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Occasional Paper

Mortality of Aboriginal and Torres Strait Islander Australians

1997

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Australian Bureau of Statistics

Aboriginal and Torres Strait Islander Health and Welfare Information: a joint program of the Australian Bureau of Statistics and the Australian Institute of Health and Welfare.

This Occasional Paper is intended to make the results of current research available to other interested parties. The aim is to encourage discussion and comment.

Views expressed in this paper are those of the authors and do not necessarily represent those of the Australian Bureau of Statistics. Where quoted or used, they should be attributed clearly to the authors.

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SUMMARY

This publication describes the mortality of Aboriginal and Torres Strait Islander Australians in the three-year period 1995–97. Most of the data presented are from Western Australia, South Australia and the Northern Territory combined, as these jurisdictions were believed to have the most complete coverage of Indigenous deaths during the period of interest. The process used by the Australian Bureau of Statistics to assess completeness of coverage is described in detail in this publication.

Data quality remains a critical issue in the assessment of Indigenous mortality, and there is under-identification of Indigenous deaths to some degree in all jurisdictions. As a result, the observed differences between Indigenous and non-Indigenous or all-Australian mortality reported in this publication are under-estimates of the true differences. Limitations in the quality and availability of data also compromise our ability to assess changes in Indigenous mortality over time, both in absolute terms, and relative to the rest of the Australian population.

In 1995–97 in Western Australia, South Australia and the Northern Territory combined, there were three times as many deaths among males and females identified as Indigenous as would have been expected if Indigenous people had experienced the same death rates as all Australians. Deaths identified as Indigenous occurred at younger ages than other deaths. About 23% of infant deaths were identified as Indigenous, compared with about 1% of deaths in people aged 65 years or more. More than half (53%) of deaths among Indigenous males occurred in people less than 50 years old, compared with 13% of all male deaths in Australia. Similarly, 41% of deaths among Indigenous females, and 7% of all Australian female deaths, occurred before age 50 years.

Age-specific death rates were higher for Indigenous people than for the total Australian population in every age group, but the largest differences were observed among males and females aged 35–54 years old, when the rates were 6–7 times higher. There were more deaths than expected among Indigenous males and females for virtually every cause of death. The rates of death from many chronic diseases rose earlier and stayed higher throughout the life span for Indigenous people than for all Australians.

The majority of deaths identified as Indigenous were due to circulatory diseases, injury, cancer, respiratory diseases and endocrine diseases, which together accounted for about three out of every four Indigenous deaths. These same causes accounted for the majority of deaths for Australians overall, but deaths from these causes occurred at greater rates among Indigenous people. For example, among Indigenous males, there were three times more deaths from circulatory diseases, three times more deaths from injury, five times more deaths from respiratory diseases, six times more deaths from endocrine diseases, and 40% more deaths from cancer than would have been expected based on Australian rates. Similar results were observed for these causes among Indigenous females, with the exception of endocrine diseases, for which there were 12 times more deaths than expected.

Death rates from all causes were higher in almost every age group for Indigenous males and females in Western Australia, South Australia and the Northern Territory in 1995–97 than for their New Zealand Maori and Native American counterparts in 1996.

CHAPTER 1 INTRODUCTION

This publication examines the mortality of Aboriginal and Torres Strait Islander people using deaths which occurred in 1995–97 and were registered by the end of 1998, the latest year for which data are currently available. Although mortality is not always sensitive to subtle changes in health status, and there can be relatively long delays between improvements in health and reductions in mortality, it is still an important measure of the health of a population. Analysis of deaths by age, sex, cause, and other characteristics can provide a useful indication of the pattern of ill health in the Indigenous population.

The health disadvantage faced by Aboriginal and Torres Strait Islander Australians is well known and exists throughout the life cycle. Despite clear differences in health status between Indigenous and other Australians, however, the precise magnitude of these differences is difficult to determine because of inadequate data quality and/or availability. Data on mortality and other health measures are limited by incomplete identification of Indigenous people as well as difficulties in estimating the size and composition of the Indigenous population. These shortcomings in turn result in a lack of comparable data over time, which makes it difficult to assess trends (ABS & AIHW 1999). As a result, no information on trends in mortality is reported in this publication.

Most of the information presented in this publication is based on deaths in Western Australia, South Australia and the Northern Territory, as these are the jurisdictions that have been assessed by the Australian Bureau of Statistics (ABS) as having the most complete coverage of Indigenous deaths during the time period of interest (ABS 1999a). The ABS publishes detailed Indigenous mortality data only for jurisdictions which are judged to have adequate data quality, a decision which is based on an estimation of the proportion of Indigenous deaths which are recorded as such (ABS 1999a). As this process may not be well understood outside the ABS, this publication includes an explanation of the assessment of completeness of coverage of Indigenous deaths.

CHAPTER 2 METHODS AND DATA SOURCES

MORTALITY DATA

Information on deaths was obtained from the Australian Bureau of Statistics (ABS) Deaths Registration Database. This database consists of data provided by State and Territory Registrars-General, with subsequent coding of cause of death performed by the ABS. The database is currently complete for all registrations through the calendar year 1998. Information on registered deaths and causes of death for Australia as a whole is available elsewhere (e.g. ABS 1999a; ABS 1999b).

Indigenous identification in death registration data

With the introduction of a question in Queensland in 1996, all States and Territories now include on their death notification forms a question about the Indigenous status of the deceased person (ABS & AIHW 1999). Most jurisdictions use the following ABS standard question (or a slight variation):

> *Was the deceased of Aboriginal or Torres Strait Islander origin? (If of both Aboriginal and Torres Strait Islander origin, tick both 'yes' boxes.)*
>
> ☐ *No*
> ☐ *Yes, Aboriginal origin*
> ☐ *Yes, Torres Strait Islander origin*

Despite the use of a common question, there appear to be large differences in the completeness with which deaths of Indigenous people are recorded as Indigenous. Errors can occur at any of several steps. When an Indigenous person dies, his or her death will only be classified correctly as an Indigenous death in the Registrar's database if the following events occur: the question about Indigenous status is answered correctly on the death notification form (which usually requires that the question is asked of a relative or friend who knows what the deceased person would have answered, and that the answer is recorded correctly on the form); the form is completed and submitted to the Registrar's office; and the form is processed and the information about Indigenous status correctly entered into the system. This information must then be retained throughout the editing and data processing stages and captured correctly on the file sent by the Registrar to the ABS.

Indigenous identification in death registration data
continued

The assessment of the completeness of recording of Indigenous deaths is based on a comparison of registered Indigenous deaths with an estimate of the expected number of Indigenous deaths for a particular jurisdiction. The ABS publishes this information annually in its *Deaths, Australia* series (e.g. ABS 1999a). As a result of such comparisons, detailed statistics have generally only been published for the Northern Territory, Western Australia and South Australia, as these jurisdictions have had the smallest discrepancy in relative terms between the number of deaths identified as Indigenous and the estimated number of expected Indigenous deaths. Queensland, which began collecting information on Indigenous status on death records in 1996, was added to this group in the most recent release of death data, which covers death registrations in calendar year 1998 (ABS 1999a). Other jurisdictions were assessed as having inadequate identification of Indigenous deaths to allow for publication of detailed figures for the period of interest (ABS 1999a). This situation may change in the future, however, given recent improvements in data quality in many jurisdictions in response to collaborative work being undertaken by the ABS and other agencies to improve Indigenous identification in death registrations and other administrative data collections.

The process of estimating expected Indigenous deaths is quite complex and is subject to considerable variability in the estimates. This process is explained more fully in chapter 3 and Appendix 3.

Year of occurrence versus year of registration

Most deaths are registered in the year in which they occur, but a proportion of deaths are registered in the next year or in subsequent years. This proportion differs for the Indigenous and total Australian populations, with late registrations more common among Indigenous deaths (about 15% for deaths identified as Indigenous compared with about 4% for other deaths; see Appendix 2 for more details). Late registration is perhaps most common for deaths which take place late in the year and for those involved in the coronial system, but it may occur for a variety of other reasons.

In addition to the late submission of death notification forms, the number of deaths registered in a particular year can be affected by factors such as changes to processing systems, clearing up of backlogs, and data quality editing. Year to year fluctuations in registrations have a greater impact on Indigenous deaths than on other deaths, both because of the relatively small number of Indigenous deaths and because of their higher proportion of late registrations. It is important to note that changes from one year to the next in the number of deaths registered as Indigenous do not necessarily reflect changes over time in the underlying Indigenous death rate, nor do they necessarily represent changes in the quality of identification of Indigenous deaths.

Year of occurrence versus year of registration *continued*

Data by year of occurrence are much better than data by year of registration for capturing both the levels of mortality and the quality of identification. However, there is an inevitable delay in the availability of data by year of occurrence because of the necessity of waiting at least a year for the majority of late registrations. For example, in order to analyse deaths which occurred in 1997, it is necessary to wait until at least the end of 1998, or perhaps 1999, to be sure that the vast majority of relevant deaths have been registered. In this publication, data by year of occurrence are used when the mortality experience of the population is of interest, while data by year of registration are sometimes used as an indicator of the performance of the death data collection, registration and processing system.

Most of this publication deals with deaths which occurred in the three year period 1995–97 and which were registered by the end of 1998, the latest year for which data were available at the time of writing. Despite the higher proportion of late registrations among deaths identified as Indigenous, it appears that almost all Indigenous deaths are recorded by the end of the year following the year in which death occurred (see Appendix 2). Although a few deaths which occurred in the period 1995–97 will be registered in 1999 and subsequent years, no adjustments have been made for any such missing deaths, as this could imply a false sense of precision. In any case, it is likely that any underestimation resulting from the absence of post-1998 registrations is very small compared with the underestimation resulting from incomplete identification of Indigenous deaths.

Cause of death

Underlying cause of death has been coded by the ABS according to the International Classification of Diseases, 9th Revision (ICD-9; WHO 1977). In this publication, information is presented about all causes of death combined, as well as about causes of death at the level of ICD-9 chapters. Information about a few more specific causes of death which are of particular relevance for the Indigenous population is also presented. A list of chapters and specific causes of interest by ICD-9 codes is presented in Appendix 1.

Included data

The focus of this publication is on deaths which occurred in 1995–97, but earlier deaths were included in some analyses. Data from all jurisdictions are included in a few tables, but much of this publication focuses on data from Western Australia, South Australia and the Northern Territory combined. Although it appears that data quality in Queensland had improved to publishable levels by 1998 (ABS 1999a), Queensland did not begin to collect the relevant information until the middle of the period of interest (1995–97) and therefore could not be included in the more detailed analyses.

Missing data

Deaths for which Indigenous status was not recorded have been classified as 'other', and included along with those for whom Indigenous status was recorded as non-Indigenous. Deaths for which age and/or sex was missing were excluded from analyses which require this information (e.g. age standardisation).

POPULATION ESTIMATES AND PROJECTIONS

The ABS refers to its estimates and projections of the Indigenous population as 'experimental' because of the nature of the base population and deficiencies in the quality of data on births, deaths and migration. There is considerable volatility in the counts of Indigenous people from one census to the next, which affects the estimation and projection of the Indigenous population. For example, the number of people counted in the census who identified as Indigenous was much larger in 1996 than in 1991, and only about half of the difference could be explained by standard demographic factors (Ross 1999). As a result, there have been large differences between what was projected for 1996 based on 1991 Census data, and what was subsequently estimated based on 1996 Census data. (For more details, see ABS 1998a, 1998b; ABS & AIHW 1999; Ross 1999.)

This discrepancy in population figures is important in the analysis of health events because it affects the calculation of rate and ratio measures, including death rates. Such rates typically include the number of events (such as deaths) in the numerator and the relevant population estimate in the denominator. The use of 1996 Census-based estimates, which are higher than the 1991 Census-based estimates, will result in lower rates, all other things being equal, because the denominator is larger. The size of the difference between 1991 Census-based projections and 1996 Census-based estimates for the same year (for 1996, for example) varied from place to place, and the effect on rates will also vary. More information on the consequence for mortality rates of using population estimates and projections based on different census years is presented in Appendix 2.

It is reasonable to assert that data from the 1996 Census provide better information on which to estimate the Indigenous population in 1996 than do data from other census years. Similarly, it could be argued that the 1991 Census-based experimental estimates are possibly more appropriate for 1991 than are 1996 Census-based estimates for 1991. However, there is increasing uncertainty as one moves away from a census year.

In this publication, data are presented for the three year period 1995–97. One advantage of using deaths which occurred in 1995–97 is that this period is centred on the census year 1996, thus providing the best possible population estimates. This is especially important for Indigenous population estimates which are subject to much greater uncertainty than those for the total population. However, it should be noted that changes in the completeness of identification of Indigenous people in death records may take place at different rates than changes in the identification of Indigenous people in the census.

Unless otherwise specified, the rates in this publication were calculated using population estimates and projections based on the 1996 Census. Estimates (for years up to and including 1996) and projections (for years after 1996) were available by age, sex and State or Territory. The following age groups (in years) were used: less than 1, 1–4, 5–14, 15–24, 25–34, 35–44, 45–54, 55–64, 65–74, 75 and over.

POPULATION ESTIMATES AND PROJECTIONS *continued*

The figures used for the Indigenous population are based on the experimental estimates and low series projections published by the ABS (1998a; 1998b). For the total population, published ABS estimates have been used (ABS 1997a; 1998c). Non-Indigenous population estimates/projections were calculated by subtracting the Indigenous population estimates/projections from the total population estimates. All ABS population estimates and projections are based on State and Territory of usual residence, as are estimates of expected deaths.

More detailed information on the estimation and projection of the Indigenous population is presented in chapter 3.

MEASURES OF MORTALITY

A number of measures of mortality are presented in this publication, including age-specific death rates, directly age-standardised death rates (ASDR), and age-standardised mortality ratios (SMR).

Although the number of deaths occurring in a given time and place can provide useful information, it is generally more meaningful to think in terms of the number of deaths in relation to the size of the population. Dividing the number of deaths by the number of people in the population (total mid-year estimated resident population) gives us the crude death rate, which is often expressed as deaths per 100,000 population. The age-specific death rate is simply the death rate for a particular age group, that is, the number of deaths in a specific age group divided by the mid-year estimated population in the same age group.

The number of deaths in a population is influenced by the age structure of the population. Older people are generally more likely to die than younger people. In order to compare the mortality experiences of two populations with different age structures, it is important to correct for the effect of age. This is especially relevant in comparisons of the Indigenous population with the non-Indigenous or total Australian population, as the Indigenous population has a considerably younger age structure than the non-Indigenous (and total Australian) population (ABS & AIHW 1999).

Correction for differences in age structure is performed in this publication through the use of age standardisation. Standardisation can be performed using either the direct or indirect method. In direct standardisation, a standard population (such as the total Australian population) is chosen, and the age-specific rates for the groups of interest (e.g. Indigenous and other) are applied to the standard population. This results, for each group, in an age-standardised death rate, which is a theoretical estimate of what the death rate would have been if age-specific death rates of the group of interest (e.g. Indigenous) had applied to the age structure of the standard population (e.g. all of Australia). ASDRs are reported per 100,000 population. The ASDRs for different groups can be compared, and a ratio of these rates can be calculated. In this publication, the standard population used is the total Australian population as at 30 June 1991,

which is the current convention in Australia. The use of a different standard population, such as the World Standard Population, would result in different ASDRs as well as different rate ratios. Appendix 2 presents a comparison of ASDRs for deaths from all causes, using different standard populations.

In indirect standardisation, a set of standard rates (rather than a standard population's age distribution) is used. The standard age-specific rates (e.g. all-Australian rates) are applied to the age structure of the group(s) of interest to calculate the 'expected' number of deaths. This number indicates how many deaths would be expected in the group of interest if it had experienced the standard rates (e.g. if the Indigenous population had experienced the all-Australian rates). The number of deaths which were actually observed (in the case of the Indigenous population, those which occurred *and were recorded as Indigenous*) is then divided by the number expected, to produce the standardised mortality ratio (SMR). An SMR greater than 1.0 indicates that more deaths were observed than expected. An SMR less than 1.0 indicates that there were fewer than expected deaths. In this publication, the standard rates used are those for the all-Australian population for the relevant sex and year(s) for which the comparison is made (usually 1995–97 combined). Although it is possible to calculate an SMR for the Indigenous and non-Indigenous populations using all-Australian rates in this way, only Indigenous SMRs are presented in this publication.

It should be noted that the concept of 'expected' deaths in indirect standardisation is different from the calculation of 'expected' Indigenous deaths discussed in the first section of this chapter and in chapter 3. The former is related to the adjustment for differences in age structures for two or more groups, with 'expected' deaths based on a *standard* set of rates (such as those of the total Australian population). The latter is related to the assessment of the completeness of registration of Indigenous deaths; 'expected' numbers in this context are based on the assumed underlying *Indigenous* rates.

All of the measures of mortality discussed in this section are affected by the incomplete identification of Indigenous deaths. Because some proportion of deaths of Indigenous people are not identified as Indigenous, the rates and ratios used in this publication will underestimate any differences between the Indigenous population and the total Australian population.

COMPARISON GROUP

The total Australian population is used as the comparison group in most of this publication. Although it may be theoretically preferable to use the non-Indigenous population as the comparison group (because the Indigenous population is included in the total population), there are practical difficulties in doing so. The incomplete identification of Indigenous deaths means that a number of Indigenous deaths are misclassified and included as non-Indigenous deaths. In addition, the challenges of estimating the size and composition of the Indigenous population are carried through to the estimation of the non-Indigenous population. These difficulties can be avoided by using total Australian deaths and the total Australian population, neither of which is affected by the imperfect recording of Indigenous status. Although the total population includes the Indigenous population, this does not present major difficulties in comparison because the Indigenous population is very small relative to the total population. In particular, the Indigenous population of Western Australia, South Australia and the Northern Territory combined is small relative to the total Australian population.

In a few instances, in which direct standardisation is used, the comparison group is 'Other', which consists of all deaths not specifically identified as Indigenous. Although the rates of death in the total Australian population are not identical to those in the 'Other' group, they are very similar, and the choice of a comparison group makes little difference to the results.

COMPARISON WITH FIGURES FROM OTHER SOURCES

Comparison of figures presented in this publication with figures from other sources should only be undertaken with extreme caution. Differences between the figures presented in this publication and figures presented elsewhere may be due to a variety of factors. These include changes over time in the quality of data, especially with respect to the recording of Indigenous status; differences in the population estimates used, both for the Indigenous population (due to the difference in the census year on which estimates are based) and for the total population (due to changes between provisional and final estimates); the use of data by year of registration rather than by year of occurrence; the choice of the standard population or standard rates used in age standardisation; and real changes in the mortality experience of the Indigenous population over time. Unfortunately it is not possible to quantify adequately the relative contribution of each of these potential sources of difference. Data presented in Appendix 2 illustrate how the results can change depending on factors such as which population estimates are used and whether year of occurrence or year of registration data are used.

Many of these factors also limit our ability to estimate trends over time. This is why no data on trends are presented in this publication. In addition to the strong possibility of changes in data quality over time, the large increase in the number of people counted as Indigenous between the 1991 Census and the 1996 Census makes it difficult to determine the most appropriate estimates to use for intercensal years (see ABS & AIHW 1999 for more details).

COMPARISON WITH FIGURES FROM OTHER SOURCES *continued*

It should be noted that this publication uses the age group '75 years and over' as the oldest age group, due to small numbers at older age groups in the Indigenous population. By contrast, for routinely published data on the Australian population as a whole, the age groups '75–84 years' and '85 year and over' are used (ABS 1999a). As a result, the age standardised rates for Australia as a whole will not agree exactly with those published elsewhere (for example, ABS 1999a). Similarly, the age-specific rates for the age group '75 years and over' will not match those for the two age groups '75–84 years' and '85 years and over'.

STATISTICAL SIGNIFICANCE

Statistical significance is concerned with the type of error known as sampling error. However, in the case of Indigenous mortality, non-sampling error (e.g. under-identification of deaths) is of much greater concern. No measures of statistical significance are used in this publication, as this could falsely suggest greater precision than actually exists. All comparisons should be interpreted with great caution, and readers should always bear in mind the limitations of the data, such as those outlined above. The emphasis should be on broad differences and similarities, and on patterns rather than on detailed numerical figures.

CHAPTER 3

ASSESSING THE COMPLETENESS OF COVERAGE OF INDIGENOUS DEATHS

WHY AND HOW ASSESS THE COMPLETENESS OF COVERAGE?

The coverage of Indigenous deaths in Australia is not perfect. That is, not every death of a person who identifies as Indigenous is recorded as such in the relevant death collection. This results in an underestimation of the number of Indigenous deaths actually occurring, and, by extension, an underestimation of the difference in mortality between the Indigenous population and the rest of the Australian population.

Using inadequate data for such comparisons can result in incorrect interpretations. For example, if no deaths of Indigenous people were recorded as being Indigenous (a situation which existed until recently in Queensland), then the Indigenous population would appear to be immortal, based on the observed mortality rate (that is, the number of deaths, in this case nil, divided by the number of people in the Indigenous population). In this extreme example, it is highly likely that potential users of the data would easily recognise the deficiencies. If the level of under-identification were somewhat less extreme, however, it would be more likely that at least some users would not be aware of the shortcomings of the data and would make conclusions based on observed death rates which might be quite different to the true rates. Depending on the level of completeness, it would be possible for a given level of Indigenous mortality to appear either somewhat higher than, somewhat lower than, or not very different to that of the total Australian population.

If the level of under-coverage were known, it would be possible to adjust for it by multiplying the number of registered deaths by the inverse of the proportion complete. For example, if deaths were 90% complete, we could multiply registered 'Indigenous' deaths by 1/0.90, or 1.11, to estimate the total number of actual Indigenous deaths. Ideally, there would be a separate correction factor for each combination of geography, age, sex and cause, but this is unlikely to be possible, due to relatively small numbers of deaths.

Jurisdictions (and smaller areas) are likely to differ in the completeness of coverage of Indigenous deaths. Some jurisdictions, such as the Northern Territory, are widely believed to be good at identifying Indigenous deaths. Others are perceived to be less successful. Jurisdictions began to ask about Indigenous status on their death registration forms starting in the 1980s, with the exception of Queensland, which began in 1996, and most jurisdictions are now using the ABS standard question, or something very close to it (ABS & AIHW 1999). However, the circumstances in which the question is asked, or, indeed, whether it is asked at all, may vary from place to place.

WHY AND HOW ASSESS THE COMPLETENESS OF COVERAGE? *continued*

Because of the real possibility that the use of inadequate data will mislead rather than inform, it is important to assess the quality of data and to communicate this information to users. At the same time, such assessments can help to target efforts to improve quality by identifying areas of greatest need. The challenge is to identify and use measures of data quality that are valid, easily understandable, and can be calculated using existing information (or for which the collection of additional data is not prohibitively expensive).

Trends by year of registration

One possible method of quantifying changes in the completeness with which Indigenous deaths are recorded as Indigenous is to look at changes in the number of deaths identified as Indigenous over time. For example, in the six year period 1993–98, a total of 758,695 deaths were registered in Australia. Of these, 8,551 (1.1%) were identified as Indigenous. The number of registered deaths identified as Indigenous, and their proportion of the total, has increased over the period (table 3.1). This increase could be explained by improved recording of Indigenous deaths, including the introduction of a question on Indigenous status on Queensland death registration forms in 1996. However, it could also be explained by increases in the actual numbers of Indigenous deaths (i.e. increased mortality), or by a combination of changes in identification and mortality. The problem is that it is not possible to determine with certainty the relative contributions of these factors, without collecting additional information. In particular, it is important to note that increases in the number of deaths registered may occur even if underlying Indigenous mortality is actually decreasing (and vice versa).

3.1 DEATHS IDENTIFIED AS INDIGENOUS, AUSTRALIA(a)

Year of registration	*no.*	*% of all deaths*
1993	1 134	0.9
1994	1 153	0.9
1995	1 182	0.9
1996(b)	1 306	1.0
1997	1 662	1.3
1998	2 114	1.7

(a) Based on year of registration.

(b) Queensland began recording Indigenous status on death registration forms in 1996.

Source: Deaths Registration Database, ABS.

A method used by the ABS

Using trends in the number of deaths registered as Indigenous is obviously not an adequate method for assessing completeness. A better and more direct way is to use information on the demographic features of the Indigenous population, which is how the Australian Bureau of Statistics (ABS) assesses the completeness of coverage of Indigenous deaths.

The method is deceptively simple in concept. The number of deaths registered as Indigenous in a particular area in a given time period is compared with the number of Indigenous deaths expected to occur in the corresponding place and time. The number of registered deaths is expressed as a proportion of the number of expected deaths. For example, if 100 Indigenous deaths were expected and 90 were registered, then the coverage is 0.9, or 90% complete. The ABS includes this information for each State and Territory in its annual series *Deaths, Australia* (see, for example, ABS 1999a).

The expected number of Indigenous deaths is based on the size and structure of the Indigenous population in the area of interest and its age- and sex-specific mortality rates. In essence, the mortality rate for each age group is multiplied by the number of people in that age group, with separate calculations for males and females. For example, if there were 2,000 Indigenous males in an age group, and the death rate for that age group was 5 per 1,000, then 10 deaths would be expected among males in that age group. The results for each age-group and sex are then summed up to get the number of expected deaths for the Indigenous population as a whole (either for Australia or for the State or Territory of interest).

Despite the apparent simplicity, however, the process required to calculate the estimates of expected Indigenous deaths is actually an extremely complex one. The calculations depend on accurate population estimates and accurate age-specific mortality rates. This would be a straightforward task if good information about Indigenous births, deaths and migration were available, and if census counts of Indigenous people were stable, but this is not the case. As a result of limitations in the quality and availability of relevant data, experimental methods of population estimation are required. The accuracy of the estimation of expected deaths ultimately rests on the accuracy of the estimation of the size and composition of the Indigenous population and its age-specific mortality rates.

ESTIMATING THE SIZE AND COMPOSITION OF THE INDIGENOUS POPULATION

The ABS produces experimental estimates and experimental projections of the Indigenous population. The term 'estimate' relates to the relevant census year and prior years, while the term 'projection' refers to future years. For example, based on data from the 1996 Census, estimates have been produced for 1996, 1995, 1994, 1993, 1992 and 1991 (ABS 1998a), while projections are available for 1997–2006 (ABS 1998b). Different methods are used to produce the estimates and projections, but the estimates provide the starting point for the projections, so the two processes are related.

How the estimates were calculated

The estimation of the Indigenous population begins with the Census of Population and Housing, which is conducted every five years, most recently in 1996. The number of Indigenous people counted in the census is derived from the number of people who either personally indicated on a census form that they were of Aboriginal and/or Torres Strait Islander origin, or for whom this was indicated by another person who filled out the form (such as another member of the household, for example).

Two types of census forms were used in the 1996 Census (and other censuses) for Indigenous people. One of these was the standard self-administered household form, which was used in the majority of households. In some Indigenous communities, interviewer-administered, Special Indigenous Household and Personal Forms were used as part of the ABS strategy to improve the enumeration of Indigenous people (Alphenaar, Majchrzak-Hamilton & Smith 1999).

The number of Indigenous people counted in the census does not perfectly represent the size of the Indigenous population, a situation which is also the case for the total population. Several adjustments are made to get from the census count to the experimental estimate of the Indigenous population (the estimated resident population, or ERP) for the day of the census. Counts based on place of usual residence (that is, where people said they usually lived) are used as the starting point. Adjustments to the 1996 Indigenous census count were made based on birthplace of parents, non-response to the question on Indigenous status, net census undercount, and births which occurred in the year before the census (ABS 1998a). These are discussed in more detail in the following paragraphs. The impact of all the adjustments can be seen by comparing the ERP and the census count. The Indigenous ERP for 6 August 1996 was 386,913, while the census count for the same day was 352,949 (ABS 1998a).

Adjustment for parental birthplace occurred in two parts, the first as part of the data quality procedures used to minimise the amount of error in the census, and the second as part of the population estimation procedure. During the processing of census forms, data are checked wherever possible, and implausible values (such as a two-year-old with a job) are queried and, in some cases, changed. In 1996, if individuals indicated that they were Indigenous but both they and their parents were recorded as having been born overseas, then it was judged to be highly unlikely (although not impossible) that they were actually Indigenous. In this case, the data were changed and the individuals were re-assigned to the 'non-Indigenous' category (Ross 1999).

How the estimates were calculated *continued*

In the second stage, during the estimation process, an additional filter was used. In this case, people who said they were Indigenous and that both parents were born overseas, but who were themselves born in Australia, were excluded from the Indigenous count for the purposes of population estimation only (that is, their census records remained unaltered). This was done to ensure comparability with the edits used after the 1991 Census (ABS 1998a; Ross 1999).

For some people who were included in the census, there was no answer to the question on Indigenous status. This could have occurred either because a person did not fill out a census form at all or because a census form was completed but the question on Indigenous status was not answered. If no census form was filled out, a 'dummy' form was completed by a census collector in some cases. This form indicated only the sex and State of usual residence of the person, with age imputed later. No other information about the person's characteristics was available.

Regardless of the reason, people for whom Indigenous status was missing were allocated for the purposes of population estimation to the categories 'Indigenous' or 'non-Indigenous', according to the distribution of these groups (based on those with information on Indigenous status) in the relevant Statistical Local Area and for the type of form used (either the standard household form or a Special Indigenous Form), with separate adjustments for males and females (ABS 1998a).

In any census, some people are not included on any census form, while others are counted more than once. The ABS conducts a post-enumeration survey after each census to estimate the extent to which people have been missed or double-counted. The results of this survey are used to estimate the net census undercount. The survey is not conducted in remote areas of Australia, and the net census undercount from non-remote areas is assumed to apply to remote areas. In 1996, the overall net census undercount was estimated to be 1.5% for the non-Indigenous population and 7.1% for the Indigenous population. As a result of the size of the Indigenous population relative to the size of the total population, the Indigenous sample in the post-enumeration survey was small, and the relative standard errors were much larger for the Indigenous estimates (14.7%) than for the non-Indigenous estimates (7.0%). Separate estimates were available by age, sex and State or Territory for the total population, but this was not possible for the Indigenous population due to limitations in the availability of Indigenous data from the post-enumeration survey. As a result, the corresponding distribution by age, sex and State or Territory for the total population was applied to the Indigenous undercount rate (ABS 1998a).

How the estimates were calculated *continued*

The final adjustment occurred because of the especially high undercount of children less than one year old. Data on birth registrations from the previous financial year were compared with the number of infants counted in the census. In those jurisdictions (South Australia, Western Australia, Tasmania, the Northern Territory and the Australian Capital Territory) in which the number of registered births exceeded the number of infants counted in the census, the census counts were adjusted upwards to the level of registered births. The data for children aged 0–4 years were then smoothed so that the distribution by single year of age was more even but the total (revised) count remained unchanged. No change was made for jurisdictions (New South Wales, Victoria and Queensland) for which the census count was greater than or equal to the number of births registered (ABS 1998a).

The application of all of these adjustments resulted in an Indigenous ERP for the day of the 1996 Census (6 August 1996). As indicated above, the adjustments together resulted in a net increase of 33,964 people (9.6%) in moving from the census count to the ERP. However, the conventional date for which population estimates are calculated is 30 June for the given year. For the total population, moving from 6 August to 30 June is a simple matter of using what is known as the basic demographic equation, and adding or subtracting (depending on whether one is going forward or backward in time) births, deaths, in-migration and out-migration. The basic demographic equation is: $P_{t+1} = P_t + B - D + IN - OUT$, where P_t is the baseline population (that is, the population at time t), P_{t+1} is the population at time $t+1$, B is the number of births, D is the number of deaths, IN is the number of people moving in to the population and OUT is the number moving out, all referring to the period between time t and $t + 1$ (see, for example, Newell 1988).

Estimating the population at a point in time by adding to and/or subtracting from the base population in this way is referred to as the 'cohort component' method. It requires good information on all the terms in the equation, namely births, deaths, in- and out-migration and the base population. This information is available for the total population, but not for the Indigenous population as a whole, so the cohort component method can not be used. Instead, the ABS uses the 'reverse survival' method and classifies as 'experimental' the resulting Indigenous population estimates and projections. The reverse survival method is based on a life table spanning the intercensal period. The most recent Indigenous experimental life tables (one for males and one for females) are based on data from the 1991 and 1996 Censuses (ABS 1998a). The resulting estimates and projections are referred to as being based on the 1996 Census. A previous set of experimental life tables was based on data from the 1986 and 1991 Censuses, and the resulting estimates and projections are referred to as 1991 Census-based (ABS 1996). In both cases, the life tables were constructed using the Preston-Hill method. The premise of this method is that, in a closed population with no migration, the only factor that can cause a change in the size of an existing cohort (i.e. one already born) is death (Preston and Hill 1980). More details on this method are presented in Appendix 3.

How the estimates were calculated *continued*

Experimental life tables were used to go from the date of the census (e.g. 6 August 1996) back to 30 June of the same year, using reverse survival methods. The life tables were subsequently used to 'grow' the population back one year at a time to 30 June of preceding years (e.g. 1995, 1994, 1993, 1992 and 1991) (ABS 1998a).

How the projections were calculated

Once the ERP for 30 June 1996 was obtained, it was also possible to project the Indigenous population forward in time. The ERP for 30 June 1996 was used as the base, and the population was then 'grown' forward, using the cohort component method, by assuming rates of fertility, mortality and migration, as well as changes in the propensity of people to identify as Indigenous. Although change in the propensity to identify as Indigenous has usually been assumed to be zero, this was not the case for all the series of the 1996-based projections. The low series projections assumed no change in the propensity of Indigenous people to identify as such, but the high series projections assumed that the rate of increase in propensity to identify observed between 1991 and 1996 was continued forward in time (ABS 1998b).

Both the low series and the high series projections assumed a decrease in female fertility rates of 1% per year; constant male paternity rates (i.e. rates of births of babies with an Indigenous father and a non-Indigenous mother); constant mortality rates (the same as those reflected in the Indigenous experimental life tables); constant interstate migration rates (based on State and Territory-specific average net flows in 1990–91 and 1995–96, scaled up to take into account the difference between the counts and the estimates); and no overseas migration (ABS 1998b). With respect to births, it is usually only necessary for the purposes of population projection to take into account the fertility rate of females. However, because some Indigenous babies have an Indigenous father and a non-Indigenous mother (and are therefore not represented in the fertility rates for Indigenous females), and because such babies account for an increasing proportion of Indigenous births, assumptions about the rates of such births (referred to as 'male paternity rates') must also be made (ABS 1998b). Projections were made for each State and Territory by sex and single year of age up to 30 June 2006.

Projections using 1991-based estimates, for 30 June 1991 through 30 June 2001 were published previously (ABS 1996). Low, medium and high series projections were produced, based on the 1986–91 life tables. The low series projections used similar assumptions to those used in the 1996-based low series projections (i.e. a 1% decline in fertility, constant paternity, constant mortality, constant interstate migration and no change in the propensity to identify). The medium and high series assumed constant, rather than declining, fertility, and decreasing mortality. None of the 1991-based series factored in a change in the propensity to identify as Indigenous, and as a result, the 1991-based high series was lower than the 1996-based low series for every State and Territory.

ESTIMATING AGE-SPECIFIC MORTALITY RATES

Indigenous age-specific mortality rates are based on the experimental life tables derived using the Preston-Hill method as part of the population estimation process described in the preceding section. There are separate life tables for males and females. A copy of the life tables is included in Appendix 3.

Life tables are commonly used to calculate life expectancy at various ages, such as life expectancy at birth. Among other things, the Indigenous experimental life tables provide, for each single year of age for ages 0–99 years, an estimate of the probability of dying between exact age x and exact age $x + 1$ (e.g. between exact age 7 years and exact age 8 years, or between the 7th and 8th birthday). This probability is referred to as q_x, where the subscript x indicates the age at the start of the period (Newell 1988).

In standard situations, such as for the total Australian population, the age-specific mortality rate (denoted M_x) is easily calculated using information from death registrations and population estimates, and q_x is then derived from M_x. This is not difficult, as the population at the start of the year (required for q_x) is directly related to the mid-year population, having been changed only by deaths, migration into and out of the relevant area and, for the youngest age group, births.

In the case of the Indigenous population, however, adequate information from death registrations is not available, so M_x is not available directly. Values for q_x are estimated using the experimental methods described above, and in this case, M_x (which is required for the estimation of expected deaths) must be estimated based on q_x Again, due to lack of adequate data, this is not a straightforward task and assumptions must be made. More information about the estimation of M_x from q_x is presented in Appendix 3.

ESTIMATING THE EXPECTED NUMBER OF INDIGENOUS DEATHS

Once M_x has been estimated, it can be used in conjunction with experimental estimates and projections of the Indigenous population to calculate expected Indigenous deaths. Details of the calculations are presented in Appendix 3. The estimated number of expected Indigenous deaths for a particular jurisdiction is then compared with the number of deaths registered as Indigenous in that jurisdiction.

ESTIMATING THE EXPECTED NUMBER OF INDIGENOUS DEATHS *continued*

One limitation of the assessment procedure is that the number of expected deaths is based on year of occurrence, while the number of registered deaths is based on year of registration. Depending on the circumstances, this could result in an over- or under-estimate of completeness of coverage for a particular year. For example, if the Registrar's Office in a particular jurisdiction were short-staffed in the last quarter of a year, a number of deaths that would normally be processed (i.e. registered) in that year might be put off until the next year. All other things being equal, this would result in a lower apparent completeness level in the first year, and a higher apparent level of completeness in the second year, despite there having been no change in the probability of an Indigenous death being recorded as such. It is possible to overcome this problem by using data by year of occurrence for registered deaths, but this would mean a delay of at least a year before a reasonable comparison could be made, and the estimated level of completeness would have to be revised in future years to reflect any further late registrations.

Table 3.2 shows the number of deaths registered as Indigenous by year of registration and by year of occurrence for 1995–98, including all deaths registered by the end of 1998. These numbers are also shown as a proportion of Indigenous deaths expected in those years, based on the 1996-based experimental estimates and low series projections described above. It should be noted that the data by year of occurrence exclude any late registrations after 1998, and this would be expected to have the greatest impact on figures for 1998. Based on the pattern of late registrations for deaths identified as Indigenous, it is likely that about 15% of deaths which occurred in 1998 (and which would be identified as Indigenous) had not been registered by the end of that year (see Appendix 2 for more details). As a result, the proportions reported for 1998 for year of occurrence data are under-estimates and are not directly comparable to the proportions for year of registration data for that year.

As the table shows, the figures for registered Indigenous deaths as a proportion of expected Indigenous deaths were similar but not identical for year of occurrence data and year of registration data for the years 1995–97. Although the interpretation of the level of completeness would not be greatly affected by the choice of year of registration or year of occurrence data, it is conceivable that a jurisdiction could find itself on one side or the other of an arbitrary cutoff for determining whether the data were of sufficient quality for a particular use, depending on which data were used. For example, if the cutoff for publication were 0.80, or 80%, the Northern Territory in 1996 would meet this criterion using year of occurrence data (0.84) but would not do so using year of registration data (0.73). In this case, the relatively large difference was due to a processing backlog which was resolved in 1997 (ABS 1998d). However, a smaller difference (e.g. 0.79 and 0.81) could produce the same result, and this degree of discrepancy is quite common. In part because of this problem, ABS practice is to make available data from all States and Territories, along with an estimation of the completeness of coverage of Indigenous deaths.

3.2 RATIO OF REGISTERED TO EXPECTED INDIGENOUS DEATHS(a)

	NSW	*Vic.*	*Qld*	*SA*	*WA*	*Tas.*	*NT*	*ACT*	***Aust.(b)***
					NUMBER				
Registered deaths by year of registration									
1995	224	50	—	121	384	3	387	9	**1 182**
1996	177	49	258	118	370	—	328	5	**1 306**
1997	88	93	531	132	351	5	458	4	**1 662**
1998	462	123	593	127	378	13	415	3	**2 114**
Registered deaths by year of occurrence(c)									
1995	234	48	20	117	371	4	370	10	**1 176**
1996	166	55	331	122	349	—	381	5	**1 409**
1997	96	95	542	137	372	5	407	3	**1 657**
1998(d)	442	100	481	114	318	13	362	3	**1 833**
Estimated and projected deaths (1996 Census based)(e)									
1995	932	209	887	186	488	119	446	18	**3 289**
1996	950	211	900	189	494	124	452	18	**3 341**
1997	966	215	915	193	499	126	460	20	**3 394**
1998	984	219	936	199	509	130	471	21	**3 469**
					RATIO				
Registered to expected deaths based on year of registration									
1995	0.24	0.24	—	0.65	0.79	0.03	0.87	0.50	**0.36**
1996	0.19	0.23	0.29	0.63	0.75	—	0.73	0.28	**0.39**
1997	0.09	0.43	0.58	0.68	0.70	0.04	1.00	0.20	**0.49**
1998	0.47	0.56	0.63	0.64	0.74	0.10	0.88	0.14	**0.61**
Registered to expected deaths based on year of occurrence(c)									
1995	0.25	0.23	0.02	0.63	0.76	0.03	0.83	0.56	**0.36**
1996	0.17	0.26	0.37	0.65	0.71	—	0.84	0.28	**0.42**
1997	0.10	0.44	0.59	0.71	0.75	0.04	0.88	0.15	**0.49**
1998(d)	0.45	0.46	0.51	0.57	0.62	0.10	0.77	0.14	**0.53**

(a) Based on place of usual residence.

(b) Includes 'Other Territories'.

(c) Includes only those deaths which were registered by the end of 1998.

(d) Figures for 1998 would be expected to be missing approximately 15% of deaths due to late registration (see Appendix 2).

(e) Based on experimental estimates for 1995 and 1996 (ABS 1998a) and low series projections for 1997 and 1998 (ABS 1998b).

Source: ABS 1999a and unpublished data.

ESTIMATING THE EXPECTED NUMBER OF INDIGENOUS DEATHS *continued*

A more serious limitation of the method arises as a result of the use of a single life table for males and one for females. The use of a single national life table for Indigenous males implies that the same age-specific mortality rates apply for Indigenous males throughout Australia; that is, they apply equally to Indigenous males in New South Wales and the Northern Territory, for example. Similarly, a single life table for Indigenous females implies that mortality rates are the same for females in, for example, Western Australia and Tasmania. While this may or may not be the case, it is impossible to know for certain in the absence of complete coverage of Indigenous deaths and/or more predictable census counts. If such data were available, however, there would be no need to use experimental methods in the first place.

How different might the figures be for estimated deaths (and therefore the estimated completeness of coverage) if more than one life table were used? It is difficult to answer this question with any great precision, but it is possible to provide some evidence as to the size of the difference which might be plausible.

For example, separate Indigenous experimental life tables for eastern and western parts of Australia have been produced using the method described in Appendix 3. Although the life tables themselves have not been published, the resulting estimates of life expectancy at birth have been published (AIHW 1998; ABS & AIHW 1999) and are shown in table 3.3. While these eastern and western life tables are subject to even greater variability and uncertainty than a single national life table, the resulting life expectancy figures imply that the underlying age-specific death rates are different for Indigenous people living in different parts of Australia.

3.3 ESTIMATED INDIGENOUS LIFE EXPECTANCY AT BIRTH, 1991–96

	Western(a)	*Eastern(b)*	*Australia*
	years	*years*	*years*
Males	53.7	59.2	56.9
Females	58.9	63.6	61.7

(a) Western Australia, South Australia and Northern Territory combined.

(b) New South Wales, Victoria, Queensland, Tasmania and Australian Capital Territory combined.

Source: ABS & AIHW 1999; AIHW 1998.

ESTIMATING THE EXPECTED NUMBER OF INDIGENOUS DEATHS *continued*

If the differences in estimated life expectancy shown in table 3.3 are an indication of real underlying differences in mortality, then the use of a single national life table would result in an over-estimation of expected deaths for some jurisdictions and an under-estimation for others. This would mean that achieving the *appearance* of completeness (i.e. when the number of registered deaths is equal to the number of 'expected' deaths) would be easier for some jurisdictions than others. In the present example, if the lower estimated life expectancy at birth for western parts of Australia reflects reality (or at least is closer to reality than are the estimates based on the national life table), then the age-specific death rates for Indigenous people living in South Australia, Western Australia and/or the Northern Territory must be higher, at least for some age groups, than they are for Indigenous people living elsewhere in Australia. All other things being equal, higher age-specific death rates would result in more expected deaths. If separate life tables were used for eastern and western parts of Australia, then the number of expected deaths would increase for the western group as a whole and decrease for the eastern group as a whole.

In table 3.4, the numbers of Indigenous deaths expected in 1997 and 1998 based on a single national life table are compared with a rough estimate of the numbers expected using separate life tables for western and eastern jurisdictions. The estimated numbers of expected deaths based on separate eastern and western life tables were calculated by applying the relevant age-specific mortality rates (based on the q_x values from the life tables) to the 1996-based estimates and projections of the Indigenous population. This is not technically correct, because the life tables are themselves used in the estimation and projection of the Indigenous population. It would therefore be necessary (although certainly not trivial) to re-calculate the population estimates/projections using eastern and western specific life tables before applying the revised age-specific mortality rates. All other things being equal, the lower age-specific mortality rates implied by the eastern life tables would result in slightly higher population estimates and projections for eastern jurisdictions than those based on the single Australian life table, while the higher mortality rates implied by the western life tables would result in slightly lower estimates and projections for western jurisdictions. The figures for expected deaths based on eastern and western life tables, as shown in table 3.4, are therefore overestimated for western jurisdictions and underestimated for eastern jurisdictions to some degree. They are provided only as an indication of the magnitude of the differences which might be expected. As can be seen in table 3.4, the large degree of movement, especially in eastern jurisdictions, suggests that the estimates are very sensitive to the assumptions made. As a consequence, the results of any assessment of the completeness of coverage of Indigenous deaths should be interpreted with caution.

3.4 ESTIMATED INDIGENOUS DEATHS BASED ON ONE OR TWO LIFE TABLES(a)

	Western(b)	*Eastern(c)*	*Australia(d)*
	NUMBER		
Registered deaths			
1997	941	721	1 662
1998	920	1 194	2 114
Estimated deaths based on a single national life table (1996-based)			
1997	1 152	2 242	3 394
1998	1 179	2 290	3 469
Estimated deaths based eastern and western life tables (1996-based)			
1997	1 199	1 739	2 938
1998	1 223	1 777	3 000
Estimated deaths based on a single national life table (1991-based)			
1997	911	1 344	2 257
1998	924	1 369	2 293
	RATIO		
Registered to expected deaths, single life table (1996-based)			
1997	0.82	0.32	0.49
1998	0.78	0.52	0.61
Registered to expected deaths, separate life tables (1996-based)			
1997	0.78	0.41	0.57
1998	0.75	0.67	0.70
Registered to expected deaths, single life table (1991-based)			
1997	1.03	0.54	0.74
1998	1.00	0.87	0.92

(a) All figures are based on year of registration. High series projections were used for 1991-based population figures (ABS 1996). Estimates (ABS 1998a) and low series projections (ABS 1998b) were used for 1996-based population figures.

(b) South Australia, Western Australia and Northern Territory combined.

(c) New South Wales, Victoria, Queensland, Tasmania and Australian Capital Territory combined.

(d) Australian figures based on a single national life table include Other Territories. Figures based on eastern and western life tables exclude Other Territories.

Source: ABS 1999a and unpublished data.

ESTIMATING THE EXPECTED NUMBER OF INDIGENOUS DEATHS *continued*

Table 3.4 also includes the number of estimated deaths derived from 1991 Census-based estimates and a 1986–91 life table. The fact that these estimates are closer to the 1996-based figures for eastern jurisdictions using an eastern life table, than they are to the 1996-based estimates derived using a single life table is purely coincidental. If the 1991-based population projections are incorrect, or at least less correct than the 1996-based estimates and projections (as seems likely for the years presented), then the 1991-based estimates of the numbers of expected deaths are no longer relevant and should not be used to assess completeness of coverage. On the other hand, as the example using separate eastern and western life tables indicates, the common age-specific mortality rates implied by the 1996-based single national life table may not accurately reflect the mortality of particular jurisdictions, and it is this very important issue which deserves further attention.

State-specific life tables could, at least in theory, help to refine the estimation of expected deaths and the assessment of completeness of coverage. The extreme volatility of the resulting estimates has precluded their use to date, but the ABS is actively exploring the possibility of generating satisfactory State and Territory specific life tables for at least some States and Territories.

It should be noted that the true situation is actually more complicated than what has been presented here, because the assumptions used to generate the experimental projections (which are in turn used in the estimation of deaths) can also be changed. In this case, we have used projections based, among other things, on an assumption of constant mortality rates. If a different assumption had been used, or if different assumptions were used for different jurisdictions, then the results would also have been different.

In the absence of adequate information on Indigenous births, deaths and migration, it remains necessary to use experimental methods to estimate the size and composition of the Indigenous population and, in turn, the number of expected deaths. These experimental methods will never be as good as the more standard methods, but the latter continue to be impossible to use for the Indigenous population. As the level of completeness of coverage of Indigenous deaths (and births) improves, however, so too do the prospects of being able to use birth and death registration data in Indigenous population estimation and projection. In the meantime, it is important to understand—and accept—the limitations of the methods, including the sensitivity of the results to the assumptions used and the many uncertainties inherent in the process.

ESTIMATING THE EXPECTED NUMBER OF INDIGENOUS DEATHS *continued*

It should be noted that there are a number of other indirect methods which can be used to estimate mortality, and these have been well described by Hill (1984) and the United Nations (1983). Although many of these methods require the collection of additional data, that alone should not preclude their use in future if they can significantly improve the resulting estimates. It is worth noting that Hill himself has expressed strong reservations about the usefulness of the Preston-Hill method for estimating mortality, although he was somewhat more positive about its usefulness in the estimation of the completeness of enumeration on successive censuses (Hill 1984, p. 169).

CHAPTER 4 INDIGENOUS MORTALITY, 1995–97

As discussed in chapter 3, there is some uncertainty about the actual level of coverage of Indigenous deaths, but it is clear that not all Indigenous deaths are correctly identified. Although the number of registered deaths identified as Indigenous is therefore an underestimate of the total number of Indigenous deaths, registered deaths currently provide the best available information about the mortality of the Indigenous population.

DEATHS IDENTIFIED AS INDIGENOUS BY STATE AND TERRITORY

Of all deaths registered in Australia by the end of 1998, a total of 382,167 were reported as having occurred in the period 1995–97. Of these, 4,242 (1.1%) were identified as Indigenous. The Northern Territory and Western Australia had the highest number of deaths identified as Indigenous in 1995–97 (table 4.1).

4.1 DEATHS IDENTIFIED AS INDIGENOUS, BY STATE AND TERRITORY(a)

	Deaths identified as Indigenous(b)		
		Proportion of all deaths(b)	*Indigenous people as a proportion of the population(c)*
State or Territory	*no.*	*%*	*%*
New South Wales	496	0.4	1.8
Victoria	198	0.2	0.5
Queensland(d)	893	1.4	3.1
South Australia	376	1.1	1.5
Western Australia	1 092	3.4	3.2
Tasmania	9	0.1	3.2
Northern Territory	1 158	47.1	28.5
Australian Capital Territory	18	0.5	1.0
Australia(e)	**4 242**	**1.1**	**2.1**

(a) Based on year of occurrence. Data are for the years 1995–97 combined.

(b) Among usual residents of that jurisdiction.

(c) Estimated resident population, as at 30 June 1996 (ABS 1998a).

(d) Queensland began recording Indigenous status in 1996.

(e) Includes two deaths identified as Indigenous with place of usual residence listed as 'Other Territories'.

Source: Deaths Registration Database, ABS.

In all jurisdictions except the Northern Territory and Western Australia, the proportion of deaths identified as Indigenous was considerably lower than the estimated proportion of the population which was Indigenous in 1996 (table 4.1). Although this suggests the possibility of significant under-identification of Indigenous deaths in most States and Territories, it is important to take into account the younger age structure of the Indigenous population when making such comparisons. The method described in chapter 3 for assessing the completeness with which Indigenous deaths are recorded does take age into account. The calculation of the number of Indigenous deaths expected in each jurisdiction is based on estimates of the size and age structure of the Indigenous population and of its underlying age-specific mortality rates.

DEATHS IDENTIFIED AS INDIGENOUS BY STATE AND TERRITORY *continued*

Despite the uncertainties and limitations discussed in chapter 3, the best available estimates suggest that, for the period 1995–97, the jurisdictions with the most complete identification of Indigenous deaths were the Northern Territory, Western Australia, and South Australia. As noted in chapter 2, Queensland was estimated to have a high level of completeness in 1998, but did not begin to collect the relevant information until 1996.

Standardised Mortality Ratios (SMRs) by place of residence

The number of deaths recorded as Indigenous was almost twice the number which would have been expected if the Indigenous population had experienced the same death rates as the total Australian population (table 4.2). Because not all Indigenous deaths were identified as such, the SMR is an underestimate of the excess mortality experienced by the Indigenous population. (It should be noted that the use of the word 'expected' in this chapter is different than the use of the word in chapter 3. See chapter 2 for more details.)

As can be seen in table 4.2, the SMRs were lower for jurisdictions which are believed to have poorer identification of Indigenous deaths. The differences in SMRs from jurisdiction to jurisdiction are due in part to differences in the completeness of identification from place to place and in part to differences in the true underlying death rates by jurisdiction. It is not currently possible to determine with any certainty the relative contributions of these two factors.

4.2 STANDARDISED MORTALITY RATIOS(a) BY PLACE OF RESIDENCE

	Males identified as Indigenous			*Females identified as Indigenous*		
	Observed deaths(b)	*Expected deaths(a)*	*SMR(c)*	*Observed deaths(b)*	*Expected deaths(a)*	*SMR(c)*
State or Territory	*no.*	*no.*	*ratio*	*no.*	*no.*	*ratio*
New South Wales	286	385	0.7	209	288	0.7
Victoria	116	90	1.3	82	71	1.2
Queensland	522	389	1.3	371	282	1.3
South Australia	236	82	2.9	140	61	2.3
Western Australia	642	221	2.9	448	156	2.9
Tasmania	7	17	0.4	2	9	0.2
Northern Territory	650	199	3.3	508	142	3.6
Australian Capital Territory	10	6	1.7	8	3	3.2
Australia(d)	**2 469**	**1 421**	**1.7**	**1 770**	**1 046**	**1.7**

(a) Based on all Australian age-, sex-, and cause-specific rates. Data are based on year of occurrence and are for the years 1995–97 combined.

(b) Excludes deaths for which age and/or sex was missing.

(c) Standardised mortality ratio (SMR) is equal to observed deaths divided by expected deaths.

(d) Includes Other Territories.

Source: Deaths Registration Database, ABS.

The rest of this chapter is based on deaths of usual residents of Western Australia, South Australia and the Northern Territory combined.
A comparison of deaths identified as Indigenous in western jurisdictions (Western Australia, South Australia and the Northern Territory) and eastern jurisdictions (New South Wales, Victoria, Queensland, Tasmania and the Australian Capital Territory) can be found in Appendix 2.

DEATHS IDENTIFIED AS INDIGENOUS IN WESTERN AUSTRALIA, SOUTH AUSTRALIA AND THE NORTHERN TERRITORY, ALL CAUSES COMBINED, 1995–97

In 1995–97, there were 2,626 deaths of usual residents of Western Australia, South Australia and the Northern Territory for which the deceased person was identified as Indigenous. These three jurisdictions accounted for just over a third (34%) of the Indigenous population of Australia in 1996, but 62% of all deaths identified as Indigenous in 1995–97 in Australia.

Deaths identified as Indigenous represented 3.8% of the deaths registered in 1995–97 of usual residents of Western Australia, South Australia and the Northern Territory combined.

After adjusting for differences in age structure, there were three times as many deaths as would be expected, based on all-Australian rates (table 4.3).

4.3 STANDARDISED MORTALITY RATIOS(a)

	Males	*Females*
Deaths identified as Indigenous	1 528	1 096
Indigenous deaths expected(b)	502	360
Apparent excess deaths(c)	1 026	736
Standardised mortality ratio(d)	3.0	3.0

(a) Usual residents of Western Australia, South Australia and Northern Territory combined. Based on year of occurrence. Data are for the years 1995–97 combined. Excludes death for which age and/or sex was missing.

(b) Based on all-Australian rates.

(c) Apparent excess deaths are equal to identified deaths minus expected deaths.

(d) Standardised mortality ratio is equal to identified deaths divided by expected deaths.

Age at death

Deaths identified as Indigenous were more likely than other deaths to occur among people of younger ages (table 4.4; graph 4.5).

Nearly one in four (23.1%) infant deaths in Western Australia, South Australia and the Northern Territory combined in 1995–97 were identified as Indigenous. By contrast, less than one in seventy deaths (1.4%) among those aged 65 years or more was identified as Indigenous.

4.4 AGE DISTRIBUTION OF DEATHS

	Identified as Indigenous(a)			*Other(a)(b)*			*All Australia*		
	Males	*Females*	*Total*	*Males*	*Females*	*Total*	*Males*	*Females*	*Total*
Age groups (years)	*%*	*%*	*%*	*%*	*%*	*%*	*%*	*%*	*%*
Less than 1	6.8	8.3	7.4	1.1	0.8	1.0	1.2	1.0	1.1
1–4	1.6	1.9	1.8	0.3	0.2	0.3	0.3	0.2	0.3
5–14	2.0	1.3	1.7	0.3	0.3	0.3	0.4	0.3	0.3
15–24	7.0	2.5	5.1	2.1	0.8	1.5	2.1	0.8	1.5
25–34	12.0	7.0	9.9	2.7	1.2	2.0	2.8	1.2	2.0
35–44	15.5	13.1	14.5	3.6	2.1	2.9	3.6	2.1	2.9
45–54	15.2	15.2	15.2	5.9	3.8	4.9	6.0	4.0	5.1
55–64	16.4	17.8	17.0	10.8	6.6	8.9	11.4	7.1	9.4
65–74	12.1	16.8	14.1	25.5	17.2	21.6	25.6	17.2	21.6
75 and over	11.4	16.1	13.4	47.6	67.1	56.7	46.8	66.0	55.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

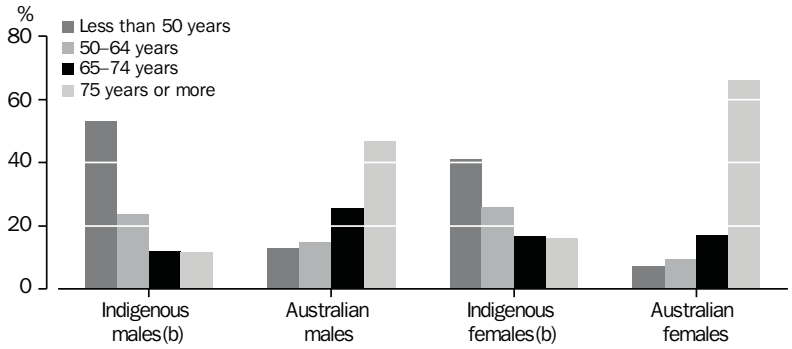
(a) Usual residents of Western Australia, South Australia and Northern Territory combined. Based on year of occurrence. Data are for the years 1995–97 combined.

(b) Includes all deaths not identified as Indigenous.

Source: Deaths Registration Database, ABS.

More than half (53%) of male deaths identified as Indigenous were among males less than 50 years old (graph 4.5). This was true for only 13% of other male deaths in Western Australia, South Australia and the Northern Territory, and 13% of all Australian male deaths. Among females deaths, 41% of those identified as Indigenous occurred in females younger than 50 years old, compared with 7% of other female deaths in the same jurisdictions and 7% of all Australian female deaths.

4.5 AGE AT DEATH(a)

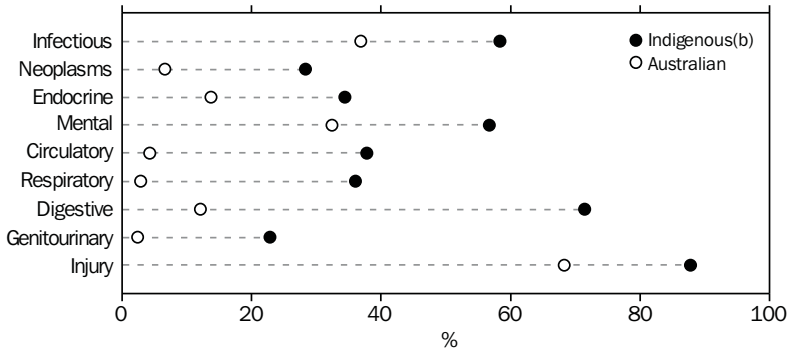


(a) Data are for the years 1995–97 combined, based on year of occurrence.
(b) Usual residents of Western Australia, South Australia and the Northern Territory combined.

Age at death *continued*

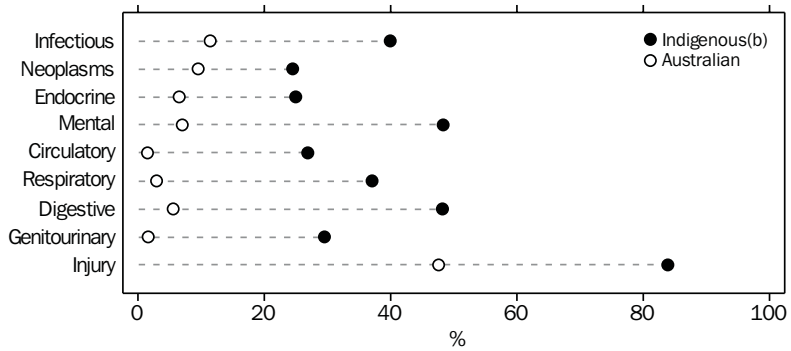
The proportion of deaths occurring before age 50 was higher for deaths identified as Indigenous than for all Australian deaths for every category of cause of death for both males and females. Among Indigenous males, for example, 38% of deaths from circulatory disease, 36% of deaths from respiratory disease, and 28% of deaths from cancer occurred among those less than 50 years old, compared with 4%, 3% and 7%, respectively, among all Australian male deaths. Similar disparities were observed among females. Data for selected categories of causes of death are presented in graphs 4.6 and 4.7.

4.6 PROPORTION OF MALE DEATHS BEFORE AGE 50 YEARS(a)



(a) Data are for the years 1995–97 combined, based on year of occurrence.
(b) Usual residents of Western Australia, South Australia and Northern Territory combined.

4.7 PROPORTION OF FEMALE DEATHS BEFORE AGE 50 YEARS(a)



(a) Data are for the years 1995–97 combined, based on year of occurrence.
(b) Usual residents of Western Australia, South Australia and the Northern Territory combined.

Years of potential life lost before age 65 ($YPLL_{65}$)

The burden of premature mortality is sometimes measured using years of potential life lost (YPLL). This measure takes into account both the number of deaths which occurred before a certain age (before age 65 years, for example) and the age at which those deaths occurred. For example, a death occurring in a 35 year old would result in 30 years of potential life lost before age 65 ($YPLL_{65}$), while the death of a 63 year old would result in 2 $YPLL_{65}$.

Years of potential life lost before age 65 ($YPLL_{65}$) *continued*

In 1995–97 in Western Australia, South Australia and the Northern Territory combined, there were more than 51,000 years of potential life lost before age 65 among Indigenous people (table 4.8). The $YPLL_{65}$ rate per 1,000 was 166 for Indigenous males and 97 for Indigenous females, compared with 38 for other males and 19 for other females in the same jurisdictions.

4.8 YEARS OF POTENTIAL LIFE LOST BEFORE AGE 65 YEARS ($YPLL_{65}$)(a)

	Deaths to persons aged under 65 years		*YPLL65*			
	no.	*% of all deaths*	*no.*	*rate per 1,000*	*no. per death*	*no. per death before age 65*
Indigenous(b)						
Males	1 168	76.4	32 165	166.5	21.0	27.5
Females	736	67.1	19 067	96.8	17.4	25.9
Other(b)						
Males	9 514	26.9	187 564	37.9	5.3	19.7
Females	4 912	15.8	92 919	18.8	3.0	18.9
All Australian						
Males	55 809	27.7	1 095 013	40.1	5.4	19.6
Females	30 250	16.8	581 151	21.1	3.2	19.2

(a) Based on year of occurrence. Data are for the years 1995–97 combined.

(b) Data for Western Australia, South Australia and Northern Territory combined.

Source: Deaths Registration Database, ABS.

Age-specific death rates

Rates of death from all causes combined were higher for Indigenous males and females than for their all-Australian counterparts in every age group (table 4.9). The largest differences were seen among adults of working age, particularly those aged 35–44 and 45–54 years. The differences were smallest among those aged 75 years and over, but this may be explained at least in part by a younger average age in this age group for Indigenous people compared with all Australians.

4.9 AGE-SPECIFIC DEATH RATES(a)

	Males			*Females*		
Age group (years)	*Indigenous rate(b)*	*Australian rate(c)*	*Rate ratio(d)*	*Indigenous rate(b)*	*Australian rate(c)*	*Rate ratio(d)*
Less than 1	1 873	605	3.1	1 731	495	3.5
1–4	114	38	3.0	102	27	3.7
5–14	60	18	3.3	29	14	2.0
15–24	275	103	2.7	69	36	2.0
25–34	574	132	4.4	226	49	4.6
35–44	1 107	172	6.4	627	89	7.0
45–54	1 923	343	5.6	1 288	215	6.0
55–64	3 869	988	3.9	2 566	559	4.6
65–74	5 976	2 805	2.1	4 704	1 525	3.1
75 and over	11 334	9 086	1.2	8 889	7 074	1.3

(a) Rates are per 100,000. Based on year of occurrence. Data are for the years 1995–97 combined.

(b) Data for deaths identified as Indigenous for usual residents of Western Australia, South Australia and the Northern Territory combined.

(c) Data are for all of Australia, including deaths identified as Indigenous.

(d) Indigenous rate divided by Australian rate.

Source: Deaths Registration Database, ABS.

CAUSE OF DEATH

Diseases of the circulatory system accounted for the largest number of deaths identified as Indigenous among males and females in Western Australia, South Australia and the Northern Territory combined in 1995–97 (table 4.10). Circulatory diseases, injury, neoplasms, respiratory diseases and endocrine diseases together accounted for about three out of every four deaths identified as Indigenous. Although these same causes were responsible for the majority of deaths in Australia as a whole, they occurred at greater rates among the Indigenous population.

4.10 DEATHS BY CAUSE(a)

	Indigenous males			*Indigenous females*		
	no.	*%*	*SMR(b)*	*no.*	*%*	*SMR(b)*
Circulatory	431	28.2	2.9	290	26.4	2.5
Injury	292	19.1	3.2	112	10.2	3.5
Neoplasms	180	11.8	1.4	143	13.0	1.4
Respiratory	174	11.4	5.2	151	13.8	6.0
Endocrine/metabolic	90	5.9	6.1	136	12.4	12.0
Digestive	70	4.6	5.1	56	5.1	5.5
Mental disorders	60	3.9	4.1	28	2.6	3.0
Ill-defined	48	3.1	7.3	33	3.0	7.2
Certain perinatal conditions	38	2.5	2.5	28	2.6	2.3
Infectious/parasitic	36	2.4	4.1	25	2.3	6.5
Genitourinary	35	2.3	6.7	44	4.0	7.9
Nervous system	32	2.1	2.6	11	1.0	1.1
Congenital anomalies	27	1.8	2.2	22	2.0	2.1
Blood/blood-forming organs	8	0.5	6.5	5	0.5	4.3
Skin, subcutaneous	4	0.3	8.7	5	0.5	9.6
Musculoskeletal	3	0.2	2.5	7	0.6	2.5
Complications of pregnancy and childbirth	0	0.0	0.0	0	0.0	0.0
All causes	**1 528**	**100.0**	**3.0**	**1 096**	**100.0**	**3.0**

(a) Data for usual residents of Western Australia, South Australia and the Northern Territory combined. Based on year of occurrence. Data are for the years 1995–97 combined. Excludes deaths for which age and/or sex was missing.

(b) Standardised mortality ratio is equal to observed deaths divided by expected deaths, based on all Australian age-, sex-, and cause-specific rates.

Source: Deaths Registration Database, ABS.

Deaths which were over and above the number expected based on all Australian rates can be considered excess deaths. For example, about 502 deaths from all causes were expected among Indigenous males, but 1,528 were recorded, resulting in an SMR of 3.0. The estimated number of excess deaths among Indigenous males was 1,026 (1,528–502) (table 4.3). This calculation can be done for each individual cause or for groups of causes.

Although there were excess deaths from almost every cause of death (as indicated by an SMR greater than 1.0), the majority (about 68%) of excess deaths among the Indigenous population were due to circulatory diseases, injury, respiratory diseases and endocrine diseases (table 4.11).

4.11 MAIN CAUSES OF EXCESS DEATHS(a)(b)

	Indigenous males	*Indigenous females*
	Proportion of excess	*Proportion of excess*
Disease category	*%*	*%*
Circulatory	27.7	23.5
Injury	19.6	10.9
Respiratory	13.7	17.1
Endocrine/metabolic	7.3	16.9
All other causes	31.7	31.6
Total	**100.0**	**100.0**

(a) Excess deaths are equal to observed deaths minus expected deaths (based on all-Australian age, sex-and cause specific rates).

(b) Data for usual residents of Western Australia, South Australia and the Northern Territory combined. Based on year of occurrence. Data are for the years 1995–97 combined.

Source: Deaths Registration Database, ABS.

Among more specific causes, 13.3% of the excess among Indigenous males was due to ischaemic heart disease, 8.4% from motor vehicle traffic accidents, 7.5% from pneumonia and influenza, 6.4% from diabetes, 5.6% from cerebrovascular disease and 4.8% from chronic obstructive pulmonary disease and allied conditions (COPD). Among females, 14.8% of the excess was due to diabetes, 8.3% from pneumonia and influenza, 7.5% from ischaemic heart disease, 7.1% from COPD, and 4.7% from motor vehicle traffic accidents.

Age specific death rates for Indigenous and all Australian males and females are presented in tables 4.12–4.15. The Indigenous population is relatively small and there were few deaths from particular causes in some age groups, especially among children and young adults. The resulting small rates are subject to great variability, as they may be based on only a single death. A rate of 0 may indicate either that no deaths occurred or that the rate was so small (less than 0.5 deaths per 100,000) that it was rounded to 0.

4.12 AGE-SPECIFIC DEATH RATES BY CAUSE, INDIGENOUS MALES(a)(b)

Age group (years)

	Less than 1	*1–4*	*5–14*	*15–24*	*25–34*	*35–44*	*45–54*	*55–64*	*65–74*	*75 and over*
Infectious/parasitic	54	9	4	3	22	19	41	93	65	259
Neoplasms	0	9	4	10	22	107	265	805	1 130	1 490
Endocrine/metabolic	18	0	0	5	9	65	174	402	420	648
Blood, blood-forming organs	18	0	0	3	3	0	0	46	0	130
Mental disorders	0	0	0	8	38	79	58	46	355	453
Nervous system	0	9	4	3	13	33	25	77	97	324
Circulatory	0	5	6	36	85	336	787	1 300	2 293	4 145
Respiratory	234	9	0	8	25	117	157	557	904	2 591
Digestive	0	5	2	8	31	126	91	93	323	65
Genitourinary	0	0	0	0	9	9	41	124	129	842
Complications of pregnancy and childbirth	0	0	0	0	0	0	0	0	0	0
Skin and subcutaneous tissue	0	0	0	0	0	5	8	31	0	0
Musculoskeletal	0	0	0	0	0	0	17	0	32	0
Congenital anomalies	270	9	8	3	9	0	17	0	0	0
Certain perinatal conditions	684	0	0	0	0	0	0	0	0	0
Ill-defined	540	0	0	8	16	9	25	15	0	259
Injury	54	59	32	183	292	201	215	279	226	130
All causes	**1 873**	**114**	**60**	**275**	**574**	**1 107**	**1 923**	**3 869**	**5 976**	**11 334**

(a) Data from Western Australia, South Australia and the Northern Territory combined. Based on year of occurrence. Data are for the years 1995–97 combined.

(b) Rates are per 100,000 population. Rates shown as 0 may indicate either no deaths or a rate less than 0.5 per 100,000 (and rounded to 0).

Source: Deaths Registration Database, ABS.

4.13 AGE-SPECIFIC DEATH RATES BY CAUSE, AUSTRALIAN MALES(a)(b)

Age group (years)

	Less than 1	*1–4*	*5–14*	*15–24*	*25–34*	*35–44*	*45–54*	*55–64*	*65–74*	*75 and over*
Infectious/parasitic	10	1	0	1	6	9	8	10	21	81
Neoplasms	4	5	4	6	12	31	118	415	1 074	2 207
Endocrine/metabolic	9	1	0	1	5	8	13	34	92	245
Blood, blood-forming organs	1	0	0	0	0	0	0	2	7	29
Mental disorders	0	0	0	7	14	10	6	8	26	213
Nervous system	13	3	2	4	3	4	6	13	46	211
Circulatory	7	0	1	3	9	30	105	340	1 092	4 317
Respiratory	15	2	1	1	2	4	11	57	264	1 078
Digestive	3	0	0	0	2	8	19	41	78	240
Genitourinary	1	0	0	0	0	1	1	7	24	225
Complications of pregnancy	0	0	0	0	0	0	0	0	0	0
Skin, subcutaneous tissue	0	0	0	0	0	0	0	1	2	16
Musculoskeletal	0	0	0	0	0	0	1	3	10	32
Congenital anomalies	161	5	1	2	1	1	2	2	2	5
Certain perinatal conditions	276	0	0	0	0	0	0	0	0	0
Ill-defined	86	1	0	1	1	2	1	2	2	15
Injury	20	18	8	76	77	63	51	53	65	173
All causes	**605**	**38**	**18**	**103**	**132**	**172**	**343**	**988**	**2 805**	**9 086**

(a) Based on year of occurrence. Data are for the years 1995–97 combined.

(b) Rates are per 100,000 population. Rates shown as 0 may indicate either no deaths or a rate less than 0.5 per 100,000 (and rounded to 0).

Source: Deaths Registration Database, ABS.

4.14 AGE-SPECIFIC DEATH RATES BY CAUSE, INDIGENOUS FEMALES(a)(b)

Age group (years)

	Less than 1	*1–4*	*5–14*	*15–24*	*25–34*	*35–44*	*45–54*	*55–64*	*65–74*	*75 and over*
Infectious/parasitic	0	5	0	8	6	17	31	13	77	354
Neoplasms	0	0	4	0	15	61	185	632	844	859
Endocrine/metabolic	38	0	0	3	12	52	231	500	818	859
Blood, blood-forming organs	0	0	0	0	0	4	8	26	26	0
Mental disorders	0	0	0	3	15	17	39	53	51	354
Nervous system	19	0	2	3	3	4	15	26	0	101
Circulatory	38	0	4	8	59	135	347	645	1 764	3 485
Respiratory	247	29	0	5	15	96	154	316	741	1 515
Digestive	0	5	0	0	18	57	116	132	153	253
Genitourinary	0	0	0	0	9	30	62	158	102	505
Complications of pregnancy	0	0	0	0	0	0	0	0	0	0
Skin, subcutaneous tissue	0	0	0	0	0	0	8	0	51	101
Musculoskeletal	0	0	2	0	3	9	0	0	0	152
Congenital anomalies	323	5	2	3	0	9	0	0	0	0
Certain perinatal conditions	533	0	0	0	0	0	0	0	0	0
Ill-defined	456	0	0	3	0	4	31	13	0	101
Injury	76	58	14	36	73	131	62	53	77	253
All causes	**1 731**	**102**	**29**	**69**	**226**	**627**	**1 288**	**2 566**	**4 704**	**8 889**

(a) Data for usual residents of Western Australia, South Australia and the Northern Territory combined. Based on year of occurrence. Data are for the years 1995–97 combined.

(b) Rates are per 100,000 population. Rates shown as 0 may indicate either no deaths or a rate less than 0.5 per 100,000 (and rounded to 0).

Source: Deaths Registration Database, ABS.

4.15 AGE-SPECIFIC DEATH RATES BY CAUSE, AUSTRALIAN FEMALES(a)(b)

Age group in years

	Less than 1	*1–4*	*5–14*	*15–24*	*25–34*	*35–44*	*45–54*	*55–64*	*65–74*	*75 and over*
Infectious/parasitic	5	1	0	1	1	1	2	4	14	65
Neoplasms	5	3	3	4	12	41	125	298	599	1 167
Endocrine/metabolic	7	1	1	1	1	2	6	20	60	211
Blood, blood-forming organs	0	0	0	0	0	0	1	1	4	26
Mental disorders	0	0	0	2	3	2	2	3	15	277
Nervous system	11	2	2	2	2	2	5	12	34	181
Circulatory	4	1	1	1	4	11	32	128	539	3 885
Respiratory	13	2	1	1	1	3	9	40	141	619
Digestive	1	1	0	0	1	4	7	18	44	231
Genitourinary	0	0	0	0	0	1	2	7	24	177
Complications of pregnancy	0	0	0	0	1	0	0	0	0	0
Skin, subcutaneous tissue	0	0	0	0	0	0	0	0	1	21
Musculoskeletal	0	0	0	0	0	1	1	5	14	61
Congenital anomalies	144	4	1	1	1	1	1	2	2	3
Certain perinatal conditions	230	1	0	0	0	0	0	0	0	0
Ill-defined	63	1	0	0	0	0	1	1	2	22
Injury	12	10	5	21	19	19	20	19	31	125
All causes	**495**	**27**	**14**	**36**	**49**	**89**	**215**	**559**	**1 525**	**7 074**

(a) Based on year of occurrence. Data are for the years 1995–97 combined.

(b) Rates are per 100,000 population. Rates shown as 0 may indicate either no deaths or a rate less than 0.5 per 100,000 (and rounded to 0).

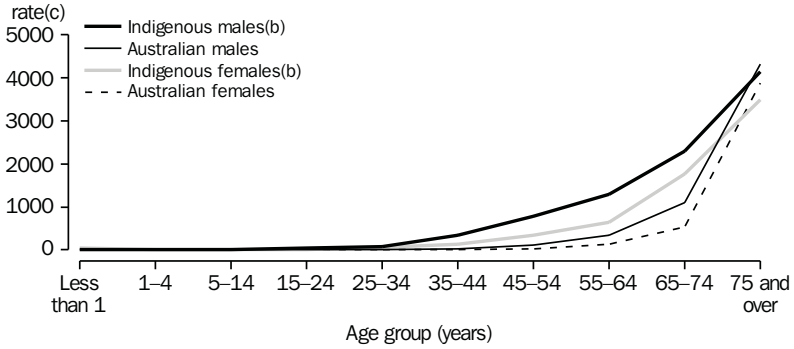
Source: Deaths Registration Database, ABS.

Circulatory diseases

Diseases of the circulatory system, such as ischaemic heart disease and cerebrovascular disease, were a major cause of mortality among Indigenous males and females, accounting for more than one in four deaths identified as Indigenous (table 4.10). There were almost three times as many deaths as expected among Indigenous males and females, based on all Australian rates.

The rates of death from circulatory diseases were higher for Indigenous males and females than for their all-Australian counterparts in every age group from 15 to 74 years, and the steep rise in death rates began many years earlier among Indigenous people than among all-Australian males and females (tables 4.12–4.15, graph 4.16).

4.16 DEATH RATES FROM CIRCULATORY DISEASES(a)



(a) Data are for the years 1995–97 combined, based on year of occurrence.
(b) Indigenous data are for usual residents of Western Australia, South Australia and Northern Territory combined.
(c) Per 100,000.

Ischaemic heart disease was responsible for the largest number of deaths from circulatory disease among Indigenous males and females, with cerebrovascular disease also an important contributor (table 4.17). The greatest discrepancy in relative terms between observed and expected deaths was for rheumatic heart disease, for which there were 20–25 times more deaths than expected, based on Australian rates. However, ischaemic heart disease accounted for a greater absolute number of excess deaths because it was much more common.

4.17 STANDARDISED MORTALITY RATIOS(a) FOR CIRCULATORY DISEASES(b)

	Indigenous males			*Indigenous females*		
	Observed deaths			*Observed deaths*		
			SMR(c)			*SMR(c)*
	no.	*%*	*ratio*	*no.*	*%*	*ratio*
Rheumatic heart disease	23	1.5	25.3	28	2.6	19.6
Hypertensive disease	16	1.0	6.6	18	1.6	6.3
Ischaemic heart disease	226	14.8	2.5	113	10.3	1.9
Other heart disease	77	5.0	4.2	54	4.9	3.2
Cerebrovascular disease	84	5.5	3.2	70	6.4	2.2
Other diseases of the circulatory system	5	0.3	0.6	7	0.6	1.0
All circulatory diseases	**431**	**28.2**	**2.9**	**290**	**26.4**	**2.5**

(a) Based on all Australian age-, sex-, and cause-specific rates.

(b) Data are for usual residents of Western Australia, South Australia and the Northern Territory combined. Based on year of occurrence. Data are for the years 1995–97 combined.

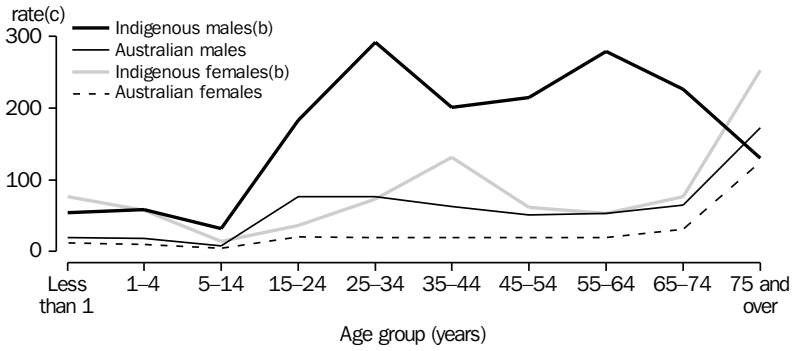
(c) Standardised mortality ratio (SMR) is equal to observed deaths divided by expected deaths.

Source: Deaths Registration Database, ABS.

Injury

Injury accounted for 19% of deaths among Indigenous males and 10% of deaths among Indigenous females. There were more than three times as many injury deaths as would be expected based on Australian rates (table 4.10). The highest death rates in all age groups from 1–34 years among Indigenous males and females were for injury deaths. The death rates for injury were higher for Indigenous males and females than their all Australian counterparts in almost every age group (graph 4.18).

4.18 DEATH RATES FROM INJURY(a)



(a) Data are for the years 1995–97 combined, based on year of occurrence.
(b) Indigenous data are for usual residents of Western Australia, South Australia and Northern Territory combined.
(c) Per 100,000.

Injury *continued*

Motor vehicle traffic accidents were the most common cause of death from injury and there were more than four times as many deaths from this cause among Indigenous males and females as would be expected based on all-Australian rates (table 4.19). The number of deaths due to homicide or other purposely inflicted injury was 7–8 times higher than expected. About 23% of all homicide deaths in Western Australia, South Australia and the Northern Territory combined in 1995–97 were identified as Indigenous. Deaths from suicide and self-inflicted injury were also more common than expected, with 40% more deaths among Indigenous females and 70% more deaths among Indigenous males than would be expected based on Australian rates.

4.19 STANDARDISED MORTALITY RATIOS(a) FOR INJURY(b)

	Indigenous males			*Indigenous females*		
	Observed deaths			*Observed deaths*		
			SMR(c)			*SMR(c)*
	no.	*%*	*ratio*	*no.*	*%*	*ratio*
Motor vehicle traffic accidents	113	7.4	4.3	45	4.1	4.3
Other accidents	89	5.8	3.5	39	3.6	4.1
Suicide and self-inflicted injury	58	3.8	1.7	12	1.1	1.4
Homicide, purposely inflicted injury	31	2.0	7.6	16	1.5	7.0
Other external causes	1	0.1	0.5	0	0.0	0.0
All injury	**292**	**19.1**	**3.2**	**112**	**10.2**	**3.5**

(a) Based on all Australian age-, sex-, and cause-specific rates.

(b) Data are for usual residents of Western Australia, South Australia and the Northern Territory combined. Based on year of occurrence. Data are for the years 1995–97 combined.

(c) Standardised mortality ratio (SMR) is equal to observed deaths divided by expected deaths.

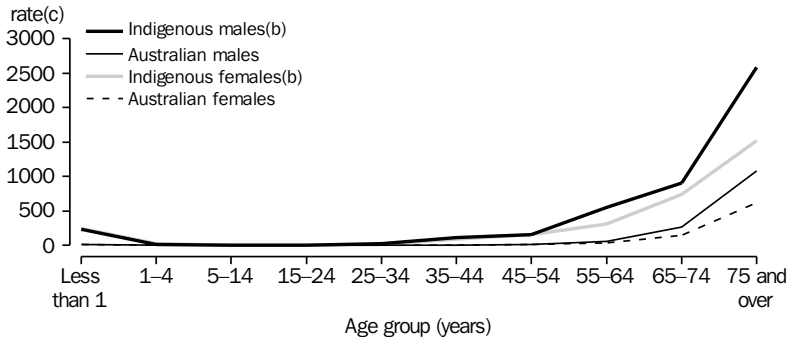
Source: Deaths Registration Database, ABS.

Respiratory diseases

Diseases of the respiratory system, such as pneumonia, influenza, and chronic obstructive pulmonary disease, accounted for 11% of deaths among Indigenous males and 14% of deaths among Indigenous females (table 4.10). This group of diseases accounted for 5–6 times more deaths than expected based on all-Australian rates.

Death rates for respiratory diseases were considerably higher for Indigenous males and females than for their all-Australian counterparts among infants and for every age group from age 25 years and up (graph 4.20). The rise in death rates began much earlier for Indigenous males and females than for Australians generally.

4.20 DEATH RATES FROM RESPIRATORY DISEASES(a)



(a) Data are for the years 1995–97 combined, based on year of occurrence.
(b) Indigenous data are for usual residents of Western Australia, South Australia and Northern Territory combined.
(c) Per 100,000.

Pneumonia and influenza were important contributors to the higher rates of death from respiratory diseases (table 4.21). Taken together, they accounted for almost half of all respiratory deaths. There were 9–11 times more deaths from pneumonia and influenza than expected, based on all Australian rates.

4.21 STANDARDISED MORTALITY RATIOS(a) FOR RESPIRATORY DISEASES(b)

	Indigenous males			*Indigenous females*		
	Observed deaths			*Observed deaths*		
			SMR(c)			*SMR(c)*
	no.	*%*	*ratio*	*no.*	*%*	*ratio*
Pneumonia and influenza	84	5.5	11.4	69	6.3	9.2
COPD(d) and other allied conditions	70	4.6	3.3	66	6.0	4.7
Other diseases of the respiratory system	20	1.3	4.2	16	1.5	4.6
All respiratory diseases	**174**	**11.4**	**5.2**	**151**	**13.8**	**6.0**

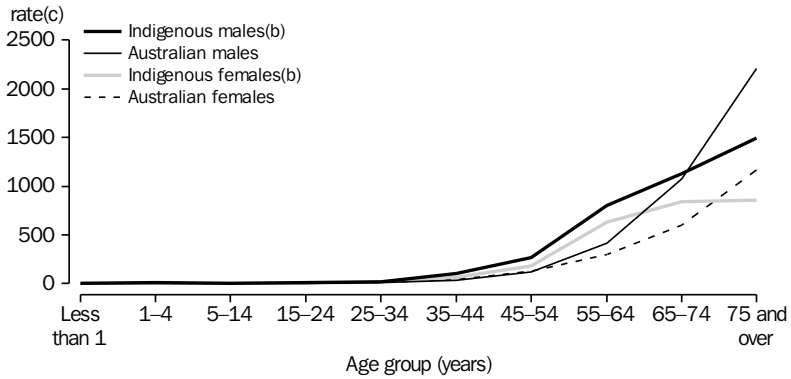
(a) Based on all Australian age-, sex-, and cause-specific rates.
(b) Data are for usual residents of Western Australia, South Australia and the Northern Territory combined. Based on year of occurrence. Data are for the years 1995–97 combined.
(c) Standardised mortality ratio (SMR) is equal to observed deaths divided by expected deaths.
(d) Chronic Obstructive Pulmonary Disease. Includes such diseases as asthma, chronic bronchitis and emphysema.

Source: Deaths Registration Database, ABS.

Neoplasms

Neoplasms (or cancers) were responsible for about 12–13% of all deaths identified as Indigenous (table 4.10), and there were 40% more deaths from this cause than would be expected based on Australian rates. Death rates from neoplasms were higher among Indigenous males and females than among their all-Australian counterparts throughout most of adulthood (graph 4.22).

4.22 DEATH RATES FROM NEOPLASMS(a)



(a) Data are for the years 1995–97 combined, based on year of occurrence.
(b) Indigenous data are for usual residents of Western Australia, South Australia and Northern Territory combined.
(c) Per 100,000.

The majority of cancer deaths among Indigenous people were due to digestive/peritoneal cancers, respiratory/intrathoracic cancers, and, among females, cancer of the genitourinary organs (table 4.23). For these types of cancer and for lip, oral and pharynx cancers, there were more deaths than expected among Indigenous people. However, there were fewer than the expected number of deaths among Indigenous people for some other types of cancers.

4.23 STANDARDISED MORTALITY RATIOS(a) FOR NEOPLASMS(b)

	Indigenous males			*Indigenous females*		
	Observed deaths		*SMR(c)*	*Observed deaths*		*SMR(c)*
	no.	*%*	*ratio*	*no.*	*%*	*ratio*
Lip, oral, pharynx cancer	13	0.9	3.9	5	0.5	3.9
Digestive, peritoneal cancer	65	4.3	1.9	38	3.5	1.5
Respiratory, intrathoracic cancer	50	3.3	1.6	31	2.8	2.3
Cancer of bone, connective tissue, skin, breast	6	0.4	0.8	16	1.5	0.6
Cancer of genitourinary organs	8	0.5	0.4	27	2.5	2.0
Lymphatic, haematopoietic cancer	9	0.6	0.6	10	0.9	0.9
Other and unspecified cancer	29	1.9	1.8	16	1.5	1.2
All cancers	**180**	**11.8**	**1.4**	**143**	**13.0**	**1.4**

(a) Based on all Australian age-, sex-, and cause-specific rates.

(b) Data are for usual residents of Western Australia, South Australia and the Northern Territory combined. Based on year of occurrence. Data are for the years 1995–97 combined.

(c) Standardised mortality ratio (SMR) is equal to observed deaths divided by expected deaths.

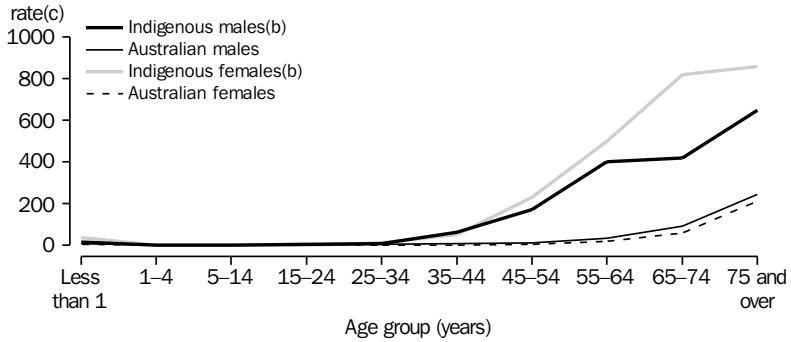
Source: Deaths Registration Database, ABS.

Endocrine, metabolic and nutritional diseases

Endocrine, metabolic and nutritional diseases accounted for 6% of deaths among Indigenous males and 12% of deaths among Indigenous females (table 4.10). There were six times more deaths than expected among Indigenous males and 12 times more than expected among Indigenous females, based on Australian rates.

Death rates from this category of diseases rose steeply in early middle-age and were markedly higher for Indigenous males and females than for their all-Australian counterparts throughout the remainder of the life span (graph 4.24).

4.24 DEATH RATES FROM ENDOCRINE, METABOLIC AND NUTRITIONAL DISEASES(



(a) Data are for the years 1995–97 combined, based on year of occurrence.
(b) Indigenous data are for usual residents of Western Australia, South Australia and Northern Territory combined.
(c) Per 100,000.

The majority of deaths in this category were due to diabetes, for which there were 16 times more deaths than expected among Indigenous females and nine times more than expected among Indigenous males (table 4.25).

4.25 STANDARDISED MORTALITY RATIOS(a) FOR ENDOCRINE DISEASES(b)

	Indigenous males			*Indigenous females*		
	Observed deaths			*Observed deaths*		
			SMR(c)			*SMR(c)*
	no.	*%*	*ratio*	*no.*	*%*	*ratio*
Diabetes	74	4.8	8.9	116	10.6	16.2
Other endocrine, metabolic and nutritional disorders	16	1.0	2.4	20	1.8	4.8
All endocrine, metabolic and nutritional disorders	**90**	**5.9**	**6.1**	**136**	**12.4**	**12.0**

(a) Based on all Australian age-, sex-, and cause-specific rates.

(b) Data are for usual residents of Western Australia, South Australia and the Northern Territory combined. Based on year of occurrence. Data are for the years 1995–97 combined.

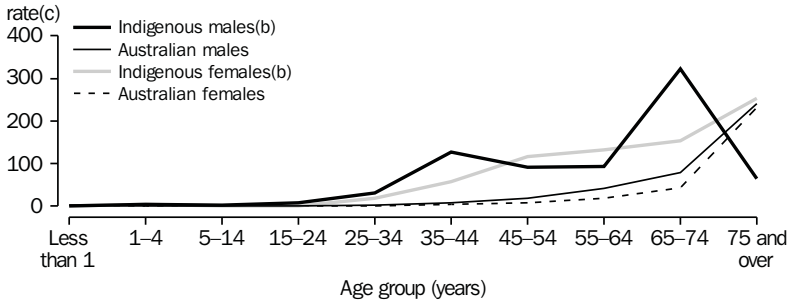
(c) Standardised mortality ratio (SMR) is equal to observed deaths divided by expected deaths.

Source: Deaths Registration Database, ABS.

Digestive diseases

Diseases of the digestive system accounted for about 5% of all deaths identified as Indigenous (table 4.10), and there were more than five times more deaths from these diseases among Indigenous males and females than would be expected based on Australian rates. Rates of death from digestive diseases were higher for Indigenous males and females than for their all-Australian counterparts throughout most of adult life (graph 4.26).

4.26 DEATH RATES FROM DIGESTIVE DISEASES(a)



(a) Data are for the years 1995–97 combined, based on year of occurrence.
(b) Indigenous data are for usual residents of Western Australia, South Australia and Northern Territory combined.
(c) Per 100,000.

More than half of all Indigenous deaths from digestive disease were due to chronic liver disease and cirrhosis, which accounted for about 3% of all deaths identified as Indigenous (table 4.27). There were about 7 times more deaths than expected from chronic liver disease and cirrhosis among Indigenous males and 13 times more than expected among Indigenous females, based on Australian rates.

4.27 STANDARDISED MORTALITY RATIOS(a) FOR DIGESTIVE DISEASES(b)

	Indigenous males			*Indigenous females*		
	Observed deaths			*Observed deaths*		
			SMR(c)			*SMR(c)*
	no.	*%*	*ratio*	*no.*	*%*	*ratio*
Chronic liver disease and cirrhosis	43	2.8	6.7	34	3.1	13.0
Other digestive diseases	27	1.8	3.7	22	2.0	2.9
All digestive diseases	**70**	**4.6**	**5.1**	**56**	**5.1**	**5.5**

(a) Based on all Australian age-, sex-, and cause-specific rates.
(b) Data are for usual residents of Western Australia, South Australia and the Northern Territory combined. Based on year of occurrence. Data are for the years 1995–97 combined.
(c) Standardised mortality ratio (SMR) is equal to observed deaths divided by expected deaths.

Source: Deaths Registration Database, ABS.

Other causes

Mental disorders accounted for about 4% of deaths among Indigenous males and almost 3% of deaths among Indigenous females (table 4.10). The majority of deaths in this category were from alcohol- and/or drug-related psychosis, dependence or non-dependent abuse (table 4.28). There were four times more deaths than expected from mental disorders among Indigenous males and three times more deaths than expected among Indigenous females, based on all-Australian rates.

4.28 STANDARDISED MORTALITY RATIOS(a) FOR MENTAL DISORDERS(b)

	Indigenous males			*Indigenous females*		
	Observed deaths			*Observed deaths*		
			SMR(c)			*SMR(c)*
	no.	*%*	*ratio*	*no.*	*%*	*ratio*
Alcohol and drug-related psychosis, dependence, abuse	48	3.1	4.5	20	1.8	7.0
Other mental disorders	12	0.8	3.1	8	0.7	1.3
All mental disorders	**60**	**3.9**	**4.1**	**28**	**2.6**	**3.0**

(a) Based on all Australian age-, sex-, and cause-specific rates.

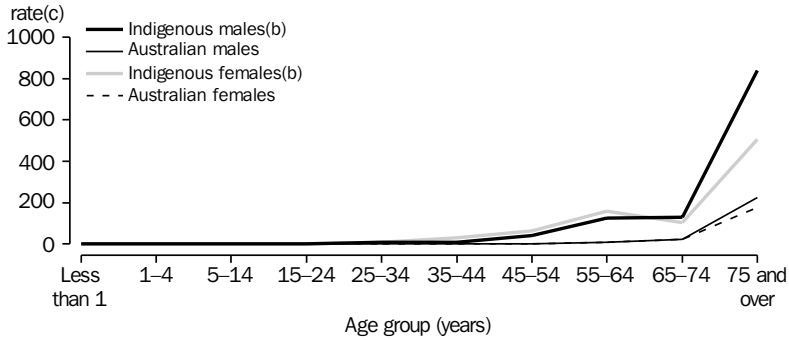
(b) Data are for usual residents of Western Australia, South Australia and the Northern Territory combined. Based on year of occurrence. Data are for the years 1995–97 combined.

(c) Standardised mortality ratio (SMR) is equal to observed deaths divided by expected deaths.

Source: Deaths Registration Database, ABS.

Diseases of the genitourinary system were responsible for just over 2% of Indigenous male deaths and about 4% of Indigenous female deaths (table 4.10). There were 7–8 times more deaths from genitourinary diseases than expected among Indigenous males and females. The majority of deaths in this category were due to kidney disease. Rates of death from genitourinary diseases began to rise in early middle-age and were markedly higher for Indigenous males and females than for their all-Australian counterparts throughout the remainder of the life span (graph 4.29).

4.29 DEATH RATES FROM GENITOURINARY DISEASES(a)



(a) Data are for the years 1995–97 combined, based on year of occurrence.
(b) Indigenous data are for usual residents of Western Australia, South Australia and Northern Territory combined.
(c) Per 100,000.

Other causes *continued*

Infectious and parasitic diseases accounted for over 2% of deaths among Indigenous males and females and were 4–6 times more common than expected (table 4.10).

Diseases of the nervous system (such as meningitis, encephalitis, multiple sclerosis, cerebral palsy, epilepsy and Parkinson's disease), were recorded more often among Indigenous males than Indigenous females (table 4.10). They were responsible for about 2% of Indigenous male deaths and about 1% of Indigenous female deaths.

Deaths from diseases of the blood and blood-forming organs, skin and subcutaneous tissue, and the musculoskeletal system were not very common, but there were more deaths than expected, based on all-Australian rates, among Indigenous males and females (table 4.10).

Deaths from 'certain perinatal conditions' and from congenital anomalies occurred almost exclusively among those less than one year old, and these deaths are discussed in more detail in the section below on infant deaths.

Deaths due to ill-defined conditions are by definition a heterogeneous group, but the majority of deaths in this category were due to Sudden Infant Death Syndrome (SIDS). There were six times more deaths from SIDS among Indigenous males and seven times more deaths from SIDS among Indigenous females than would be expected based on all-Australian rates. Over one-third (36%) of all SIDS deaths in Western Australia, South Australia and the Northern Territory combined in 1995–97 were among infants identified as Indigenous.

No deaths due to complications of pregnancy, childbirth and the puerperium were recorded among Indigenous women in Western Australia, South Australia and the Northern Territory for the period 1995–97.

INFANT DEATHS

About 7% of Indigenous male deaths and 8% of Indigenous female deaths occurred among people less than one year old (table 4.4). By contrast, only about 1% of all Australian male and female deaths occurred among infants. The major causes of death among infants were quite different to those in other age groups.

The majority of Indigenous infant deaths were accounted for by the group of conditions classified as 'certain perinatal conditions' (which includes disorders relating to prematurity, low birth weight, birth trauma and respiratory distress), congenital anomalies, ill-defined conditions (primarily SIDS) and respiratory diseases (table 4.30), which together accounted for just over 90% of deaths among infants identified as Indigenous. There were more than the expected number of deaths, based on all-Australian rates, from each of these groups of causes, but the differentials for respiratory diseases and ill-defined conditions were especially large.

4.30 STANDARDISED MORTALITY RATIOS(a) FOR INFANT DEATHS(b)

	Indigenous males			*Indigenous females*		
	Observed deaths			*Observed deaths*		
			SMR(c)			*SMR(c)*
	no.	*%*	*ratio*	*no.*	*%*	*ratio*
Certain perinatal conditions	38	36.5	2.5	28	30.8	2.3
Ill-defined conditions(d)	30	28.8	6.3	24	26.4	7.2
Congenital anomalies	15	14.4	1.7	17	18.7	2.2
Respiratory diseases	13	12.5	15.9	13	14.3	19.2
Other causes	8	7.7	2.1	9	9.9	3.8
All causes	**104**	**100.0**	**3.1**	**91**	**100.0**	**3.5**

(a) Based on all Australian age-, sex-, and cause-specific rates.

(b) Data are for usual residents of Western Australia, South Australia and the Northern Territory combined. Based on year of occurrence. Data are for the years 1995–97 combined.

(c) Standardised mortality ratio (SMR) is equal to observed deaths divided by expected deaths.

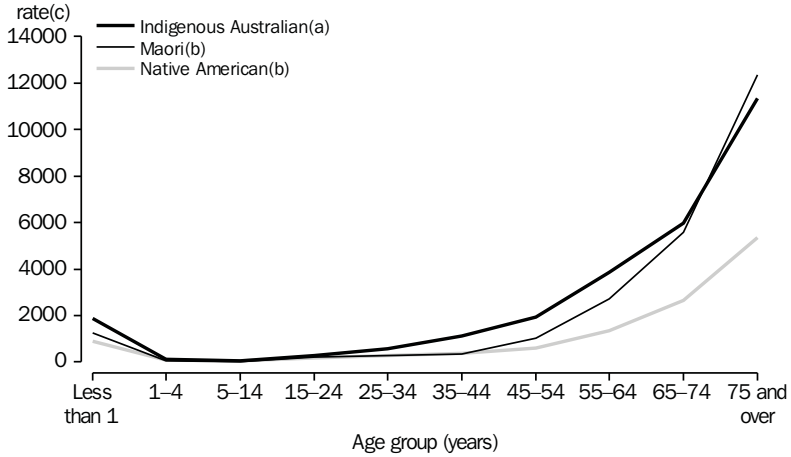
(d) Includes Sudden Infant Death Syndrome (SIDS).

Source: Deaths Registration Database, ABS.

INDIGENOUS MORTALITY IN AN INTERNATIONAL CONTEXT

Despite the under-identification of Indigenous deaths, and the resulting under-estimation of age-specific mortality, Indigenous males and females in Western Australia, South Australia and the Northern Territory had higher apparent death rates in 1995–97 than did their indigenous counterparts in New Zealand and the United States in 1996 (graphs 4.31 and 4.32). Age-specific death rates from all causes were higher for Indigenous Australian males and females than for New Zealand Maori and Native American males and females in almost all age groups, and the rise in death rates among adults began much earlier for Indigenous Australians than for the other indigenous groups.

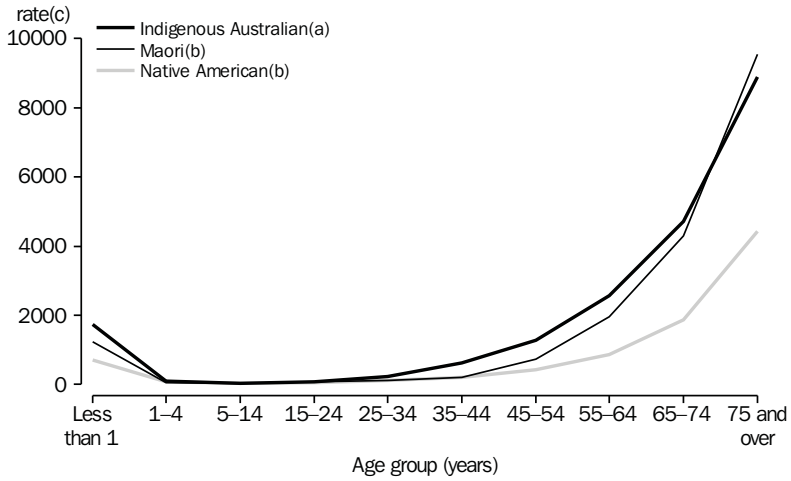
4.31 DEATH RATES FOR SELECTED INDIGENOUS GROUPS, MALES



(a) Data are for usual residents of Western Australia, South Australia and Northern Territory for 1995–97.
(b) Data are for 1996.
(c) Per 100, 000.

Source: ABS Deaths Registration Database; New Zealand Health Information Service 1999; Peters, Kochanek & Murphy 1998.

4.32 DEATH RATES FOR SELECTED INDIGENOUS GROUPS, FEMALES



(a) Data are for usual residents of Western Australia, South Australia and Northern Territory for 1995–97.
(b) Data are for 1996.
(c) Per 100, 000.

Source: ABS Deaths Registration Database; New Zealand Health Information Service 1999; Peters, Kochanek & Murphy 1998.

Data quality is an important issue in all countries with minority indigenous populations. The age-specific mortality rates are therefore likely to be under-estimated to some degree for each of the groups represented in graphs 4.31 and 4.32. However, this is not likely to explain completely the higher rates of premature death among Indigenous Australians.

CHAPTER 5 DISCUSSION

Data quality remains a critical issue in the assessment of Indigenous mortality. Most of the data presented in this publication are from Western Australia, South Australia and the Northern Territory, as these jurisdictions were believed to have the most complete coverage of Indigenous deaths during the period of interest. However, there is under-identification of Indigenous deaths to some degree in all jurisdictions. As a result, the observed differences between Indigenous and all-Australian mortality reported in this publication are under-estimates of the true differences. Unfortunately, measures of the accuracy of the data are not yet sufficiently precise to allow for satisfactory correction or adjustment of the numbers of Indigenous deaths. In addition, limitations in the quality and availability of data compromise our ability to assess changes in Indigenous mortality over time, both in absolute terms, and relative to the rest of the Australian population.

Results for Western Australia, South Australia and the Northern Territory for 1995–97 are similar to those reported previously (e.g. ABS & AIHW 1999; AIHW 1998; Anderson, Bhatia & Cunningham 1996). In short, despite under-identification of Indigenous people in death records, there were more deaths identified as Indigenous than would be expected if the Indigenous population experienced the same death rates as the Australian population as a whole. Deaths identified as Indigenous were more likely to occur prematurely, with 53% of male deaths and 41% of female deaths occurring in people less than 50 years old. The observed death rates were higher for Indigenous people than for the total Australian population in every age group, with the largest differences among people aged 35–54 years old. Circulatory diseases, injury, respiratory diseases and endocrine diseases were responsible for most of the excess mortality among Indigenous people, and the rates of death from a wide range of chronic diseases rose earlier and stayed higher throughout the life span for Indigenous males and females than for their all-Australian counterparts. Deaths registered as Indigenous in eastern jurisdictions (New South Wales, Victoria, Queensland, Tasmania and the Australian Capital Territory) were similar to those registered as Indigenous in western jurisdictions (Western Australia, South Australia and the Northern Territory) with respect to their distributions by age and cause, but nothing is known about the deaths of Indigenous people (whether in eastern or western jurisdictions) who were not identified as Indigenous.

Assessment of the completeness with which Indigenous deaths are recorded as Indigenous depends on the existence of alternative source(s) of accurate information. The ABS currently uses experimental Indigenous population estimates and projections (including assumptions about age-specific mortality rates) to estimate expected deaths. The Preston-Hill method (see Appendix 3) plays an important but not always obvious role in this process. The accuracy of the assessment of completeness of Indigenous deaths therefore ultimately rests both on the assumptions used in generating the estimates and projections (including assumptions about changes in the propensity of people to identify as Indigenous, as well as changes in demographic factors) and the characteristics and performance of the Preston-Hill method. Preston and Hill (1980), in their original description of this method, indicated that it was likely to perform better in estimating relative completeness of census enumeration than in estimating completeness of death registrations, and Hill (1984, p. 169) subsequently wrote that 'as a procedure for estimating mortality it appears that this technique should not be recommended'. The difficulty faced by the ABS is that, without additional data, there are few satisfactory alternatives for estimating and projecting the size and composition of the Indigenous population, especially in the face of the volatility of census counts of Indigenous people over time.

To add to uncertainties about age-specific mortality rates due to the use of the Preston-Hill method, there are additional difficulties relating to the use of a single national Indigenous life table. In the example presented in chapter 3 (table 3.4), expected Indigenous deaths in eastern jurisdictions were more than 20% lower when estimated using separate eastern and western life tables than when estimated using a single national life table, while expected Indigenous deaths in western jurisdictions differed by less than 5%. The figures resulting from this example should not be taken as a precise measure of expected Indigenous deaths, but they do indicate the sensitivity of the results to the assumed levels of mortality. Unfortunately, the instabilities and uncertainties associated with the use of the Preston-Hill method to estimate mortality are magnified when more than one life table is used. While work is in progress within the ABS to assess the feasibility of state-specific life tables for at least some jurisdictions, there is a limit to what can be done with the data and methods that currently exist.

There are other indirect methods of assessing mortality (see, for example, Hill (1984) and United Nations (1983)) which could be investigated. Many of these methods require the collection of additional data. While this would not be without cost, it may represent a worthwhile investment, as high quality information about the size, composition and characteristics (including mortality) of the Indigenous population is of great importance to a broad range of decision-makers. The use of complementary methods could help to reduce the levels of uncertainty with respect to Indigenous mortality, especially if similar results were obtained in different ways.

As a summary measure of the health status of a population, mortality has some well-known limitations. Most importantly, it may not be sufficiently sensitive to subtle changes in health status, especially in the short term, and there may be delays of many years before improvements in health status lead to reductions in mortality. Despite such shortcomings, mortality remains an important health indicator, in part because of its irreversibility. Although mortality is generally one of the easiest health indicators to measure, there are obvious challenges with respect to monitoring the mortality of the Indigenous population. These in turn result in uncertainty about the precise levels of Indigenous mortality, the relative mortality differentials between Indigenous and other Australians, and changes in absolute and relative mortality over time. There have been strong and sustained efforts in recent years by the ABS in partnership with other agencies to improve the identification of Indigenous people in administrative collections, including death registrations, and recent progress with respect to death registrations has been encouraging. This work will help to increase the quality and availability of data. In the meantime, it is clear, despite the recognised deficiencies in the data, that Indigenous Australians continue to die at greater rates and at younger ages than the rest of the Australian population.

APPENDIX 1 ICD-9 CODES

The ICD-9 codes (World Health Organisation 1977) used in this publication are listed below.

Chapter	Name used in this publication	ICD-9 codes
I	Infectious/parasitic diseases	001–139
II	Neoplasms	140–239
III	Endocrine/nutritional/metabolic diseases	240–279
IV	Diseases of blood and blood forming organs	280–289
V	Mental disorders	290–319
VI	Nervous system diseases	320–389
VII	Circulatory diseases	390–459
VIII	Respiratory diseases	460–519
IX	Digestive diseases	520–579
X	Genitourinary diseases	580–629
XI	Complications of pregnancy and childbirth	630–677
XII	Diseases of skin and subcutaneous tissue	680–709
XIII	Musculoskeletal diseases	710–739
XIV	Congenital anomalies	740–759
XV	Certain perinatal conditions	760–779
XVI	Ill-defined conditions	780–799
XVII	Injury	E800–E999

The following sub-chapter groupings were used.

Chapter	Sub-chapter	ICD-9 codes
Neoplasms	Lip, oral, pharynx cancer	140–149
	Digestive, peritoneal cancer	150–159
	Respiratory, intrathoracic cancer	160–165
	Cancer of bone, connective tissue, skin, breast	170–176
	Cancer of genitourinary organs	179–189
	Lymphatic, haematopoietic cancer	200–208
	Other & unspecified cancer	190–199 and 210–239
Endocrine/nutritional disorders		
	Diabetes	250
	Other endocrine, metabolic and nutritional disorders	240–249 and 251–279
Mental disorders		
	Alcohol and drug-related psychosis, dependence, abuse	291–292 and 303–305
	Other mental disorders	290, 293–302 and 306–319
Circulatory diseases		
	Rheumatic heart disease	390–398
	Hypertensive disease	401–405
	Ischaemic heart disease	410–414
	Other heart disease	415–429
	Cerebrovascular disease	430–438
	Other diseases of circulatory system	440–459
Respiratory diseases		
	Pneumonia and influenza	480–487
	COPD and other allied conditions	490–496
	Other diseases of respiratory system	460–479 and 500–519
Digestive diseases		
	Chronic liver disease and cirrhosis	571
	Other digestive diseases	520–570 and 572–579
Ill-defined conditions		
	Sudden Infant Death Syndrome (SIDS)	798.0
	Non-SIDS signs, symptoms & ill-defined conditions	all other codes from 780–799
Injury		
	Motor vehicle traffic accidents	E810–E819
	Other accidents	E800–E809 and E820–E949
	Suicide and self-inflicted injury	E950–E959
	Homicide, purposely inflicted injury	E960–E969
	Other external causes	E970—E999

APPENDIX 2 SENSITIVITY ANALYSIS

This appendix presents information about a number of assessments of the sensitivity of the results to various decisions made during analysis. Among the comparisons are: results by year of registration versus by year of occurrence; results by place of registration versus by place of usual residence; results using 1991-based versus 1996-based population estimates, for both year of registration and year of occurrence data; and results obtained using the 1991 total Australian population versus the World Standard Population for direct standardisation. There is also a section on comparison of deaths identified as Indigenous in eastern and western jurisdictions.

YEAR OF REGISTRATION VERSUS YEAR OF OCCURRENCE

Most deaths are registered in the year in which they occur, with most of the rest being registered in the following year (table A2.1). Registration in a year following the year of death can occur if the death occurs late in the year, if the death is referred to the coroner, or if there are other delays in the submission and/or processing of the form. Because deaths may be registered many years after their occurrence, it is not possible to be certain at a given point in time that all deaths which occurred in a particular year have been recorded. That is, regardless of how long one waits, there may remain a small (but unknown) number of deaths still to be registered at some point in the future. As a result, the total number of deaths which occurred in a given year can never be known precisely. This makes the calculation of proportions relating to year of occurrence subject to a small amount of error. Proportions in which the denominator is the number of deaths which occurred in a given year(s) will be over-estimated to the extent that there are still deaths to be registered in the future. This over-estimation is not likely to be large provided a lag of at least a few years is allowed. As can be seen in table A2.1, the number of deaths registered for a particular year of occurrence decreases markedly over time.

This same problem does not exist for year of registration. It is possible to be certain about the number of deaths registered in a particular year, so proportions with year of registration as the denominator are not subject to the same source of error. (Errors related to the classification of deaths as Indigenous or non-Indigenous are still relevant, however.) For deaths registered in the six year period 1993–98, about 95% of all deaths occurred in the same year in which they were registered. For deaths identified as Indigenous, however, the proportion of registered deaths which occurred in the same year ranged between 85–89% over the period.

A2.1 YEAR OF REGISTRATION BY YEAR OF OCCURRENCE, DEATHS REGISTERED IN 1993–98

							Year of occurence	
Year of registration	*pre–1993(b)*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*Total*
				DEATHS RECORDED AS INDIGENOUS				
1993	156	978	—	—	—	—	—	1 134
1994	7	134	1 012	—	—	—	—	1 153
1995	7	11	133	1 031	—	—	—	1 182
1996	2	5	12	127	1 160	—	—	1 306
1997	2	0	6	11	231	1 412	—	1 662
1998	3	4	4	7	18	245	1 833	2 114
Total	*177*	*1 132*	*1 167*	*1 176*	*1 409*	*1 657*	*1 833*	*8 551*
				OTHER DEATHS				
1993	6 209	114 256	—	—	—	—	—	120 465
1994	73	5 374	120 092	—	—	—	—	125 539
1995	47	44	5 724	118 136	—	—	—	123 951
1996	52	10	21	5 860	121 470	—	—	127 413
1997	20	8	12	36	5 352	122 260	—	127 688
1998	16	2	3	10	23	4 778	120 256	125 088
Total	*6 417*	*119 694*	*125 852*	*124 042*	*126 845*	*127 038*	*120 256*	*750 144*

(a) Deaths by year of occurrence are not necessarily complete, especially for later years, as there may still be registrations to come in future years for deaths which have already occurred.

(b) Includes deaths for which year of occurrence was unknown.

Source: Deaths Registration Database, ABS.

The following section refers to deaths which occurred in 1995–97 and were registered by the end of 1998. As noted above, it is likely that a small number of deaths which occurred in 1995–97 will be registered in 1999 and later years, but no adjustment has been made for late registration. The proportions shown in tables below therefore represent slight over-estimates of the level of agreement between year of occurrence and year of registration.

For Australia as a whole, about 85% of deaths identified as Indigenous occurred in the same year as that in which they were registered, compared with almost 96% of other deaths (table A2.2). There were differences by State and Territory in the proportion of deaths for which year of registration was the same as year of occurrence, with a greater range for deaths identified as Indigenous than for other deaths. Differences by jurisdiction could be due to differences in a range of factors, such as the timeliness with which forms are submitted and/or processed, the extent of editing undertaken, and the level of coronial involvement in certain types of deaths. It should be noted that there can be a tradeoff in the registration process between speed and thoroughness. A slightly slower process which included adequate editing and data quality checking could result in a more useful end product. However, because the reporting of death statistics in Australia is based on year of registration, this can affect the results.

A2.2 PROPORTION OF DEATHS WITH THE SAME YEAR OF REGISTRATION AND YEAR OF OCCURRENCE(a)

	Deaths identified as Indigenous	*Other deaths*
	%	*%*
Place of registration		
New South Wales	91.3	96.6
Victoria	79.2	95.7
Queensland(c)	78.2	93.5
South Australia	94.2	96.3
Western Australia	86.9	96.7
Tasmania	88.9	95.9
Northern Territory	83.4	92.1
Australian Capital Territory	91.3	94.6
Australia	*84.9*	*95.8*
Place of usual residence of deceased		
New South Wales	91.5	96.5
Victoria	78.3	95.7
Queensland(c)	78.3	93.5
South Australia	93.9	96.3
Western Australia	87.3	96.7
Tasmania	88.9	95.9
Northern Territory	83.2	92.1
Australian Capital Territory	88.9	94.5
Australia	*84.9*	*95.8*

(a) For all deaths which occurred in 1995–97, and were registered by the end of 1998.

Source: Deaths Registration Database, ABS.

Deaths among infants were more likely to be subject to a delay in registration than were deaths among older people, but this difference was more apparent among deaths identified as Indigenous than among other deaths (table A2.3).

A2.3 PROPORTION OF DEATHS WITH THE SAME YEAR OF REGISTRATION AND OCCURRENCE, BY AGE(a)

	Deaths identified as Indigenous	*Other deaths*
Age group (years)	*%*	*%*
Less than 1	77.2	92.1
1–14	88.1	93.3
15–34	84.1	92.2
35–54	84.9	94.2
55–64	86.2	95.5
65 and over	86.6	96.2

(a) For deaths which occurred in 1995–97, and were registered by the end of 1998.

Source: Deaths Registration Database, ABS.

YEAR OF REGISTRATION VERSUS YEAR OF OCCURRENCE *continued*

There were also differences in delays in registration according to cause of death (table A2.4). Deaths registered as being from ill-defined causes and certain perinatal conditions were more likely than deaths from other causes to be registered in a later year.

A2.4 PROPORTION OF DEATHS WITH THE SAME YEAR OF REGISTRATION AND OCCURRENCE, BY CAUSE(a)

	Deaths identified as Indigenous	*Other deaths*
	%	%
Infectious/parasitic diseases	84.0	95.3
Neoplasms	86.3	95.9
Endocrine/nutritional/metabolic diseases	84.4	96.0
Diseases of blood and blood-forming organs	88.9	95.6
Mental disorders	85.8	95.5
Nervous system diseases	89.2	96.0
Circulatory diseases	85.9	96.1
Respiratory diseases	84.0	96.3
Digestive diseases	85.2	95.7
Genitourinary diseases	85.8	96.1
Complications of pregnancy and childbirth	—	93.5
Diseases of skin and subcutaneous tissue	92.3	95.0
Musculoskeletal diseases	91.7	96.3
Congenital anomalies	89.8	94.1
Certain perinatal conditions	76.6	90.9
Ill-defined conditions	74.1	90.8
Injury	84.6	92.2
All causes	**84.9**	**95.8**

(a) For all deaths which occurred in 1995–97 and were registered by the end of 1998.

Source: Deaths Registration Database, ABS.

PLACE OF REGISTRATION VERSUS PLACE OF USUAL RESIDENCE

For the large majority of deaths, both those identified as Indigenous and those not identified as Indigenous, the State or Territory of registration was the same as the State or Territory of usual residence (table A2.5). For example, of all deaths identified as Indigenous and registered in Victoria in the relevant period, about 90.5% were of people who usually lived in Victoria, and about 9.5% were from interstate, mostly from New South Wales. Conversely, of all deaths of Victoria residents which were identified as Indigenous, about 96.5% were registered in Victoria, with only about 3.5% of Indigenous deaths registered elsewhere.

A2.5 PROPORTION OF DEATHS WITH THE SAME PLACE OF REGISTRATION AND PLACE OF USUAL RESIDENCE(a)

	Proportion of deaths registered in this jurisdiction for which this was place of usual residence		*Proportion of deaths of usual residents of this place which were registered in this jurisdiction*	
	Deaths identified as Indigenous	*Other deaths*	*Deaths identified as Indigenous*	*Other deaths*
State and Territory	*%*	*%*	*%*	*%*
New South Wales	98.1	98.9	93.4	98.3
Victoria	90.5	99.0	96.5	98.9
Queensland(c)	99.0	98.0	99.2	98.6
South Australia	87.0	99.0	92.3	99.2
Western Australia	99.7	99.4	97.4	99.5
Tasmania	100.0	99.1	100.0	98.8
Northern Territory	95.6	91.8	96.3	92.9
Australian Capital Territory	73.9	85.6	94.4	94.8

(a) For all deaths which occurred in 1995–97, and were registered by the end of 1998.

Source: Deaths Registration Database, ABS.

COMPARISON OF RATES USING DIFFERENT ASSUMPTIONS

As noted in chapter 2, the volatility of census counts of Indigenous people makes it difficult to determine the most appropriate population estimates to use as the denominator for health rates and ratios. This is especially the case for years between censuses. The increase in the counts between 1991 and 1996 was largest in southern and eastern regions of Australia (Ross 1999), so these areas would be expected to be the most affected by the choice of population estimate.

Table A2.6 presents directly age-standardised all-cause death rates for 1995–97 using different assumptions. Rates were calculated using either 1991-based or 1996-based population estimates, as well as either year of registration data or year of occurrence data. Separate estimates were calculated for eastern jurisdictions (New South Wales, Victoria, Queensland, Tasmania and the Australian Capital Territory combined), western jurisdictions (Western Australia, South Australia and the Northern Territory combined) and for all of Australia, both for deaths identified as Indigenous and for other deaths. The Indigenous rates should not be interpreted as approximating the true rates, due to the under-identification of Indigenous deaths, which varies by jurisdiction. They are provided only to give an indication of the sensitivity of the rates to changes in the population estimates and whether year of occurrence or year of registration data are used.

COMPARISON OF RATES USING DIFFERENT ASSUMPTIONS *continued*

As can be seen in table A2.6, the choice of a population denominator had a larger effect on rates and rate ratios than did the choice between year of registration and year of occurrence data. Greater differences between year of occurrence and year of registration data would be expected if only a single year's data were used, rather than three years combined. Death rates for deaths not identified as Indigenous were largely unaffected, and as a result, the rate ratios were lower using 1996-based estimates than 1991-based estimates in the denominator. As expected, the differences were greater in relative terms for eastern jurisdictions than for western jurisdictions.

A2.6 COMPARISON OF OBSERVED DEATH RATES(a) UNDER DIFFERENT ASSUMPTIONS

	Identified as Indigenous		*Other(b)*		*Rate ratio(c)*	
	Males	*Females*	*Males*	*Females*		
	rate	*rate*	*rate*	*rate*	*Males*	*Females*
	WESTERN JURISDICTIONS(d)					
Deaths registered in 1995–97						
1991-based population estimates	20.7	14.4	7.8	5.1	2.7	2.8
1996-based population estimates	18.4	12.6	7.8	5.1	2.4	2.5
Deaths occurring in 1995–97 and registered by the end of 1998						
1991-based population estimates	20.2	14.4	7.8	5.1	2.6	2.8
1996-based population estimates	18.0	12.5	7.8	5.1	2.3	2.5
	EASTERN JURISDICTIONS(e)					
Deaths registered in 1995–97						
1991-based population estimates	7.3	5.2	8.0	5.3	0.9	1.0
1996-based population estimates	5.8	4.2	8.0	5.3	0.7	0.8
Deaths occurring in 1995–97 and registered by the end of 1998						
1991-based population estimates	7.9	5.6	7.9	5.3	1.0	1.1
1996-based population estimates	6.3	4.4	7.9	5.3	0.8	0.8
	ALL AUSTRALIA					
Deaths registered in 1995–97						
1991-based population estimates	12.4	8.6	7.9	5.3	1.6	1.6
1996-based population estimates	10.2	7.0	7.9	5.3	1.3	1.3
Deaths occurring in 1995–97 and registered by the end of 1998						
1991-based population estimates	12.6	8.8	7.9	5.2	1.6	1.7
1996-based population estimates	10.4	7.2	7.9	5.3	1.3	1.4

(a) Rates are per 1,000 for deaths from all causes and are directly age standardised to the 1991 Australian population. The Indigenous rates should not be interpreted as approximating the true rates, due to the under-identification of Indigenous deaths, which varies by jurisdiction. They are provided only to give an indication of the sensitivity of the rates to changes in the population estimates and whether year of occurrence or year of registration data are used.

(b) Includes all deaths not identified as Indigenous, from the relevant jurisdictions.

(c) Rate ratio is equal to the rate of deaths identified as Indigenous divided by the rate of Other deaths, with separate calculations for males and females.

(d) South Australia, Western Australia and Northern Territory combined.

(e) New South Wales, Victoria, Queensland, Tasmania and Australian Capital Territory combined.

Source: Deaths Registration Database, ABS.

CHOICE OF STANDARD POPULATION

In direct standardisation, a standard population is used to adjust death rates so that two or more groups with different age structures can be compared. The age-standardised death rate indicates what the death rate would have been, in theory, if the groups of interest had the same age structure as the standard population, but their own age-specific death rates. The standard population merely provides a means of weighting the age-specific rates of the groups of interest. There is no 'right' or 'wrong' standard population to use (although there are conventions), but the choice of standard can affect the results.

Two commonly used standard populations in Australia are the total Australian population as at 30 June 1991, and the World Standard Population. The 1991 Australian population is used by convention for most mortality reporting in Australia, while the World Standard Population is used by Australian cancer registries, as well as being in common use internationally. The World Standard Population gives greater weighting to younger age groups than does the total Australian population (table A2.7). This means that deaths in younger age groups have a greater weight when the World Standard Population is used, while deaths in older age groups have greater weight when the 1991 Australian population is used.

A2.7 COMPARISON OF TWO DIFFERENT STANDARD POPULATIONS

	Total Australian Population as at 30 June 1991		*World Standard Population*	
Age group (years)	*no.*	*%*	*no.*	*%*
Less than 1	259 085	1.5	2 400	2.4
1–4	1 012 618	5.9	9 600	9.6
5–14	2 513 827	14.5	19 000	19.0
15–24	2 760 838	16.0	17 000	17.0
25–34	2 825 398	16.3	14 000	14.0
35–44	2 622 658	15.2	12 000	12.0
45–54	1 876 079	10.9	11 000	11.0
55–64	1 462 818	8.5	8 000	8.0
65–74	1 182 145	6.8	5 000	5.0
75 and over	768 570	4.4	2 000	2.0
Total	17 284 036	100.0	100 000	100.0

Source: ABS 1993; Breslow & Day 1987.

As table A2.8 shows, the choice of a standard population made a difference not only to the standardised rates, but also to the rate ratios which are used to compare the groups of interest. The rate ratio was higher when using the World Standard Population than when using the total Australian population as the standard, for both males and for females overall and for most categories of cause of death (table A2.8). Among males, for example, the rate ratio ('Indigenous' rate divided by 'Other' rate) for all causes of death combined was 2.7 using the World Standard Population, but only 2.3 using the Australian population as the standard.

A2.8 DEATH RATES FROM SELECTED CAUSES USING DIFFERENT STANDARD POPULATIONS(a)(b)

	Males						Females					
	Using All-Australian 1991 Population			Using World Standard Population			Using All-Australian 1991 Population			Using World Standard Population		
	Indigenous rate	Other rate	Rate ratio	Indigenous rate	Other rate	Rate ratio	Indigenous rate	Other rate	Rate ratio	Indigenous rate	Other rate	Rate ratio
Infectious/parasitic	37	8	4.8	29	5	5.6	31	5	6.2	20	3	6.4
Neoplasms	263	224	1.2	199	148	1.3	182	140	1.3	140	98	1.4
Endocrine/ nutritional/metabolic	123	24	5.2	96	15	6.2	172	16	10.6	133	10	13.4
Blood, blood-forming organs	11	2	5.5	8	1	6.7	5	2	3.4	5	1	5.0
Mental disorders	74	18	4.1	53	11	4.6	33	17	2.0	23	9	2.6
Nervous system	39	16	2.4	28	10	2.8	11	15	0.7	8	9	0.9
Circulatory	608	304	2.0	448	178	2.5	400	214	1.9	275	113	2.4
Respiratory	268	72	3.7	184	41	4.5	185	41	4.5	133	23	5.7
Digestive	69	23	3.0	57	15	3.7	57	16	3.7	46	9	5.0
Genitourinary	64	12	5.5	40	6	6.7	56	9	6.1	40	5	8.2
Complications of pregnancy, childbirth	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
Skin, subcutaneous tissue	4	1	4.8	4	0	8.3	9	1	8.0	5	1	9.5
Musculoskeletal	4	2	1.9	3	1	2.7	9	4	2.0	5	3	1.9
Congenital anomalies	9	4	2.3	12	6	2.2	7	3	2.3	10	4	2.5
Certain perinatal conditions	10	4	2.5	16	7	2.5	8	3	3.0	13	4	3.1
Ill-defined	29	3	9.3	27	3	8.0	17	2	8.0	18	2	8.6
Injury	184	60	3.1	169	53	3.2	72	22	3.3	62	18	3.4
All causes	**1 798**	**777**	**2.3**	**1 374**	**502**	**2.7**	**1 253**	**509**	**2.5**	**935**	**311**	**3.0**

(a) Data for usual residents of Western Australia, South Australia and the Northern Territory combined for 1995–97. Based on year of occurrence.

(b) Rates are per 100,000 population.

Source: Deaths Registration Database, ABS.

Most of the figures presented in this publication are the result of indirect rather than direct standardisation. In indirect standardisation, a set of standard rates, rather than a standard population, is used to account for differences in age. The standard rates which have been used in this publication are the all-Australian rates for the year(s) for which the comparison is being made. The use of a different set of rates would have resulted in different standardised mortality ratios (SMRs), but the magnitude of this difference would depend on the relationship between the rates. For example, the rates of death for people not identified as Indigenous are similar to all-Australian rates, so the SMRs would not be very different if these rates were used as the standard.

COMPARISON OF DEATHS IDENTIFIED AS INDIGENOUS IN EASTERN AND WESTERN JURISDICTIONS

Due to concerns relating to data quality, most previous analyses of Indigenous mortality in Australia have been limited to deaths in Western Australia, South Australia and the Northern Territory combined. However, it is not clear how well the mortality experience of those jurisdictions represents the situation in other parts of Australia. Although it is not possible to examine Indigenous deaths which have not been identified as such, it is possible to look at those deaths which have been identified, keeping in mind that they may not be representative of all deaths of Indigenous people. In this way, one can determine whether deaths identified as Indigenous in New South Wales, Victoria, Queensland, Tasmania and the Australian Capital Territory are similar in their distribution to other deaths in the same jurisdictions, or are more like deaths identified as Indigenous in Western Australia, South Australia and the Northern Territory. In this section, the term 'eastern' will be used to refer to the combination of New South Wales, Victoria, Queensland, Tasmania and the Australian Capital Territory, while the term 'western' will be used to indicate Western Australia, South Australia and the Northern Territory combined. It could be argued that Queensland should be examined separately from New South Wales, Victoria, Tasmania and the Australian Capital Territory, but data for Queensland were only available for some of the period of interest.

Among deaths which occurred in 1995–97 and were registered by 1998, those identified as Indigenous in eastern jurisdictions were more similar to deaths identified as Indigenous in western jurisdictions than they were to other deaths (whether in eastern or western jurisdictions), both according to age at death (table A2.9) and cause of death (table A2.10). While this does not necessarily indicate that the overall mortality experience of Indigenous people in eastern jurisdictions was similar to that of Indigenous people in western jurisdictions, it does indicate that it was similar *among those who were identified as Indigenous in death records*. It could be that Indigenous people living in discrete Indigenous communities are more likely than those living in more heterogeneous communities (such as large cities) to be identified as Indigenous when they die, and that the similarity of the mortality experience for people identified as Indigenous in eastern and western jurisdictions may reflect similarities in living conditions, for example. If this were the case, then the mortality experience of people who were identified as Indigenous would not necessarily represent the mortality experience of other Indigenous people in eastern (or, indeed, western) jurisdictions.

A2.9 AGE DISTRIBUTION OF DEATHS BY PLACE OF USUAL RESIDENCE(a)

	Identified as Indigenous			*Other(d)*		
	Western(b)	*Eastern(c)*	*Total*	*Western(b)*	*Eastern(c)*	*Total*
Age groups (years)	%	%	%	%	%	%
Less than 1	7.4	9.4	8.2	1.0	1.0	1.0
1–-14	3.4	2.7	3.2	0.6	0.6	0.6
15–-34	15.0	15.6	15.2	3.5	3.3	3.4
35–-54	29.7	24.2	27.6	7.8	7.7	7.7
55–64	17.0	16.4	16.7	8.9	9.4	9.3
65 and over	27.4	31.8	29.1	78.3	78.0	78.0
Total	100.0	100.0	100.0	100.0	100.0	100.0

(a) For deaths which occurred in 1995–97 and were registered by 1998.

(b) South Australia, Western Australia and the Northern Territory combined.

(c) New South Wales, Victoria, Queensland, Tasmania and the Australian Capital Territory combined.

(d) Includes all deaths not identified as Indigenous.

Source: Deaths Registration Database, ABS.

A2.10 DISTRIBUTION OF DEATHS BY CAUSE(a)

	Identified as Indigenous			*Other(d)*		
	Western(b)	*Eastern(c)*	*Total*	*Western(b)*	*Eastern(c)*	*Total*
	%	%	%	%	%	%
Infectious/parasitic diseases	2.3	2.0	2.2	1.0	1.1	1.1
Neoplasms	12.3	14.7	13.2	27.7	27.4	27.4
Endocrine/nutritional/metabolic diseases	8.6	6.7	7.9	3.1	3.0	3.0
Disease of the blood and blood-forming organs	0.5	0.3	0.4	0.3	0.3	0.3
Mental disorders	3.4	3.2	3.3	2.8	2.5	2.6
Nervous system diseases	1.6	1.9	1.7	2.4	2.3	2.3
Circulatory diseases	27.5	30.6	28.7	41.0	42.1	41.9
Respiratory diseases	12.4	8.4	10.9	8.6	8.6	8.6
Digestive diseases	4.8	3.5	4.3	3.1	3.0	3.0
Genitourinary diseases	3.0	1.7	2.5	1.6	1.8	1.8
Complications of pregnancy and childbirth	0.0	0.0	0.0	0.0	0.0	0.0
Diseases of the skin and subcutaneous tissue	0.3	0.2	0.3	0.2	0.2	0.2
Musculoskeletal diseases	0.4	0.9	0.6	0.6	0.6	0.6
Congenital anomalies	1.9	2.4	2.1	0.5	0.5	0.5
Certain perinatal conditions	2.5	4.6	3.3	0.4	0.5	0.5
Ill-defined conditions	3.1	2.2	2.7	0.4	0.4	0.4
Injury	15.4	16.5	15.8	6.2	5.7	5.8
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

(a) For deaths which occurred in 1995–97 and were registered by 1998.

(b) South Australia, Western Australia and the Northern Territory combined.

(c) New South Wales, Victoria, Queensland, Tasmania and the Australian Capital Territory combined.

(d) Includes all deaths not identified as Indigenous.

Source: Deaths Registration Database, ABS.

APPENDIX 3 ADDITIONAL INFORMATION ON METHODS FOR ESTIMATING MORTALITY

CONSTRUCTING THE EXPERIMENTAL INDIGENOUS LIFE TABLE, 1991–96

The life table, according to Newell (1988, p. 67) 'is simply an elegant and convenient way of analysing Age-Specific Death Rates'. In order to construct a life table, the only data required are age-specific mortality rates (denoted M_x). From these, it is possible to calculate values of q_x (the probability of dying between exact age x and exact age $x + 1$) and e_x (the expectation of life at age x).

However in the case of the Indigenous population, age-specific mortality rates calculated using deaths registered as Indigenous are an under-estimate of the actual mortality rates experienced by the Indigenous population. As a result, experimental methods must be used to calculate the life table.

The Preston-Hill Method

The Preston-Hill method provides the means by which the experimental Indigenous life table is calculated. The method is used to estimate the extent of the under-coverage of Indigenous death registrations so that a correction factor can be applied to the observed values of M_x (that is, those derived using deaths registered as Indigenous). These corrected M_x values are then used to construct the experimental Indigenous life tables.

According to Preston and Hill (1980, p. 360), 'the procedure is based on the simple notion that, in a closed population experiencing perfect reporting, a cohort at the first census will be equal to the sum of the survivors of the same cohort at the second census and the deaths occurring to cohort members during the intercensal period'. That is, Count at time 1 = Count at time 2 + Deaths between time 1 and time 2. (Alternatively, using a form analogous to the basic demographic equation, Count at time 2 = Count at time 1 – Deaths between time 1 and time 2.)

The method does not assume that perfect recording actually exists. On the contrary, it assumes that under-enumeration has occurred and it attempts to estimate the magnitude using observed data. The observed count at time 1 is made up of an unknown proportion (K_1) of the true population existing at this time (that is, the number of people who would have been observed if the count at time 1 had been complete). Similarly, the observed count at time 2 is an unknown proportion (K_2) of the true population at time 2. The observed number of deaths between time 1 and time 2 is an unknown proportion (C) of the true number of deaths during that time period.

The Preston-Hill Method *continued*

This information can be transformed algebraically (under the assumption of a closed population) to allow estimates to be made of the relative under-enumeration of successive censuses as well as the under-coverage of intercensal deaths. This is done by first plotting data based on two successive censuses (e.g. 1991 and 1996) and deaths registered in the intercensal period (e.g. 1991–96) and then estimating the equation for the line of best fit. For each age group and sex, the Cohort Size Ratio (CSR) is plotted on the y-axis against the Cohort Death Ratio (CDR) on the x-axis. The CSR is the inverse survival ratio, and is equal to the observed count at the first census divided by the observed count at the second census (e.g. the 1991 count divided by the 1996 count). The CDR is equal to the number of observed intercensal deaths divided by the observed count at the second census (e.g. the 1996 count).

For example, if the enumerated population of 5–9 year old girls in the first census was 1,000 and the enumerated population of 10–14 year old girls in 1996 (the same group of girls five years later) was 900 then the CSR for this cohort would be 1.11 (1,000/900). If there were 12 registered deaths in the intercensal period to girls in this cohort (that is, those aged 5–9 years in 1991, 6–10 years in 1992, 7–11 years in 1993, 8–12 years in 1994, 9–13 years in 1995 and 10–14 years in 1996), then the CDR for this cohort would be 0.013 (12/900). The plotted point would have x and y coordinates (0.013, 1.11). The same process would be used to plot values for all age groups, with separate graphs for males and females.

Assuming the levels of coverage in the two censuses and in death registrations do not differ across age groups, then according to Preston and Hill (1980), the values for CSR and CDR for each cohort should lie on a straight line with a y-intercept equal to K_1 / K_2 and a slope equal to K1 / C. That is, the line is specified by the equation: $CSR = K_1 / C * CDR + K_1 / K_2$. In a closed population which is perfectly measured and for which all intercensal deaths are registered, then K_1, K_2, and C are all equal to 1, so $CSR = 1 * CDR + 1$.

Once the points for all the age groups have been plotted, a line is fitted, and numerical values for the slope and the y-intercept are calculated. These values are then used to estimate the completeness of coverage of death registrations. Dividing the y-intercept by the slope, we get $(K_1 / K_2) / (K_1 / C)$, which is equal to C / K_2. If it is assumed that the second census count is complete (i.e. that K_2 is equal to 1), then C (the completeness of enumeration of deaths) is equal to the y-intercept divided by the slope of the fitted line. The age-specific mortality rates obtained from registered deaths (that is, the observed values for M_x) are then divided by C to produce adjusted age-specific mortality rates by single year of age (adjusted M_x). These adjusted M_x values are smoothed so that the results are internally consistent, and q_x values are then derived.

The Preston-Hill Method *continued*

The Preston-Hill method depends on a number of assumptions, including a closed population; no variation by age in the levels of completeness of enumeration of the population or of deaths; correct reporting of age in the censuses and in death registrations; and stable mortality during the intercensal period. For the purposes of estimating completeness of coverage of death registrations, it also assumes that the second census count is complete.

A closed population is one in which there is no migration in or out. Aside from important issues relating to changes over time in the propensity of people to identify as Indigenous, the migration of Indigenous people into and out of the population (in this case, into and out of Australia) is not likely to have a major effect for Australia as a whole, which is the level at which the method has been used. Indigenous people are not identified in the overseas arrivals and departures collection, but census data indicate that the rate of in-migration for Indigenous people is very low (ABS 1998b). The rate of out-migration is assumed to be very low as well, and net overseas migration of Indigenous people is assumed to be nil for the purposes of population estimation and projection. The levels of migration into and out of a particular State or Territory are more significant (ABS 1998b), but they may not be high enough to preclude the use of the method for particular jurisdictions, provided other assumptions are met.

The issue of changes over time in the propensity of people to identify as Indigenous would seem at first glance to be a potentially important one. However, the calculation of the completeness of coverage of deaths assumes that the observed count at the second census is complete, which means that changes between 1991 and 1996 in the propensity of people to identify as Indigenous on the census are taken into account.

The second assumption is that under-enumeration of the population and under-registration of deaths are both constant across age. This assumption is used to allow the application of the same death correction factor $(1 / C)$ for all age groups. The completeness of enumeration of the Indigenous population by age is not known with certainty, but it is likely to vary considerably for different age groups. For example, young adult males are consistently the most likely to be under-enumerated (ABS 1998a). Some variation by age in the completeness of registration of deaths is also likely, but the degree of such variation is unknown. With respect to the Indigenous population, variation in the completeness of enumeration of the population and/or of deaths can also arise if the propensity to identify as Indigenous varies by age.

Correct reporting of age is important to ensure that the correct number of people and deaths are included for the appropriate age cohort. Mis-reporting of age distorts the relationships which underpin the method. For example, an overstatement of age, whether in the census or in death registrations, tends to result in an over-estimate of the completeness of death registrations (Preston and Hill 1980).

The Preston-Hill Method *continued*

The assumption that there are no significant changes in mortality during the intercensal period is not unreasonable, but it is impossible to quantify changes in mortality over time due to the under-enumeration of Indigenous deaths.

Preston and Hill (1980, p. 366) have noted their method 'may provide a better estimate of relative enumeration completeness than of the completeness of death registration' because of 'the bunching of points close to the origin'. As a result of this bunching, the y-intercept is estimated with more precision than is the slope. The slope is a critical element for the estimation of completeness of death registration but is not used in the estimation of the relative completeness of census enumeration. This is why Hill (1984) expressed strong reservations about the usefulness of the procedure as an indirect method of estimating mortality.

The experimental Indigenous life table for 1991–96

The experimental Indigenous life table for the Indigenous population for the period 1991–96 is presented in table A3.1. This life table, which was derived using the Preston-Hill method, has been published previously (ABS 1998a), but an error was subsequently discovered. In the original table, the lx values for males aged 50–99 were inadvertently retained for females of the corresponding ages (all other columns were correct). This error was corrected in a subsequent publication (ABS 1999a). The correct figures are included in the table below.

A3.1 EXPERIMENTAL LIFE TABLE OF THE INDIGENOUS POPULATION, 1991 TO 1996

Age	*lx*	*qx*	*Lx*	*e°x*	*Age*	*lx*	*qx*	*Lx*	*e°x*
				MALES					
0	100 000	0.02572	98 071	56.87	50	68 762	0.02373	67 946	17.60
1	97 428	0.00274	97 268	57.37	51	67 130	0.02531	66 281	17.01
2	97 161	0.00134	97 096	56.52	52	65 431	0.02699	64 548	16.44
3	97 031	0.00094	96 985	55.60	53	63 666	0.02878	62 750	15.88
4	96 940	0.00067	96 907	54.65	54	61 833	0.03067	60 885	15.34
5	96 875	0.00049	96 851	53.69	55	59 937	0.03269	58 957	14.81
6	96 827	0.00042	96 807	52.71	56	57 978	0.03481	56 968	14.29
7	96 786	0.00040	96 767	51.74	57	55 959	0.03706	54 922	13.79
8	96 747	0.00040	96 728	50.76	58	53 885	0.03944	52 823	13.30
9	96 708	0.00040	96 689	49.78	59	51 760	0.04193	50 675	12.83
10	96 669	0.00042	96 649	48.80	60	49 590	0.04456	48 485	12.37
11	96 628	0.00047	96 606	47.82	61	47 380	0.04732	46 259	11.92
12	96 583	0.00054	96 557	46.84	62	45 138	0.05022	44 004	11.49
13	96 531	0.00065	96 500	45.86	63	42 871	0.05326	41 729	11.07
14	96 469	0.00085	96 428	44.89	64	40 587	0.05644	39 442	10.66
15	96 387	0.00123	96 328	43.93	65	38 297	0.05976	37 153	10.27
16	96 269	0.00203	96 171	42.98	66	36 008	0.06323	34 870	9.89
17	96 073	0.00271	95 943	42.07	67	33 732	0.06685	32 604	9.53
18	95 813	0.00320	95 660	41.18	68	31 477	0.07062	30 365	9.17
19	95 507	0.00365	95 333	40.31	69	29 254	0.07454	28 164	8.83
20	95 158	0.00408	94 964	39.46	70	27 073	0.07862	26 009	8.50
21	94 770	0.00447	94 558	38.62	71	24 945	0.08285	23 912	8.19
22	94 346	0.00485	94 118	37.79	72	22 878	0.08725	21 880	7.88
23	93 889	0.00521	93 645	36.97	73	20 882	0.09181	19 924	7.59
24	93 400	0.00555	93 141	36.16	74	18 965	0.09652	18 050	7.30
25	92 882	0.00588	92 609	35.36	75	17 134	0.10141	16 266	7.03
26	92 335	0.00621	92 049	34.57	76	15 397	0.10645	14 577	6.77
27	91 762	0.00654	91 462	33.78	77	13 758	0.11167	12 990	6.51
28	91 161	0.00687	90 848	33.00	78	12 222	0.11705	11 506	6.27
29	90 535	0.00722	90 208	32.23	79	10 791	0.12260	10 130	6.04
30	89 881	0.00757	89 541	31.46	80	9 468	0.12831	8 861	5.81
31	89 201	0.00794	88 847	30.69	81	8 253	0.13420	7 699	5.59
32	88 493	0.00833	88 125	29.93	82	7 146	0.14025	6 645	5.38
33	87 756	0.00874	87 372	29.18	83	6 143	0.14647	5 693	5.18
34	86 989	0.00919	86 589	28.43	84	5 244	0.15287	4 843	4.98
35	86 190	0.00967	85 773	27.69	85	4 442	0.15943	4 088	4.79
36	85 356	0.01018	84 922	26.96	86	3 734	0.16615	3 424	4.60
37	84 487	0.01074	84 033	26.23	87	3 113	0.17305	2 844	4.42
38	83 579	0.01135	83 105	25.51	88	2 575	0.18011	2 343	4.24
39	82 631	0.01200	82 135	24.80	89	2 111	0.18734	1 913	4.06
40	81 639	0.01271	81 120	24.09	90	1 715	0.19473	1 548	3.88
41	80 601	0.01348	80 058	23.40	91	1 381	0.20229	1 242	3.69
42	79 515	0.01431	78 946	22.71	92	1 102	0.21001	986	3.50
43	78 377	0.01521	77 780	22.03	93	871	0.21789	776	3.30
44	77 184	0.01618	76 560	21.36	94	681	0.22593	604	3.08
45	75 935	0.01723	75 281	20.71	95	527	0.23413	465	2.84
46	74 627	0.01835	73 942	20.06	96	404	0.24248	355	2.55
47	73 257	0.01956	72 540	19.43	97	306	0.25098	267	2.21
48	71 824	0.02086	71 075	18.81	98	229	0.25964	199	1.78
49	70 326	0.02224	69 544	18.20	99	170	0.26844	147	1.23

lx number of persons alive at exact age x

qx proportion dying between exact age x and exact age x + 1

Lx number of person-years lived between exact age x and exact age x + 1

e°x complete expectation of life at exact age x

Source: ABS 1999a.

A3.1 EXPERIMENTAL LIFE TABLE OF THE INDIGENOUS POPULATION, 1991 TO 1996—*continued*

Age	*lx*	*qx*	*Lx*	*e°x*	*Age*	*lx*	*qx*	*Lx*	*e°x*
				FEMALES					
0	100 000	0.02282	98 289	61.66	50	76 870	0.01786	76 184	20.19
1	97 718	0.00199	97 601	62.10	51	75 497	0.01917	74 774	19.55
2	97 523	0.00094	97 477	61.22	52	74 050	0.02057	73 289	18.92
3	97 432	0.00066	97 399	60.28	53	72 527	0.02205	71 728	18.31
4	97 367	0.00048	97 344	59.32	54	70 928	0.02363	70 090	17.71
5	97 320	0.00037	97 302	58.34	55	69 252	0.02529	68 376	17.13
6	97 284	0.00033	97 268	57.37	56	67 501	0.02706	66 587	16.56
7	97 252	0.00031	97 237	56.38	57	65 674	0.02892	64 725	16.01
8	97 222	0.00031	97 207	55.40	58	63 775	0.03088	62 791	15.47
9	97 192	0.00031	97 177	54.42	59	61 806	0.03294	60 788	14.94
10	97 162	0.00032	97 146	53.44	60	59 770	0.03510	58 721	14.44
11	97 131	0.00035	97 114	52.45	61	57 672	0.03737	56 595	13.94
12	97 097	0.00039	97 078	51.47	62	55 517	0.03974	54 414	13.47
13	97 059	0.00046	97 036	50.49	63	53 311	0.04223	52 185	13.00
14	97 014	0.00059	96 985	49.51	64	51 060	0.04482	49 915	12.55
15	96 956	0.00083	96 916	48.54	65	48 771	0.04752	47 612	12.12
16	96 876	0.00130	96 813	47.58	66	46 454	0.05033	45 285	11.70
17	96 749	0.00176	96 664	46.64	67	44 116	0.05326	42 941	11.29
18	96 579	0.00209	96 478	45.73	68	41 766	0.05629	40 591	10.90
19	96 377	0.00238	96 262	44.82	69	39 415	0.05944	38 244	10.52
20	96 148	0.00264	96 021	43.93	70	37 072	0.06270	35 910	10.15
21	95 894	0.00288	95 756	43.04	71	34 748	0.06608	33 600	9.80
22	95 618	0.00311	95 469	42.16	72	32 451	0.06957	31 323	9.46
23	95 320	0.00333	95 161	41.29	73	30 194	0.07317	29 089	9.13
24	95 002	0.00354	94 834	40.43	74	27 985	0.07689	26 909	8.81
25	94 666	0.00375	94 488	39.57	75	25 833	0.08071	24 790	8.50
26	94 311	0.00396	94 124	38.72	76	23 748	0.08465	22 743	8.20
27	93 938	0.00416	93 742	37.87	77	21 738	0.08870	20 773	7.91
28	93 547	0.00438	93 342	37.03	78	19 809	0.09286	18 890	7.64
29	93 137	0.00461	92 922	36.19	79	17 970	0.09713	17 097	7.37
30	92 708	0.00485	92 483	35.35	80	16 225	0.10150	15 401	7.10
31	92 258	0.00510	92 023	34.52	81	14 578	0.10599	13 805	6.85
32	91 788	0.00538	91 541	33.70	82	13 033	0.11057	12 312	6.60
33	91 294	0.00568	91 034	32.88	83	11 592	0.11527	10 924	6.36
34	90 775	0.00602	90 502	32.06	84	10 255	0.12006	9 640	6.13
35	90 229	0.00638	89 941	31.25	85	9 024	0.12496	8 460	5.89
36	89 653	0.00677	89 349	30.45	86	7 897	0.12996	7 383	5.66
37	89 046	0.00721	88 725	29.66	87	6 870	0.13506	6 406	5.44
38	88 404	0.00769	88 064	28.87	88	5 942	0.14026	5 526	5.21
39	87 724	0.00821	87 364	28.09	89	5 109	0.14556	4 737	4.97
40	87 004	0.00878	86 622	27.31	90	4 365	0.15096	4 036	4.74
41	86 241	0.00940	85 835	26.55	91	3 706	0.15646	3 416	4.49
42	85 430	0.01008	84 999	25.80	92	3 126	0.16206	2 873	4.23
43	84 569	0.01081	84 112	25.06	93	2 620	0.16776	2 400	3.95
44	83 655	0.01161	83 169	24.33	94	2 180	0.17357	1 991	3.65
45	82 683	0.01247	82 168	23.61	95	1 802	0.17947	1 640	3.31
46	81 652	0.01340	81 105	22.90	96	1 478	0.18548	1 341	2.92
47	80 558	0.01440	79 978	22.20	97	1 204	0.19161	1 089	2.48
48	79 398	0.01547	78 784	21.52	98	973	0.19759	877	1.94
49	78 169	0.01662	77 520	20.8	99	781	0.23239	701	1.30

lx number of persons alive at exact age x

qx proportion dying between exact age x and exact age x + 1

Lx number of person-years lived between exact age x and exact age x + 1

e°x complete expectation of life at exact age x

Source: ABS 1999a.

ESTIMATING M_x FROM q_x

As noted above and in chapter 3, M_x is used to denote the age-specific mortality rate at age x. Values for q_x are usually calculated from values for M_x as derived from registered deaths and estimated population, but this can not be done directly in the case of the Indigenous population. As noted above, as part of the application of the Preston-Hill method, a correction factor is estimated and applied to the observed death rates. These corrected M_x values are then smoothed so that the results are internally consistent. Values for q_x are then derived from these smoothed values and form the basis of the experimental life table. For the purposes of estimating expected deaths, new values for M_x must be calculated by sex and single year of age from the q_x column of the relevant experimental life table, using the following formulae.

(a) For age 1–99 years

$$M_x = \left[a_x * q_x + (1 - a_{x+1}) * (1 - q_x) * q_{x+1}\right] / \left[1 - (1 - a_x) * q_x\right]$$

where a_x = the estimated fraction of a year lived on average by those who died between exact ages x and $x + 1$ (see table A3.2)

This formula essentially takes the form Deaths / Population, as is expected for M_x. It looks slightly more complicated than this because the deaths are taken from two different years of age (the age of interest, x, plus the following year of age, $x + 1$). In addition, some terms have dropped out of the equation. Although this simplifies the calculations, it makes the derivation less obvious.

This same formula can not be used for the youngest age group, and a different set of formulae must be used. The following formulae essentially split the mortality rates for infants into two parts, one for age 0–6 months, and the other for age 6–12 months.

(b) For age 0 years

$$M_b = (1 - a_0) * q_0 \quad \text{(for 0–6 months)}$$

and $$M_0 = \left[a_0 * q_0 + (1 - a_1) * (1 - q_0) * q_1\right] / \left[1 - (1 - a_0) * q_0\right]$$ for 6–12 months)

where a_x = the estimated fraction of a year lived on average by those who died between exact ages x and $x + 1$ (see table A3.2).

A3.2 VALUES OF ax BY SEX

	a0	*a1*	*a2–99*
Males	0.117	0.39	0.50
Females	0.120	0.39	0.50

Source: ABS unpublished data.

ESTIMATING M_x FROM q_x *continued*

For most age groups, deaths are spread relatively evenly throughout the year, and people who died during the year are assumed to have lived on average for half of that year. Hence a_x for ages 2–99 years is 0.5 (table A3.2). By contrast, for infants (age 0 years), there is a significant clustering of deaths towards the beginning of the time period (i.e. around the time of birth). This is also the case to a lesser extent among one-year-old children. To reflect this, a_x values of 0.117 (males) and 0.120 (females) have been assigned for 0 year-olds and the value 0.39 (for both males and females) has been assigned for 1 year-olds.

CALCULATING EXPECTED INDIGENOUS DEATHS

The number of expected Indigenous deaths by sex and single year of age during the projected interval *(t, t + 1)* is calculated by applying the appropriate formula as shown below. Nil overseas migration is assumed, as is stability of death rates over time. Expected deaths by sex and single year of age are summed to provide an estimate of total expected Indigenous deaths for the relevant jurisdiction, or for all of Australia, for the time period in question.

(a) Deaths at age 2 to 99 last birthday (D_x), where $x = 2,3, \ldots 99$

$$D_x(t) = 0.5\left[P_{x-1}(t) * M_{x-1}(t) + P_x(t) * M_x(t)\right]$$

where $D_x(t)$ = deaths at age x in the interval $(t, t+1)$;

$P_x(t)$ = estimated mid-year resident population age x at time t;

$M_x(t)$ = mortality rate for age x years in the interval $(t, t+1)$.

The above formula essentially uses an unweighted average of the number of deaths expected for the preceding and the current ages. That is, the component $(P_{x-1} * M_{x-1})$ is an estimate of the deaths expected from the previous age group $(x - 1)$, while $(P_x * M_x)$ is an estimate of the deaths expected for the current age group. D_x at time t is simply the average of these two values, obtained by summing and then dividing by two (or multiplying by 0.5).

(b) Deaths at age 100 years or more last birthday (D_{100+})

$$D_{100+}(t) = 0.5 * P_{99}(t) * M_{99}(t) + P_{100+}(t) * M_{100+}(t)$$

where $D_x(t)$ = deaths at age x in the interval $(t, t+1)$;

$P_x(t)$ = estimated mid-year resident population age x at time t;

$M_x(t)$ = mortality rate for age x years in the interval $(t, t+1)$.

CALCULATING EXPECTED INDIGENOUS DEATHS *continued*

The oldest age group (100 years or more) is an open-ended interval, rather than a single year of age. This means that a slightly different formula is required. The first part of the formula, $0.5 * P_{99}(t) * M_{99}(t)$, is analogous to the first part of the formula for ages 2–99 years. The second part of the formula, $P_{100+}(t) * M_{100+}(t)$, differs slightly (in that the term is not multiplied by 0.5) to reflect that the age group is open-ended.

(c) Deaths of those aged less than one year (D_0)

$$D_0(t) = B(t) * M_b(t) + M_b(t) * FACTOR * \left(1 - M_b(t)\right) * P_0(t)$$

where $D_0(t)$ = infant deaths in the interval $(t,\ t+1)$;.

$B(t)$ = births in the interval $(t,\ t+1)$;

$M_b(t)$ = mortality rate from birth to 6 months of age in the interval $(t,\ t+1)$;

$FACTOR = a_0\ /\ (1 - a_0) = (.117/.883)$ for males and $(.120/.880)$ for females;

$P_0(t)$ = estimated mid-year resident population age 0 at time t.

Calculating expected deaths for ages 0 and 1 is significantly more complicated, as indicated by the formulae above and below, but the underlying concepts are essentially the same.

(d) Deaths of those aged one year (D_1)

$$D_1(t) = \left[0.5 * P_1(t) * M_1(t)\right] + \left[P_0(t) * M_0(t)\right]$$
$$-\left[\left(M_b(t) * FACTOR\right) / \left(1 - M_b(t)\right) * P_0(t)\right]$$

where $D_1(t)$ = deaths at age 1 year in the interval $(t,\ t+1)$;

$P_1(t)$ = estimated mid-year resident population age 1 at time t.

$M_1(t)$ = mortality rate for age 1 in the interval $(t,\ t+1)$

$P_0(t)$ = estimated mid-year resident population age 0 at time t.

$M_0(t)$ = mortality rate from 6 months to one year of age in the interval $(t,\ t+1)$

$M_b(t)$ = mortality rate from birth to 6 months of age in the interval $(t,\ t+1)$;

$FACTOR = a_0\ /\ (1 - a_0) = (.117/.883)$ for males and $(.120/.880)$ for females.

LIST OF REFERENCES

ABS Australian Bureau of Statistics
AIHW Australian Institute of Health and Welfare
UN United Nations
WHO World Health Organization

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