emergency measures, if the clot cannot be promptly treated some of the person's heart muscle will die, a condition known as acute myocardial infarction (AMI).

In angina, a plaque has markedly narrowed a coronary artery to the point where, although the blood flow can usually meet most daily demands, it cannot increase to meet extra demands such as exercise or emotion, resulting in temporary chest pain. In typical angina, the event is not life-threatening, there is no associated blood clot and the heart muscle is not in immediate danger.

## 1.3 Risk factors and prevention

A large part of the death, disability and illness caused by CHD is preventable. The main behavioural risk factors for CHD are the high-fat and excess-energy Western diet, physical inactivity and cigarette smoking. The Western diet and physical inactivity interact to produce the biological risk factors of high blood cholesterol, high blood pressure and excess weight. Each of these factors increases the risk of CHD on its own, and in an individual the risk increases progressively with the number of risk factors present (AIHW 2001).

Prevention of CHD includes both public health and medical interventions aimed at reducing risk factors. Apart from efforts to encourage healthy eating, physical activity and non-smoking, there are now effective drugs for controlling high levels of blood cholesterol and blood pressure. Over the last decade the use of these drugs has increased considerably.

## 1.4 Medical treatment and cardiac procedures

When CHD occurs, treatment depends on whether the disease is in the form of a heart attack or angina. Heart attacks need CPR (cardiopulmonary resuscitation) if there is cardiac arrest, rapid transit to hospital, drugs to inhibit and dissolve the blood clot, and external 'countershock' if the heart's rhythm is critically disturbed. Other drugs are usually given to reduce the immediate and long-term damage to the heart. For angina, drugs can be given to reduce the episodes of chest pain and to relieve the pain when it occurs.

For patients who have persistent blockage of the coronary arteries, either in the case of angina or after a heart attack, there are several procedures to 'revascularise' the heart by removing or bypassing the blockages, to restore adequate blood flow. The revascularisation procedures are percutaneous coronary intervention (PCI) and coronary artery bypass grafting (CABG).

PCIs involve inserting a catheter with a balloon into the point where a coronary artery has been narrowed by a plaque, then inflating the balloon to reduce the obstruction. Recent years have seen the introduction and rapidly growing use of coronary stents, metal tubes that are expanded within an artery to hold it open where it has been narrowed. This has improved outcomes for PCIs by reducing the risk of the artery closing acutely or in the months after the procedure.

CABG entails opening the patient's chest and using blood vessel grafts to bypass blockages in the coronary arteries and restore adequate blood supply to the heart muscle.

Before either of these revascularisation procedures is performed, a procedure known as cardiac catheterisation is necessary. This identifies the location of any coronary blockages. A catheter is inserted into the bloodstream and threaded through the blood vessels to the heart and the coronary arteries. The catheter then releases a dye that outlines the arteries under X-ray.

## 1.5 Greater risk among the elderly

Despite great improvements, the burden of CHD is likely to remain large over the coming decades and there will be a growing number of elderly Australians among whom it is highly prevalent. CHD predominantly affects middle-aged and older Australians, with the majority of hospital admissions for heart attack and cardiac procedures occurring among the population aged 60 years and over—70% of AMI hospital admissions, 73% of CABG procedures and 61% of PCI procedures. These proportions are substantial, especially as those aged 60 years and over account for only 16% of the total population. Almost all CHD deaths (92%) occur among the population aged 60 years and over, with the population aged 80 years and over accounting for over 50% of such deaths.

Because CHD is much less common in younger ages, this report focuses on the Australian population aged 40 years and over. An upper age limit of 90 years has been imposed because multiple diseases in very old individuals may result in unreliable data.

## 1.6 Purpose and structure of this report

Recognising that the prevention and control of CHD has been a prominent and constant challenge in developed countries, the Organisation for Economic Co-operation and Development (OECD) compared treatments, costs and outcomes of CHD across 16 OECD countries, including Australia. The Australian data used in this international study form the basis of this report, which aims to provide the community, researchers, health professionals and policy makers with the latest available data and trends relating to the epidemic of CHD and its treatment in Australia.

Although the title of this report refers to the broad category of CHD, data limitations mean that some sections in this report relate mainly to heart attack. For example, it is difficult to adequately estimate the incidence of angina or count the number of people admitted to hospital for it, whereas this information can be reliably obtained for heart attack. On the other hand, information about mortality, risk factors and drug treatment relate to CHD generally.

The report has six chapters. Chapter 2 outlines the methods used. Chapter 3 provides an overview of CHD by presenting patterns and trends in incidence, mortality, case-fatality and prevalence. Much of the data in Chapter 3 have been presented in previous AIHW reports and the purpose of this chapter is to provide a context for the analysis presented in the remainder of the report. Chapter 4 examines possible reasons for the decline in coronary death rates and incidence observed in Chapter 3, by examining current patterns and trends in risk factors and drug treatment for CHD. Improvements in heart attack survival rates suggest that acute care cardiac interventions are becoming more and more effective and this is discussed in detail in Chapter 5. This chapter focuses on patterns and recent trends for patients admitted to hospital for a heart attack and the acute care invasive treatments that they receive (cardiac catheterisation, PCI and CABG). In-hospital case-fatality for these interventions and for heart attack patients are also discussed in Chapter 5. Chapter 6 examines economic aspects of CHD treatment in Australia. The Appendix contains supplementary tables.

# 2 Methods

## 2.1 Overview

The data presented in this report are obtained from administrative data collections, cardiac procedure registers and national surveys. Australia does not have a national heart disease register, so it is a complex task to estimate the incidence and prevalence of CHD and the number of people receiving cardiac procedures. Australia is, however, fortunate to have national hospital morbidity data, which provide valuable information on treatment in Australian hospitals.

This chapter provides an overview of data sources used in the report, explains the methodology for estimating incidence and counting the number of patients receiving cardiac procedures, and details the coding classification presented in the report.

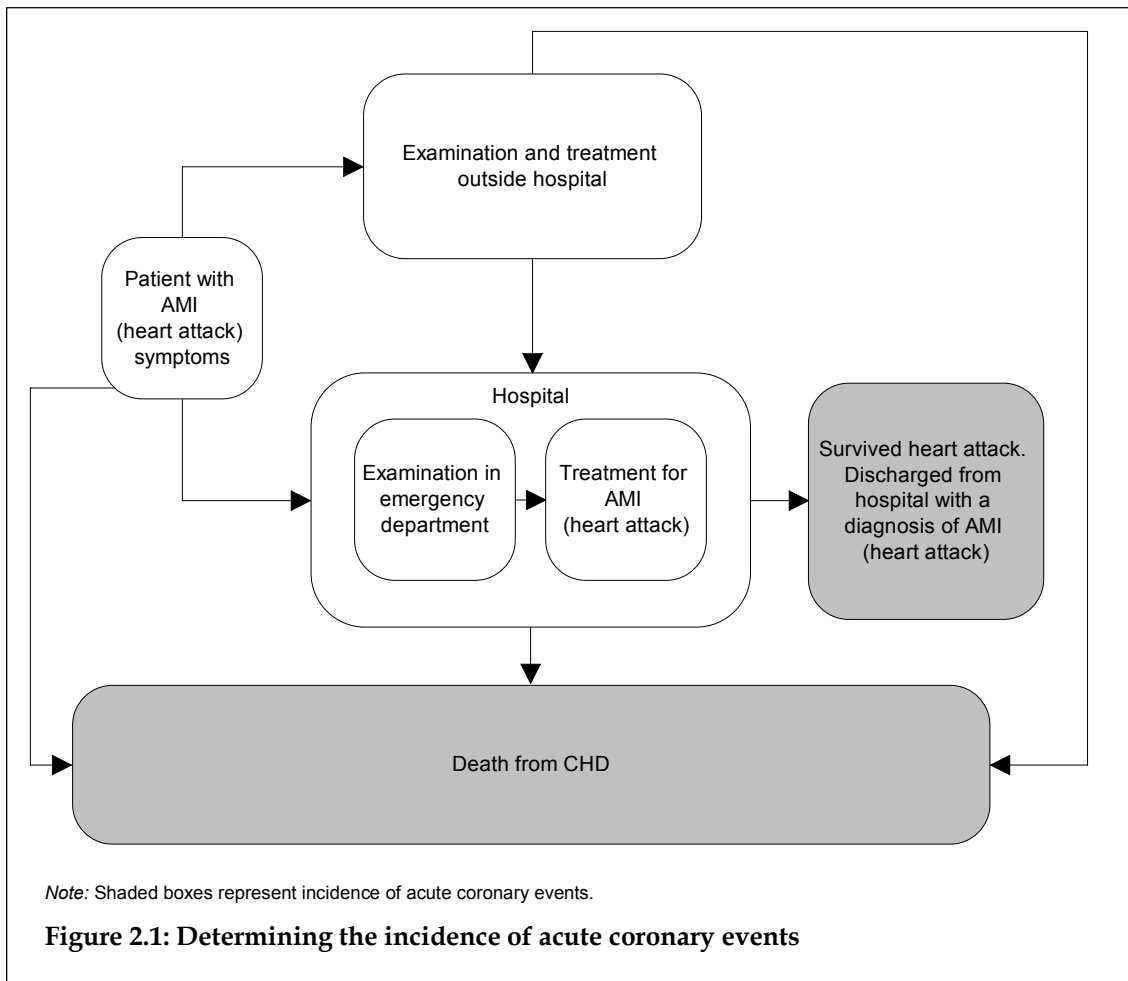
## 2.2 Incidence of acute coronary events

Incidence is defined as the number of new cases of a condition or disease, in this report CHD, occurring in a population within a specified time period. However, measuring the overall incidence of CHD is far from straightforward. For example, it would be very difficult to measure the incidence of angina. Its onset is not always clear-cut, people may delay visiting a doctor, new cases will often be treated in general practice, and there is no system of required notification.

For these reasons it is only practicable to measure the incidence of what can be termed major acute coronary events – those events that result either in an acute admission to hospital or in death. This effectively amounts to estimating the incidence of heart attack. The admissions are recorded in routinely collected hospital data (see Section 2.3) and the deaths are drawn from death certificates (see Section 2.4).

Incidence is estimated as the sum of the number of non-fatal hospital admissions for heart attack (recorded as AMI) and the number of deaths recorded as CHD deaths (Figure 2.1). As it is not possible to know whether the non-fatal hospital admissions are new cases or recurrent events in people with previous CHD, the definition of incidence used here does not specifically refer to new cases and so is an overestimate of the true incidence.





## 2.3 Hospital admissions

Data on hospital admissions have been obtained from the National Hospital Morbidity Database. This database, held at the AIHW, contains the most comprehensive national data on hospital admissions in Australia. The data supplied for the National Hospital Morbidity Database are based on the National Minimum Data Set for Admitted Patient Care and are provided to the AIHW by State and Territory health authorities. Data relating to admitted patients in almost all hospitals are included: public and private acute hospitals, public and private psychiatric hospitals, and private free-standing day hospital facilities. Information is available on demographic, diagnostic and procedural (principal and associated), administrative and length of stay information on episodes of care for patients admitted to hospital.

However, a major limitation with the database is that data are event-based rather than person-based. As a result individual patients cannot be tracked following discharge. For example, a single individual who is admitted for AMI, receives treatment during the initial episode and is readmitted for scheduled follow-up treatment involving hospitalisation may be counted as two people. To minimise this double-counting, only those admissions with a principal diagnosis of AMI are included. The data exclude false AMIs (i.e. patients who are admitted for less than 3 days but are released from hospital, are not transferred to another

hospital and did not die) as these patients were unlikely to have suffered a heart attack. This method has been shown to produce a more accurate estimate of AMIs in the population than using all admissions coded as AMI (AIHW: Jamrozik et al. 2001). Given the acute nature of AMI and the need for hospitalisation, it is easier to use hospital admission data to measure AMIs specifically as opposed to measuring all CHD admissions, which may include hospitalisation for less severe disease.

In this report the terms AMI admissions and AMI patients actually refer to what is technically known as an episode of care, or hospital separation for AMI. Data in the National Hospital Morbidity Database are based on financial years, reflecting how the data are supplied to the AIHW.

## **2.4 Mortality**

Mortality data are obtained from Australian death certificates. Registration of deaths in Australia is the responsibility of the State and Territory Registrars of Births, Deaths and Marriages. Registrars provide the deaths data to the Australian Bureau of Statistics (ABS) for coding of cause of death and compilation into aggregate statistics. The AIHW also holds these data in a National Mortality Database. The data in this report have been extracted from the National Mortality Database.

Both demographic and cause of death information are recorded on Australian death certificates. Since 1997 all morbid conditions, diseases and injuries listed on the death certificate were recorded and coded, enabling identification of both the underlying cause (the disease or injury initiating the sequence of events leading to death) plus any associated causes of death. Associated causes include conditions leading directly to death, excluding the underlying cause, and conditions that contribute to death but do not lead directly to death. However, as CHD is predominantly recorded as the underlying cause of death (in 74% of cases where it appears on a death certificate) and because information on multiple causes of death has only been available since 1997, this report focuses on mortality data where CHD is the underlying cause of death.

Studies examining the reliability of coding of AMI and CHD on death certificates have shown that while CHD is coded accurately and reliably on Australian death certificates, subclassifications within this category, such as AMI, are too unreliable for useful analysis (Dobson et al. 1983). As a result, this report, in relation to death certificate data, focuses on the broader category of CHD rather than the more specific category of AMI. It is highly likely that most deaths coded as CHD are in fact deaths due to AMI.

## **2.5 Prevalence of heart disease**

Prevalence data provide a measure of the number of people with a characteristic (for example CHD) at a particular point in time. Prevalence data, however, are difficult to obtain at a national level and surveys are the main source of such information. In Australia there have been a number of Australia-wide surveys that have collected self-reported information on the prevalence of heart disease – ABS National Health Surveys (1989–90, 1995) and the capital city-based National Heart Foundation Risk Factor Prevalence Surveys (1980, 1983, 1989). Self-reported data on diseases may be unreliable as they can be subject to misinterpretation by survey respondents and be influenced by changing perceptions of the disease over time. Although there are limitations with prevalence data in Australia, the

information is still important as it provides some indication of the number of people with heart disease in the community.

In the Risk Factor Prevalence Surveys (1980, 1983 and 1989), participants reported whether they had been diagnosed with angina or heart attack. However, in the National Health Surveys (1989–90 and 1995) CHD was not separately identified as a condition in the reporting but was grouped into a broader heart disease category. This category therefore included several other forms of heart disease as well as CHD (rheumatic fever with heart involvement, diseases of the mitral valve, other rheumatic heart disease, CHD, diseases of pulmonary circulation, other forms of heart disease). The 1995 heart disease prevalence estimates presented in this report are therefore an overestimate of the prevalence of CHD in Australia. Given the difference in the heart disease definitions in the National Health Surveys and the Risk Factor Prevalence Surveys, the trend data in this report are based on the 1989–90 and 1995 National Health Surveys.

## 2.6 Risk factor prevalence

Over the last two decades several national surveys have collected information on self-reported and measured CHD risk factors. The risk factor data in this report are drawn from some of these major surveys – 1999–2000 Australian Diabetes, Obesity and Lifestyle Study (AusDiab); 2001 National Drug Strategy Household Survey; 1995 National Nutrition Survey; National Physical Activity Survey (1997–2000); and Risk Factor Prevalence Studies (1980, 1983 and 1989). Further information on these surveys can be found in *Heart, Stroke and Vascular Diseases – Australian Facts 2001* (AIHW 2001).

In interpreting results from the AusDiab Survey it should be noted that approximately 50% of eligible households participated in the household interview, and 55% of eligible adults in these households took part in the physical examination. The effect of any non-response bias on estimates from AusDiab is yet to be determined (AIHW 2002a).

## 2.7 Drug treatment

Data on drug use have been obtained from the Drug Utilization Sub-committee Database, which is held at the Commonwealth Department of Health and Ageing. The database monitors the community (i.e. non-public hospital) use of prescription medicines in Australia, combining information on prescriptions subsidised by the Pharmaceutical Benefits Scheme and the Repatriation Pharmaceutical Benefits Scheme with an estimate, from the Pharmacy Guild Survey, of those prescriptions that are not subsidised. Not included in this database is information on drugs prescribed in public hospitals and highly specialised drugs available for outpatients through public hospital pharmacies.

Drug use is expressed in terms of volume, defined as daily doses (DDDs) per 1,000 population per day (DDD/1,000/day), following the unit of measurement approved by the World Health Organization (WHO). This is based on the assumed average dose per day of a drug used for its main indication in adults. The DDD enables valid comparisons between drugs independent of differences in price, preparation and quantity per prescription (AIHW 2001).

Drug treatment information in this report has also been obtained from the MONICA Project, a WHO study MONItoring trends and determinants of CARDiovascular disease. Forty well-

defined populations from 25 countries were involved in the study from the mid-1980s to the mid-1990s. Australia participated in the project with two centres, one in Perth, Western Australia, and the other in Newcastle, New South Wales. Each centre collected standardised data on CHD mortality, AMI incidence, the main risk factors for cardiovascular disease and medical care of patients with AMI. Drugs used by individual patients before admission to hospital, during the stay in hospital and on discharge were also collected.

## 2.8 Cardiac procedures

Data on cardiac procedures have been obtained primarily from the National Hospital Morbidity Database. Information on cardiac procedures relates mostly to AMI treatment, although a greater number of hospital admissions are for angina than for AMI. Given that revascularisation procedures, such as PCI and CABG, have been shown to be very effective treatments for relieving angina and more recently for AMI, the procedure analysis in this report should ideally be undertaken separately for both AMI and angina. As already noted, it is too difficult to count the number of people admitted to hospital for angina adequately, due to the high rate of hospital readmissions for angina within the observation period. This leads to a high risk of multiple counting of patients for the same coronary event. On the other hand, counting people admitted for AMI can be reliably obtained from hospital records by selecting only those admissions with a principal diagnosis of AMI and length of stay greater than 2 days (and those that died within 2 days of admission). This definition of AMI patients reduces the risk of counting patients more than once for the same coronary event. For this reason procedure information in this report relates mostly to AMI patients.

In some sections of the report, cardiac procedure data have been drawn from the National Coronary Angioplasty and National Cardiac Surgery Registers so that long-term trends and total number of procedures for PCI and CABG can be presented (AIHW: Davies & Senes 2001; AIHW: Davies & Senes 2002). Since 1980 the National Heart Foundation has been collecting data on coronary angioplasty procedures, indications, associated complications, lesion location, success rates and adjunctive techniques such as stenting. Since the 1960s the National Heart Foundation has also been collecting information on a range of heart surgery procedures and associated deaths. The data are supplied annually to the AIHW by coronary angioplasty units and cardiac surgery units. The registers are not patient-based and so demographic information on patients undergoing these procedures is not available.

## 2.9 Expenditure

Information on aggregate expenditure on CHD has been obtained from the Disease Costs and Impact Study undertaken by the AIHW. This study takes known aggregate expenditures on health care and apportions these to disease categories using Australian data – hospital morbidity data, casemix data, the national survey of morbidity and treatment in general practice, and the 1989–90 National Health Survey. Total recurrent expenditure is divided into five dimensions: disease (defined by ICD-9 codes), sector (hospital inpatient, non-patient, medical, pharmaceuticals), program (treatment, prevention), sex and age. For further details on this method see *Health System Costs of Cardiovascular Diseases and Diabetes in Australia 1993–94* (AIHW: Mathers & Penm 1999). The most recent data for health system costs for CHD are for the financial year 1993–94.

## 2.10 Classifications

Australia has recently moved to a new classification system for coding cause of death and hospital admission, the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision (ICD-10). In this report mortality data before 1998 have been coded to ICD-9 (International Classification of Diseases, Ninth Revision) and thereafter to ICD-10. Table 2.1 lists the ICD-9 and ICD-10 codes used in this report. The introduction of ICD-10 and the move from manual coding to automation of cause of death coding has resulted in a break in the mortality time series. To overcome this difficulty the ABS coded the 1997 deaths data using both ICD-9 (manual coding) and ICD-10 (automatic coding), which allowed comparability factors between ICD-9 and ICD-10 to be derived. For CHD, mortality data for 1997 and earlier have been multiplied by 1.01.

For hospital diagnosis and procedures these international classifications (ICD-9 and ICD-10) have been modified for Australia. Hospital data before 1998–99 were coded using ICD-9-CM (International Classification of Diseases, Ninth Revision, Clinical Modification) and thereafter using ICD-10-AM (International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification).

**Table 2.1: Diagnosis and procedure codes for acute coronary events**

Diagnosis and procedures	ICD-9 and ICD-9-CM codes	ICD-10 and ICD-10-AM codes
Acute myocardial infarction (AMI)	410	I21
Coronary heart disease (CHD)	410–414	I20–I25
Cardiac catheterisation	37.22, 37.23, 88.53–88.57	38203–00, 38206–00, 38215–00, 38218–00, 38218–02, 59900–00, 59900–02 (Blocks: 667–668, 607)
Percutaneous coronary interventions (PCI)	36.01, 36.02, 36.05–36.07	35304–00, 35305–00, 35310 (Blocks: 670, 671)
Coronary artery bypass grafting (CABG)	36.1	38497, 38500, 38503, 90201 (Blocks: 672–679)

# 3 Incidence, prevalence and mortality of coronary heart disease

## 3.1 Introduction

CHD is a major cause of morbidity and is the most common cause of sudden death in Australia, accounting for 21% of all deaths in 2000. This chapter focuses on patterns and recent trends in CHD incidence, mortality, case-fatality and prevalence; and provides a context for the analysis presented in the following chapters which will examine risk factor levels, drug treatment and patterns in treatments, outcomes and costs for people hospitalised for a heart attack.

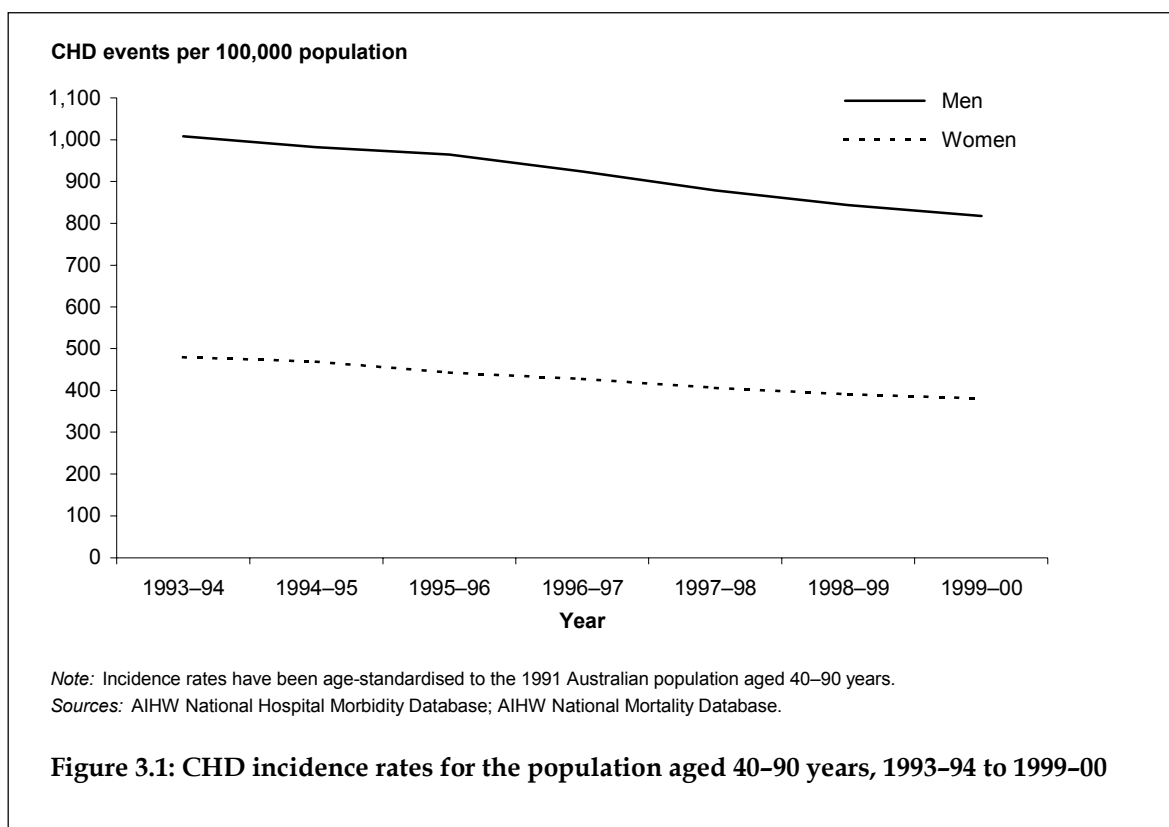
## 3.2 Incidence

Incidence data are an important indicator for understanding the impact of lifestyle changes and improvements in primary prevention. Since incidence data measure the rate of first occurrence of a disease in the population, they also reflect the influence or levels of factors that cause that disease. In the case of CHD, these influences are the coronary risk factors (see Section 4.2) with their well-known relationship to lifestyle, as well as the primary prevention efforts by individuals, healthcare providers, governments and other agencies.

In 1999–00, there were an estimated 48,313 CHD events in Australia among 40–90 year-olds (29,731 among men and 18,582 among women), equating to an incidence rate of 605 coronary events per 100,000 population aged 40–90 years. In this report, CHD events are defined as CHD deaths plus non-fatal hospital admissions for AMI (for further details see Chapter 2).

### Recent trends

Incidence rates for CHD have been declining over the last decade, with rates falling around 20% (or 3% per year) among 40–90 year-olds between 1993–94 and 1999–00 (Figure 3.1). The actual number of CHD events among 40–90 year-olds has also been falling over this period, from 50,611 in 1993–94 to 48,313 in 1999–00. The declines occurred across and within all age groups for the population aged 40–90 years (Appendix Table A1).

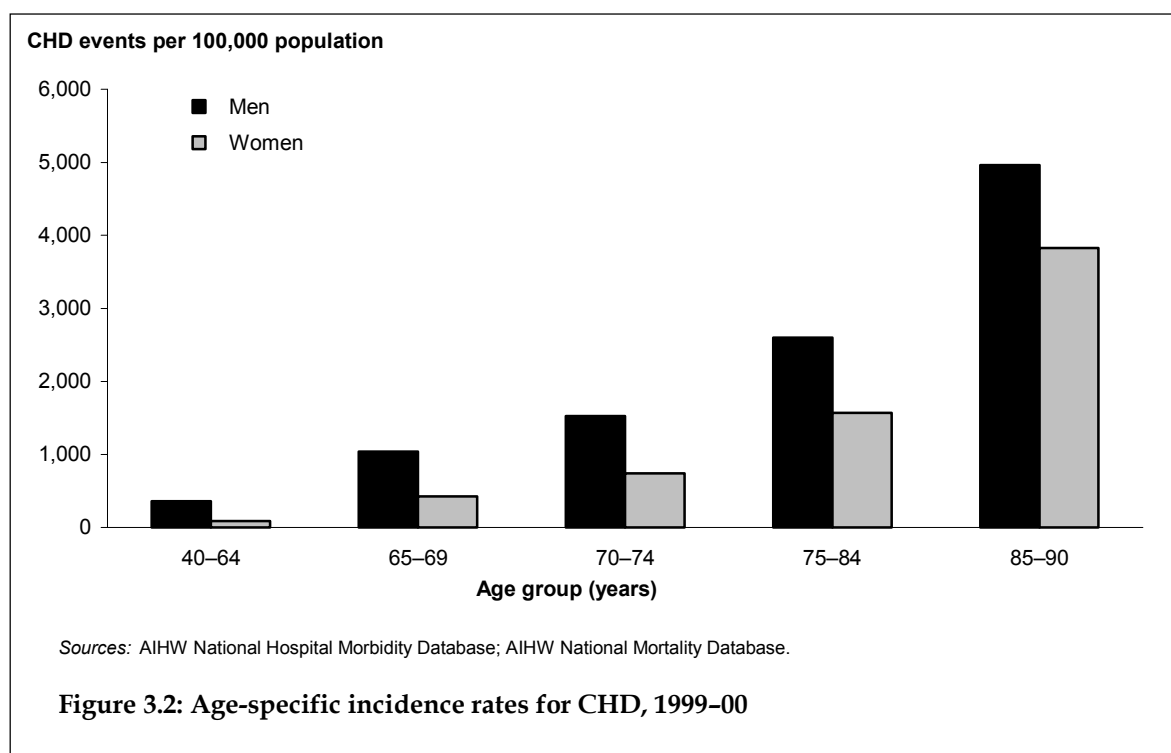


## Sex and age

In 1999–00, men were twice as likely to have a coronary event as women, based on age-standardised rates. The crude incidence rate for men aged 40–90 years was 766 coronary events per 100,000 population compared with 453 coronary events per 100,000 population for women of the same age. Incidence rates were higher for men than women across all age groups (Figure 3.2).

CHD incidence rates increase dramatically with age, so that incidence rates among men aged 75–90 years in 1999–00 were eight times those of 40–64 year-olds (Figure 3.2). Among women the gap between these age groups was even greater. This pattern has remained consistent over time (Appendix Table A1).

The CHD incidence rate for women aged 75–84 years was comparable to men aged 70–74 years, indicating that men usually suffer from heart disease at a younger age than women (Figure 3.2).



### 3.3 Mortality

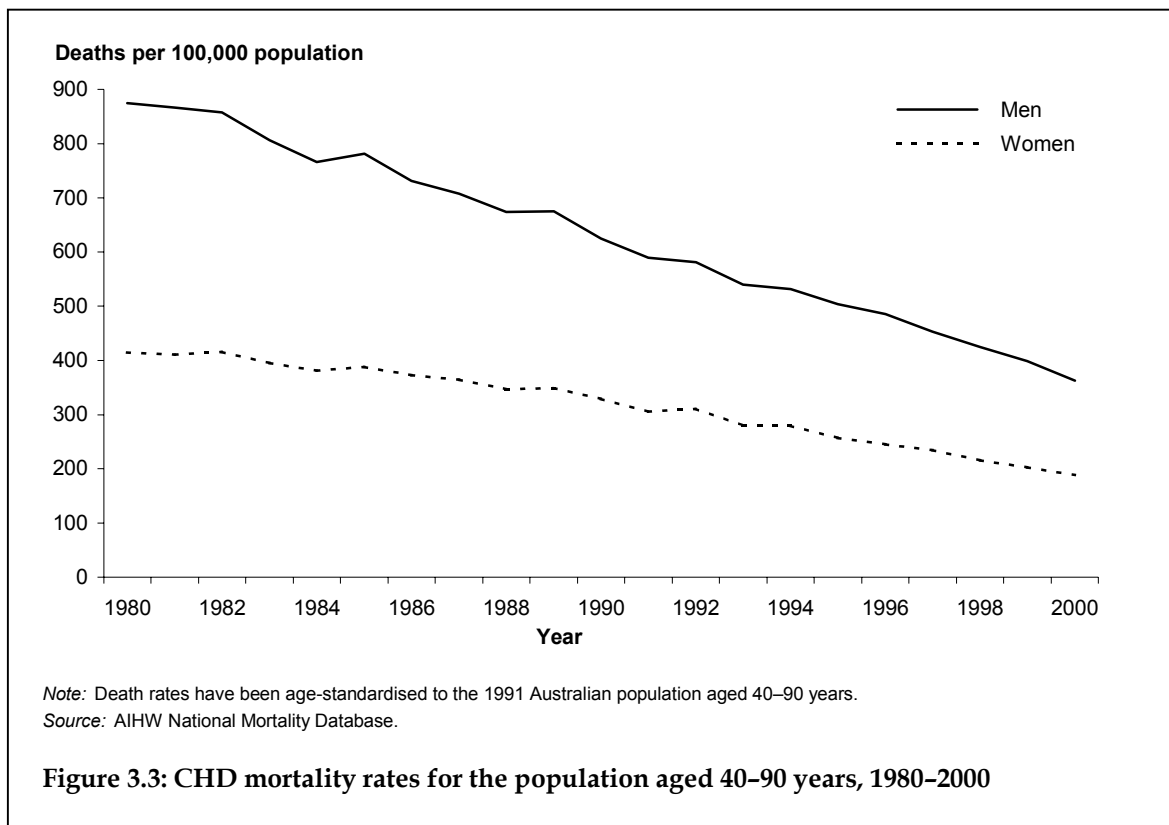
In 2000, CHD was the largest single cause of death in Australia, accounting for 23,012 deaths, or 21% of all deaths, among 40-90 year-olds (13,034 among men and 9,978 among women). This equates to a mortality rate of 285 deaths per 100,000 population aged 40-90 years.

#### Trends

Over the last three decades CHD death rates have declined substantially, by over 60%. This compares with falls of around 20% in deaths from non-cardiovascular diseases. Between 1989 and 2000, death rates from CHD fell at a rate of 4.8% per year among males and 4.7% per year among females, representing a total decline of around 46% over this 12-year period (AIHW 2002a). A comparison of death rates (men and women combined) across OECD countries between 1987 and 1997 shows that Australia had one of the largest declines in CHD death rates (36% decline), together with Denmark (38%), Luxembourg (35%), New Zealand (36%) and Norway (34%). In the United States and Canada, death rates declined at a slower rate than in Australia (26% and 32% respectively) (OECD 2001).

Among the population aged 40-90 years, CHD death rates have fallen by 59% for men and 55% for women between 1980 and 2000 (Figure 3.3). The absolute number of CHD deaths among 40-90 year-olds also fell over this period from 29,510 in 1980 to 23,012 in 2000. The declines occurred across and within all age groups although the most rapid decline occurred among 40-64 year-olds, at around 71-73% over the 20-year period. The corresponding fall in death rates among 75-90 year-olds was considerably lower, at around 45-46% (Appendix Table A2).



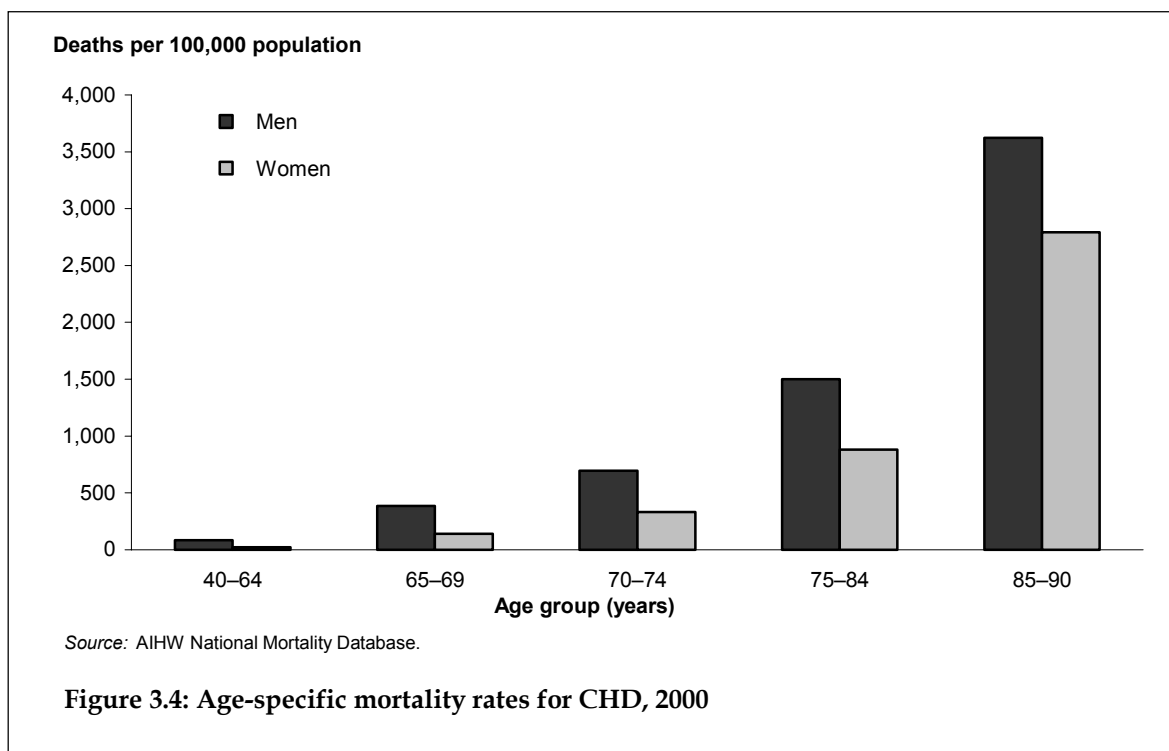


## Sex and age

In 2000, CHD killed a greater number of men than women, and age-standardised death rates indicated that men aged 40–90 years were almost twice as likely to die from CHD as women of the same age. The crude mortality rate for men aged 40–90 years was 332 deaths per 100,000 population compared with 241 deaths per 100,000 population for women. The higher mortality rate among men than women has remained consistent over the last two decades (Figure 3.3 and Appendix Table A2).

Death rates for CHD increase markedly with age, with rates for 75–90 year-olds substantially higher than for 40–64 year-olds (Figure 3.4). The age gradient between the youngest and oldest age groups has become steeper over time, with the absolute difference in age-standardised death rates between the 40–64 years and 75–90 years age groups doubling over the last two decades (Appendix Table A2).

Consistent with the incidence data presented earlier, men tend to die from CHD at an earlier age than women, with death rates for men approximately the same as those for women who are five years older (Figure 3.4).



## Higher burden among certain Australians

While there has been continuous decline in CHD mortality in Australia since the late 1960s, certain Australians continue to experience considerably higher death rates from CHD than other Australians, in particular Aboriginal and Torres Strait Islander peoples and people who are at a socioeconomic disadvantage. While population differentials are beyond the scope of this report, the considerably higher burden of ill health among certain groups deserves a brief mention. CHD death rates are considerably higher among Aboriginal and Torres Strait Islander peoples (6–8 times that of other Australians) and among people from lower socioeconomic groups (twice as high as those from the higher socioeconomic groups) (AIHW 2001). The lack of progress in reducing mortality among Aboriginal and Torres Strait Islander peoples and those from lower socioeconomic groups is of growing concern. *Australia's Health 2002* (AIHW 2002a) identified some of the underlying reasons for the higher burden of disease among these groups of Australians.

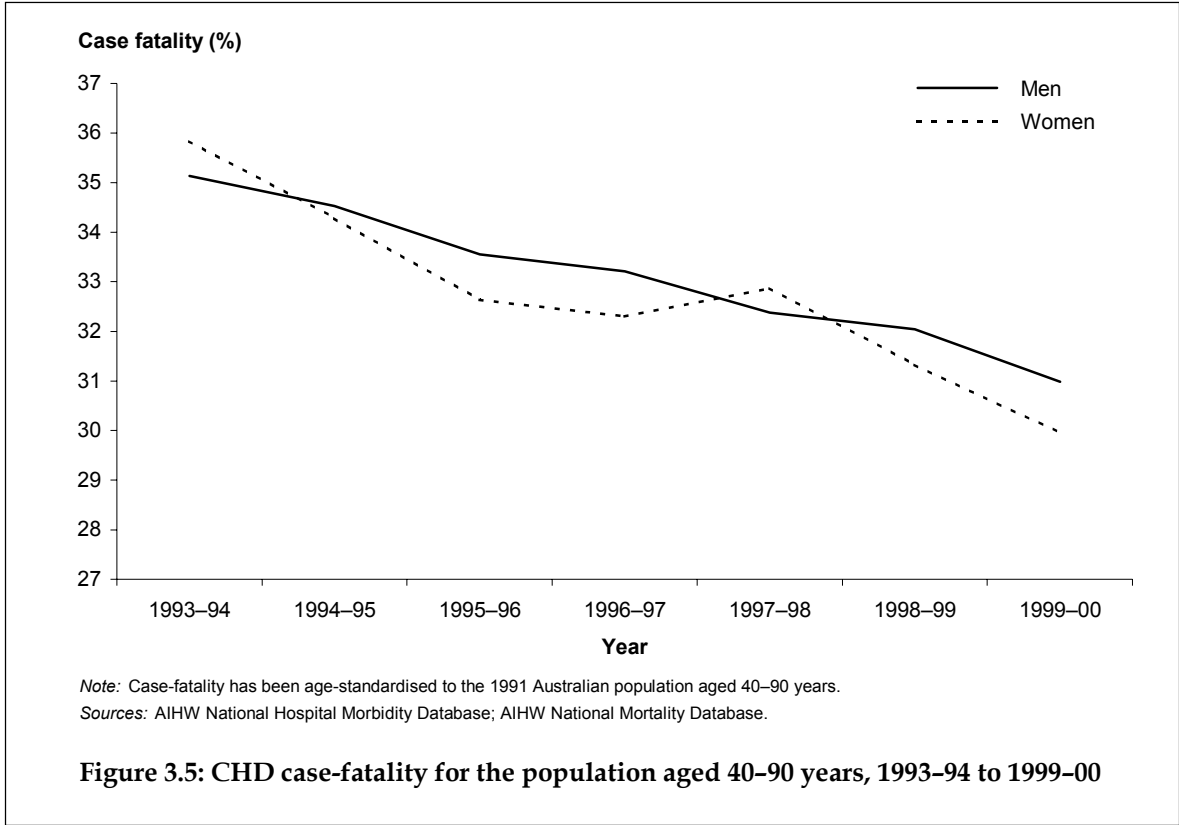
## 3.4 Case-fatality

This section draws together the analysis of the previous two sections by examining trends in survival after an acute event that involved an admission to hospital, and overall trends in mortality; that is, deaths that occurred in and out of hospital. The term 'case-fatality' refers to the proportion of cases that prove fatal. The definition of total case-fatality used in this report is the number of CHD deaths in the population divided by the sum of all CHD deaths and non-fatal hospital admissions for AMI.

In 1999–00, there were 48,313 CHD events in Australia among 40–90 year-olds, or 132 coronary events per day on average. Of these coronary events, almost half (23,633) were fatal and of these CHD deaths 87% occurred outside hospital. Evidence suggests that about one-quarter of those who have a heart attack die within an hour of their first-ever symptoms (AIHW 2001). Case-fatality for persons who reached hospital alive was around 15%, where case-fatality in this case is defined as number of CHD deaths occurring in hospital divided by the sum of CHD deaths in hospital and non-fatal hospital admissions for AMI.

### Recent trends

Between 1993–94 and 1999–00 the age-adjusted total case-fatality rate declined significantly for men and women aged 40–90 years (decline of 12% for men and 16% for women) (Figure 3.5). The level of case-fatality for patients aged 40–90 years who reached hospital alive also fell over this period (19–20% decline in age-standardised rates). Most of the decline in total case-fatality among 40–90 year-olds was due to declines in coronary deaths, with age-standardised CHD death rates declining by 28–30% between 1993–94 and 1999–00. The rate of non-fatal AMIs declined by around 8% over this same period. Coronary deaths that occurred outside hospital were declining faster than deaths that occurred in hospital (30% decline compared with 25% decline between 1993–94 and 1999–00) (Appendix Table A3).



## Sex and age

In 1999–00, case-fatality for CHD was similar for men and women aged 40–90 years, after adjusting for age. However, crude case-fatality rates were higher for women than for men (55% compared with 45%) (Table 3.1).

Case-fatality increased markedly with age, from 25% among 40–64 year-olds to 65% among 75–90 year-olds (Table 3.1). As is evident from Figure 3.6, the number of non-fatal AMIs as a proportion of CHD events decreases markedly with age.

For persons who reached hospital alive, case-fatality was higher for women than men (crude rate of 19% compared with 12%), even after adjusting for age. The age gradient between the youngest and oldest age group was even steeper than for total case-fatality with rates increasing from 5% among 40–64 year-olds to 24% among 75–90 year-olds (Table 3.1).

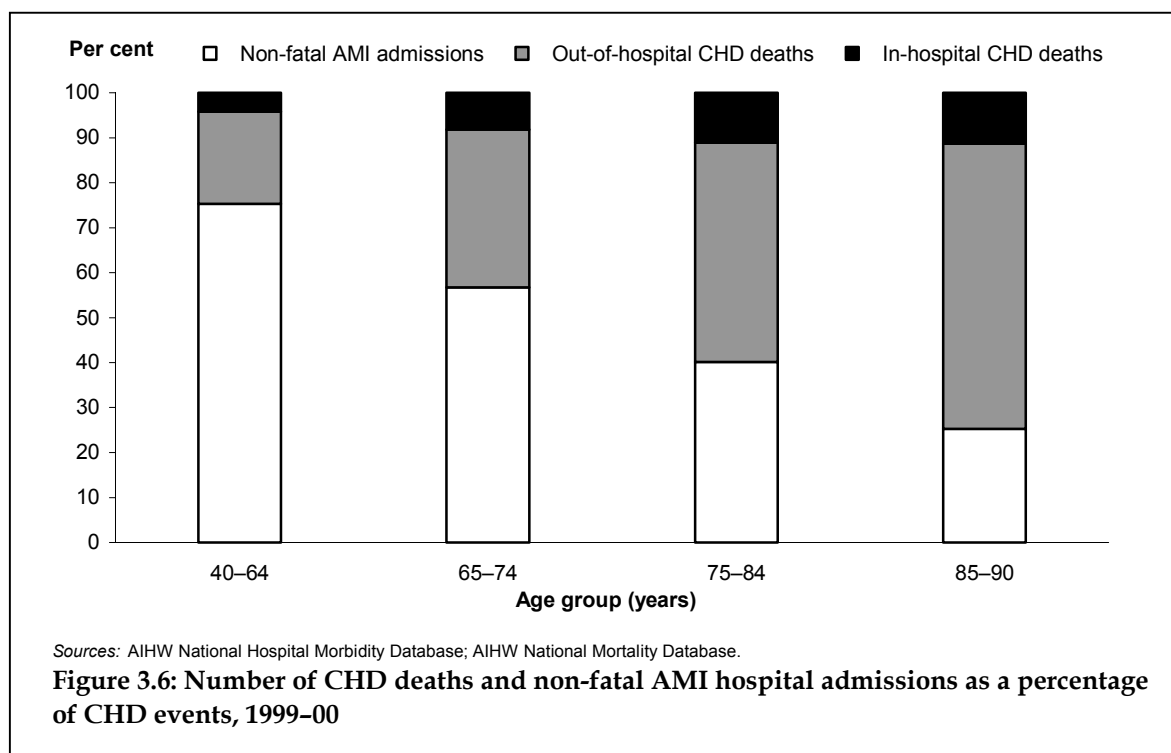
**Table 3.1: CHD case-fatality by age and sex, 1999–00**

Case-fatality by age group	Men	Women	Persons
<b>Per cent</b>			
<b>Total case-fatality</b>			
40–64	24.6	25.1	24.7
65–74	44.4	41.0	43.3
75–84	60.2	59.4	59.8
85–90	75.2	74.4	74.7
<b>40–90</b>	<b>45.3</b>	<b>54.8</b>	<b>48.9</b>
<b>Case-fatality for those admitted to hospital</b>			
40–64	4.8	7.3	5.3
65–74	11.5	14.6	12.6
75–84	21.1	22.4	21.7
85–90	32.8	29.9	31.0
<b>40–90</b>	<b>12.1</b>	<b>18.7</b>	<b>14.5</b>

### Notes

1. Total case-fatality is defined as the number of CHD deaths in the population divided by the sum of all CHD deaths and non-fatal hospital admissions for AMI.
2. In-hospital case-fatality is defined as number of CHD deaths occurring in hospital divided by the sum of CHD deaths in hospital and non-fatal hospital admissions for AMI.

Sources: AIHW National Hospital Morbidity Database; AIHW National Mortality Database.



### 3.5 Prevalence

Prevalence data are of interest as they are an important indicator of the burden of the disease in the community. In the 1995 National Health Survey, 2.8% of respondents reported that they had heart disease, which would translate to 506,461 Australians.<sup>1</sup>

#### Recent trends

Between 1989-90 and 1995 there has been no significant change in the prevalence rate of self-reported heart disease in Australia, with age-standardised rates around 3.1-3.3% for males and 2.1-2.3% for females. Over this 6-year period, however, the estimated number of people with self-reported heart disease increased from 450,175 to 506,461, with this increase in heart disease faster than the population growth over this period (12% compared with 7%). However, great caution should be exercised when interpreting these results. Self-reported data on diseases may be subject to misinterpretation by survey respondents and influenced by changing perceptions of heart disease over time.

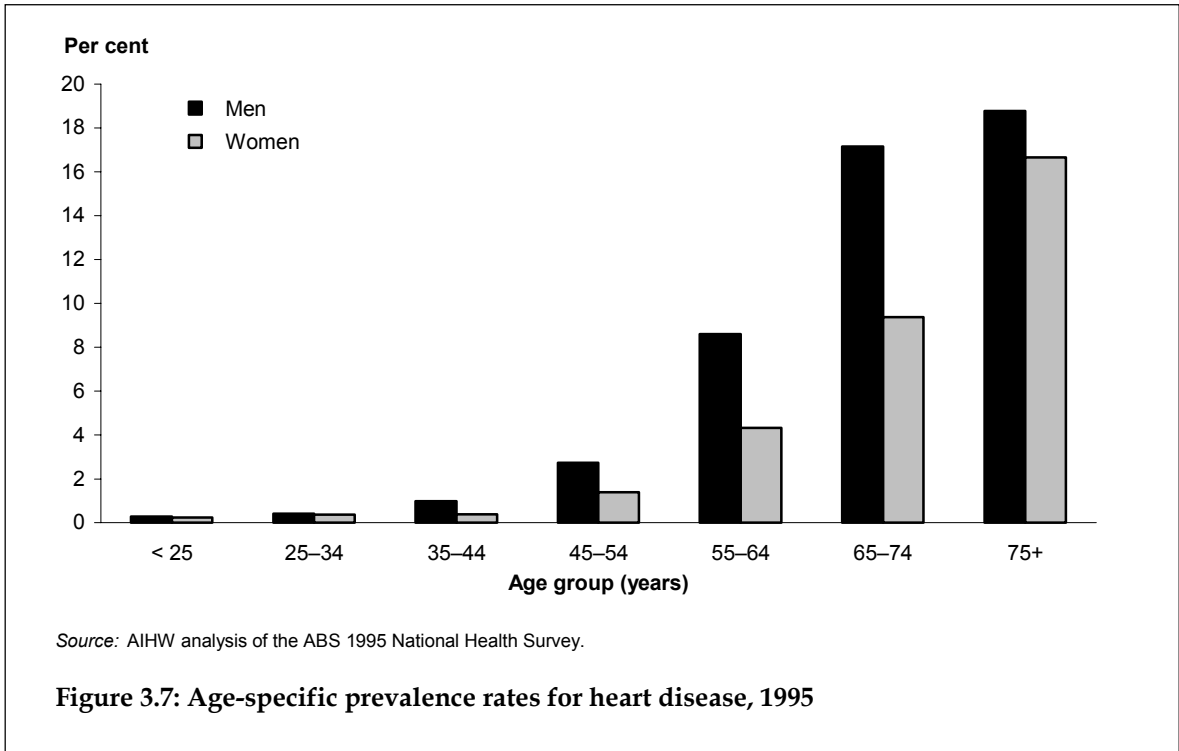
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1. See Chapter 2 for the definition of heart disease used in the National Health Survey.

### Sex and age

In 1995 more men than women reported that they had heart disease, with age-standardised rates suggesting that men were 1.6 times as likely to have heart disease as women (Figure 3.7).

The prevalence of self-reported heart disease increases rapidly with age, from less than 0.5% for people under 44 years of age to 6% for 55–64 year-olds and 17% for those aged 75 years and over (Figure 3.7). The positive age gradient and the sizeable difference between the youngest and oldest age group follow the same broad pattern as for CHD incidence and mortality.



### 3.6 Discussion

This chapter has highlighted the large declines in CHD incidence, mortality and case-fatality observed in Australia over the last decade. Incidence and mortality rates were also shown to be considerably higher among men than women and among older Australians.

#### Trends in incidence, mortality and case-fatality

Over the last decade age-adjusted incidence and mortality rates for CHD have been declining gradually each year, on average 3–5% per year among the population aged 40–90 years. Similar declines were also seen for case-fatality. There are a number of possible reasons for the declines in CHD incidence, mortality and case-fatality:

- reduced occurrence of heart attacks may be due to reduced overall levels of CHD risk factors, improved medical care for those at higher risk of heart attack, or both;
- reduced mortality from CHD may be due to the reduced occurrence of heart attacks, better survival of those who do have a heart attack, or both; and
- improved survival after a heart attack may be due to a change in the natural history of the disease, protective effects of drugs already being taken at the time of the event, better emergency care, better care after the emergency stage, or some combination of these factors.

The following chapters describe levels of risk factors and aspects of medical care. This may shed light on the possibilities suggested above. However, it should be noted that the decline in case-fatality indicates that better treatment and survival have contributed to the fall in mortality.

### **Sex and age**

CHD incidence and mortality rates among Australians aged 40–90 years are twice as high among men as women. The prevalence of self-reported heart disease is also considerably higher among men than women. Studies in the United States have indicated that women have an average of 10–15 years more CHD-free life expectancy than men due to a later onset of disease (Mark 2000). The data presented in this chapter have also shown that men tend to die or have CHD at a younger age than women, although this gap does not appear to be as large as in the United States and tends to vary with age.

While total case-fatality for CHD was similar for men and women, of those admitted to hospital for a coronary event women were more likely to die in hospital than men. This may be due to their condition being more severe on admission to hospital, resulting from their older age, or perhaps women tend to delay more in getting to hospital, which predisposes them to a fatal event. In addition, several studies have suggested that women have a higher risk of adverse outcomes than men after coronary interventions (Mehilli et al. 2000; Maynard et al. 1992).

Heart disease prevalence, and CHD incidence and mortality rates, are substantially higher among older Australians. Given the growing number of elderly Australians, this burden may become more acute over the next few decades. The age gradient in incidence rates between 40–64 year-olds and older Australians has remained consistent since 1993–94; however, for mortality the age gradient has become steeper since 1980. This can be attributed to the substantially larger falls in death rates among 40–64 year-olds compared with those aged 75 years and over.

# 4 Risk factors and drug treatment for coronary heart disease

## 4.1 Introduction

The reduction in the occurrence of heart attacks in Australia (shown in the previous chapter) may be due to reduced overall levels of CHD risk factors in the population and/or improved medical care for those at higher risk of heart attack. Reducing the levels of biomedical and behavioural risk factors, and improving the use of effective drug treatments has the potential to lead to large reductions in coronary event rates (McElduff et al. 2001).

This chapter explores these issues in detail by examining the major established risk factors for CHD, and drug treatment for people with higher risk factors and established CHD.

## 4.2 Risk factors for coronary heart disease

Given that CHD remains highly fatal despite major gains in treatment, prevention still offers the greatest scope for reducing mortality. The previous chapter highlighted that increasing age and being male are risk factors for CHD. Although these risk factors cannot be modified, there are biomedical and lifestyle and behavioural factors for CHD that can be modified – high blood cholesterol, high blood pressure, overweight and obesity, tobacco smoking, insufficient physical activity and dietary factors. Diabetes is also associated with a high risk of CHD as it shares several of the risk factors with, and is itself a risk factor for, CHD.

Although beyond the scope of this project, risk factors themselves are influenced by other factors such as people's economic resources, education, living and working conditions, social support, and access to healthcare and social services, as well as by psycho-social factors. This section briefly examines patterns and trends in the major modifiable risk factors for CHD (for further details see AIHW 2001 and AIHW 2002a).

### High blood cholesterol

In 1999–00, it was estimated that over six million Australians aged 25 years and over (around 50% of the population) had total blood cholesterol levels higher than 5.5 mmol/L; however, this is an arbitrary value and CHD risk actually increases continuously from very low cholesterol levels. Rates were similar among men and women. The prevalence of high blood cholesterol increases with age, to age 74 in women and 64 in men. Men aged 45–64 years and women aged 55–74 years were twice as likely to have high blood cholesterol levels as those aged 25–34 years. The age gradient is steeper for women than for men (Table 4.1). There has been no marked reduction in the prevalence of high blood cholesterol since 1980, when the first nationwide survey was run (Table 4.2).



## High blood pressure

In 1999–00, 29% or 3.6 million Australians aged 25 years and over had high blood pressure ( $\geq 140/90$  mm Hg) or were on medication for that condition. There was no significant difference in the proportion of men and women aged 25 years and over with high blood pressure (31% of men and 26% of women). The prevalence of high blood pressure increases with age, from less than 8% among 25–34 year-olds to over 70% among those aged 65 years and over. The age gradient is steeper for women than for men (Table 4.1). There have been significant declines in the proportion of people with high blood pressure and/or receiving treatment since the 1980s, with rates halving over this period among urban adults aged 25–64 years (Table 4.2). Average blood pressure levels have also declined over this period. At a population level, this decline has occurred among those not on medication for high blood pressure as well as among those on treatment. The reason for these findings is not certain but they are consistent with the greater availability of low-salt products in the food supply (AIHW 2002a).

**Table 4.1: Risk factor prevalence rates by age and sex, 1999–2001**

	18–24	25–34	35–44	45–54	55–64	65–74	75+	25+ <sup>(a)</sup>
	<b>Per cent</b>							
<b>Men</b>								
Tobacco smoking <sup>(b)</sup>	24.5	29.0	26.7	22.0	15.2	11.0	4.8	21.4 <sup>(c)</sup>
Insufficient physical activity <sup>(d)</sup>	18.1	46.7	44.5	47.6	50.1	45.8	—	42.0 <sup>(e)</sup>
High blood pressure <sup>(f)</sup>	—	7.9	16.2	30.5	46.5	69.7	75.1	30.7
High blood cholesterol <sup>(g)</sup>	—	31.0	54.2	60.7	61.8	54.1	49.2	49.9
Overweight or obese <sup>(h)</sup>	—	60.2	65.5	72.5	74.0	73.7	64.3	67.3
Obesity <sup>(i)</sup>	—	16.7	18.7	20.9	26.3	20.2	11.7	19.2
<b>Women</b>								
Tobacco smoking <sup>(b)</sup>	23.7	23.8	23.8	17.5	13.5	6.6	4.4	18.3 <sup>(c)</sup>
Insufficient physical activity <sup>(d)</sup>	32.4	40.1	46.3	52.0	46.9	46.1	—	43.5 <sup>(e)</sup>
High blood pressure <sup>(f)</sup>	—	4.1	7.9	22.8	42.3	66.7	77.2	25.6
High blood cholesterol <sup>(g)</sup>	—	30.1	39.8	54.7	71.6	74.0	65.2	49.7
Overweight or obese <sup>(h)</sup>	—	35.8	45.6	58.1	67.2	70.7	56.4	51.7
Obesity <sup>(i)</sup>	—	11.9	20.9	26.1	31.6	31.0	17.2	21.8

(a) Age-standardised to the 1991 Australian population aged 25 years and over.

(b) The daily smoking of tobacco products, including packet cigarettes, roll-your-own cigarettes, pipes and cigars. Data are for 2001.

(c) Data for ages 18 years and over.

(d) Insufficient physical activity is defined as less than 150 minutes of physical activity for recreation or exercise (including walking for transport) in the previous week.

(e) Data for ages 18–75 years.

(f) High blood pressure is defined as  $\geq 140/90$  mm Hg or receiving medication for high blood pressure.

(g) High blood cholesterol is defined as  $\geq 5.5$  mmol/L.

(h) Overweight or obese is defined as body mass index (BMI)  $\geq 25$ .

(i) Obesity is defined as body mass index (BMI)  $\geq 30$ .

Sources: AIHW analysis of the 1999–2000 AusDiab; 2001 National Drug Strategy Household Survey; 2000 National Physical Activity Survey.

**Table 4.2: Risk factor prevalence rates among urban adults aged 25–64 years, 1980 to 1999–00**

	1980	1983	1989	1995	1999–00
	Per cent				
<b>Men</b>					
High blood pressure	45.3	34.8	33.1	26.3	22.3
High blood cholesterol	49.5	51.6	50.9	n.a.	47.4
Overweight or obese	47.5	48.2	52.5	66.3	64.4
Obesity	9.1	8.5	9.9	19.8	19.2
<b>Women</b>					
High blood pressure	29.4	23.0	21.0	16.0	15.6
High blood cholesterol	40.9	48.1	42.8	n.a.	43.8
Overweight or obese	26.1	31.0	35.5	45.9	44.0
Obesity	7.6	10.0	11.8	19.2	21.8

n.a. = not available.

*Notes*

1. Rates have been age-standardised to the 1991 Australian population aged 25–64 years.
2. High blood pressure is defined as  $\geq 140/90$  mm Hg or receiving medication for high blood pressure.
3. High blood cholesterol is defined as  $\geq 5.5$  mmol/L.
4. Overweight or obese is defined as body mass index (BMI)  $\geq 25$ .
5. Obese is defined as body mass index (BMI)  $\geq 30$ .

Sources: AIHW analysis of the 1980, 1983, 1989 Risk Factor Prevalence Studies; 1995 National Nutrition Survey; 1999–2000 AusDiab.

## Overweight and obesity

In 1999–00, an estimated 7.5 million Australians aged 25 years and over were overweight or obese (60%), and of these over 2.6 million (21% of the population aged 25 years and over) were obese.<sup>2</sup> Men aged 25 years and over were more likely to be overweight or obese than women of the same age (67% compared with 52%). The proportion of overweight or obese people increased with age and peaked at 55–74 years for men (74%) and 65–74 years for women (71%) (Table 4.1). The age gradient for women is steeper than for men. The prevalence of overweight and obesity has increased significantly over the last two decades by 36% among men and 69% among women aged 25–64 years living in urban areas (Table 4.2). The increase has been even greater among obese Australians, with prevalence rates more than doubling over this 20-year period.

## Tobacco smoking

In 2001, one in five Australians aged 14 years and over smoked regularly (3.1 million adults). Men aged 18 years and over were more likely to smoke regularly than women of the same age (21% and 18% respectively). Regular smoking declines with age, with the highest rates occurring among 25–34 year-olds (29% for men and 24% for women) and rates falling to less than 5% for those aged 75 years and over (Table 4.1). Smoking rates have been declining

2. The body mass index (BMI) is the measure used to estimate the prevalence of overweight or obesity in the population and is calculated by weight (kg) divided by height squared (m<sup>2</sup>). A BMI of 25 or greater indicates overweight, and 30 or greater indicates obesity.

since the 1950s, when it was estimated that around 70% of men and 30% of women smoked. Since 1985, smoking rates have continued to decline and in 2001 they fell below 20% for the first time (AIHW 2002a).

### **Insufficient physical activity**

In 2000, around 5.7 million Australians aged 18–75 years (42% of men and 44% of women) had insufficient levels of physical activity, meaning that they were not active enough to achieve health benefits (Table 4.1). Rates of physical inactivity were highest among 45–64 year-olds (around 50%) and lowest among 18–24 year-olds (18% for men and 32% for women) (Table 4.1). More than 15% of people reported no leisure-time physical activity at all during the previous week and around 28% did some activity, but not enough to achieve a sufficient level to obtain health benefits (AIHW 2002a). During the 1980s and much of the 1990s there was little change in physical activity patterns. However, between 1997 and 2000, rates of physical inactivity among Australians increased significantly from 38% in 1997 to around 43% in 1999 and 2000 (Bauman et al. 2001).

### **Diabetes**

In 1999–00, an estimated 938,700 Australians aged 25 years and over had diabetes (7.5% of the population). About half of these people were not aware that they had diabetes. An additional 11% had evidence of impaired glucose tolerance (a metabolic stage between normal glucose tolerance and diabetes). In 1999–00 there were 336,976 hospitalisations for diabetes (almost 6% of all hospitalisations) and diabetes accounted for 10,130 deaths in 2000. Males were more likely to be hospitalised and die from diabetes than women. Diabetes prevalence, morbidity and mortality increases markedly with age. There are no national data on trends in the prevalence of diabetes in Australia based on measurements. However, results from the 1981 Busselton Population Survey and the 1999–2000 AusDiab study suggests that the prevalence rate of diabetes in Australia may have doubled over the 20-year period (AIHW 2002b).

### **Higher risk factor levels among certain Australians**

Socioeconomic and cultural factors largely influence the health of individuals and populations, and while these factors are beyond the scope of this project they deserve a brief mention. Aboriginal and Torres Strait Islander Australians and people who are at a socioeconomic disadvantage have much poorer risk factor profiles than other Australians. Aboriginal and Torres Strait Islander peoples are far more likely to smoke tobacco, be physically inactive, be obese, have high blood pressure (in the Kimberley region) and have Type 2 diabetes than other Australians (AIHW 2001). People from lower socioeconomic backgrounds are also more likely to smoke tobacco, be physical inactive, be overweight or obese (women only), and have Type 2 diabetes compared with those from higher socioeconomic groups (AIHW 2002a). Multiple risk factors are also often associated with lower socioeconomic status.

### **Multiple risk factors**

In 1995, over 10 million Australians aged 18 years and over, or 81% of the adult population, had at least one major modifiable risk factor (i.e. tobacco smoking, high blood pressure, overweight and obesity, or physical inactivity). Around 43% of adults had two or more of

these risk factors and 13% had three or more (Table 4.3). The risk of CHD rises progressively with the number of risk factors present.

**Table 4.3: Age-specific rates by number of risk factors present, 1995**

Age group (years)	Men			Women		
	1+	2+	3+	1+	2+	3+
	Per cent					
18–24	71.5	30.4	5.5	63.4	21.7	3.1
25–34	81.3	39.5	12.2	67.8	24.5	4.8
35–44	85.6	47.6	15.4	72.0	30.0	7.3
45–54	90.9	53.9	19.5	78.8	41.0	11.8
55–64	92.7	65.9	23.4	86.9	53.1	14.6
65–74	92.9	65.5	18.7	88.5	59.1	20.8
75 and over	93.0	65.5	21.7	92.7	65.5	29.3
<b>18 and over</b>	<b>85.3</b>	<b>49.0</b>	<b>15.5</b>	<b>75.9</b>	<b>37.7</b>	<b>10.7</b>

Note: Risk factors include tobacco smoking, high blood pressure (140/90 mm Hg), overweight (BMI  $\geq$  25) and physical inactivity.

Source: AIHW analysis of the ABS 1995 National Nutrition Survey.

Men were generally more likely to have multiple risk factors than women, with this gender gap becoming steeper as the number of risk factors increase. For example, around half of men aged 18 years and over had two or more risk factors compared with 38% for women. The higher prevalence of multiple risk factors among men was observed across most age groups, except among those aged 65 years and over where women were more likely to have three or more risk factors than men (Table 4.3).

Multiple risk factors are far more prevalent among older Australians than younger Australians. For example, nearly two-thirds of people aged 75 years and over have at least two risk factors compared with 30% of men and 22% of women aged 18–24 years (Table 4.3).

Multiple risk factors are also linked with a condition known as the metabolic syndrome, which has not been addressed in this report. The metabolic syndrome is a clustering of inter-related risk factors including high cholesterol, high blood pressure and central obesity, with insulin resistance thought to be the underlying defect in this syndrome (AIHW 2002a).

### **Risk factors in people with heart disease**

Analysis from the 1995 National Health Survey indicates that Australians reporting heart disease were more likely to have one or more risk factors than those without heart disease (88% compared with 68% respectively) (Table 4.4).

However, when examining each of these risk factors specifically it is interesting to note that people reporting heart disease were less likely to smoke than those without heart disease (12% compared with 18%). On the other hand, being overweight or obese and having high blood pressure was far more prevalent among those with heart disease than those without (overweight: 47% compared with 30%; high blood pressure: 48% compared with 10%). Australians with heart disease were also more likely to be physically inactive than those without heart disease (58% compared with 52%) (Table 4.4).

**Table 4.4: Proportion of Australians with a risk factor by condition, 1995**

	Heart disease	No heart disease
	Per cent	
Smoking	11.9	17.8
Overweight	47.2	29.9
High blood pressure	48.3	9.6
Physically inactive	58.3	51.8
<b>Total with a risk factor</b>	<b>88.0</b>	<b>68.4</b>

Note: Overweight and high blood pressure is based on self-reported data.

Source: AIHW analysis of the ABS 1995 National Health Survey.

## 4.3 Drug treatment

While the substantial decline in CHD mortality and incidence can be partly attributed to declines in some of the major modifiable risk factors, other factors such as medication use also have an effect. Recent evidence from randomised controlled trials has shown that reducing cholesterol or reducing blood pressure will cause a reduction in coronary events (McElduff et al. 2001). There is a wide range of effective drugs to reduce the occurrence of atherosclerosis and high blood pressure – important factors in the prevention and treatment of people with CHD – and these will be discussed in this section. The data refer mainly to the use of prescription drugs in the community, although the use of aspirin and thrombolytics will also be briefly discussed.

The drugs presented in this section are prescribed not only for the purpose of lowering the levels of blood pressure and blood cholesterol but also for other purposes such as inhibiting and dissolving blood clots, and reducing the immediate and long-term damage done to the heart. As the indication for which the drug is prescribed is not recorded, it is not possible to determine the actual use of the drug for specific conditions or purposes.

Drug use in this report is expressed in terms of defined daily doses per 1,000 population per day (DDD/1,000/day). For further details see Chapter 2.

### Blood pressure lowering drugs

Although drugs in this class are grouped as ‘blood pressure lowering’, in general they have other important and useful effects, and are used to treat various conditions as well as high blood pressure.

#### ACE inhibitors

Angiotensin-converting enzyme (ACE) inhibitors are commonly prescribed to treat people with high blood pressure or heart failure. These drugs limit the progressive enlargement of the heart after a heart attack and relieve heart failure symptoms. If given early during a heart attack, they can reduce deaths (AIHW 2001). In 1998, ACE inhibitors were one of the most widely dispensed drugs for cardiovascular disease (66.2 DDD/1,000/day). Between 1990 and 1998, there was a threefold increase in the consumption of this drug, with the greatest increase occurring in the early 1990s (twofold increase between 1991 and 1994). Since then

the consumption of ACE inhibitors has increased steadily by around 27% (between 1995 and 1998) (Table 4.5).

In 1998, enalapril was the most widely used ACE inhibitor (19.1 DDD/1,000/day) (AIHW 2001).

Results from the MONICA study in Perth and Newcastle (see Chapter 2 for details) show that less than 19% of people aged 35–64 years were treated with ACE inhibitors before the coronary event, with this proportion increasing to around 32–37% during the admission for a coronary event in 1991–93 (Table 4.6). Treatment with ACE inhibitors after discharge was also estimated to be around 30–35% (AIHW: McElduff et al. 2000). Between 1985–87 and 1991–93 the use of ACE inhibitors increased markedly before and during the coronary event admission, with a more rapid growth in the use of this drug observed during the admission (Table 4.6).

### Beta blockers

Beta blockers are used to treat people with high blood pressure. They can also reduce pain and death in people with angina and a history of heart attacks, and prevent further heart attacks and stroke by lowering blood pressure. Between 1990 and 1998, the use of beta blockers was highest in 1990 but fell progressively to 1994 and has remained steady since then (Table 4.5). In a recent OECD study with 11 other countries, Australia was the only country where the prescription of beta blockers decreased (OECD 2002).

In 1998, atenolol was the most commonly used beta blocker (10.1 DDD/1,000/day) (AIHW 2001).

Results from the MONICA study estimate that around 20% and 18–25% of people aged 35–64 years in Perth and Newcastle respectively were treated with beta blockers before the coronary event, with this proportion increasing almost threefold during the coronary event in 1991–93 (Table 4.6). Treatment with beta blockers after discharge was estimated to be around 68–81% in Perth and 46–51% in Newcastle (AIHW: McElduff et al. 2000). In Perth, the use of beta blockers during the coronary event increased considerably between 1985–87 and 1991–93, while in Newcastle there was no significant increase over this period (Table 4.6).

**Table 4.5: Prescription drugs used in the community by defined daily dosage (DDD), 1990–98**

	1990	1991	1992	1993	1994	1995	1996	1997	1998
	<b>DDD per 1,000 population per day</b>								
ACE inhibitors	22.4	24.3	31.6	40.7	44.5	52.1	57.3	61.18	66.2
Beta blocking agents	29.0	24.2	24.2	23.1	21.5	21.6	21.4	21.2	21.3
Calcium channel blockers	24.3	26.1	30.4	33.3	35.5	40.5	44.2	47.1	46.5
Diuretics	89.3	68.7	68.4	64.6	61.0	60.0	58.6	56.8	56.2
Cholesterol and triglyceride lowering drugs	5.3	8.2	10.1	10.9	11.8	16.4	21.8	28.6	41.6
Antithrombotic agents	2.0	2.1	2.3	2.6	3.0	3.3	4.1	4.9	9.3
Antiplatelet drugs	0.5	0.6	0.5	0.4	0.5	0.6	0.9	1.4	5.5

#### Notes

1. No data available before 1990.
2. The Community Prescription Database combines the prescription estimates for the non-subsidised sector (under the general copayment and private prescriptions) from the Pharmacy Guild Survey with the actual counts of those prescription categories submitted to the Health Insurance Commission for payment of a subsidy.

Source: Community Prescription Database monitored by Drug Utilization Sub-committee, Commonwealth Department of Health and Ageing.

## Calcium channel blockers

Calcium channel blockers cause blood vessels to dilate and are therefore effective in reducing blood pressure and angina. The use of calcium channel blockers has increased steadily in the 1990s with usage levels almost doubling between 1990 and 1998 (24.3 DDD/1,000/day in 1990 to 46.5 DDD/1,000/day in 1998) (Table 4.5).

Amlodipine and felodipine were the most widely used calcium channel blockers in 1998 (13.9 and 11.9 DDD/1,000/day respectively) (AIHW 2001).

Results from the 1991–93 MONICA study suggest that around 17–24% and 24–28% of patients in Perth and Newcastle respectively were treated with calcium channel blockers before the coronary event, with this proportion doubling to around 40% during the coronary event (Table 4.6). After discharge the proportion of patients treated with calcium channel blockers was around 23–29% in Perth and 36–41% in Newcastle (AIHW: McElduff et al. 2000). Between 1985–87 and 1991–93 the use of calcium channel blockers during the coronary event increased in Newcastle but declined in Perth (Table 4.6).

## Diuretics

Diuretics are effective in reducing blood pressure. Diuretics also assist in the dilation of blood vessels and can be useful in the treatment of CHD. Diuretics are often used in combination with other drugs, usually ACE inhibitors. Although diuretics are still one of the most widely prescribed drugs for treating people with cardiovascular disease (56.2 DDD/1,000/day in 1998), their use has fallen substantially, by almost 40%, over the last decade. Between 1990 and 1991 the use of diuretics fell by around 23% and since then there has been a gradual decline in consumption between 1% and 6% per year (Table 4.5).

**Table 4.6: Drug treatment before and during the coronary event, among 35–64 year-olds, MONICA study, 1985–87 and 1991–93**

	Men				Women			
	Perth		Newcastle		Perth		Newcastle	
	1985–87	1991–93	1985–87	1991–93	1985–87	1991–93	1985–87	1991–93
	Per cent <sup>(a)</sup>							
<b>Before the coronary event</b>								
ACE inhibitors	1.5	10.2	3.1	18.1	2.6	18.6	5.3	15.1
Beta blocking agents	23.6	19.6	26.1	18.4	25.8	21.0	37.3	24.5
Calcium channel blockers	12.8	16.8	17.0	24.1	21.8	23.8	24.0	28.1
Diuretics	19.4	12.7	21.1	15.6	38.0	25.9	40.7	36.7
Aspirin <sup>(b)</sup>	7.3	19.7	12.0	21.0	9.3	15.5	10.0	19.1
<b>During the coronary event</b>								
ACE inhibitors	2.1	32.1	2.2	37.3	2.9	36.1	2.8	33.3
Beta blocking agents	59.6	78.3	45.1	53.3	49.3	66.0	39.9	47.3
Calcium channel blockers	53.2	38.0	21.1	39.5	58.1	41.2	22.1	42.6
Diuretics	43.6	34.2	36.9	32.4	56.1	46.8	40.5	48.2
Aspirin <sup>(b)</sup>	46.4	88.6	17.4	82.0	41.1	79.6	24.5	77.1

(a) Age-standardised using Australian MONICA populations.

(b) Data from 1985.

Source: AIHW: McElduff et al. 2000.

Frusemide was the most commonly prescribed diuretic in 1998 (22.6 DDD/1,000/day) (AIHW 2001).

Results from the 1991–93 MONICA study in Perth and Newcastle estimate that 13–26% and 16–37% respectively of patients aged 35–64 years were treated with diuretics before the coronary event, with this proportion increasing to 34–47% and 32–48% respectively during the coronary event (Table 4.6).

### **Cholesterol and triglyceride lowering drugs**

Cholesterol and triglyceride lowering drugs are effective in preventing CHD in individuals with a history of cardiovascular disease. The use of cholesterol and triglyceride lowering drugs has increased substantially, with an eightfold increase in use between 1990 and 1998 (5.3 DDD/1,000/day compared with 41.6 DDD/1,000/day) (Table 4.5). The increase in consumption has been particularly rapid in more recent years. In a recent comparative study with 11 other countries conducted by the OECD, Australia had the highest per capita consumption of lipid lowering drugs. An increase in drug use occurred in all countries, although the magnitudes of this increase varied somewhat (OECD 2002).

Statins (HMG CoA reductase inhibitors) are recognised as the most effective drug in reducing cholesterol, and their use has increased dramatically since 1994 when their effectiveness was established conclusively in clinical trials. Simvastatin is the most widely prescribed lipid lowering agent (22.0 DDD/1,000/day) in 1998, followed by atorvastatin (11.0 DDD/1,000/day) (AIHW 2001).

### **Antithrombotic drugs**

Antithrombotic drugs are used to prevent or treat blood clots and have been shown to be effective treatments for heart attacks. While discussion of these drugs may be more appropriate in the following chapter, which deals with medical treatment for people who have a heart attack, they have been included in this chapter for ease of reference.

The prescription of antithrombotic agents in the community has increased markedly over the last decade, with usage levels more than quadrupling between 1990 and 1998 (2.0 DDD/1,000/day in 1990 compared with 9.3 DDD/1,000/day in 1998) (Table 4.5).

#### **Aspirin and other antiplatelet agents**

Antiplatelet drugs, such as aspirin, ticlopidine and dipyridamole, interfere with the formation of blood clots. If given during a heart attack, aspirin reduces the risk of death, and if used long-term it reduces deaths and heart attacks among people with CHD. Between 1990 and 1995 the use of antiplatelet drugs remained relatively stable but it rose between 1995 and 1998, with the greatest rise in the last year (Table 4.5).

In 1998, the consumption of aspirin on prescription was 5.4 DDD/1,000/day. This is an underestimate of the overall consumption of aspirin in Australia as it excludes over-the-counter supply. Unfortunately, limited up-to-date data exist on the use of aspirin in Australia. Results from the MONICA study in Perth and Newcastle have shown, however, that over 80% of CHD patients who were discharged from hospital were being treated with aspirin, compared with around 19% of patients being treated with aspirin before the coronary event in 1991–93 (AIHW: McElduff et al. 2000).

Results from the MONICA study in Perth and Newcastle show a rapid increase in the use of aspirin among patients who were treated in hospital for a coronary event, with the proportion of such patients in Perth increasing from 41–46% in 1985 to 80–89%



in 1991–93. In Newcastle the use of aspirin increased from 17–25% to 77–82% over this period (Table 4.6). Furthermore, results from the MONICA study in Newcastle has shown that between 1983 and 1994 there was a substantial increase in the daily use of aspirin in the general population among men aged 35–64 years (2.5-fold increase), while among women there was no significant increase over this period (AIHW: McElduff et al. 2000).

### **Thrombolytic drugs**

Thrombolytic drugs dissolve the blood clot responsible for the heart attack and are used to restore blood flow to the affected heart muscle to prevent or reduce the death of the muscle. For best results, these drugs must be given early during the heart attack, within 6–12 hours of onset. Unlike the other drugs mentioned in this section, these drugs are only given in hospital under close supervision. The traditional drugs of choice have been streptokinase and urokinase, and more recently tissue plasminogen activator (tPA) has been used. Thrombolytic therapy is often a first-line treatment for AMI as there is greater access for patients (the hospital does not need to be equipped with a cardiac catheterisation laboratory), shorter treatment times and ease of use for the physician.

Unfortunately, Australia does not have any national data on the use of thrombolytic therapy. However, data from the MONICA study suggest that among 35–64 year-olds, an estimated 43–46% and 37–43% of people suffering a heart attack in Perth and Newcastle respectively were treated with thrombolytics in 1991–93, a 5% increase per year since 1985 (AIHW: McElduff et al. 2000).

## **4.4 Discussion**

This chapter has highlighted that over the last two decades there have been large improvements in the levels of some established risk factors for CHD, and substantial increases in the use of lipid lowering and other effective drugs such as ACE inhibitors. These factors would have largely contributed to the falls in heart attack rates that have occurred in Australia in past decades. A recent Australian study has indicated that aggressive medical treatment of people with elevated risk factors and established CHD could reduce the number of coronary events by 40%. The study estimates that 14,000 coronary events could be avoided each year if the average level of cholesterol in the population was reduced by 0.5 mmol/L, smoking prevalence halved, prevalence of physical inactivity reduced to 25% and the use of aspirin in people with established CHD was increased (McElduff et al. 2001).

### **Risk factors**

Most Australians have at least one major modifiable risk factor for CHD (tobacco smoking, high blood pressure, overweight and obesity, or physical inactivity), and four in ten have at least two of these risk factors. Recent evidence suggests high blood cholesterol, high blood pressure and cigarette smoking explain about 75% of the occurrence of CHD in the population (Magnus & Beaglehole 2001; Stamler et al. 1999).

The analysis presented in this chapter also shows that people reporting heart disease have a higher prevalence of certain risk factors (such as overweight and obesity, high blood pressure and physical inactivity) than those without heart disease. While tobacco smoking increases the risk of CHD death, analysis from the National Health Survey indicates that people with heart disease are less likely to smoke than those without heart disease, suggesting that the strong advice from doctors and other health professionals to quit

smoking is having an effect. However, a major limitation with the risk factor analysis presented in this chapter is that the cross-sectional nature of the study does not allow for any assessment of cause and effect.

### **Trends and their effects on coronary heart disease levels**

There is a mixed pattern of trends in the levels of major risk factors. Tobacco smoking and blood pressure levels have declined, blood cholesterol levels appear unchanged and levels of physical inactivity, body weight and diabetes have increased, the last two markedly. It appears that the favourable changes have been sufficient to outweigh the unfavourable changes, given the fall in CHD incidence noted. Estimates vary about the contribution of risk factor trends to the fall in CHD mortality. Hunink and others (1997) estimated that most of the decline in CHD mortality in the United States between 1980 and 1990 was explained by improvements in the management of CHD patients through risk factor reduction and improvements in treatment. However, Dobson and others (1999) estimated that the fall in major coronary events in the Hunter region of Australia between 1985 and 1993 could be fully explained by reductions in risk factors and increased use of aspirin.

### **Sex and age**

Men are at a greater risk of CHD than women and the higher prevalence of modifiable risk factors among men supports this pattern. Men are more likely to have multiple risk factors and are more likely to smoke tobacco, be physically inactive, be overweight or obese and have diabetes than women are. Similar proportions of men and women had high blood pressure and high blood cholesterol.

Advanced age is also a risk factor for CHD, as reflected in the higher prevalence of most of these risk factors among the elderly. The prevalence of multiple risk factors and physical inactivity, high blood pressure, high blood cholesterol, overweight and obesity, and diabetes increases markedly with age up to age 65–74 years. Smoking rates, however, decline with age.

### **Drug treatment**

Between 1990 and 1998 there were substantial increases in the use of lipid lowering drugs, and blood pressure lowering drugs such ACE inhibitors and calcium channel blockers. The use of diuretics and beta blockers declined over this period, perhaps because these drugs are relatively old and established drugs and more modern drugs, such as ACE inhibitors and calcium channel blockers are becoming increasingly popular for treating high blood pressure.

Between 1991 and 1998 there was a 23% increase in the use of drugs for treating high blood pressure in Australia. This may have contributed to the observed decline in the prevalence of high blood pressure among Australian adults aged 25–64 years (around 30% decline between 1989 and 1999–00). However, over this period there has also been a substantial reduction in average blood pressure levels among those not on medication for high blood pressure as well as those on treatment (AIHW 2001). For high blood pressure to be managed, lifestyle modifications are essential and can successfully diminish or eliminate the need for blood pressure lowering drugs (NHF 1999).

Although there have been substantial increases in the prescription of cholesterol and triglyceride lowering drugs between 1990 and 1998 (eightfold increase), data from national surveys suggest that there has been no reduction in the prevalence of high blood cholesterol or in average blood cholesterol levels in Australia between 1989 and 1999–00.

While current patterns in the use of aspirin in the general population are not known, data from the MONICA study suggest that the use of aspirin in the general community increased substantially between 1984 and 1993 (for men aged 35–64 years). The use of aspirin for treating CHD patients in hospital also increased rapidly over this period. Results from the International Study of Infarct Size (ISIS-2 study), released in the late 1980s, demonstrated that aspirin reduces mortality following a heart attack and this knowledge has been a significant factor in the increased use of aspirin and other antiplatelets during this period.

# 5 Admissions and in-hospital treatment for acute myocardial infarction

## 5.1 Introduction

The previous two chapters highlighted the progress made in reducing CHD in the community, and described some clinical measures aimed at improving the risk factor profiles of Australians. Improvements in heart attack survival rates (as shown in Chapter 3) also suggest that medical and surgical treatment for heart attacks is becoming increasingly effective. A recent Australian study argues that for people with established CHD significant reductions in coronary events can be achieved by increasing the use of revascularisation procedures such as PCI and CABG (McElduff et al. 2001). These procedures are very effective for relieving angina and are increasingly being used in patients with AMI, although presently still at a low level. Many factors, such as the severity of the disease, risk factor profile, age and other medical conditions, will influence the choice of procedure in a given patient.

There are two main first-line strategies to restore coronary blood flow during the acute stage of a heart attack: thrombolytic therapy or PCI. Further treatment is often needed to reduce complications and the risk of recurrent attack. This could involve PCI (if not used acutely) or CABG. Diagnostic techniques such as cardiac catheterisation are necessary before either of these procedures can be performed.

This chapter examines these procedures in detail and is divided into three sections:

- hospital admissions for AMI
- acute cardiac procedures
- outcomes of acute care interventions.

The acute cardiac procedures examined in this chapter are cardiac catheterisation, PCI and CABG. Although the benefits of thrombolytic therapy during the acute stage of a heart attack have been well documented, no national data on this treatment are available in Australia. The previous chapter briefly discussed the use of thrombolytic therapy in Perth and Newcastle.

Information on cardiac procedures in this report relates mostly to AMI treatment because of the difficulties in counting the number of people admitted to hospital for angina (see Chapter 2 for further details).

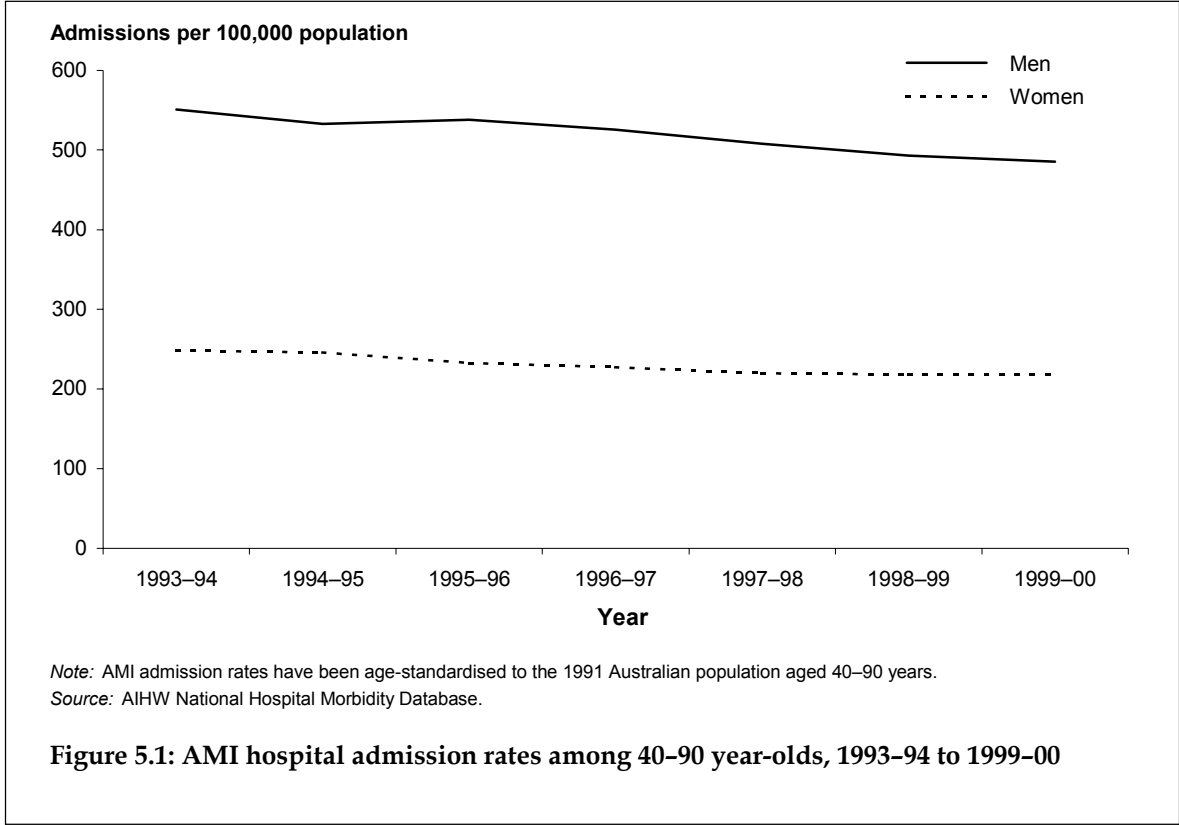
# 5.2 Hospital admissions for acute myocardial infarction

Data on hospital admissions for AMI are a useful indicator as they may reflect the incidence of AMI as well as both the demand and supply of acute healthcare services for AMI. In 1999–00, among 40–90 year-olds there were 28,002 hospital admissions where AMI was the principal diagnosis and length of stay was greater than 2 days or the patient died within 2 days of admission (17,986 men and 10,016 women). This equates to an admission rate of 351 per 100,000 population aged 40–90 years.

## Recent trends

Between 1993–94 and 1999–00 there was a 12% decline in the age-standardised rate of AMI admissions for men and women aged 40–90 years, representing a decline of almost 2% per year (Figure 5.1). This corresponds reasonably well with the decline of about 20% in incidence which occurred over this period. The decline in AMI admission rates occurred in most age groups, with the slowest declines among those aged 75–90 years (5–6%) (Appendix Table A4). Australia, together with the Nordic countries, has experienced the largest declines in AMI admission rates over the last decade, with the majority of OECD countries experiencing relatively stable AMI admission rates over this period (OECD 2002).

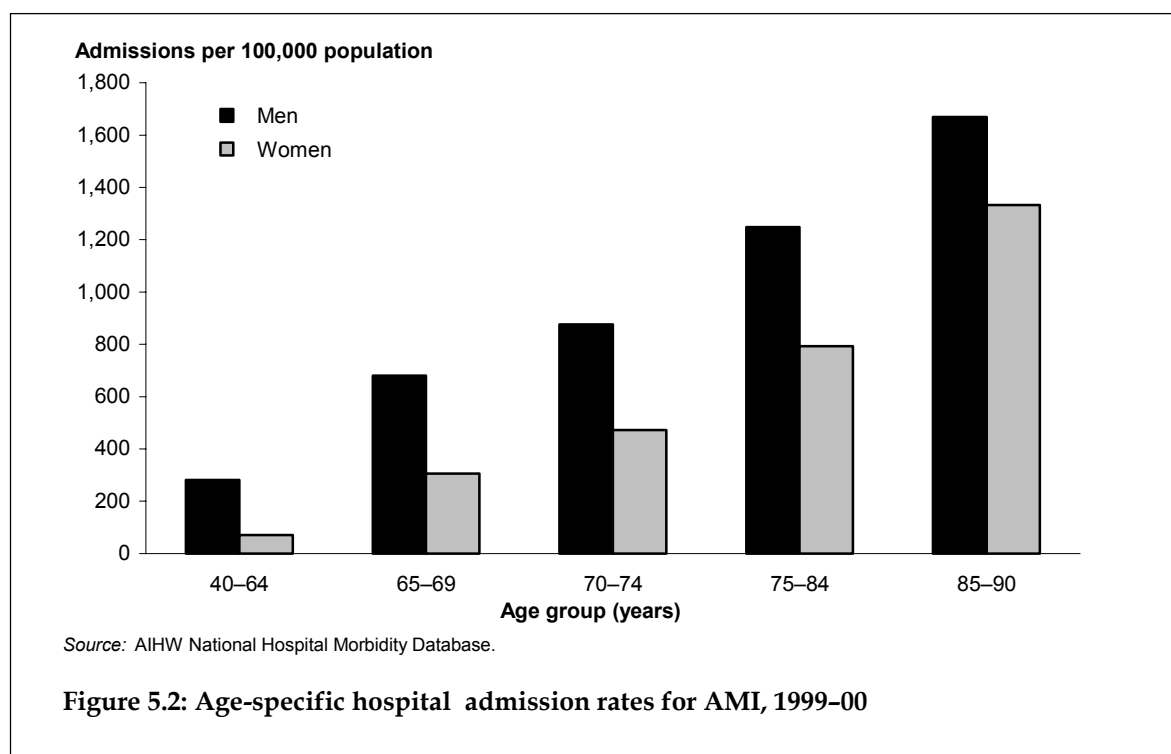
While AMI admission rates have been falling over the last decade in Australia, the absolute number of AMI admissions has remained relatively stable due to the increasing average age and overall growth of the population. In 1993–94 there were 27,213 AMI hospital admissions among 40–90 year-olds compared with 28,002 in 1999–00.



## Sex and age

Men were twice as likely to be admitted to hospital for an AMI than women in 1999–00 (based on age-standardised rates), consistent with their greater risk of suffering a heart attack. The crude AMI admission rate for men aged 40–90 years was 464 per 100,000 population compared with 244 per 100,000 population among women. Among 40–90 year-olds AMI admission rates were higher for men than women across all age groups (Figure 5.2). This difference in admission rates between men and women has remained consistent since 1993–94 (Appendix Table A4).

The average age for AMI hospital admissions was 65 years for men and 74 years for women.<sup>3</sup> Nearly all hospital admissions for AMI occurred among 40–90 year-olds (98%), with almost two-thirds of these aged 65–90 years. AMI admission rates increase markedly with age, consistent with the association between age and incidence. Admission rates for men aged 75–90 years were almost five times those for 40–64 year-olds, with the age gap in admission rates even greater for women (Figure 5.2).



3. Includes all persons, including those aged greater than 90.

## 5.3 Acute cardiac procedures

This section provides information on several cardiac procedures, with a special focus on their use in the acute case of those admitted to hospital for AMI. The procedures covered are cardiac catheterisation, PCI and CABG. Revascularisation procedures, such as PCI and CABG, are important treatment options following a heart attack. Not all patients are appropriate candidates, due to the higher risks associated with surgery for people whose heart muscle was damaged by a heart attack. However, revascularisation may be performed on AMI patients for whom other therapies are not suitable.

Thrombolytic therapy is often a first-line strategy during the acute stage of a heart attack, but as national data are not collected on thrombolytic use they cannot be included. Also for reasons already discussed in Chapter 2, it is not possible to provide clear information on the use of procedures specifically for patients admitted to hospital for angina.

In this section of the report the term 'AMI patients' has commonly been used. This refers to admissions with a principal diagnosis of AMI and length of stay greater than 2 days, and includes those that died within 2 days of admission (for further details see Chapter 2). Furthermore, the analysis includes only those admissions in the acute stage of the heart attack (i.e. the first occurrence of the heart attack during the observation period), which are referred to as acute hospital admissions. Readmissions for the same coronary event are not included in the national analysis, due to data limitations.

### General patterns

In 1999-00, 30% of those admitted to hospital for AMI aged 40-90 years (8,317 patients) received either cardiac catheterisation, PCI or CABG. Another third had a variety of services but none of those cardiac procedures, and a further third had no hospital procedures, diagnostic/imaging services or allied health interventions. The National Hospital Morbidity Database does not collect information on thrombolytics or other pharmacological treatment, which may account for the high proportion of AMI patients with no procedures or interventions recorded.

### Cardiac catheterisation

Cardiac catheterisation, a minimally invasive diagnostic procedure, is used to identify the location of any coronary blockages by the insertion of a catheter into the bloodstream, threading it back to reach the heart and the coronary arteries, then releasing a dye that outlines the arteries under X-ray. In 1999, there were 57 interventional cardiology laboratories in Australia that performed cardiac catheterisation, with all of these located in acute care hospitals in urban areas.

### Aggregate trends in cardiac catheterisation use

In 1999-00, there were 76,125 cardiac catheterisations performed in Australia, an increase from 1993-94 where 55,199 cardiac catheterisations were performed (22% increase based on age-standardised rates). A recent study conducted by the OECD has shown that Australia, together with Germany and Belgium, has the highest overall levels of cardiac catheterisation

procedures among 40–90 year-olds, with these countries performing around five times the number of cardiac catheterisations per capita as Greece, Canada and Italy (OECD 2002).

While the overall use of cardiac catheterisations in Australia has been increasing steadily between 1993–94 and 1997–98, in more recent years there has been a slight decline. This decline coincides with a change in statistical coding practice (i.e. moving from ICD-9-CM to ICD-10-AM), and disappears when cardiac catheterisations are examined among AMI patients only (Appendix Table A5).

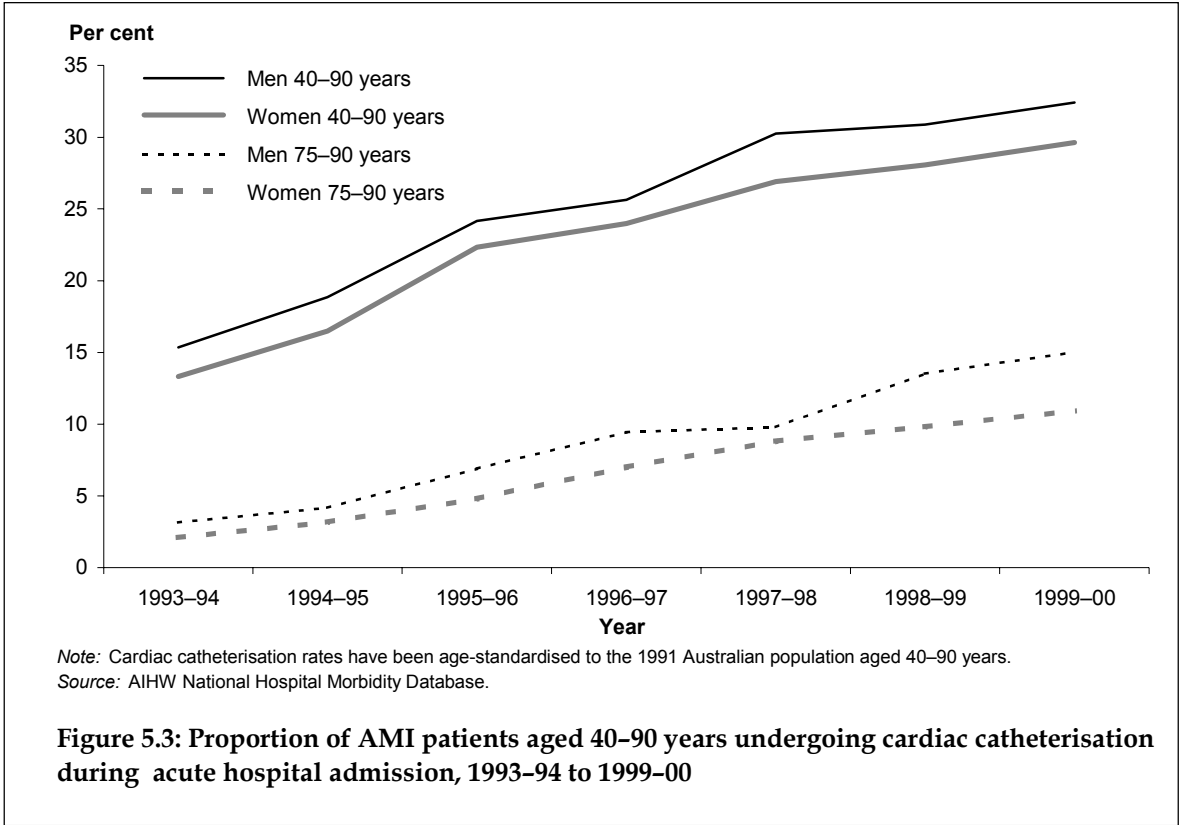
**Cardiac catheterisation use during acute admission for acute myocardial infarction**

In 1999–00, almost a quarter of AMI patients aged 40–90 years (6,822 patients) underwent a cardiac catheterisation during acute hospital admission (Appendix Table A6).

**Recent trends**

Cardiac catheterisation use during acute hospital admission for AMI patients aged 40–90 years has been increasing rapidly over the last decade, with age-standardised rates doubling between 1993–94 and 1999–00 (Figure 5.3). The proportion of AMI patients aged 40–90 years undergoing cardiac catheterisation during acute admission has increased from a crude rate of 11% to 24% over this period, representing an increase in the number of cardiac catheterisations from 2,902 in 1993–94 to 6,822 in 1999–00.

While the use of cardiac catheterisations during acute admission declines with age, there has still been substantial increases in the use of this procedure among AMI patients aged 75–90 years (Figure 5.3).



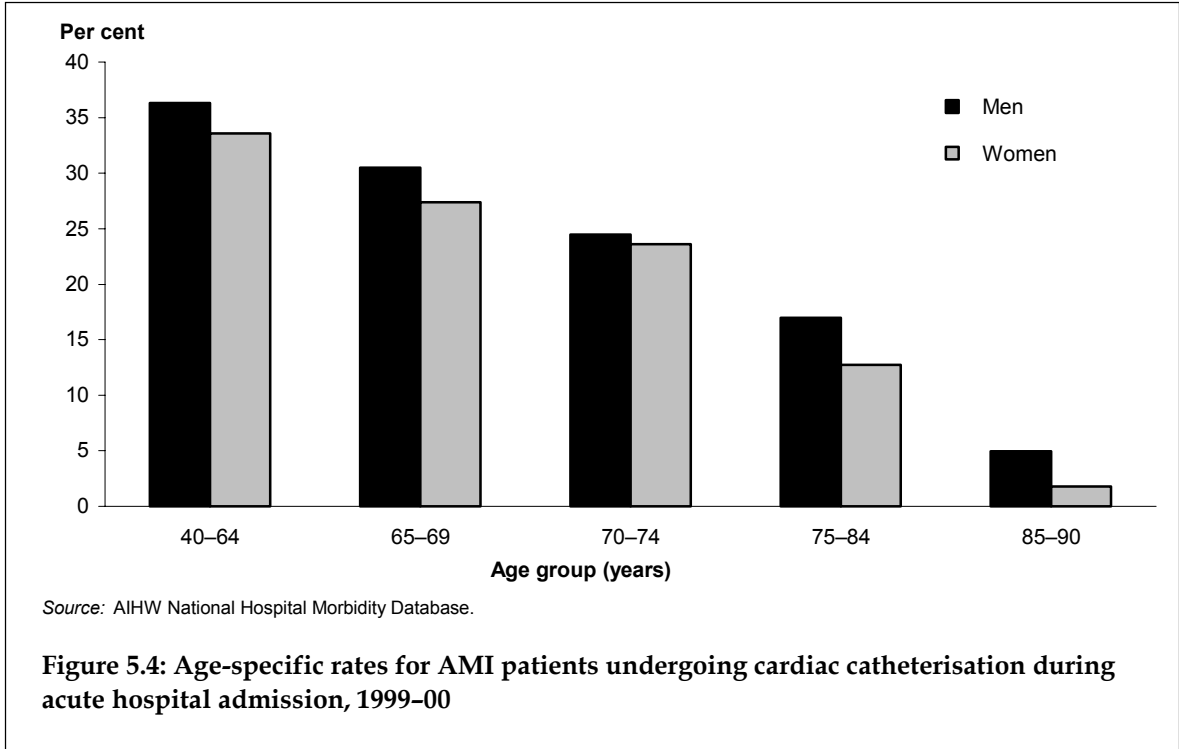


**Sex and age**

In 1999-00, men aged 40-90 years admitted to hospital for an AMI were more likely to undergo a cardiac catheterisation during acute admission than women of the same age, with 28% of men and 18% of women undergoing this procedure (based on crude rates). Among 40-90 year-olds, cardiac catheterisation rates were higher for men than for women in all age groups, with the gender gap increasing with age (Figure 5.4 and Appendix Table A6).

Patient-based data from Perth indicate that the use of cardiac catheterisations among AMI patients during acute hospital admission in Perth is even greater than the national crude rates, being 45% for men and 33% for women aged 40-84 years in 1997. The proportion of Perth AMI patients receiving this procedure within 90 days from acute admission increased considerably to 61% of men and 41% of women aged 40-84 years (Appendix Table A7).

Nationally, the average age of AMI patients undergoing cardiac catheterisation during acute admission was 62 years for men and 67 years for women in 1999-00. Cardiac catheterisation use among AMI patients declined with advanced age, with men and women aged 40-64 years three times as likely to have a cardiac catheterisation than those aged 75-90 years. Cardiac catheterisation was performed on 3% of AMI patients aged 85-90 years compared with 36% of 40-64 year-olds (Figure 5.4).



## Percutaneous coronary intervention

Percutaneous coronary intervention (PCI) is a newer term used to encompass all forms of percutaneous revascularisation, including percutaneous transluminal coronary angioplasty (PTCA) and coronary stenting. PTCA involves inserting a catheter with a balloon into a narrowed coronary artery. The catheter is first inserted into a leg or arm artery via the skin (percutaneous) and then is threaded through the vessel back towards the heart and into the coronary arteries to the area of vessel blockage. The balloon is then inflated against the blocked area to create a wider passage for blood flow. PTCA is used for discrete obstructions in patients with both single- and multi-vessel blockages.

PTCA is used mainly to treat patients with angina and is increasingly being used in the acute AMI setting (in which case it is referred to as primary PTCA). According to the National Angioplasty Register, in 1999 the main uses of PTCA were for stable angina (42% of cases), unstable angina<sup>4</sup> (42% of cases) and AMI (9% of cases). Furthermore, 13% of PTCA procedures were done on patients with previous CABG, and thrombolytic therapy was used before PTCA in 11% of procedures. In 1999, one in five PTCA procedures were repeats, and in 45% of such cases these repeats occurred within 12 months (AIHW: Davies & Senes 2002).

Although success rates for initial PTCA are high, there is a risk of early acute closure of the coronary artery and a high rate of recurrence of obstruction (restenosis). This led to the development of other catheter-based techniques, with coronary stenting being the most successful because it is associated with lower rates of restenosis as compared with PTCA alone. Coronary stenting involves expanding a metal mesh tube within the artery to form a supporting structure to hold the artery open at the point where narrowing occurs.

The capacity to perform PCI depends on the number of catheterisation laboratories available. According to the National Angioplasty Register there were 122 PCI cardiologists in the 57 interventional cardiology units throughout Australia in 1999, an increase of 14% and 24%, respectively, from 1998 (AIHW: Davies & Senes 2002). This compares with 579 practising cardiologists reported in the Medical Labour Force Survey in 1998 (AIHW 2000).

### Aggregate trends in PCI use

In 1999, there were 19,444 PCIs performed in Australia, an increase of 7% from 1998. In 1980 when this procedure was first introduced there were 11 PCIs performed in Australia. A recent study conducted by the OECD has shown that Australia has one of the highest levels of PCI use per capita, exceeded only by the United States, Germany and Belgium (300–400 PCIs per 100,000 population aged 40–90 years). Australia, Norway, Canada and Denmark were performing PCIs at a similar rate in 1998 (around 150–250 PCIs per 100,000 population aged 40–90 years), while Finland, Italy and the United Kingdom have the lowest usage rates for PCIs of the countries included in the study (OECD 2002).

While the overall use of PCIs in Australia has increased dramatically since the 1980s, its growth has slowed in more recent years, based on age-standardised rates (10% increase between 1998–99 and 1999–00 compared with annual rates of increase of around 13–23% between 1993–94 and 1997–98 among 40–90 year-olds) (Appendix Table A5).

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4. Stable angina is where there is no associated blood clot and the heart muscle is not in immediate danger. Unstable angina is marked by clots that tend to resolve but threaten to develop into a full heart attack.

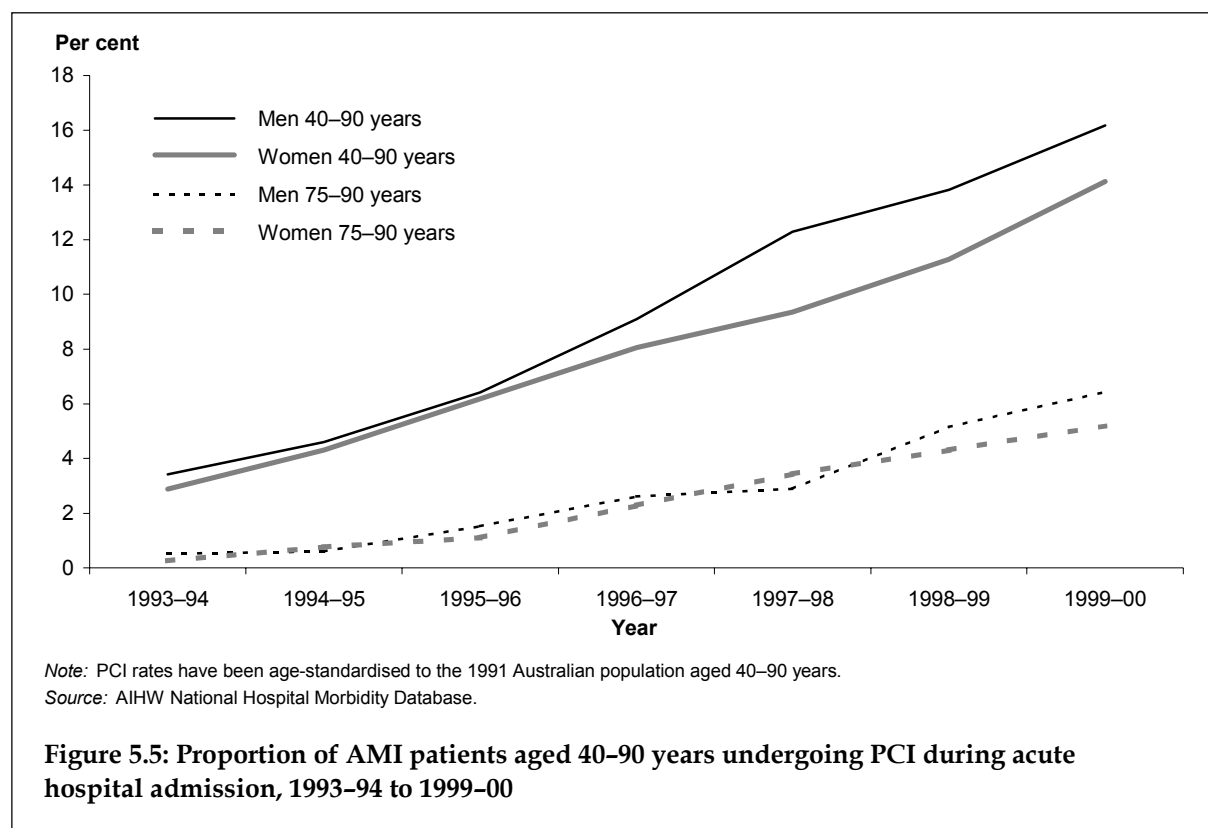
## PCI use during acute admission for acute myocardial infarction

In 1999-00, 12% of AMI patients aged 40-90 years (3,260 patients) underwent a PCI during acute hospital admission (Appendix Table A6). The number of AMI patients receiving PCI may in fact be larger, as around 6-10% of AMI patients are treated with PCI and successfully discharged within 2 days of acute admission (AIHW: Davies & Senes 2002).

### Recent trends

Between 1993-94 and 1999-00 there has been almost a fivefold increase in the utilisation rates of PCIs during acute hospital admission among AMI patients aged 40-90 years, based on age-standardised rates (Figure 5.5). The proportion of AMI patients aged 40-90 years undergoing PCIs during acute admission has increased from a crude rate of 2% to 12% over this period, which is an increase in the number of PCIs performed from 609 in 1993-94 to 3,260 in 1999-00. The growth in PCIs among AMI patients appears to be slowing in more recent years, with annual rates of increase between 1998-99 and 1999-2000 of 12-25% compared with growth rates of 35-50% in the mid-1990s.

While the use of PCIs during acute admission declines with age, there have still been substantial increases in the use of this procedure among AMI patients aged 75-90 years (Figure 5.5).

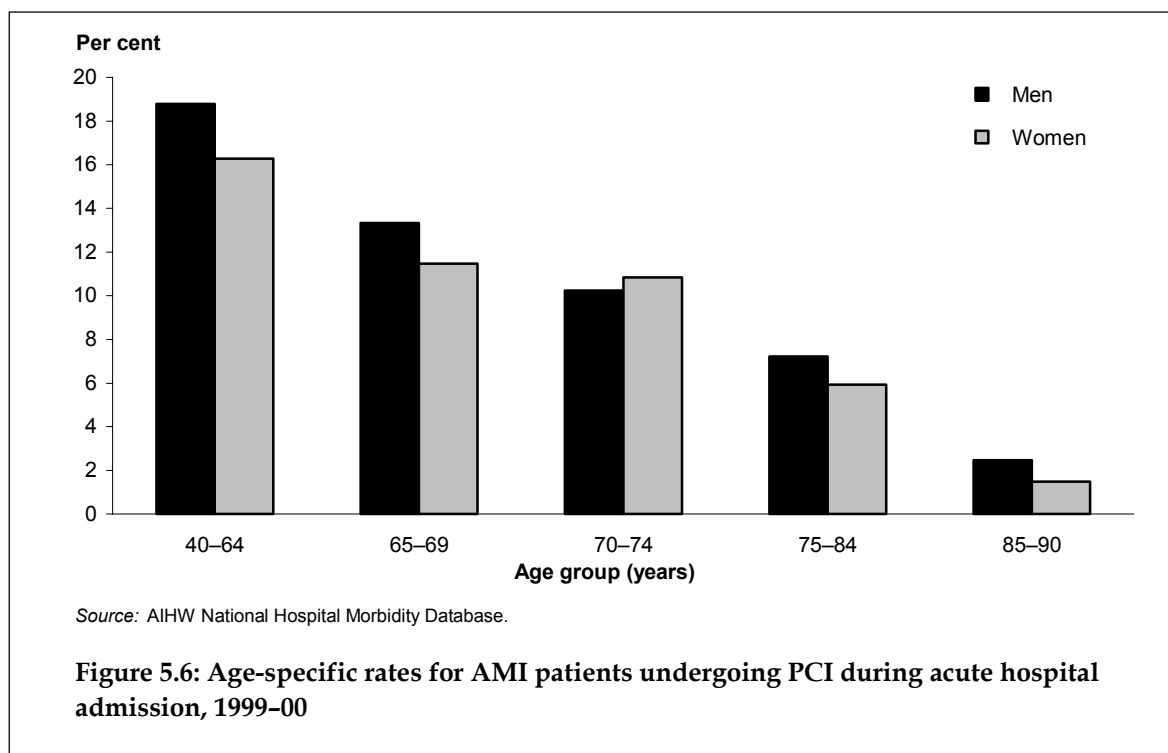


## Sex and age

In 1999–00, men aged 40–90 years admitted to hospital for an AMI were more likely to undergo a PCI during acute admission than women of the same age, with crude rates indicating that 13% of the men and 9% of the women aged 40–90 years had this procedure (Figure 5.6 and Appendix Table A6).

Patient-based data from Perth indicate that the use of PCI among AMI patients during acute hospital admission is even greater than the national crude rates, being 22% for men and 14% for women aged 40–84 years in 1997. The proportion of Perth AMI patients aged 40–84 years receiving this procedure within 90 days from acute admission increased to 27% for men, while for women there was no significant increase in the proportion of such patients (Appendix Table A8).

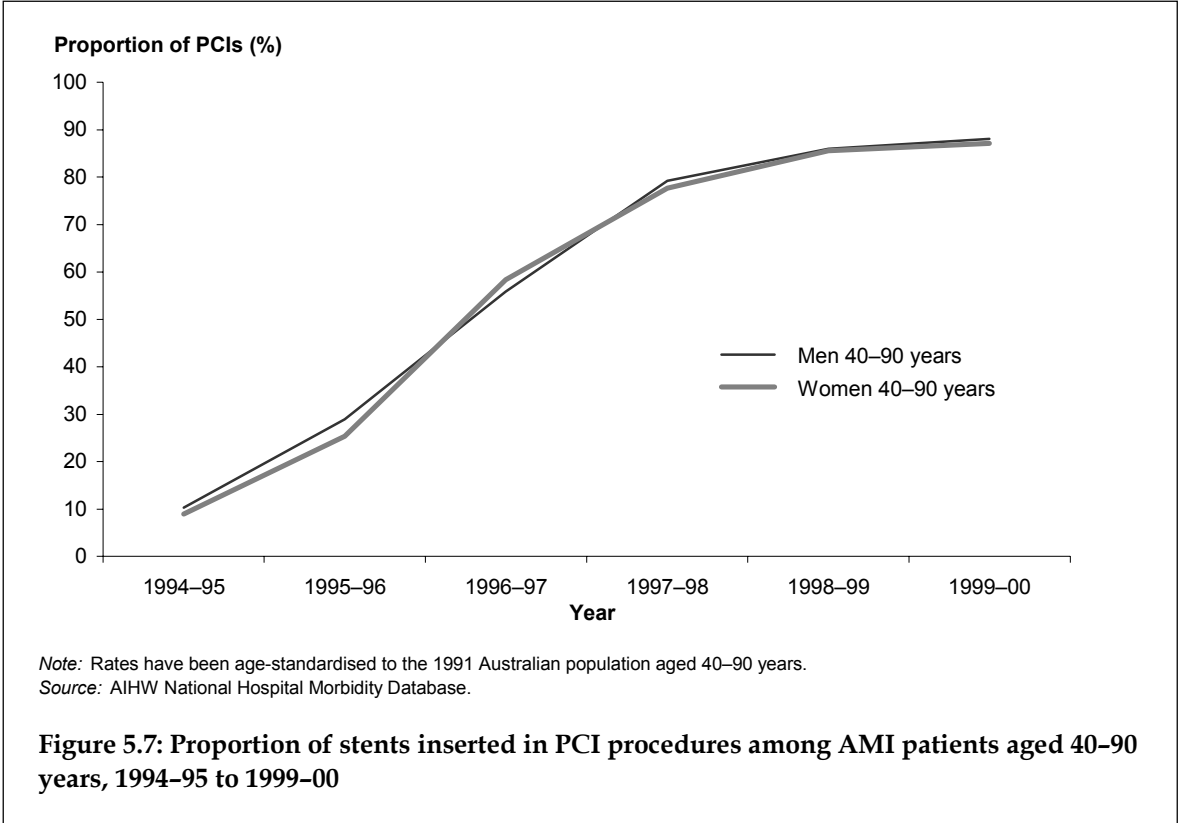
Nationally, the average age of AMI patients undergoing PCI during acute admission was 60 years for men and 66 years for women in 1999–00. The use of PCI among AMI patients declined with advancing age, being over three times as common among 40–64 year-olds as among 75–90 year-olds. PCI was seldom performed on AMI patients aged 85–90 years (less than 2%) compared with rates of around 18% for those aged 40–64 years (Figure 5.6).



## Coronary stenting

Since the mid-1990s there has been a rapid increase in the use of coronary stenting as an adjunct to coronary angioplasty. In 1999, stents were inserted in 92% of patients undergoing a PCI (11,968 patients), a sharp increase from 1994 where the figure was 11%. Data from the National Angioplasty Register in 1999 indicate that coronary angioplasty, including the use of stents, achieves an adequate reduction in the lesion in 95% of lesions attempted (AIHW: Davies & Senes 2002).

Among AMI patients aged 40–90 years stents were inserted in 88% of PCI procedures in 1999–00. As shown in Figure 5.7, the greatest increase in stent use among AMI patients aged 40–90 years occurred between 1994–95 and 1996–97 where the use of stents increased two- to threefold each year. Since then their rate of use has slowed somewhat, increasing by 9–10% per year between 1997–98 and 1998–99 and 2–3% per year between 1998–99 and 1999–00.



## **Coronary artery bypass grafting**

Coronary artery bypass grafting (CABG) involves opening the patient's chest. The obstructions in the coronary vessels are bypassed by veins taken from the patient's legs and/or arteries from the chest wall. According to the National Cardiac Surgery Register, in 1998 the average number of bypass grafts was three per patient, and 6% of CABGs were for re-operations (AIHW: Davies & Senes 2001). CABG is rarely used as a first-line treatment for AMI. However, for some patients it may be needed as an adjunct to other procedures to treat a 'mechanical' complication of the AMI or to reduce symptoms and pain as well as recurrent attack after receiving first-line treatment.

The capacity to perform CABG depends on the number of hospitals equipped to undertake cardiac surgery. According to the National Cardiac Surgery Register, in 1999 there were 74 cardiothoracic surgeons operating in 52 cardiac surgery units throughout Australia, all located in acute care hospitals in urban or metropolitan areas. This compares with 97 practising cardiothoracic surgeons reported in the Medical Labour Force Survey in 1998 (AIHW 2000).

### **Aggregate trends in CABG use**

CABG was developed in the 1960s and since then its use has grown rapidly in Australia. In 1980 there were 3,816 CABG procedures performed in Australia. By 1996 the procedures reached a height of 17,759, falling to 17,321 in 1999. While the use of this procedure increased rapidly in the 1970s and 1980s, in more recent years it has declined, based on age-standardised rates (5–6% decline among 40–90 year-olds between 1993–94 and 1999–00) (Appendix Table A5).

### **CABG use during acute admission for acute myocardial infarction**

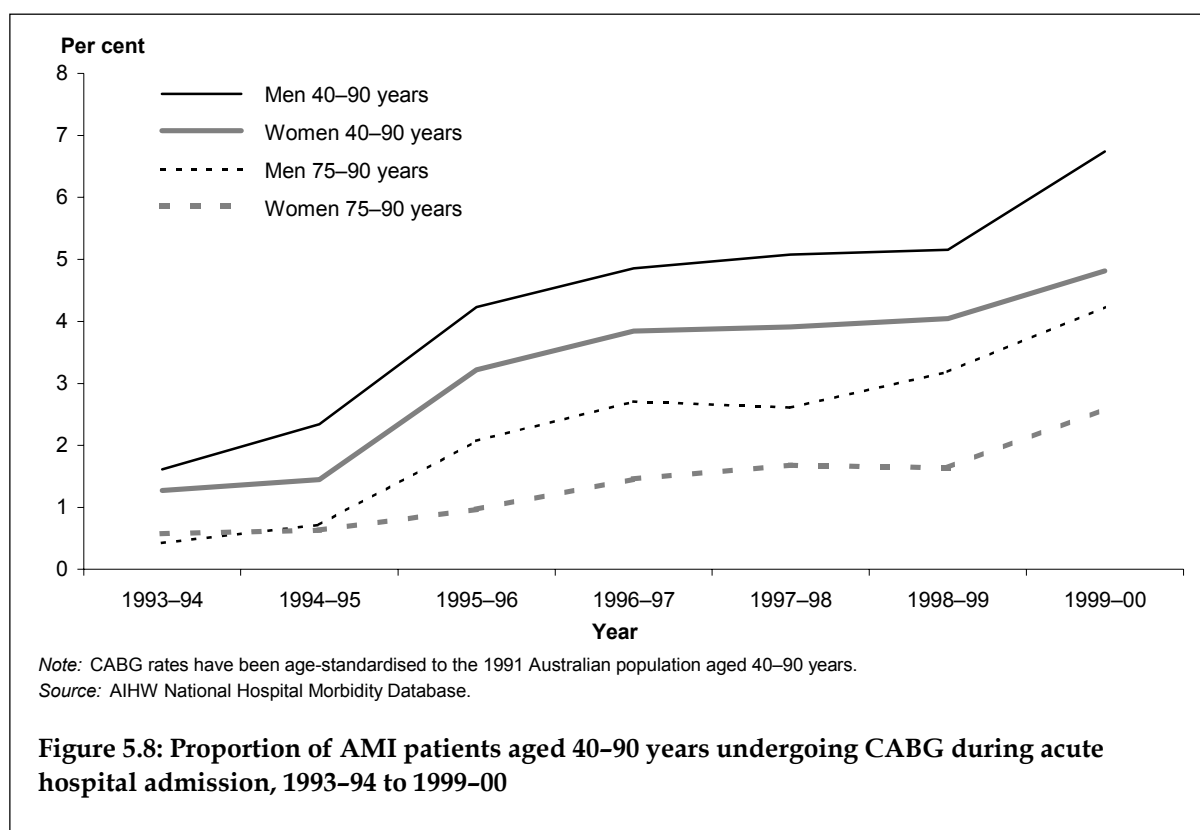
In 1999–00, 5% of AMI patients aged 40–90 years (1,491 patients) underwent a CABG during acute hospital admission (Appendix Table A6). The risk associated with having CABG is generally much greater following an AMI, and PCI is the more frequent choice for revascularisation in this situation. The main use of CABG is still overwhelmingly for patients with significant angina where drug treatment has not improved their condition sufficiently, rather than for those who have suffered a heart attack.

A comparative study on cardiac treatment patterns undertaken by the OECD has shown that the use of CABG in treating AMI in the United States is considerably higher than in all other countries. Such use in Australia, particularly for women, is higher than in Belgium, Canada, Italy, Sweden and Spain across most age groups. The United Kingdom had the lowest rate for this procedure among the seven OECD countries supplying this data (OECD 2002).

### **Recent trends**

Between 1993–94 and 1999–00 there was a fourfold increase in the rate of CABGs for AMI patients aged 40–90 years during acute hospital admission (based on age-standardised rates) (Figure 5.8). The crude rates are still, however, relatively low at 5% in 1999–00 and have come from a very low base of 1% in 1993–94. This is an increase in the number of CABGs from 341 in 1993–94 to 1,491 in 1999–00.

While CABG use during acute admission declines with age, there have still been significant increases in the use of this procedure among those aged 75–90 years (Figure 5.8).

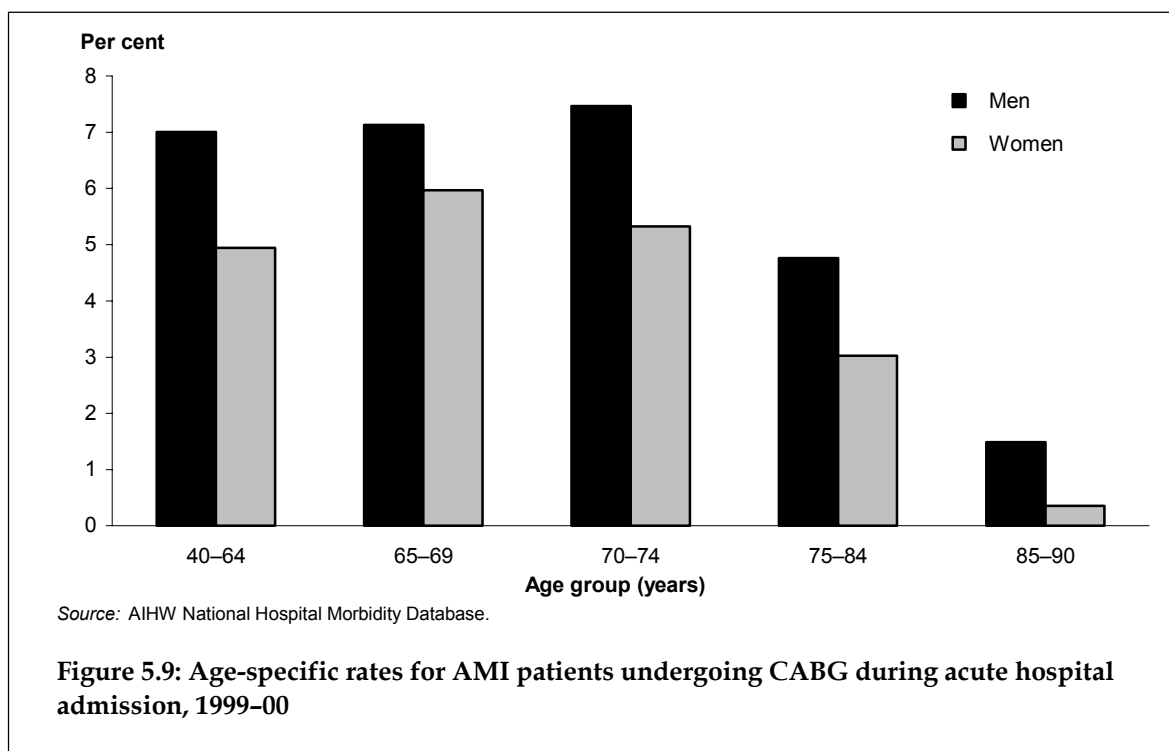


### Sex and age

In 1999-00, men aged 40-90 years admitted to hospital for an AMI were more likely to undergo CABG during acute admission than women of the same age, with crude rates indicating that 6% of men and 4% of women had this procedure. Among 40-90 year-olds CABG rates were higher for men than women across all age groups (Figure 5.9 and Appendix Table A6).

Given that CABG is a very intensive procedure that requires considerable planning, time after admission is an important factor to consider. Patient-based data from Perth indicate that the proportion of AMI patients aged 40-84 years receiving CABG increased significantly between acute admission and within 90 days and 1 year from acute admission. For men the proportions increased from 6% to 12% to 16% respectively, and for women the corresponding proportions were 4%, 7% and 9% in 1997 (Appendix Table A9).

Nationally, the average age of AMI patients undergoing CABG during acute admission was 64 years for men and 69 years for women in 1999-00. Among AMI patients aged 40-74 years, CABG use remained relatively stable and declined thereafter, a different pattern to that observed for cardiac catheterisation and PCI where use of these procedures declines with age. AMI patients aged 40-64 years were twice as likely to receive a CABG as those aged 75-90 years. In fact, CABG was rarely performed on AMI patients aged 85-90 years (less than 1%) while for 40-74 year-olds utilisation rates were approaching 7% (Figure 5.9).



## 5.4 Outcomes of acute care interventions

Health outcomes are often used to monitor the performance of the health system. Outcomes are measured in terms of a variety of indicators, including mortality and morbidity through to quality of life measures. As with most diseases, CHD outcomes are difficult to measure and as a result there are limited data. Case-fatality is often used to measure health outcomes, as it is relatively easy to measure. It is a suitable outcome indicator for AMI because the high death rate from heart attacks allows scope to detect improvements.

Among Australians having a heart attack, about one in four will die within an hour of their first-ever symptoms and almost nine in ten coronary deaths will occur before the person reaches hospital (see Chapter 3). In measuring the outcomes for acute care interventions for AMI, deaths that occur after admission to hospital (in-hospital case-fatality) are of interest. In this report in-hospital case-fatality is defined as the number of AMI deaths in hospital divided by the number of AMI hospital admissions. Estimates of case-fatality for any subgroup only include those events that belong to that subgroup.

Note that in-hospital case-fatality based on cross-sectional data may underestimate case-fatality due to double-counting of individuals readmitted for AMI. In addition, in-hospital case-fatality based on acute admission should be interpreted with caution as differences in length of stay may account for some differences in case-fatality.

In 1999-00, 3,258 AMI patients (or 12% of AMI patients) died in hospital.



## Recent trends

Over the last decade, in-hospital case-fatality during acute admission for AMI patients aged 40–90 years has been declining steadily, with age-standardised rates falling by 19% for men and 17% for women between 1993–94 and 1999–00 (Figure 5.11). The number of in-hospital deaths during acute admission for AMI patients aged 40–90 years has declined from 3,520 in 1993–94 to 3,258 in 1999–00.

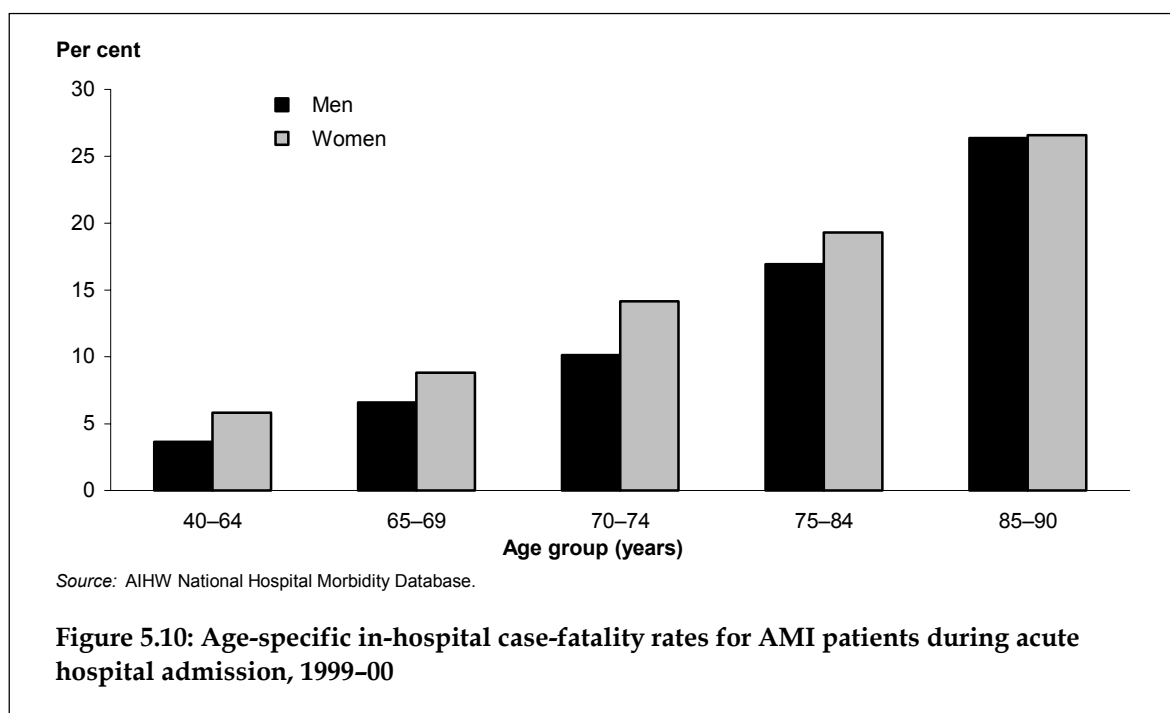
For AMI patients aged 40–90 years undergoing cardiac catheterisation, PCI or CABG during acute admission, the trend in in-hospital case-fatality rates over the last decade has not been as stable as for AMI patients overall, as illustrated in Figure 5.11. For both men and women there has been no significant decline in in-hospital case-fatality rates for those receiving these interventions between 1993–94 and 1999–00.

## Sex and age

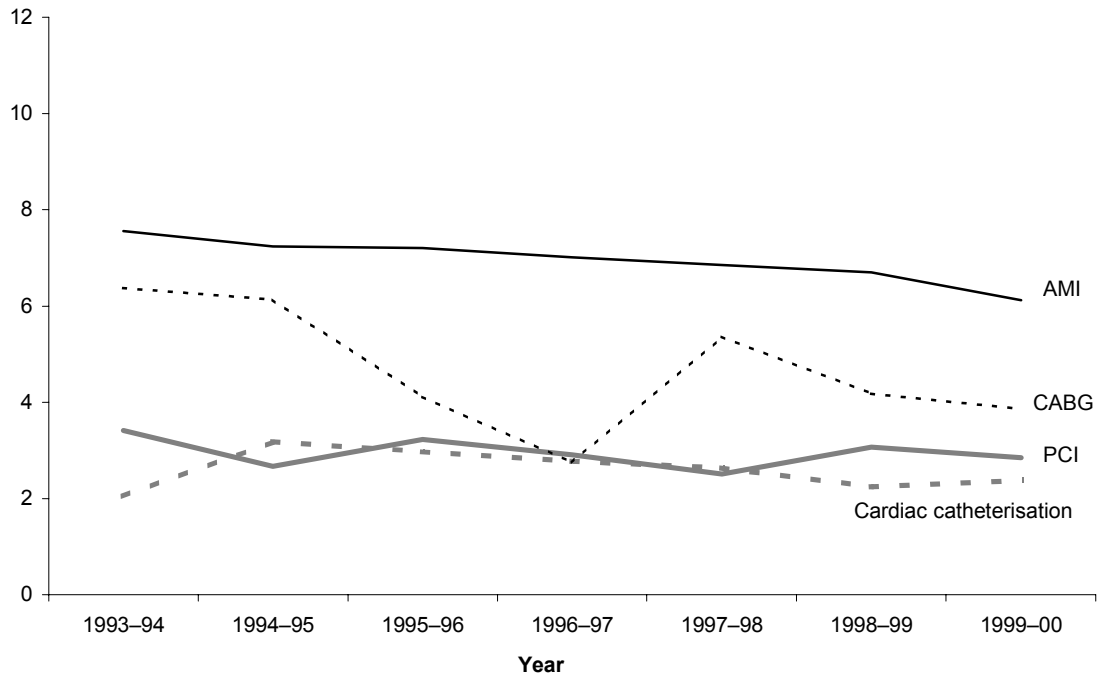
### AMI patients overall

In 1999–00, women aged 40–90 years admitted to hospital for an AMI were more likely to die during their acute admission than men of the same age, after adjusting for age. Crude in-hospital case-fatality rates were also higher for women than for men, with 16% of women and 9% of men dying in hospital following an AMI. Among 40–84 year-olds, in-hospital case-fatality rates were higher for women than men across all age groups. However, among 85–90 year-olds rates were generally similar for men and women (Figure 5.10).

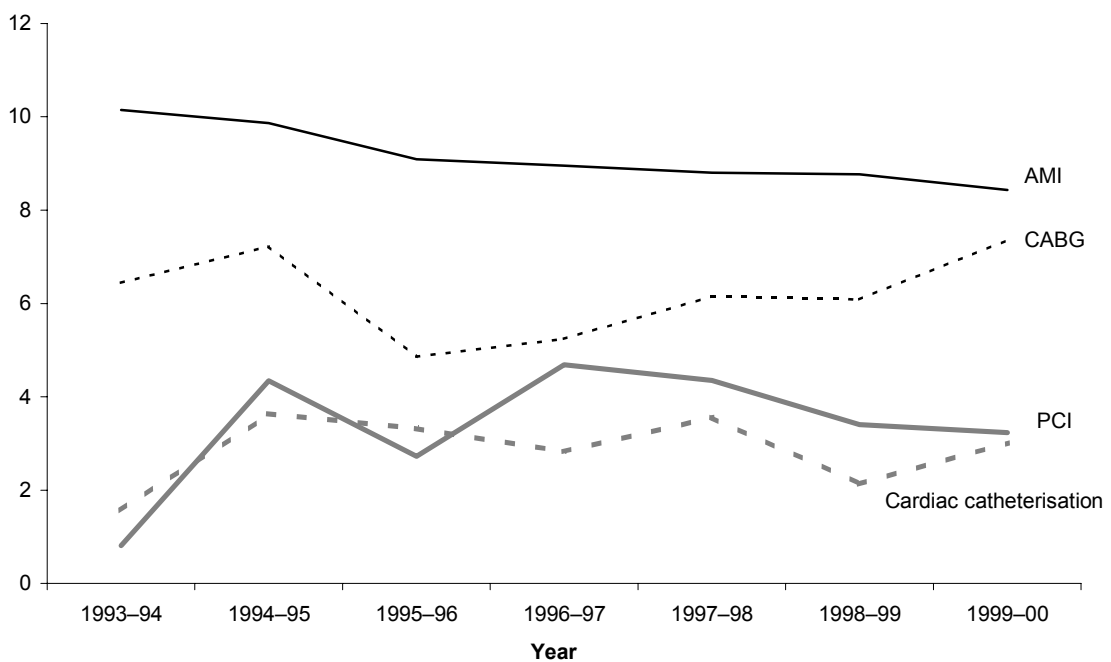
In 1999–00, the average age of AMI patients who died during their acute hospital admission was 75 years for men and 79 years for women, with these patients on average 6–9 years older than those who survived. In-hospital case-fatality rates increase rapidly with advanced age, from around 4% among 40–64 year-olds to 10% among 65–74 year-olds and 20% among 75–90 year-olds. Over a quarter (26%) of AMI patients aged 85–90 years died during their acute hospital admission (Figure 5.10).



**Case fatality (%) — Males**



**Case-fatality (%) — Females**



Note: Rates have been age-standardised to the 1991 Australian population aged 40-90 years.

Source: AIHW National Hospital Morbidity Database.

**Figure 5:11: In-hospital case-fatality rates for AMI patients aged 40-90 years during acute hospital admission, 1993-94 to 1999-00**

### **AMI patients undergoing cardiac catheterisation, PCI or CABG**

In 1999-00, AMI patients aged 40-90 years undergoing cardiac catheterisation, PCI or CABG during acute admission were less likely to die in hospital than AMI patients overall (3.1%, 3.5%, 5.4% and 11.6% respectively) (Table 5.1). AMI patients undergoing these interventions were younger than AMI patients overall; however, it is not known whether these patients had more severe disease than those not receiving these interventions. In-hospital case-fatality rates were significantly higher for AMI patients undergoing CABG (5.4%) than for those who had PCI or cardiac catheterisation (3.1% and 3.5% respectively) during acute admission. According to the National Cardiac Surgery and Angioplasty Registers, overall mortality rates for PCI and CABG were 0.8% (in 1999) and 2.1% (in 1998), respectively, a considerably lower death rate than for AMI patients undergoing these procedures (AIHW: Davies & Senes 2002; AIHW: Davies & Senes 2001).

In-hospital case-fatality rates during acute admission vary considerably between men and women depending on the procedure performed. For example in 1999-00, after adjusting for age, women aged 40-90 years undergoing CABG were twice as likely to die after this procedure as men of the same age, while for cardiac catheterisation the gender difference, although still higher among women, was not as marked (the female rate was 1.3 times the male rate). For PCI there was no significant difference in in-hospital case-fatality rates between men and women (Table 5.1).

In-hospital case-fatality rates for cardiac catheterisation, PCI and CABG during acute admission increase markedly with age, a similar pattern to that for AMI patients overall. Mortality rates among 75-90 year-olds were 3-4 times higher than for 40-64 year-olds (Table 5.1).

**Table 5.1: In-hospital case-fatality rates for AMI patients during acute admission, 1999–00**

	40–64	65–69	70–74	75–84	85–90	40–90	40–90
	Per cent						Number
<b>Men</b>							
AMI patients overall	3.7	6.6	10.1	16.9	26.4	9.3	1,665
AMI patients undergoing:							
cardiac catheterisation	1.5	2.9	4.0	6.3	6.0	2.7	136
PCI	2.0	3.3	5.3	5.7	8.0	3.0	73
CABG	2.5	6.2	5.2	8.7	13.3	4.7	53
<b>Women</b>							
AMI patients overall	5.8	8.8	14.2	19.3	26.6	15.9	1,593
AMI patients undergoing:							
cardiac catheterisation	2.2	3.1	3.5	7.9	6.7	4.1	76
PCI	2.1	2.5	7.7	7.8	8.0	4.9	42
CABG	7.0	3.2	6.0	10.7	33.3	7.7	28
<b>Persons</b>							
AMI patients overall	4.1	7.3	11.7	18.1	26.5	11.6	3,258
AMI patients undergoing:							
cardiac catheterisation	1.6	3.0	3.8	6.9	6.3	3.1	212
PCI	2.0	3.1	6.3	6.6	8.0	3.5	115
CABG	3.2	5.4	5.5	9.4	19.0	5.4	81

*Notes*

1. AMI patients are defined as those admissions with a principal diagnosis of AMI and length of stay greater than 2 days, and includes those that died within 2 days of admission.
2. In-hospital case-fatality defined as number of AMI deaths in hospital divided by the number of AMI hospital admissions.

Source: AIHW National Hospital Morbidity Database.

## 5.5 Discussion

This chapter has highlighted the rapid increases in the use of cardiac catheterisation, PCI and CABG among AMI patients over the last decade. Men are far more likely than women to be admitted to hospital for an AMI; although once admitted the gender-based differences in treatment reduce. In-hospital case-fatality rates for AMI have improved, but the mortality rate is significantly higher in women than in men. In-hospital case-fatality rates for AMI patients undergoing CABG are considerably higher than for PCI and cardiac catheterisation, but still lower than for AMI patients overall.

### Trends in AMI admissions and cardiac procedures

While age-adjusted hospital admission rates for AMI have been declining gradually over the last decade, the total number of AMI admissions has not declined due to the growing number of elderly, at-risk individuals. However, the use of cardiac procedures among AMI patients, both in numbers and rates, has increased considerably over this same period.

Among AMI patients aged 40–90 years, rates of cardiac catheterisation use has doubled, PCI use has increased fivefold and CABG use has quadrupled.

The rapid increase in the use of PCIs may be due to the dramatic increase in the use of coronary stents in the mid-1990s. Stenting has been shown to improve outcomes by reducing the incidence of recurrent ischaemia and the need for subsequent target-vessel revascularisation (Grines et al. 1999). Recent clinical trials have also found that primary PCI decreases short-term mortality and incidence of recurrent infarction at least as effectively as thrombolytic therapy (Berger et al. 1999). The greater increase in the use of PCIs compared with CABGs may be due to the lower risk involved with PCI procedures, and also to the refinement of the PCI procedure in recent years, so that patients who previously would have undergone CABG are perhaps now receiving the less invasive PCI procedure.

### **Age and sex**

In 1999–00, there were 28,002 hospital admissions for AMI among 40–90 year-olds. At least one in eight AMI patients received PCI during their acute hospital admission, one in twenty had CABG, and one in four underwent the diagnostic procedure of cardiac catheterisation during their acute hospital admission.

Men are twice as likely as women to be admitted to hospital for an AMI. Data from the Framingham study has indicated that women with CHD are more likely to present with angina pectoris initially, whereas men more often first present with myocardial infarction. It has also been shown that diagnosing CHD is more difficult in women than in men even with the aid of non-invasive tests (Mark 2000). However, when severity is taken into account (i.e. by including only AMI patients) sex-based differences in these cardiac procedures tend to diminish.

Compared with AMI patients overall, those receiving cardiac catheterisation, PCI and CABG tend to be 4–8 years younger. Older Australians (75–90 year-olds) are far more likely to be admitted to hospital for an AMI than 40–64 year-olds, but once admitted the younger AMI patients are far more likely to undergo cardiac catheterisation, PCI or CABG than older patients. Low use of these treatments among the very old is not a surprising finding since procedure use for most treatments declines with advanced age because of increased comorbidities and the greater likelihood of postoperative complications.

### **In-hospital case-fatality**

Almost one in eight people admitted to hospital for an AMI die in hospital. In-hospital case-fatality rates for AMI patients undergoing cardiac catheterisation, PCI and CABG were less than 6% in 1999–00.

Over the last decade in-hospital case-fatality rates for AMI have improved, with Australia experiencing declines in case-fatality in the vicinity of 17–19%. Major advances in diagnosis and treatment of cardiac patients have contributed to this decline. Hunink and others estimated that improvements in the treatment of patients with CHD explained about 71% of the decline in overall CHD mortality in the United States between 1980 and 1990. This chapter has shown that, while there have been rapid increases in the use of cardiac catheterisation, PCI or CABG among AMI patients, there has been no significant improvement in in-hospital case-fatality rates for these procedures over the last 7 years. This could reflect a trend to intervene with PCI or CABG in sicker patients who would otherwise have higher mortality. There is a need for risk-adjusted data to examine questions such as these.

Women are more likely to die in hospital following an AMI than men. The difference in case-fatality rates between men and women is even greater for AMI patients undergoing CABG, where the female death rate is twice the male rate. For cardiac catheterisation the gender difference is not as marked and for PCI there is no significant difference in in-hospital mortality rates between men and women. The higher mortality rates among women have been attributed to less intense use of both pharmacological and device-based therapies, biological factors and perhaps presentation later in the course of the disease process, older age, and more severe cardiovascular risk profiles (Mehilli et al. 2002). The considerably higher in-hospital case-fatality rates for women undergoing CABG could be due to the smaller size of coronary arteries in women, which could increase the likelihood of perioperative and postoperative complications (Vaccarino et al. 2002).

In-hospital case-fatality rates increase markedly with age with one in five AMI patients aged 75 years and over dying in hospital, compared with around 4% among 40–64 year-olds.

# 6 Expenditure

## 6.1 Introduction

CHD creates enormous costs for the healthcare system, with the associated direct healthcare costs exceeding those of any other disease. In 1993–94 the direct healthcare expenditure on CHD in Australia was \$894 million or 2.8% of total recurrent health expenditure. Healthcare costs for CHD possibly accounted for more than this, given that CHD is a major risk factor for stroke and heart failure and that the direct healthcare costs for these two diseases amounted to \$1.0 billion in 1993–94. The total direct cost of cardiovascular disease in Australia during 1993–94 was \$3,719 million, with CHD accounting for 24% of total cardiovascular disease costs, stroke 17% and heart failure 11%. While these data are somewhat dated they are the most recent available in Australia on healthcare expenditure for CHD.

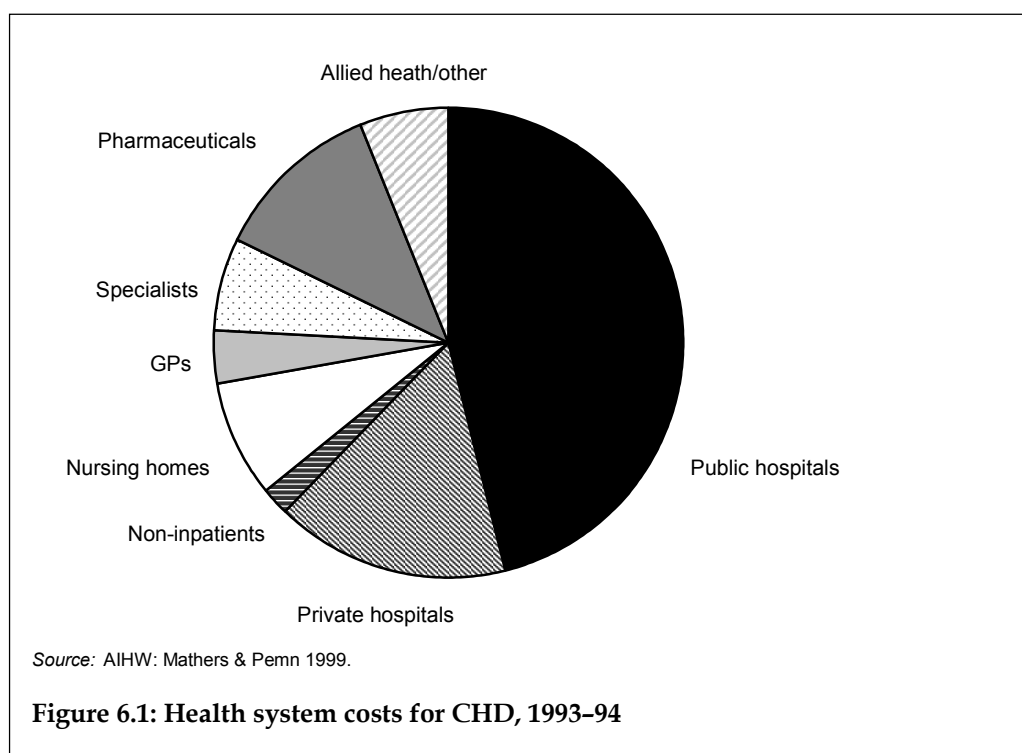
This chapter examines some economic aspects of CHD treatment and is divided into three sections:

- aggregate expenditure on CHD
- length of stay in hospital for AMI
- average expenditure for hospital treatment.

## 6.2 Aggregate expenditure on coronary heart disease

CHD is responsible for 2.8% of total recurrent health expenditure, or \$894 million in 1993–94. The majority of costs were related to hospital inpatients (65%) – public hospital costs were over \$410 million and private hospital costs nearly \$150 million (Figure 6.1). The next most expensive health service was the cost of pharmaceuticals at \$105 million (12% of CHD expenditure). Medical services accounted for \$88 million (9.8% of CHD expenditure) with nearly two-thirds of these for specialist services. Expenditure on nursing homes accounted for 8% of health expenditure for CHD, a relatively low proportion when compared with other cardiovascular diseases, particularly stroke where nursing homes account for 42% of stroke expenditure.

Health system costs for CHD for men were 1.7 times that for women in 1993–94 (\$559 million compared with \$336 million). This is consistent with the higher prevalence of CHD among men than women. The male–female difference in health system costs is greatest in the 35–64 age range with rates among men 3–4 times that of women. However, among those aged 75 years and over, health system costs for women were 32% higher than for men. Health system costs increase markedly with age, with men aged 65 years and over accounting for 54% of total health system costs and women aged 65 years and over accounting for 76% (AIHW: Mathers & Penm 1999).



### 6.3 Length of stay in hospital for AMI

Length of stay in hospital has a large impact on the health system costs for CHD. This is because a large proportion of health expenditure for CHD is related to hospital costs, and the majority of these hospital costs relate to ongoing staff costs and hospital overheads rather than diagnostic tests and procedures.

Length of stay in hospital depends on a number of factors such as the severity of the underlying problem (such as heart attack) whether the patient died in hospital, and whether the patient received rehabilitation or long-term care in hospital. Across Australia there could be considerable variation between hospitals in the length of stay of AMI patients.

Since 1993-94 the average length of stay for AMI patients has declined from 8.6 days in 1993-94 to 7.5 days in 1999-00. Falls in length of stay for the 75th percentile have been greater than for the median, which suggests that there have been considerable declines in the number of patients with very long stays (Table 6.1).

Between 1993-94 and 1999-00 average length of stay declined faster for AMI patients undergoing cardiac catheterisation, PCI or CABG than for the overall AMI population (18% decline compared with 13% decline) (Table 6.1).

In 1999-00 average length of stay for AMI patients undergoing cardiac catheterisation was 8.7 days, PCI 7.0 days and CABG 15.3 days, which was longer than for AMI patients overall (7.5 days).



**Table 6.1: Average length of stay (in days) for AMI patients aged 40–90 years, 1993–94 to 1999–00**

Year	AMI patients			Cardiac catheterisation, PCI or CABG among AMI patients		
	Mean	Median	Upper quartile (75%)	Mean	Median	Upper quartile (75%)
1993–94	8.6	7	10	10.6	9	13
1994–95	8.2	7	9	10.0	8	12
1995–96	7.9	7	9	9.5	8	12
1996–97	7.8	6	9	9.2	7	11
1997–98	7.6	6	9	8.8	7	11
1998–99	7.5	6	8	8.5	7	10
1999–00	7.5	6	8	8.7	7	10

*Notes*

1. AMI patients defined as those admissions with a principal diagnosis of AMI, length of stay greater than 2 days including those that died within 2 days of admission.
2. Average length of stay includes same-day admissions.
3. Data are for financial years, reflecting how the information is collected in the National Hospital Morbidity Database.

Source: AIHW National Hospital Morbidity Database.

## 6.4 Average expenditure for hospital treatment

This section examines average costs for selected treatment groups for treating AMI. The costs have been calculated by using Diagnosis Related Groups (DRGs) to define the treatment groups and then applying the average cost per DRG obtained from the National Hospital Cost Data Collection.

The average total expenditure per admission for AMI was \$5,898 in 1998–99. This included overhead and administrative costs, which account for 22% of the average total expenditure per admission. The cost increased somewhat for complicated AMI with PTCA, with the average total expenditure at \$9,575 per admission. For those patients undergoing CABG the cost was substantially higher than for PTCA at \$17,596 per admission. Expenditure tends to be related to length of time in hospital, with those undergoing CABG having the longest length of stay in hospital at 11.7 days on average. For those with complicated AMI with PTCA the average length of stay was 8.2 days and for AMI admissions overall 7.5 days (Table 6.2).

**Table 6.2: Expenditure related to the treatment of AMI for a given admission, 1998–99 (A\$)**

<b>Selected treatment groups</b>	<b>Total expenditure per admission (average)</b>	<b>Average length of stay (days)</b>	<b>Overhead &amp; admin. costs included?</b>	
AMI patients overall	\$5,898	7.5	Yes	22%
Uncomplicated AMI	\$5,105	4.8	Yes	21%
Uncomplicated AMI, discharged alive	\$4,803	4.9	Yes	22%
Complicated AMI, with PTCA, discharged alive	\$9,575	8.2	Yes	19%
Complicated AMI, without PTCA, discharged alive	\$6,684	8.6	Yes	22%
AMI, deceased	\$5,857	5.1	Yes	23%
Elective PTCA, excluding AMI patients	\$5,419	3.2	Yes	17%
CABG	\$17,596	11.7	Yes	20%

*Notes*

1. 'Uncomplicated AMI' refers to hospital admissions for AMI as the principal diagnosis, where there was no complication and/or comorbidity effect.
2. 'Uncomplicated AMI, discharged alive' refers to hospital admissions for AMI as the principal diagnosis, where there was no complication and/or comorbidity effect, and the patient was discharged alive.
3. 'Complicated AMI, with PTCA, discharged alive' refers to hospital admissions for AMI as the principal diagnosis, where the patient received a PTCA, where there was a mild, moderate, severe or catastrophic complication and/or comorbidity effect, and the patient was discharged alive.
4. 'Complicated AMI, without PTCA, discharged alive' refers to hospital admissions for AMI as the principal diagnosis, where the patient did not receive a PTCA, where there was a mild, moderate, severe or catastrophic complication and/or comorbidity effect, and the patient was discharged alive.
5. 'AMI, deceased' refers to hospital admissions for AMI as the principal diagnosis, where the patient died while in hospital.
6. 'Elective PTCA, excluding AMI patients' refers to hospital admissions where the patient received a PTCA and the principal diagnosis was not AMI.
7. 'CABG' refers to all hospital admissions where the patient received a CABG.

Sources: AIHW National Hospital Morbidity Database; DHAC 1999.

## 6.5 Conclusion

CHD was responsible for 2.8% of total recurrent health expenditure in 1993–94 (\$894 million). Two-thirds of these costs were related to hospital in-patients and 10% to medical services.

People admitted to hospital for an AMI tend to stay in hospital longer than other patients (7.5 days compared with 3.6 days for all conditions) and, given that length of stay is positively correlated with the cost of providing treatment, this is a useful indicator of resource use for acute care. Length of stay for cardiac catheterisation, PCI and CABG among AMI patients is considerably longer than for AMI patients overall. The average length of stay for these patients has been declining since 1993–94, and hence one would expect the total expenditure per patient to have also declined over this period. The decline in length of stay may reflect tightening budget caps that have given hospitals an increasing incentive to discharge patients quickly.

CABG was the most costly procedure for AMI admissions in 1998–99 (\$17,596 per admission), followed by complicated AMI with PTCA (\$9,575) which may reflect the longer lengths of stay for these procedures.

# Appendix



**Table A1: Incidence rates for CHD by sex and age, 1993–94 to 1999–00**

Year	Men					Women					
	40–64	65–69	70–74	75–84	85–90	40–64	65–69	70–74	75–84	85–90	40–90 <sup>(a)</sup>
	<b>CHD events per 100,000 population</b>										
1993–94	424.4	1,395.6	1,973.6	3,309.7	5,228.5	1,008.5	115.0	962.1	2,094.9	3,969.2	480.0
1994–95	410.8	1,355.2	1,892.3	3,202.1	5,423.9	982.1	108.4	937.4	2,047.2	4,043.1	468.9
1995–96	413.4	1,272.2	1,868.9	3,123.8	5,268.6	963.8	106.5	870.2	1,902.7	3,782.2	442.9
1996–97	398.6	1,236.5	1,739.1	2,946.0	5,243.0	923.4	101.0	808.1	1,824.7	3,961.2	427.7
1997–98	381.8	1,181.0	1,651.2	2,780.8	4,993.5	878.3	94.9	800.5	1,713.7	3,799.3	406.2
1998–99	365.1	1,099.5	1,583.9	2,681.0	4,976.4	843.2	90.9	751.8	1,639.2	3,757.1	391.2
1999–00	357.5	1,042.1	1,524.9	2,599.8	4,962.9	817.7	89.1	737.0	1,571.2	3,824.8	381.2

(a) Age-standardised to the 1991 Australian population aged 40–90 years.

**Notes**

1. CHD incidence is calculated as the sum of non-fatal AMI hospital admissions and CHD deaths.
2. Data are for financial years, reflecting how hospital admission data is collected in the National Hospital Morbidity Database. To align the mortality data, which is based on calendar years, with the hospital data, coronary deaths are averaged over consecutive years to obtain financial year data.

Sources: AIHW National Hospital Morbidity Database; AIHW National Mortality Database.

**Table A2: Mortality rates for CHD by sex and age, 1980–2000**

Year	Men					Women						
	40–64	65–69	70–74	75–84	85–90	40–64	65–69	70–74	75–84	85–90	40–90 <sup>(a)</sup>	
	<b>Deaths per 100,000 population</b>											
1980	318.4	1,266.1	1,835.8	3,095.8	5,170.2	874.6	93.3	485.3	840.1	1,844.0	3,770.0	414.9
1981	310.0	1,256.9	1,884.3	3,055.3	5,204.9	866.4	93.2	495.3	834.7	1,790.1	3,793.4	410.3
1982	296.5	1,217.5	1,825.5	3,118.1	5,366.3	857.7	90.7	465.1	838.9	1,858.2	3,985.8	415.9
1983	282.4	1,130.9	1,682.2	2,956.7	5,076.7	806.2	85.6	442.1	826.3	1,775.6	3,640.9	395.3
1984	263.3	1,017.0	1,680.3	2,792.8	5,045.4	765.8	78.0	448.7	770.3	1,723.1	3,628.8	381.4
1985	253.1	1,048.2	1,663.1	2,932.9	5,361.3	781.0	74.3	395.8	815.6	1,801.8	3,797.2	388.4
1986	239.5	960.1	1,506.7	2,782.7	4,967.1	731.0	72.9	412.8	753.0	1,721.1	3,544.7	372.9
1987	217.8	927.8	1,514.8	2,688.7	4,982.0	707.1	63.2	385.0	741.6	1,715.1	3,602.5	364.4
1988	202.4	916.1	1,454.7	2,567.8	4,605.8	674.1	57.0	355.8	720.0	1,638.4	3,511.3	347.1
1989	187.7	849.2	1,452.6	2,648.5	5,068.2	675.3	53.5	332.3	703.7	1,666.6	3,764.0	349.3
1990	171.3	810.5	1,285.4	2,464.6	4,762.6	624.9	48.1	329.2	670.3	1,543.8	3,627.6	329.0
1991	154.9	726.3	1,224.9	2,420.0	4,324.9	589.3	42.1	289.6	600.4	1,474.0	3,442.5	305.7
1992	148.5	707.1	1,195.2	2,377.1	4,595.4	581.4	44.0	271.0	566.2	1,528.3	3,637.3	310.7
1993	133.3	667.8	1,126.6	2,199.9	4,371.2	540.4	38.3	248.4	532.7	1,348.8	3,367.7	280.1
1994	120.7	657.5	1,047.1	2,247.4	4,585.0	531.5	34.1	241.1	476.8	1,412.8	3,495.7	279.0
1995	117.9	578.5	1,026.0	2,077.4	4,576.7	503.9	31.5	215.6	458.5	1,274.0	3,284.9	256.6
1996	111.3	552.8	959.9	2,030.3	4,428.8	485.4	29.1	197.3	421.9	1,221.4	3,252.9	245.0
1997	105.3	525.1	884.1	1,863.6	4,196.0	452.7	28.0	188.8	409.7	1,143.8	3,194.7	234.6
1998	95.6	484.3	819.5	1,784.9	3,921.0	424.5	25.4	172.6	360.4	1,057.8	2,932.0	215.4
1999	92.5	433.1	783.6	1,630.5	3,848.8	398.8	22.8	148.8	334.1	984.5	2,903.6	202.5
2000	83.8	383.7	695.2	1,501.2	3,624.3	363.0	21.9	141.3	330.3	883.0	2,791.0	188.6

(a) Age-standardised to the 1991 Australian population aged 40–90 years.

Source: AIHW National Mortality Database.

**Table A3: Trends in non-fatal AMIs and deaths from CHD by sex and age, 1993-94 and 1999-00**

Year by age group	Non-fatal AMIs		CHD deaths in hospital		CHD deaths out of hospital		All CHD deaths	
	Men	Women	Men	Women	Men	Women	Men	Women
	Rate per 100,000 population							
<b>1993-94</b>								
40-64	298.7	79.2	19.4	7.9	106.3	27.9	125.7	35.8
65-74	809.0	380.4	140.7	87.9	698.5	274.2	839.2	362.1
75-84	1,107.8	727.4	402.1	266.3	1,799.8	1,101.1	2,201.9	1,367.4
85-90	792.1	570.2	410.2	307.1	4,026.3	3,092.0	4,436.5	3,399.1
40-90 <sup>(a)</sup>	475.7	203.3	84.4	52.0	443.5	228.9	527.9	280.9
<b>1999-00</b>								
40-64	269.5	66.8	13.6	5.3	74.5	17.0	88.1	22.3
65-74	705.0	339.8	92.0	58.3	471.3	178.2	563.3	236.4
75-84	1,035.2	638.2	277.3	184.4	1,287.3	748.6	1,564.6	933.1
85-90	1,229.1	978.6	598.9	417.6	3,134.9	2,428.6	3,733.7	2,846.2
40-90 <sup>(a)</sup>	437.4	186.3	63.1	39.2	315.7	158.7	378.9	197.9

(a) Age-standardised to the 1991 Australian population aged 40-90 years.

Note: Data are for financial years, reflecting how hospital admission data is collected in the National Hospital Morbidity Database. To align the mortality data, which is based on calendar years, with the hospital data, coronary deaths are averaged over consecutive years to obtain financial year data.

Sources: AIHW National Hospital Morbidity Database; AIHW National Mortality Database.

Table A4: AMI hospital admissions by sex and age, 1993–94 to 1999–00

Year	Men					Women					
	40–64	65–69	70–74	75–84	85–90	40–64	65–69	70–74	75–84	85–90	40–90 <sup>(a)</sup>
1993–94	7,871	2,746	2,722	3,725	481	2,093	1,280	1,747	3,762	786	9,668
1994–95	7,766	2,735	2,700	3,611	556	2,041	1,284	1,796	3,761	971	9,853
1995–96	8,260	2,634	2,770	3,806	580	2,112	1,293	1,675	3,547	861	9,488
1996–97	8,244	2,603	2,678	3,768	753	2,064	1,237	1,510	3,564	1,238	9,613
1997–98	8,225	2,542	2,608	3,739	784	2,011	1,091	1,602	3,518	1,321	9,543
1998–99	8,174	2,391	2,621	3,755	883	2,039	1,102	1,556	3,577	1,419	9,693
1999–00	8,047	2,258	2,559	4,113	1,009	2,021	1,056	1,559	3,698	1,682	10,016
	<b>Admissions per 100,000 population</b>										
1993–94	318.3	829.2	1,058.3	1,437.3	1,133.9	86.5	360.7	562.8	960.6	844.0	248.1
1994–95	307.2	819.3	1,011.5	1,352.6	1,241.3	82.3	362.4	561.0	939.3	994.3	245.9
1995–96	319.0	783.2	1,014.4	1,365.2	1,221.1	82.9	364.8	515.4	858.6	836.6	232.7
1996–97	310.5	772.4	961.2	1,290.8	1,495.5	78.9	350.2	460.8	833.6	1,140.8	227.4
1997–98	301.9	757.9	919.7	1,228.0	1,464.3	74.8	311.5	486.8	797.2	1,157.5	219.7
1998–99	295.5	725.7	922.0	1,194.1	1,542.5	74.7	321.2	474.9	792.0	1,184.0	218.2
1999–00	280.8	680.4	875.6	1,247.9	1,669.2	71.4	305.1	472.1	792.2	1,332.8	217.9

(a) Age-standardised to the 1991 Australian population aged 40–90 years.

Notes

1. AMI hospital admissions refers to those admissions with a principal diagnosis of AMI and length of stay greater than 2 days and includes those that died within 2 days.
  2. Data are for financial years, reflecting how the information is collected in the National Hospital Morbidity Database.
- Source: AIHW National Hospital Morbidity Database.



**Table A5: Cardiac catheterisation, PCI and CABG use among 40–90 year-olds, 1993–94 to 1999–00**

Year	Cardiac catheterisation						PCI						CABG										
	Men			Women			Men			Women			Men			Women							
	Number <sup>(a)</sup>	Rate <sup>(b)</sup>	Number <sup>(a)</sup>	Rate <sup>(b)</sup>	Number <sup>(a)</sup>	Rate <sup>(b)</sup>	Number <sup>(a)</sup>	Rate <sup>(b)</sup>	Number <sup>(a)</sup>	Rate <sup>(b)</sup>	Number <sup>(a)</sup>	Rate <sup>(b)</sup>	Number <sup>(a)</sup>	Rate <sup>(b)</sup>	Number <sup>(a)</sup>	Rate <sup>(b)</sup>	Number <sup>(a)</sup>	Rate <sup>(b)</sup>					
1993–94	36,048	1,083.0	16,543	465.1	6,873	204.4	2,333	65.7	12,249	372.5	3,745	103.6	40,559	1,196.3	18,304	505.1	7,956	232.5	12,613	376.6	3,821	103.8	
1994–95	44,245	1,279.9	20,822	561.6	9,437	270.4	3,315	89.6	13,335	391.0	4,150	110.3	45,701	1,295.5	21,909	575.8	10,219	287.1	13,103	376.4	4,111	106.3	
1996–97	51,886	1,441.5	24,827	639.0	12,899	355.8	4,438	113.9	13,191	371.9	4,134	105.2	49,512	1,347.3	24,603	616.3	13,239	357.3	13,059	360.0	4,165	103.3	
1998–99	49,054	1,304.3	24,220	592.3	14,976	395.0	5,317	129.5	13,061	351.8	4,077	98.5											

(a) 'Number' refers to number of procedures performed among 40–90 year-olds.

(b) 'Rate' refers to the number of procedures per 100,000 population and has been age-standardised to the 1991 Australian population aged 40–90 years.

Note: Data are for financial years, reflecting how the information is collected in the National Hospital Morbidity Database.

Source: AIHW National Hospital Morbidity Database.

**Table A6: Cardiac catheterisation, PCI and CABG use among AMI patients aged 40–90 years, 1999–00**

Age group	Cardiac catheterisation						PCI				CABG					
	Men		Women		Men		Women		Men		Women		Men		Women	
	Number <sup>(a)</sup>	Per cent <sup>(b)</sup>	Number <sup>(a)</sup>	Per cent <sup>(b)</sup>	Number <sup>(a)</sup>	Per cent <sup>(b)</sup>	Number <sup>(a)</sup>	Per cent <sup>(b)</sup>	Number <sup>(a)</sup>	Per cent <sup>(b)</sup>	Number <sup>(a)</sup>	Per cent <sup>(b)</sup>	Number <sup>(a)</sup>	Per cent <sup>(b)</sup>	Number <sup>(a)</sup>	Per cent <sup>(b)</sup>
40–64	2,923	36.3	679	33.6	1,512	18.8	329	16.3	564	7.0	100	4.9				
65–69	688	30.5	289	27.4	301	13.3	121	11.5	161	7.1	63	6.0				
70–74	626	24.5	368	23.6	262	10.2	169	10.8	191	7.5	83	5.3				
75–84	698	17.0	471	12.7	297	7.2	219	5.9	196	4.8	112	3.0				
85–90	50	5.0	30	1.8	25	2.5	25	1.5	15	1.5	6	0.4				
40–90	4,985	27.7	1,837	18.3	2,397	13.3	863	8.6	1,127	6.3	364	3.6				

(a) 'Number' refers to number of AMI patients aged 40–90 years receiving these procedures during acute hospital admission. AMI patients are defined as those admissions with a principal diagnosis of AMI and length of stay greater than 2 days and includes those that died within 2 days of admission. Acute hospital admission is defined as those admissions in the acute stage of a heart attack (i.e. the first occurrence of a heart attack during the observation period).

(b) 'Per cent' refers to the proportion of AMI patients receiving these procedures during the acute hospital admission.

Note: Data are for financial years, reflecting how the information is collected in the National Hospital Morbidity Database.

Source: AIHW National Hospital Morbidity Database.

Table A7: Proportion of AMI patients receiving cardiac catheterisation, Perth, 1989 and 1997

	Acute admission		30 days after acute admission		90 days after acute admission		1 year after acute admission	
	Men	Women	Men	Women	Men	Women	Men	Women
	Per cent							
<b>1989</b>								
40-64	18.3	18.6	33.9	26.4	49.1	47.3	58.3	53.5
65-74	6.6	7.6	10.5	10.3	18.6	15.1	23.6	25.1
75-84	3.6	0.8	5.4	1.1	6.3	1.1	6.8	1.9
40-84	11.1	6.9	19.8	9.7	29.5	15.9	35.4	20.9
<b>1997</b>								
40-64	59.2	53.4	71.0	59.1	79.4	67.1	83.6	72.7
65-74	41.8	44.0	51.5	48.7	58.6	50.7	64.4	56.7
75-84	15.3	16.1	20.8	18.7	23.5	21.8	25.1	23.3
40-84	44.6	33.4	54.4	37.4	61.2	41.1	65.3	45.0

Sources: Hobbs et al. 2002; Michael Hobbs, pers. comm. 2002.

Table A8: Proportion of AMI patients receiving PCI, Perth, 1989 and 1997

	Acute admission		30 days after acute admission		90 days after acute admission		1 year after acute admission	
	Men	Women	Men	Women	Men	Women	Men	Women
	Per cent							
<b>1989</b>								
40-64	5.7	6.2	8.6	7.8	13.5	9.3	16.6	11.6
65-74	0.8	4.3	1.3	5.4	1.6	7.6	3.2	7.6
75-84	0.5	0.4	0.5	0.4	0.5	0.4	0.5	0.4
40-84	2.9	2.9	4.4	3.6	6.6	4.7	8.5	5.2
<b>1997</b>								
40-64	32.1	21.3	36.2	33.0	38.7	37.5	40.6	38.6
65-74	16.3	16.0	19.3	17.3	22.2	19.3	23.9	19.3
75-84	7.1	7.3	8.7	7.8	8.7	8.8	9.8	9.3
40-84	22.1	14.4	25.4	16.2	27.4	18.3	29.1	18.8

Sources: Hobbs et al. 2002; Michael Hobbs, pers. comm. 2002.

Table A9: Proportion of AMI patients receiving CABG, Perth, 1989 and 1997

	Acute admission		30 days after acute admission		90 days after acute admission		1 year after acute admission	
	Men	Women	Men	Women	Men	Women	Men	Women
<b>1989</b>								
40-64	2.74	2.33	3.2	2.3	6.7	4.7	15.0	12.4
65-74	2.62	2.7	3.9	3.2	6.3	4.9	10.0	11.9
75-84	0.9	0	1.3	0.0	2.3	0.0	2.7	0.4
40-84	2.32	1.38	3.1	1.6	5.7	2.6	10.7	6.7
<b>1997</b>								
40-64	6.04	3.41	8.7	4.6	13.3	5.7	17.9	10.2
65-74	7.53	6	10.5	6.0	13.8	10.0	20.5	14.0
75-84	3.28	2.07	3.8	2.6	6.0	4.7	6.0	5.2
40-84	5.86	3.71	8.1	4.2	11.8	6.7	16.0	9.3

Per cent

Sources: Hobbs et al. 2002; Michael Hobbs, pers. comm. 2002.

# References

- Australian Institute of Health and Welfare (AIHW) 2002a. Australia's health 2002: the ninth biennial health report of the Australian Institute of Health and Welfare. Canberra: AIHW.
- Australian Institute of Health and Welfare (AIHW) forthcoming. Diabetes – Australian facts 2002. Diabetes Series No. 3. AIHW Cat. No. CVD 20. Canberra: AIHW.
- Australian Institute of Health and Welfare (AIHW) 2001. Heart, stroke and vascular diseases – Australian facts 2001. Cardiovascular Disease Series No. 14. AIHW Cat. No. CVD 13. Canberra: AIHW, National Heart Foundation of Australia, National Stroke Foundation of Australia.
- Australian Institute of Health and Welfare (AIHW) 2000. Medical labour force 1998. National Health Labour Force Series No. 16. AIHW Cat. No. HWL 15. Canberra: AIHW.
- AIHW: Davies J & Senes S 2002. Coronary angioplasty in Australia 1999. Cardiovascular Disease Series No. 19. AIHW Cat. No. CVD 19. Canberra: AIHW and National Heart Foundation of Australia.
- AIHW: Davies J & Senes S 2001. Cardiac surgery in Australia 1998. Cardiovascular Disease Series No. 16. AIHW Cat. No. CVD 15. Canberra: AIHW and National Heart Foundation of Australia.
- AIHW: Jamrozik K, Dobson A, Hobbs M et al. 2001. Monitoring the incidence of cardiovascular disease in Australia. Cardiovascular Disease Series No. 17. AIHW Cat. No. CVD 16. Canberra: AIHW.
- AIHW: Mathers C & Penm R 1999. Health system costs of cardiovascular diseases and diabetes in Australia 1993–94. AIHW Cat. No. HWE 11. Canberra: AIHW.
- AIHW: McElduff P, Dobson A, Jamrozik K & Hobbs M 2000. The WHO MONICA Study, Australia, 1984–93: A summary of the Newcastle and Perth MONICA Projects. Cardiovascular Disease Series No. 13. AIHW Cat. No. CVD 11. Canberra: AIHW.
- Bauman A, Ford I & Armstrong T 2001. Trends in population levels of reported physical activity in Australia, 1997, 1999 and 2000. Canberra: Australian Sports Commission.
- Berger A, Schulman K, Gersh B et al. 1999. Primary coronary angioplasty vs thrombolysis for the management of acute myocardial infarction in elderly patients. *Journal of the American Medical Association* 282:341–8.
- Commonwealth Department of Health and Aged Care (DHAC) 1999. Report on the National Hospital Cost Data Collection 1997–98. Canberra: DHAC.
- Dobson A, McElduff P, Heller R et al. 1999. Changing patterns of coronary heart disease in the Hunter Region of New South Wales, Australia. *Journal of Clinical Epidemiology* 52(8):761–71.
- Dobson A, Gibberd R & Leeder S 1983. Death certification and coding for ischaemic heart disease in Australia. *American Journal of Epidemiology* 117:397–405.
- Grines C, Cox D, Stone G et al. 1999. Coronary angioplasty with or without stent implantation for acute myocardial infarction. *New England Journal of Medicine* 341:1949–56.
- Hunink MGM, Goldman L, Toesteson ANA et al. 1997. The recent decline in mortality from coronary heart disease, 1980–1990. The effect of secular trends in risk factors and treatment. *Journal of the American Medical Association* 277(7):535–41.

- Hobbs M, Bertuola B, Geelhoed E et al. 2002. The impact of new technology in the treatment and outcomes of acute myocardial infarction in Australia: Changes in medical treatments and their consequences for patient health outcomes. In McClellan & Kessler (eds.) Technological change in health care: A global analysis of heart attack. Ann Arbor: University of Michigan Press.
- Magnus P & Beaglehole R 2001. The real contribution of the major risk factors to the coronary epidemics. Time to end the 'Only-50%' myth. *Archives of Internal Medicine* 161:2657-60.
- Mark D 2000. Sex bias in cardiovascular care. Should women be treated more like men? *Journal of the American Medical Association* 283(5):659-61.
- Maynard C, Litwin P, Martin J & Weaver D 1992. Gender differences in the treatment and outcome of acute myocardial infarction. Results from the myocardial infarction triage and intervention registry. *Archives of Internal Medicine* 152:972-6.
- McElduff P, Dobson A, Jamrozik K & Hobbs M 2001. Opportunities for control of coronary heart disease in Australia. *Australia New Zealand Journal of Public Health* 25:24-30.
- Mehilli J, Kastrati A, Dirschinger J et al. 2000. Differences in prognostic factors and outcomes between women and men undergoing coronary artery stenting. *Journal of the American Medical Association* 284:1799-1805.
- Mehilli J, Kastrati A, Dirschinger J et al. 2002. Sex-based analysis of outcome in patients with acute myocardial infarction treated predominantly with percutaneous coronary intervention. *Journal of the American Medical Association* 287:210-15.
- Murray CJL & Lopez AD (eds) 1996. The global burden of disease: a comprehensive assessment of mortality and disability from diseases, injuries and risk factors in 1990 and projected to 2020. *Global Burden of Disease and Injury Series, Vol. 1*. Cambridge: Harvard University Press.
- National Heart Foundation of Australia (NHF) 1999. 1999 guide to management of hypertension for doctors. Sydney: NHF.
- Organisation for Economic Co-operation and Development (OECD) 2002. Summary of results from ischaemic heart disease study. Working party on social policy. Ageing Related Diseases. Directorate for education, employment, labour and social affairs. Employment, labour and social affairs committee. Paris: OECD.
- OECD 2001. *OECD Health Data 2001: a comparative analysis of 30 countries*. Paris: OECD.
- Stamler J, Stamler R, Neaton JD et al. 1999. Low risk-factor profile and long-term cardiovascular and noncardiovascular mortality and life expectancy: findings for 5 large cohorts of young adult and middle-aged men and women. *Journal of the American Medical Association* 282:2012-18.
- Vaccarino V, Abramson J, Veledar E & Weintraub W 2002. Sex differences in hospital mortality after coronary artery bypass surgery: evidence of a higher mortality in younger women. *Circulation* 105:1176-81.