Introduction

Cardiovascular disease is one of five priority areas in the new program of National Health Priority Areas (the others are injury, mental health, cancer and diabetes) agreed to at a meeting of Australian Health Ministers in July 1996. Its inclusion recognises the massive impact cardiovascular disease has in Australia in terms of burden of illness and economic costs and the need for coordinated activity to reduce these effects. This report is the first from a national monitoring system recently established to monitor this disease and its impact.

In September 1994, Australian Health Ministers endorsed the report *Better Health Outcomes for Australians* that set out national goals, targets and strategies for better health outcomes into the next century (Commonwealth Department of Human Services and Health 1994). One of the major recommendations of the report was to establish and maintain a national monitoring system for cardiovascular disease, its risk factors and management. The following year, the *National Health Information Development Plan* also recognised ongoing surveillance of risk factors and improved information on cardiovascular disease as high priority areas (Australian Institute of Health and Welfare and Australian Health Ministers' Advisory Council 1995). Also in 1995, the Institute published the *Outline of a National Monitoring System for Cardiovascular Disease*, following extensive consultation with representatives of government and non-government agencies, and public health researchers and epidemiologists (Bennett et al. 1995). The Commonwealth Department of Health and Family Services provides funding support for the monitoring system.

The National Cardiovascular Monitoring System

The system comprises the National Centre for Monitoring Cardiovascular Disease, collaborating centres, and the Advisory Committee.

The National Centre is located within the Australian Institute of Health and Welfare and commenced operation in January 1996. It will monitor trends and inequalities in mortality, morbidity and risk factors, monitor progress towards national goals and targets, promote standards and develop data systems.

The inclusion of collaborating centres (yet to be established) recognises that, for the national monitoring system to be fully effective, it is important that the expertise which exists in key agencies and centres of excellence be integrated into the structure of the system.

The function of the Advisory Committee is to advise on the development and implementation of the monitoring system, and guide and review its work program. The committee includes representatives from the Commonwealth and State and Territory Health Departments, the National Heart Foundation, medical colleges, and academics with expertise in the fields of cardiovascular disease, data collection and analysis.

The components of the national system are primary prevention, risk factors, disease incidence, pre-hospital and emergency care, medical and surgical hospital care, rehabilitation, follow-up care, disease prevalence and functional status, palliative care and death.

Mortality surveillance

This report addresses one of the important functions of the National Centre: to monitor and report on trends and differentials in cardiovascular mortality. The report provides a detailed statistical profile of death from cardiovascular disease and its major components, for Australia and for each State and Territory. Each mortality profile gives numbers of deaths and death rates at each age, and the annual rate of change in these rates. If feasible, future editions will progressively monitor trends in cardiovascular mortality among Aboriginal and Torres Strait Islander people, among regions and among socioeconomic groups.

Mortality profiles

Mortality profiles are provided for each cardiovascular cause of death, for Australia and for each State and Territory where numbers permit.

A mortality profile for a particular cause of death consists of:

- numbers of deaths by year, age group and sex,
- age-specific death rates by year, age group and sex,
- crude and age-standardised death rates by year and sex, for all ages and ages 25–74,
- annual rates of change (with indicators of statistical significance), and
- differences between the most recent death rate and that expected (with indicators of statistical significance).

A graph depicting the age-standardised death rates (all ages) and their estimated underlying trend is included for all cardiovascular disease groups at national level, and for selected disease groups at State and Territory level.

Full mortality profiles are given when there is at least 16 deaths in any age-specific group, in any year from 1983 to 1994, for either males or females.[1] This criterion is not satisfied in Tasmania, the Australian Capital Territory and the Northern Territory for the less common causes of death. In these instances, the total number of deaths is given by year and sex, in place of a full mortality profile.

Data sources, terms and concepts are explained more fully in the sections which follow.

Death registration data

Registration of deaths in Australia is the responsibility of the State and Territory Registrars of Births, Deaths and Marriages. Information on the cause of death is supplied by the medical practitioner certifying the death or by a coroner. Other information about the deceased is supplied by a relative or other person acquainted with the deceased, or by an official of the institution where the death occurred. The information is provided by the Registrars to the Australian Bureau of Statistics for coding of cause of death and compilation into aggregate statistics. The data in this publication are provided to the Institute by the State and Territory Registrars after processing by the Australian Bureau of Statistics.

Scope and coverage

Registration of deaths is a legal requirement in Australia and is virtually complete. All deaths which occur within Australia are within the scope of the collection, with the exception of deaths of foreign diplomatic personnel.

In the interest of timeliness, the statistics in this publication relate to the year of registration of the death, not the year of occurrence. Usually about 5–6% of all deaths (and deaths from cardiovascular disease) which occur in one year are not registered until the following year or later.

This report covers the period from 1983 to 1994, the latest year for which data are available. In 1984 there were abnormal delays in the registration process in New South Wales which had the effect of displacing approximately 2,000 death registrations from 1984 to 1985. In 1985, these represent about 1.7% of all deaths in Australia and 4.5% of deaths in New South Wales. The effect on estimates of trend for that State has been shown to be negligible. In 1988 legislation revisions in the Northern Territory meant that some deaths were registered in that year which may not have been registered until 1989 under the former legislation. The effect is negligible for Australia but contributed to the relatively higher cardiovascular death rate for females in the Northern Territory in 1988.

1. Although such a decision includes an element of subjectivity, the relative standard error on a count of 16 deaths is 25% (assuming a Poisson distribution for the number of deaths), which is a reasonable compromise between the need for precision and the desire to report in as much detail as possible.

Results are given for males and females separately, and for the age groups <25, 25–34, 35–44, 45–54, 55–59, 60–64, 65–69, 70–74, 75–84, and 85+. Results are also given for the age group 25–74. This age range aligns with National Health Priority Area indicators for cardiovascular mortality.

Classification of cause of death

The mortality classification is based upon the International Classification of Diseases, Ninth Revision (ICD-9) (World Health Organization 1977), which was first used in Australia in 1979. Where more than one condition is mentioned on the medical certificate of cause of death, one 'underlying cause' is selected from those shown. ICD-9 contains detailed rules for this selection. The following classification of causes of death has been used in this report:

- cardiovascular disease (ICD-9 390–459; 'Diseases of the Circulatory System')
- rheumatic heart disease (ICD-9 390–398; 'Rheumatic Fever and Rheumatic Heart Disease')
- hypertensive disease (ICD-9 401–405)
- ischaemic heart disease (ICD-9 410–414)
  - acute myocardial infarction (ICD-9 410)
  - other coronary heart disease (ICD-9 411–414; 'Other Ischaemic Heart Disease')
- heart failure (ICD-9 428)
  - congestive heart failure (ICD-9 428.0)
- cerebrovascular disease (ICD-9 430–438)
- atherosclerosis (ICD-9 440)
- peripheral vascular disease (ICD-9 441–444)
- other cardiovascular disease (ICD-9 415–427, 429, 446–459; 'Other Diseases of the Cardiovascular System')
- all causes (ICD-9 001–999)

The shorter disease descriptions are used in the commentary for easier reading. Full disease descriptions, as in ICD-9, are used in the mortality surveillance profiles.

Data quality

The Australian Bureau of Statistics uses a variety of quality control measures to ensure mortality data are as reliable as possible. These measures include seeking further information where necessary to enable accurate classification of the underlying cause of death. When a medical certificate of cause of death does not give sufficient information to enable coding, and the deceased was aged less than 75, the Australian Bureau of Statistics writes to the certifying doctor (or medical superintendent when death occurred in a hospital) seeking addition information. When the deceased was aged 75 or over, queries are made only where an operation has been performed but the condition requiring surgery was not stated, but otherwise not for cardiovascular disease. Responses are returned via the Registrar of Births, Deaths and Marriages, who supplies the original information. Other quality control measures include check-coding of cause of death, detailed computer editing of data, and checks on the statistical output, at the individual record and aggregate levels.

Since 1993, the Queensland office of the Australian Bureau of Statistics has been responsible for processing all cause of death data to ensure greater consistency in coding and improved data quality. Before this, cause of death processing was carried out in each of the Australian Bureau of Statistics offices.

It has been demonstrated that coding of death for acute myocardial infarction (ICD-9 410) and ischaemic heart disease (ICD-9 410–414) is reasonably accurate in Australia (Boyle & Dobson 1995).

Death rates

This report uses three types of mortality indicators. These are age-specific death rates, crude death rates and age-standardised death rates, as described below. All rates are calculated separately for males and females and are expressed per million population. Population data are the estimated resident population at 30 June in each year, published by the Australian Bureau of Statistics (see Appendix).

Age-specific death rates

Age-specific death rates are death rates relating specifically to a certain age group. For each age group they have been calculated as the number of deaths in that age group divided by the mid-year estimated resident population for that age group, i.e.

$$r_i = d_i \; / \; p_i$$

where r_i is the age-specific death rate for age group i, d_i is the number of deaths for age group i, and p_i is the mid-year estimated resident population for age group i.

Crude death rates

The annual crude death rate is the total number of deaths in a year divided by the total mid-year estimated resident population, i.e.

$$CR = \Sigma d_i \; / \; \Sigma p_i$$

where CR is the crude death rate, d_i is the number of death for age group i, and p_i is the mid-year estimated resident population for age group i. The crude death rate is influenced by changes in the age structure of the population over time.

Age-standardised death rates

Age-standardisation is a method of adjustment to allow for the effect of variation in the population age structure when comparing death rates for different years or different locations (e.g. States and Territories). This report has used direct standardisation by applying the age-specific death rates for a particular year to a standard population (Armitage & Berry 1987). This produces an estimate of the death rate which would have prevailed in the standard population if it had experienced the age-specific death rates in the year under study.

The standard population used is the total estimated 1991 mid-year Australian population. The usual convention of using age-specific death rates for 5-year age groups, defined as 0, 1–4, 5–9, …, 80–84, 85+ years, has been followed for the standardisation according to the following formula:

$$ASR = \Sigma r_i P_i \; / \; \Sigma P_i$$

where ASR is the age-standardised death rate, r_i is the age-specific death rate for age group i, and P_i is the standard population in age group i.

Modelling the data

The underlying annual rate of change from 1983 to 1994 has been estimated for age-specific and age-standardised death rates. An appropriate model for this type of mortality data is a Poisson regression model, with a Poisson error distribution, a log link function and the natural log of population treated

as an 'offset' (Breslow & Day 1987; Brillinger 1986; Valkonen 1989). For a particular cause of death, the model may be expressed as:

$$\log_e (D_t) = \log_e (N_t) + \text{constant} + \alpha t$$

where t is the year of registration of death, D_t is the expected number of deaths registered in year t, N_t is the mid-year population in year t, and α is the estimated annual rate of increase or decrease in mortality.

This model forms the basis for the estimate of underlying trend and the statistical tests described below. The criteria for applying it to the mortality time series data were:

- the series contained non-zero deaths for at least four years, and
- the average number of deaths across the twelve years was at least two.

Where these criteria were met, this model was fitted separately for males and females, for each age-specific group, and for the age-standardised rates (all ages and ages 25–74).

Statistical tests

Two statistical tests were applied both to the age-standardised and age-specific mortality time series for males and females separately wherever the data met the above criteria for modelling. They are a 'test for trend', and a 'test for difference' to help assess whether the death rate for the most recent year is unexpected.

Test for trend

The trend is calculated from the estimated value of α from a Poisson regression model fitted to the data for all twelve years. It indicates whether death rates are generally increasing or decreasing over the period and, if so, to what extent.

Based on α, an average annual rate of change has been derived as follows:

$$\text{percentage change} = [e^{\alpha} - 1] \times 100\%$$

The annual percentage increase (or decrease) is presented in the 'Trend' column under statistical tests and can be interpreted as the average percentage change in mortality rates between consecutive years.

A blank denotes that a model has not been fitted because the data did not meet the modelling criteria.

The test of statistical significance for the annual percentage change was two-tailed, i.e. there was no prior assumption that the mortality rate would be increasing or decreasing and the alternative hypothesis was that the change in mortality rate was *different* from zero. Trends which were statistically significant at the 5% and 1% levels of significance have been indicated by asterisks.

Test for difference

The test for difference refers to the difference between the observed and projected death rates for 1994 expressed as a percentage of the projected rate. The projected death rate for 1994 is estimated from a Poisson regression model fitted to the mortality time series for the period 1983 to 1993.

This field is left blank if a model was not fitted because the data did not meet the modelling criteria.

The test of statistical significance of the difference was two-tailed, i.e. there was no prior assumption that the mortality rate for 1994 would be above or below the value predicted from the model fitted to previous years. Differences which were statistically significant at the 5% and 1% levels of significance have been indicated by asterisks.

Significance level

Many significance tests have been performed throughout the report and it is therefore likely that some test results reported as 'statistically significant' are the result of chance. The possibility of a chance effect should be carefully considered when making judgements about whether statistically significant trends have sufficient medical or epidemiological importance to warrant further attention.

Some of the estimates for the Northern Territory in particular, but also for the Australian Capital Territory, are based on small numbers and may be unstable.

Tables and graphs

The following terms and symbols are used in tables:

ICD-9	International Classification of Diseases, Ninth Revision
Trend	Estimated annual percentage change together with its statistical significance
RD	Relative difference between the observed and projected rate for 1994, as a percentage of the projected value, together with its statistical significance
*	Statistically significant at the 5% level
**	Statistically significant at the 1% level
blank	The data did not meet modelling criteria

For each cause of death, the scale on the vertical axis of the graph has been chosen to display best the scatter of the twelve observed mortality rates about the fitted trend line. The same scale has been used for males and females, but care should be taken when comparing graphs of trends between causes of death because the scales differ.

Graphs are based on rates which are accurate to one decimal place, whereas rates in tables are rounded to the nearest integer. This can result in apparent minor discrepancies between plotted values and their corresponding table values.