Diabetes as a cause of death, Australia, 1997 and 1998

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Diabetes as a cause of death, Australia, 1997 and 1998

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Preface

Diabetes is increasingly being recognised as a significant and growing public health problem both in Australia and worldwide. The disorder imposes a considerable burden on individuals and the health care system due in part to the morbidity and mortality it causes from a wide range of complications, mainly cardiovascular disease, eye and kidney diseases and limb amputations. This has been recognised by Australian Health Ministers who made diabetes one of the six National Health Priority Areas. This focus has intensified the need for up-to-date information on diabetes and its impact on the Australian community.

Diabetes as a Cause of Death, Australia, 1997 and 1998 is the first national report on diabetes mortality that examines diabetes as an associated cause of death as well as the underlying cause of death. This report has been made possible by the recent move by the Australian Bureau of Statistics to code all causes of death on the death certificate and not just the underlying cause of death. Data are presented for each State and Territory as well as national data. Data on special population groups such as Indigenous Australians, people living in rural and remote areas of Australia, and people who are at a socioeconomic disadvantage are also included.

The report will be relevant to policy makers, health professionals, researchers, and the broader community as a valuable reference on the extent to which diabetes may cause death in Australia.

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Richard Madden

Director

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Summary

This report highlights the considerable contribution that diabetes makes to all-cause mortality in Australia. The recent move by the Australian Bureau of Statistics to code all causes of death listed on the death certificate provides the opportunity to examine diabetes as an associated cause as well as the underlying cause of death. The underlying cause of death refers to the disease or injury initiating the sequence of events leading to death, and the associated causes refers to all other morbid conditions, diseases and injuries leading to death or contributing to death. The term 'diabetes-related deaths' is used in the report to refer to deaths where diabetes is the underlying or an associated cause of death. Multiple cause of death coding first became available for 1997 deaths data and in this report, deaths data for 1997 and 1998 are combined to allow for more detailed analysis.

Diabetes-related deaths

Diabetes-related deaths account for 18,982 deaths, or 7.4% of all deaths in 1997 and 1998. Diabetes-related deaths are substantially higher among Aboriginal and Torres Strait Islander peoples (16.4% of deaths among Indigenous Australians), people living in remote areas of Australia (9.5% of deaths in remote areas) and people living in the most disadvantaged area (8.4% of deaths in the most disadvantaged area)[1]. Variation also exists across the States and Territories, with age-standardised rates for diabetes-related deaths highest in the Northern Territory, and lowest in the Australian Capital Territory. The higher proportion of diabetes-related deaths in the Northern Territory and remote areas of Australia can largely be attributed to the high proportion of Indigenous Australians in these areas. Further, the report clearly indicates the strong association between deaths from diabetes and diseases of the circulatory system and diseases of the genito-urinary system.

Diabetes as the underlying cause of death

Diabetes is the underlying cause of death in 2.2% of all deaths. However, in the Northern Territory, among females in remote areas of Australia and among Aboriginal and Torres Strait Islander peoples diabetes is the underlying cause of death between two and three times as often as for other Australians.

When diabetes is coded as the underlying cause of death, diseases of the circulatory system and diseases of the genito-urinary system are commonly listed as associated causes (82.8% and 22.0% of deaths respectively). This pattern is reflected across all population groups. Among Indigenous Australians and people living in the Northern Territory and remote areas of Australia diseases of the circulatory system, while still accounting for the largest proportion of deaths, are less likely to be listed as an associated cause and diseases of the genito-urinary system are more likely to be listed as an associated cause compared with the national average. A possible explanation for this is that among Indigenous Australians with diabetes as the underlying cause of death, renal disease may be selectively competing with coronary heart disease as an associated cause of death.

[1] The most disadvantaged area is derived from an index of relative socioeconomic disadvantage, which classifies people according to the average disadvantage of their statistical local area of usual residence based on social and economic characteristics. For further details see Chapter 2.

Diabetes as an associated cause of death

Diabetes is an associated cause of death in 5.2% of all deaths. This varied across all population groups, with the highest rates occurring among Indigenous Australians (10.0% of deaths among Indigenous Australians) and people living in the Northern Territory (7.3%).

When diabetes is an associated cause of death, diseases of the circulatory system and diseases of the genito-urinary system account for a higher proportion of deaths than when diabetes is not an associated cause of death. This is not surprising given that Type 2 diabetes shares several of the risk factors with and is itself a risk factor for diseases of the circulatory system. Diabetes is, however, less often associated with neoplasms and injury and poisoning. This pattern is reflected across most States and Territories, in urban, rural and remote areas of Australia and for each of the quintiles of socioeconomic disadvantage.

Among Aboriginal and Torres Strait Islander peoples, diseases of the circulatory system are twice as likely to be listed as the underlying cause when diabetes is an associated cause than when it is not an associated cause.

More likely to be an associated than the underlying cause of death

Diabetes is twice as likely to be listed as an associated cause than as the underlying cause of death at the national level. This pattern is reflected across most of the States and Territories, for each of the quintiles of socioeconomic disadvantage, and for urban and rural areas of Australia. In remote areas and among Indigenous Australians, while diabetes is more likely to be an associated cause than the underlying cause, the difference is not as marked (1.5–1.6 times as likely).

Conclusions

As can be seen from these findings, when diabetes is examined as an associated cause of death as well as the underlying cause of death from Australian death certificate data, further insight is gained into the contribution that diabetes makes to all-cause mortality. This report highlights that there are particular population groups, such Indigenous Australians, people living in the Northern Territory and remote areas of Australia, and people who are at a socioeconomic disadvantage, who clearly experience higher diabetes-related mortality than other Australians. For these populations it is particularly important to identify the underlying causes of these health inequalities, such as the link between risk factors and social and economic circumstances.

1 Introduction

Background

Diabetes is increasingly being recognised as a significant and growing public health problem both in Australia and worldwide. Diabetes is the seventh leading underlying cause of death in Australia, and contributes to significant illness, disability, poor quality of life and premature mortality. Diabetes causes almost as much disability burden as mortality burden; however, it also accounts for a high proportion of premature mortality, almost 5.3% of all years of life lost in 1996 (Mathers et al. 1999). The prevalence of diabetes in Australia is also on the rise. The number of Australians with diabetes is projected to pass the one million mark over the next 15–20 years if effective prevention strategies are not put into place (DHAC & AIHW 1999). This situation is likely to be aggravated by increasing levels of physical inactivity and overweight and obesity in Australia (Armstrong et al. 2000; AIHW 2000). Early results from the Australian Diabetes, Obesity and Lifestyle Study (AusDiab) suggest that almost one in four Australians aged 25 and over have either diabetes or a condition of impaired glucose metabolism (DeCourten et al. 2000). Diabetes and its complications account for a considerable proportion of health care expenditure, 2.2% of total direct health system costs.

Due to the substantial economic and health impact of diabetes and its potential for prevention, Australian Health Ministers made diabetes one of six National Health Priority Areas (NHPAs). The first NHPA report on diabetes was published in 1999. The Commonwealth Department of Health and Aged Care funds the Australian Institute of Health and Welfare to monitor and report on the disease, its risk factors, treatment and care.

Purpose

The purpose of this report is to inform the community, health professionals and policy makers of the extent to which diabetes may cause death in Australia, either directly or indirectly. The report examines diabetes as the underlying cause of death as well as an associated cause using Australian death certificate data. The report takes the first step in filling the important gap in our knowledge of the contribution diabetes may make to all-cause mortality, both as the underlying cause and as an associated cause of death.

Types of diabetes

Diabetes is not one disease but a collection of closely related diseases. There are three main types of diabetes affecting Australians: Type 1, Type 2 and gestational diabetes. Type 1 diabetes typically develops during childhood and is marked by a complete lack of insulin. Type 2 diabetes is the most common type of diabetes and is characterised by insulin resistance and insulin deficiency. Gestational diabetes occurs during pregnancy and is a marker of greater risk of developing Type 2 diabetes later in life.

Type 2 diabetes can be prevented or at least delayed through modification of risk factors. The risk of developing Type 2 diabetes increases with body fat, and regular physical activity plays a protective role against its development (AIHW 2000).

National mortality data

National mortality data, which are based on death certificates, can be seen to provide a measure of the distribution and importance of more severe diseases such as diabetes. Death certificates list the underlying cause, which is the disease or injury initiating the sequence of events leading to death (i.e. the main cause of death). They also list the associated causes, which refer to all morbid conditions, diseases and injuries leading directly to death or contributing to death (other than the underlying cause). It is believed that until recently these data resulted in an underestimation of diabetes-related deaths in Australia, as until 1997 only the underlying cause was coded from the death certificates. Diabetes can lead to a variety of conditions and complications including coronary heart disease, stroke, blindness, kidney failure, neurological problems and amputation. Several of these complications are life-threatening and may be coded as the underlying cause of death on the death certificates, when diabetes contributes to but does not lead directly to death. The recent move to coding all causes of death provides an opportunity to obtain a fuller picture of diabetes-related mortality in Australia.

Structure of this report

Chapter 2 details the methodology used in this report. Chapter 3 provides a national profile of diabetes mortality, for all diabetes-related deaths and more specifically where diabetes is the underlying cause of death and where it is an associated cause of death. Chapter 4 focuses on diabetes as the underlying or an associated cause of death among Aboriginal and Torres Strait Islander peoples. Chapter 5 discusses diabetes as the underlying or an associated cause of death for particular population groups—States and Territories, urban, rural and remote areas of Australia and people who are at a socioeconomic disadvantage. The appendix contains supplementary tables.

2 Methodology

2.1 Overview

The data analysis presented in this report is based on Australian death certificate data. Information on diabetes as the underlying cause of death has been available in Australia since the early part of this century, but, information on associated causes of death has been available electronically only since 1997, when multiple cause of death coding was first introduced. Diabetes-related mortality can now be more fully explored by extensively analysing death certificate data to identify where diabetes is listed as an associated cause of death as well as the underlying cause of death.

This chapter provides an overview of Australian death certificate data, details the mortality and population classifications, and explains the statistical concepts presented in the report.

2.2 Death certificate data

Registration of deaths in Australia is the responsibility of the State and Territory Registrars of Births, Deaths and Marriages. Both demographic and cause of death information are recorded on the death certificate. Information on the cause of death is supplied by the medical practitioner certifying the death or by a coroner. Other information about the deceased is supplied by a relative or other person acquainted with the deceased, or by an official of the institution where the death occurred. The State and Territory Registrars of Births, Deaths and Marriages provide the information to the Australian Bureau of Statistics (ABS) for coding of cause of death and compilation into aggregate statistics. The Australian Institute of Health and Welfare (AIHW) also holds these data without unique identifiers in a national mortality database.

Information on cause of death on the death certificate is divided into two parts. Part 1 contains information on conditions leading directly to death and Part 2 contains information on conditions that contribute to death but do not lead directly to death. The conditions listed in Part 1 follow a causal sequence, beginning with the immediate cause of death (the final condition resulting in death), and any other associated causes. The underlying cause of death (the disease or injury initiating the sequence of events leading to death) is generally selected from conditions listed in Part 1 of the death certificate, however in some cases conditions may be selected from Part 2 of the death certificate based on specific selection rules.

Multiple causes of death

Before 1997, the underlying cause of death was the only condition coded, although information on all causes of death was listed on the death certificate—this was in line with the World Health Organization recommendations. However, it is often difficult to identify a single underlying cause of death where there are multiple chronic diseases present, because a single disease may not adequately describe the cause of death, and the sequence of events leading to death may also be unclear. When only a single underlying cause of death is

coded, any other information on causes of death listed on the death certificate is not available in electronic form.

For this reason, in 1997 all morbid conditions, diseases and injuries listed on the death certificate were coded, thus enabling identification of multiple causes of death for death statistics. This change in coding practice has enabled the identification of diabetes not only when it is the underlying cause of death, but also when it is an associated or contributory cause (to be referred to as 'associated' cause). Although a flag in the mortality database has been used since 1994 to indicate whether diabetes was listed as an associated cause, no information has been available on other associated causes listed on the death certificates. Multiple cause of death coding provides a more complete picture of diabetes as a cause of death.

To allow for more detailed analysis, deaths data for 1997 and 1998 have been combined, as diabetes deaths are relatively small in number in any one year and multiple cause of death coding has been available only for data since 1997. In this report, diabetes is viewed from two perspectives: as the underlying cause of death and as an associated cause of death. Where diabetes is the underlying cause of death or an associated cause of death the term 'diabetes-related' deaths has been used.

Data quality

The Australian Bureau of Statistics uses a variety of quality-control measures to ensure mortality data are as reliable as possible. These include contacting the certifying doctor to obtain additional information if necessary, check-coding of cause of death, detailed computer editing of data, and checks on the statistical output at the individual and aggregated levels. Nonetheless, issues relating to reliability and validity of cause of death data still exist. Some of these issues include inaccurate completion of death certificates, inaccuracy of diagnoses, specifying the mode of death rather than the underlying cause, not listing all causes of death, variation in interpreting causal sequences and conditions that may have contributed to death, changing perceptions of the causal role of diseases, and poor identification of Aboriginal and Torres Strait Islander peoples.

In addition, there are some more specific issues in using death certificate data for analysing diabetes mortality. They include:

- Death certificate data do not distinguish between Type 1 and Type 2 diabetes.
- Diabetes has been shown to be under-reported on death certificates. Diabetes as a diagnosis is omitted from one in three death certificates of people known to have diabetes. A systematic under-reporting exists depending on the stated cause of death and on the mode of treatment (Whittall et al. 1990).
- The causal role of diabetes in mortality is often unrecognised. It is often difficult for physicians to decide whether diabetes was the cause of the death process or even if it had a contributory role.
- Subjectivity may exist in coding diabetes or other diseases (such as diseases of the circulatory system) as the underlying cause of death.
- The selection of a single underlying cause of death may be difficult in people with multiple chronic diseases.

In the absence of any national cohort studies on diabetes mortality, the death certificate data remain the most comprehensively collected national data pertaining to mortality in Australia.

Scope and coverage

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

The mortality statistics in this publication relate to the year of registration of death. Usually about 5–6% of all deaths which occur in one year are not registered until the following year or later. For national and State and Territory statistics, this effect is minimal as the proportion of deaths not registered in the year of occurrence is fairly constant from year to year. Year of registration has also been used in analysing death data for Indigenous Australians, urban, rural and remote areas of Australia and levels of socioeconomic disadvantage.

2.3 Classifications

Cause of death

The mortality classification is based on the International Classification of Diseases, Ninth Revision (ICD-9) (WHO 1977). The ICD-9 coding system was first used in Australia in 1979. At the three-digit level, the codes range from 001 to 999 and E800–E999. Table 2.1 lists the ICD-9 codes used for the particular causes of death included in this report.

Urban, rural and remote areas

Urban, rural and remote areas are identified in this report using the Rural, Remote and Metropolitan Areas (RRMA) classification (DPIE & DHSH 1994). The RRMA classification assigns each statistical local area (SLA) to one of seven categories which can be re-grouped into three larger zones or areas: urban (metropolitan), rural and remote. The classification takes into account population numbers and an index of remoteness. The three zones or areas are defined as follows:

- Urban area
  - Capital cities
  - Other metropolitan centres (urban centre population ≥ 100,000)
- Rural area (index of remoteness < 10.5)
  - Large rural centres (urban centre population 25,000–99,000)
  - Small rural centres (urban centre population 10,000–24,999)
  - Other rural areas (urban centre population < 10,000)
- Remote zone (index of remoteness >10.5)
  - Remote centres (urban centre population ≥ 5,000)
  - Other remote areas (urban centre population < 5,000).

SLA boundaries may be redrawn between censuses, and at each census area classifications and their population counts are updated. It is important to note that both the size of the SLAs and the distribution of the population within SLAs vary considerably. For example, within a remote SLA there can be areas that are rural rather than remote, and vice versa.

Mortality data for the three larger areas (urban, rural and remote) are presented in this report, as numbers of deaths are too small for accurate analysis in the seven-category classification. All diabetes-related deaths were assigned to these three areas.

Table 2.1: ICD-9 classification for selected causes of death

Cause of death	ICD-9 code
Infectious and parasitic diseases	001–139
Neoplasms	140–239
Endocrine, nutritional and metabolic diseases and immunity disorders	240–279
Diabetes	*250*
Diseases of the blood and blood-forming organs	280–289
Mental disorders	290–319
Diseases of the nervous system and sense organs	320–389
Diseases of the circulatory system (cardiovascular diseases)	390–459
Hypertensive disease	*401–405*
Ischaemic heart disease (coronary heart disease)	*410–414*
Heart failure	*428*
Cerebrovascular disease (stroke)	*430–438*
Peripheral vascular disease	*441–444*
Diseases of the respiratory system	460–519
Diseases of the digestive system	520–579
Diseases of the genito-urinary system	580–629
Renal failure	*584–588*
Diseases of the musculoskeletal system and connective tissue	710–739
Injury and poisoning (external causes)	E800–E999
Other[(a)]	630–676, 680–709, 740–799

(a) Includes diseases of the skin and subcutaneous tissue, congenital anomalies, certain conditions originating in the perinatal period, complications of pregnancy, childbirth and the puerperium, symptoms, signs and ill-defined conditions.

Aboriginal and Torres Strait Islander peoples

The identification of Aboriginal and Torres Strait Islander peoples (Indigenous Australians) is not accurately recorded on death certificates in all States and Territories, and consequently a reliable national picture of Indigenous mortality cannot be obtained. At present, there is considerable variation in the quality of data for Indigenous deaths from State to State. For the years 1997 and 1998, only mortality data for Western Australia, South Australia, the Northern Territory and the Australian Capital Territory are considered to be of sufficient quality for publication, with registration of Indigenous deaths estimated to be over 90% complete in these States and Territories. Due to the very small number of Indigenous deaths in the Australian Capital Territory, data from Western Australia, South Australia and the Northern Territory form the basis of the Indigenous analysis in this report. For comparability, the non-Indigenous estimates also include data only from Western Australia, South Australia and the Northern Territory.

The Indigenous identifier in the mortality database was missing for less than 0.05% of deaths in Western Australia, South Australia and the Northern Territory. These deaths were excluded from the analysis.

Socioeconomic inequalities

There are no reliable data from death certificates in Australia on levels of socioeconomic disadvantage. Although information on occupation is recorded, it is not adequate for analyses involving older people who are more likely to be retired and who are prone to chronic diseases such as diabetes. This report takes an alternative approach, using an index classifying people according to the average disadvantage of their statistical local area (SLA) of usual residence. The Index of Relative Socioeconomic Disadvantage (IRSD), developed by the Australian Bureau of Statistics, is constructed using principal components analysis. It is derived from social and economic characteristics of the local area such as a low income, low educational attainment, high levels of public sector housing, high unemployment, and jobs in relatively unskilled occupations.

For the years 1997 and 1998, deceased persons were classified into quintiles of socioeconomic disadvantage according to the IRSD for their SLA of usual residence, with quintile 1 including the least disadvantaged households and quintile 5 the most. SLAs were grouped into quintiles so that each quintile contained approximately 20% of the total Australian population.

It is important to note that the index of socioeconomic disadvantage relates to the average disadvantage of all people living in the area. Thus the resultant mortality inequalities will be smaller than if the population were classified using individual socioeconomic status areas defined at a lower level than SLA (e.g. census districts). In other words, these measures of socioeconomic inequality will generally understate the true inequality in mortality at the individual level in Australia.

SLA of usual residence could not be mapped to an IRSD value for less than 0.4% of deaths. These deaths were excluded from the analysis.

2.4 Statistical methodology

Identifying the underlying and associated causes of death

The AIHW National Mortality Database contains information on all causes of death recorded on the death certificate (up to 14 causes are coded) as well as demographic information. The database comprises two components: data on the underlying cause of death and data on all causes of death (including the underlying cause, although this is not separately identifiable from the multiple cause of death data set).

Obtaining information on diabetes as the underlying cause and an associated cause of death involved a two-stage process:

1. Identifying where diabetes was the underlying cause of death and linking these records to the multiple cause of death data set. This enabled identification of all causes of death listed on the death certificate. When diabetes was the underlying cause of death, diabetes was deleted from the multiple cause of death data set, so that only associated causes were identified.
2. Identifying where diabetes was an associated cause of death (from the multiple cause of death data set) and linking these records to the underlying cause of death data set. Diabetes was deleted from the underlying cause of death data set.

Statistics

This report generally uses three types of mortality indicators—proportions, age-specific rates and age-standardised rates. Where numbers are large enough, proportions are calculated separately for males and females and all are expressed as a percentage. Mortality data for 1997 and 1998 have been combined in all the analyses.

Proportion of all deaths which are diabetes-related

Diabetes as a proportion of all deaths has been calculated as the total number of diabetes-related deaths divided by the total number of deaths,

$$\text{i.e.} \quad r_i = \frac{d_i}{n_i}$$

where r_i is the proportion of all deaths which are diabetes-related for population group i, d_i is the number of diabetes-related deaths for population group i, and n_i is the total number of deaths for population group i, where i is, for example, New South Wales, remote areas, Indigenous Australians etc.

Proportion of deaths with diabetes as the underlying cause for each associated cause

This proportion has been calculated as the number of deaths for a particular associated cause where diabetes is the underlying cause divided by the total number of deaths where diabetes is the underlying cause,

$$\text{i.e.} \quad r_{ji} = \frac{d_{ji}}{n_i}$$

where r_{ji} is the proportion of deaths with diabetes as the underlying cause of death with associated cause j for population group i, d_{ji} is the number of deaths with diabetes as the underlying cause for associated cause j for population group i, and n_i is the total number of deaths with diabetes as the underlying cause of death for population group i, where i is, for example, New South Wales, remote areas, Indigenous Australians etc.

Proportion of deaths with diabetes as an associated cause for each underlying cause

This proportion has been calculated as the number of deaths for a particular underlying cause where diabetes is an associated cause divided by the total number of deaths where diabetes is an associated cause,

$$\text{i.e.} \quad r_{ki} = \frac{d_{ki}}{n_i}$$

where r_{ki} is the proportion of deaths with diabetes as an associated cause of death with underlying cause k for population group i, d_{ki} is the number of deaths with diabetes as an associated cause with underlying cause k for population group i, and n_i is the total number of deaths with diabetes as an associated cause of death for population group i, where i is, for example, New South Wales, remote areas, Indigenous Australians etc.

Proportion of deaths with diabetes as an associated cause within each disease group

This proportion has been calculated as the number of deaths for a particular underlying cause where diabetes is an associated cause divided by the number of deaths with that particular underlying cause,

$$\text{i.e.} \quad r'_{ki} = \frac{d_{ki}}{n_{ki}}$$

where r'_{ki} is the proportion of deaths with underlying cause k where diabetes is an associated cause for population group i, d_{ki} is the number of deaths with underlying cause k and diabetes as an associated cause for population group i, and n_{ki} is the total number of deaths with the underlying cause of death k for population group i, where i is, for example, New South Wales, remote areas, Indigenous Australians etc.

Age-specific diabetes-related death rate

For each age group, the age-specific diabetes-related death rate has been calculated as the number of diabetes-related deaths in an age group divided by the total number of deaths for that age group,

$$\text{i.e.} \quad r_{mi} = \frac{d_{mi}}{n_{mi}}$$

where r_{mi} is the age-specific diabetes–related death rate for age group m in population group i, d_{mi} is the number of diabetes-related deaths for age group m in population group i, and n_{mi} is the total number of deaths for age group m in population group i, where i is, for example, New South Wales, remote areas, Indigenous Australians etc.

The same method has been used to calculate the age-specific death rate for diabetes as the underlying cause and diabetes as an associated cause of death.

Age-standardised diabetes-related death rates

Age standardisation is a method of adjustment to allow for the effect of variation in the population age structure when comparing death rates for different years or different locations (e.g. between States and Territories). This report has used the 'direct' standardisation method, which applies the age-specific death rates for a particular year to a standard population (Armitage & Berry 1994). This produces an estimate of the death rate which would have prevailed in the standard population if it had experienced the age-specific death rates in the year under study. The standard population used is the total estimated 1991 mid-year Australian population,

$$\text{i.e.} \quad ASR_i = \frac{\sum r_{mi} P_m}{\sum P_m}$$

where ASR_i is the age-standardised diabetes-related death rate for population group i, r_{mi} is the age-specific diabetes-related death rate for age group m in population group i, where i is, for example, New South Wales, remote areas, Indigenous Australians etc., and P_m is the standard population in age group m.

Significance testing

Many significance tests have been performed throughout this report, particularly when comparing different populations, such as comparisons between Indigenous and non-Indigenous Australians, and urban, rural and remote areas of Australia. As proportions have generally been compared from unequal sample sizes, a pooled estimate and variance are calculated. These are used to calculate a *z*-score which is then compared with the normal distribution (Armitage & Berry 1994),

i.e. for comparison of the proportion of all deaths which are diabetes-related:

$$r_i = \frac{d_i}{n_i} \qquad i = 1,2$$

$$r = \frac{d_1 + d_2}{n_1 + n_2}$$

$$z = \frac{r_1 - r_2}{\sqrt{\left[r(1-r)\left(\frac{1}{n_1} + \frac{1}{n_2} \right) \right]}}$$

where r_i is the proportion of all deaths which are diabetes-related for population group i, d_i is the number of diabetes-related deaths for population group i, n_i is the total number of deaths for population group i, population group 1 is the first population group which is being compared with population group 2, r is the pooled estimate and z is the calculated z-score.

3 A profile of diabetes mortality

3.1 Introduction

Diabetes causes death, both as a disease in its own right and as a risk factor for microvascular and macrovascular complications, which affect organs through impairment of their blood supply. Macrovascular complications affect the large blood vessels and include diseases such as coronary heart disease, stroke, and peripheral vascular disease. Microvascular complications affect smaller vessels leading to kidney disease, renal failure, nerve damage and loss of vision and these complications are more likely to be associated with Type 1 diabetes. Since several of these complications are life-threatening, diabetes can contribute significantly to premature mortality through these pathways. Diabetes is rarely if ever recorded alone as the underlying cause of death with no associated causes listed. Attribution of diabetes-related mortality therefore requires an extensive analysis of diabetes as an associated cause of death as well as the underlying cause of death.

Although much of the information on the underlying causes of death has been available in Australia since the early 1900s, information on additional causes of death has become available only since 1997. The latter information, though not possible to interpret as a direct cause of death, is useful in gaining further insight into the contribution diabetes makes to mortality overall.

This chapter explores this issue in detail in three sections:

- diabetes as the underlying cause or an associated cause of death;
- diabetes as the underlying cause of death; and
- diabetes as an associated cause of death.

To allow for more detailed analysis, mortality data for 1997 and 1998 have been combined. Disaggregation by age and sex has been attempted where the numbers are sufficiently large. Interpopulation and regional differences in diabetes-related mortality are presented in chapters 4 and 5.

3.2 Diabetes as the underlying cause or an associated cause of death

Diabetes was the underlying or an associated cause of 18,982 deaths, or 7.4% of all deaths, in 1997 and 1998 (Table 3.1). In less than one-third of these cases, diabetes was recorded as the underlying cause of death. Even in these cases, diabetes was listed as the only cause in less than 2% of deaths (Table 3.4).

There were more male than female deaths with diabetes as the underlying or associated cause, even though the proportion was similar in both sexes. Age-standardised death rate comparisons clearly indicate a much higher death rate among males (57.2 per 100,000) than females (36.5 per 100,000) (Table A1).

Table 3.1: Diabetes as a cause of death, 1997 and 1998

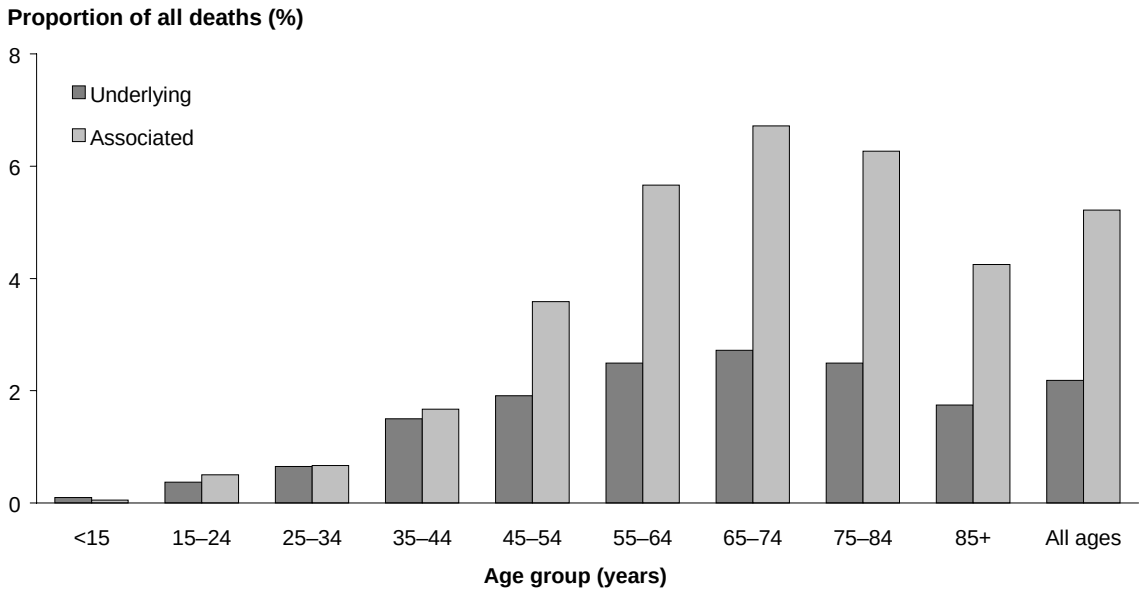
	Proportion of all deaths (%)			Number		
Cause of death	**Males**	**Females**	**Persons**	**Males**	**Females**	**Persons**
Underlying	2.1	2.3	2.2	2,849	2,747	5,596
Associated	5.3	5.1	5.2	7,187	6,199	13,386
Total diabetes deaths	*7.4*	*7.3*	*7.4*	*10,036*	*8,946*	*18,982*
Total deaths	**100.0**	**100.0**	**100.0**	**134,825**	**121,727**	**256,552**

Source: AIHW National Mortality Database.

A report from the Australian Bureau of Statistics (ABS) has shown that when diabetes is the underlying cause of death it was associated with one or more diseases in 98.5% of cases in 1998. In other words, diabetes was the only cause of death recorded in 1.5% of these deaths. This was a substantially smaller proportion than for other diseases such as malignant neoplasms (35.0%), stroke (19.6%), mental disorders (12.5%) and coronary heart disease (11.5%) (ABS 1999).

Diabetes-related deaths rise in proportion with increasing age. The increase is particularly rapid from age 45 years onwards. For example, in 1997 and 1998, the proportion of age-specific deaths from diabetes increased from less than 1% among 15–24-year-olds to 9.4% among those aged 65–74 years. The proportion declined thereafter to 8.8% among 75–84-year-olds and 6.0% among those aged 85 and over (Figure 3.1). Around 84% of all diabetes deaths occur among those aged 65 years and over.

In the younger age groups (less than age 45) there were no significant differences in diabetes being recorded as the underlying cause or an associated cause of death. From age 45 diabetes was progressively more likely to be recorded as an associated cause of death than as the underlying cause. In the 65 and over age groups, diabetes was 2.5 times as likely to be recorded as an associated cause of death than as the underlying cause of death (Figure 3.1).



Source: AIHW National Mortality Database.

Figure 3.1: Diabetes as the underlying or associated cause of death, 1997 and 1998

3.3 Diabetes as the underlying cause of death

Diabetes was a leading underlying cause of death among Australians accounting for 5,596 deaths or 2.2% of all deaths in 1997 and 1998 combined. Among females the proportion of deaths where diabetes was the underlying cause was higher than that found in males (2.3% compared with 2.1%). Over the 12-year period 1987 to 1998, the age-standardised rate for diabetes as the underlying cause of death increased among males annually by 1.3%, but no such trend was noted among females (AIHW forthcoming).

The peak age group for diabetes as the underlying cause of death was 65–74 years, with a rapid increase in proportion from age 35 onwards (Figure 3.1). During 1997 and 1998, the proportion of age-specific deaths with diabetes as the underlying cause of death rose from 0.4% among 15–24 year-olds to 2.7% among those aged 65–74 years. The proportion among those aged 85 years and over declined to 1.7%.

Diabetic complications

The ICD-9 classification of diabetes as the underlying cause of death is coded, at the fourth digit level, into nine different categories (Table 3.2). This fourth digit level identifies the complications present at death when diabetes is recorded as the underlying cause of death.

Of the 5,596 deaths where diabetes was listed as the underlying cause of death, no diabetic complication was listed in 71.4% of deaths, and peripheral circulatory disorders, renal manifestations and ketoacidosis were listed as specific diabetic complications in 15.7%, 6.4% and 2.3% of deaths, respectively (Table 3.2).

Table 3.2: Diabetic complications as the underlying cause of death, 1997 and 1998

Category	Males	Females	Persons
	Proportion of diabetes deaths (%)		
Diabetes mellitus without mention of complication (ICD-9 250.0)	70.6	72.3	71.4
Diabetes with ketoacidosis (ICD-9 250.1)	2.0	2.5	2.3
Diabetes with coma (ICD-9 250.2)	1.7	2.1	1.9
Diabetes with renal manifestations (ICD-9 250.3)	6.7	6.1	6.4
Diabetes with ophthalmic manifestations (ICD-9 250.4)	0.2	0.2	0.2
Diabetes with neurological manifestations (ICD-9 250.5)	0.4	0.6	0.5
Diabetes with peripheral circulatory disorders (ICD-9 250.6)	16.7	14.6	15.7
Diabetes with other specified manifestations (ICD-9 250.7)	1.6	1.6	1.6
Diabetes with unspecified complications (ICD-9 250.9)	0.1	0.0	0.1
Total deaths where diabetes is the underlying cause (%)	*100.0*	*100.0*	*100.0*
Total deaths where diabetes is the underlying cause (number)	**2,849**	**2,747**	**5,596**

Note: Code 250.8 has been omitted from the ICD-9 classification.

Source: AIHW National Mortality Database.

Associated causes of death where diabetes is the underlying cause of death

Number of causes of death

When diabetes is listed as the underlying cause of death it tends to be recorded with numerous associated causes. A report from the ABS highlighted that in 1998 over half of these diabetes deaths were recorded with three or more associated causes (ABS 1999). The mean number of associated causes listed on the death certificate was generally higher for diabetes (2.7 causes) than for other diseases and for all causes of death overall (1.7 causes) (Table 3.3).

Table 3.3: Mean number of associated causes for the leading underlying causes of death, 1998

Underlying causes of death	Mean number of associated causes
Diseases of the musculoskeletal system and connective tissue	2.8
Endocrine, nutritional and metabolic diseases and immunity disorders (including diabetes)	2.7
Diabetes	*2.7*
Diseases of the genito-urinary system	2.6
Diseases of the digestive system	2.5
Infectious and parasitic diseases	2.3
Diseases of the blood and blood-forming organs	2.2
Diseases of the circulatory system	1.9
Diseases of the respiratory system	1.9
Mental disorders	1.7
Diseases of the nervous system and sense organs	1.6
Neoplasms	1.3
All causes of death	**1.7**

Source: ABS 1999.

Clustering of associated causes of death

An analysis of the clustering of associated causes when diabetes was the underlying cause of death showed that diseases of the circulatory system, diseases of the genito-urinary system and/or diseases of the nervous system and sense organs were listed as an associated cause in over 90% of deaths in 1997 and 1998. Of these three diseases, diseases of the circulatory system was most likely to be recorded as the only associated cause when diabetes was the underlying cause of death (65.5% of deaths), while for diseases of the genito-urinary system the corresponding proportion was 7.2%, and for diseases of the nervous system and sense organs 0.6%. Diseases of the circulatory system and diseases of the genito-urinary system were the most common associated causes listed together (14% of diabetes deaths), while diseases of the circulatory system and diseases of the nervous system and sense organs were listed together as an associated cause in only 2.8% of deaths. All three associated causes were rarely listed together on death certificates when diabetes was the underlying cause of death (0.5%) (Table 3.4).

Table 3.4: Clustering of associated causes when diabetes is the underlying cause of death, 1997 and 1998

Number and type of associated causes	Number	Per cent
No associated causes	87	1.6
Causes other than diseases of the circulatory system, diseases of the genito-urinary system and diseases of the nervous system and sense organs	420	7.5
Diseases of the circulatory system	3,666	65.5
Diseases of the genito-urinary system	401	7.2
Diseases of the nervous system and sense organs	34	0.6
Diseases of the circulatory system and diseases of the genito-urinary system	786	14.0
Diseases of the circulatory system and diseases of nervous system and sense organs	158	2.8
Diseases of the nervous system and sense organs and diseases of the genito-urinary system	18	0.3
Diseases of the circulatory system and diseases of the genito-urinary system and diseases of the nervous system and sense organs	26	0.5
Total deaths where diabetes was the underlying cause	**5,596**	**100.0**

Source: AIHW National Mortality Database.

Associated causes of death

When diabetes was recorded as the underlying cause of death, diseases of the circulatory system was listed as an associated cause in 82.8% of deaths. The most prominent associated causes listed with diabetes were coronary heart disease (52.4%), hypertensive disease (22.3%), stroke (21.0%), renal failure (19.4%), diseases of the respiratory system (18.9%) and heart failure (17.4%) (Table 3.5). Renal failure accounts for the vast majority of deaths from diseases of the genito-urinary system when diabetes is the underlying cause (88%). Coronary heart disease accounts for almost two-thirds of deaths from diseases of the circulatory system, and stroke and hypertensive disease account for over one-quarter of these deaths.

Table 3.5: Deaths where diabetes is the underlying cause of death by associated causes of death, 1997 and 1998

Associated causes of death	Males	Females	Persons
		Proportion of diabetes deaths (%)	
Diseases of the circulatory system	84.1	81.6	82.8
Coronary heart disease	*56.3*	*48.3*	*52.4*
Hypertensive disease	*20.2*	*24.5*	*22.3*
Stroke	*20.5*	*21.4*	*21.0*
Heart failure	*16.0*	*18.9*	*17.4*
Peripheral vascular disease	*1.0*	*0.8*	*0.9*
Diseases of the genito-urinary system	21.2	22.8	22.0
Renal failure	*19.3*	*19.5*	*19.4*
Diseases of the respiratory system	20.4	17.4	18.9
Mental disorders	9.2	10.3	9.7
Infectious and parasitic diseases	8.9	10.4	9.6
Endocrine, nutritional and metabolic diseases and immunity disorders[(a)]	8.0	8.7	8.3
Diseases of the digestive system	5.6	5.6	5.6
Neoplasms	6.0	4.1	5.1
Injury and poisoning	4.4	4.2	4.3
Diseases of the nervous system and sense organs	4.6	3.9	4.2
Diseases of the musculoskeletal systems and connective tissue	2.2	3.4	2.8
Diseases of the blood and blood-forming organs	1.8	2.6	2.2
Other[(b)]	1.4	2.0	1.7
Total deaths where diabetes is the underlying cause (number)	**2,849**	**2,747**	**5,596**

(a) Excludes deaths where diabetes is an associated cause.

(b) Other includes diseases of the skin and subcutaneous tissue, congenital anomalies, complications of pregnancy, childbirth and the puerperium, certain conditions originating in the perinatal period, symptoms, signs and ill-defined conditions.

Note: Column percentages do not sum to 100, as more than one disease category may be recorded on the death certificate as an associated cause.

Source: AIHW National Mortality Database.

The pattern of associated causes in the context of diabetic complications is presented in Table 3.6. When no diabetic complication was listed as the underlying cause of death, diseases of the circulatory system as an associated cause increased from 82.8% to 88.9% of deaths, with coronary heart disease accounting for much of this increase. However, for complications relating to renal manifestations, diseases of the circulatory system was less likely to listed as an associated cause compared with diabetes overall (72.3% compared with 82.8% of deaths respectively), while renal failure was more than twice as likely to be listed as an associated cause of death (50.6% compared with 19.4%). For complications relating to peripheral circulatory disorders, diseases of the circulatory system was less likely to be listed as an associated cause (71.7% of deaths), while infectious and parasitic diseases was 2.5 times as likely to be listed as an associated cause (24.3% compared with 9.6% of deaths overall) (Table 3.6).

Table 3.6: Deaths where diabetic complications are the underlying cause of death by associated causes of death, 1997 and 1998

Associated causes of death	Without mention of complications	Renal manifestations	Peripheral circulatory disorders
		Proportion of diabetes deaths (%)	
Diseases of the circulatory system	88.9	72.3	71.7
Coronary heart disease	*58.5*	*45.5*	*38.6*
Hypertensive disease	*25.0*	*22.9*	*14.3*
Stroke	*23.3*	*9.2*	*18.2*
Heart failure	*17.3*	*20.4*	*18.8*
Peripheral vascular disease	*0.5*	*2.2*	*2.1*
Diseases of the genito-urinary system	19.1	53.1	23.1
Renal	*16.3*	*50.6*	*21.6*
Diseases of the respiratory system	19.0	19.6	17.2
Infectious and parasitic diseases	4.9	9.5	24.3
All other diseases	<10	<11	<12
Total deaths where diabetic complications are the underlying cause (number)	**3,997**	**358**	**876**

Note: Column percentages do not sum to 100 as more than one disease category may be recorded on the death certificate as an associated cause.

Source: AIHW National Mortality Database.

3.4 Diabetes as an associated cause of death

Diabetes was an associated cause of death in 13,386 deaths (5.2% of all deaths) in 1997 and 1998. Diabetes was twice as likely to be recorded as an associated cause of death rather than as the underlying cause of death. Among males the proportion of deaths where diabetes was an associated cause was higher than that found in females (5.3% compared with 5.1%) (Table 3.1).

The peak age group for diabetes as an associated cause of death was 65–74 years, with a rapid increase in proportion from age 35 years onwards. The proportion of age-specific deaths increased fourfold between 35–44-year-olds and 65–74-year-olds (1.7% compared with 6.7% of deaths respectively). The proportion among those aged 85 years and over declined to 4.2% (Figure 3.1).

Underlying causes of death where diabetes is an associated cause of death

The pattern of association between diabetes and the underlying causes of death can be examined in four different ways:

1. Diabetes as an associated cause of death within each underlying cause of death disease group (Table 3.7);
2. contribution of each of the underlying causes of death for diabetes as an associated cause of death (Table 3.8);
3. comparison of the contribution of each of the underlying causes of death where diabetes is an associated cause and where it is not an associated cause (Table 3.8); and

4. clustering of associated causes and underlying causes of death where diabetes is an associated cause.

Diabetes as an associated cause of death within each underlying cause of death disease group

Diabetes was more likely to be associated with endocrine, nutritional and metabolic diseases and immunity disorders, diseases of the circulatory system and diseases of the genito-urinary system (7.9%, 7.6%, and 6.8% respectively) compared with other disease groups (Table 3.7).

In the endocrine, nutritional and metabolic diseases and immunity disorders disease group, disorders of lipid metabolism (ICD-9 272) and obesity and other hyperalimentation (ICD-9 278) accounted for the majority of these deaths, with the proportion of these deaths where diabetes was an associated cause at 12.5% and 15.2% respectively. For diseases of the

Table 3.7: Deaths associated with diabetes within each underlying cause of death, 1997 and 1998

Underlying causes of death	Males	Females	Persons	Males	Females	Persons
	Per cent			Number		
Endocrine, nutritional and metabolic diseases and immunity disorders[(a)]	9.1	6.8	7.9	95	78	173
Disorders of lipid metabolism	*11.8*	*13.7*	*12.5*	*34*	*25*	*59*
Obesity and other hyperalimentation	*17.3*	*13.0*	*15.2*	*22*	*16*	*38*
Diseases of the circulatory system	8.1	7.2	7.6	4,065	3,806	7,871
Coronary heart disease	*8.9*	*8.7*	*8.8*	*2,736*	*2,294*	*5,030*
Hypertensive disease	*7.8*	*8.8*	*8.4*	*67*	*124*	*191*
Stroke	*7.6*	*5.9*	*6.5*	*734*	*845*	*1,579*
Heart failure	*6.9*	*5.3*	*5.9*	*140*	*171*	*311*
Peripheral vascular disease	*1.9*	*2.0*	*1.9*	*47*	*36*	*83*
Diseases of the genito-urinary system	6.7	7.0	6.8	147	195	342
Renal failure	*8.2*	*7.4*	*7.7*	*107*	*111*	*218*
Infectious and parasitic diseases	5.9	6.6	6.2	94	81	175
Diseases of the musculoskeletal systems and connective tissue	9.2	4.3	5.7	36	40	76
Diseases of the digestive system	5.6	4.8	5.2	224	186	410
Diseases of the blood and blood-forming organs	4.9	4.3	4.6	19	19	38
Diseases of the respiratory system	5.0	4.2	4.6	671	505	1,176
Neoplasms	3.9	3.3	3.6	1,542	998	2,540
Diseases of the nervous system and sense organs	3.4	2.9	3.1	90	84	174
Mental disorders	2.6	3.1	2.9	79	106	185
Injury and poisoning	1.0	1.9	1.2	106	87	193
Other[(b)]	0.9	0.7	0.8	19	14	33
All underlying causes of death[(a)]	**5.4**	**5.2**	**5.3**	**7,187**	**6,199**	**13,386**

(a) Excludes deaths where diabetes is the underlying cause.

(b) Other includes congenital anomalies, diseases of the skin and subcutaneous tissue, complications of pregnancy, childbirth and the puerperium, certain conditions originating in the perinatal period, symptoms, signs and ill-defined conditions.

Source: AIHW National Mortality Database.

circulatory system, coronary heart disease and hypertensive disease accounted for the highest proportion of deaths associated with diabetes (8.8% and 8.4% respectively), while peripheral vascular disease accounted for less than 2% of such deaths. Renal failure also features prominently with diabetes as an associated cause, accounting for 7.7% of deaths.

The pattern of association between diabetes and the leading underlying causes of death is generally similar for males and females. The most notable difference was for diseases of the muscoskeletal systems and connective tissue, where the proportion of deaths where diabetes was an associated cause among males was more than twice that of females (9.2% compared with 4.3%) (Table 3.7).

Contribution of each of the underlying causes of death for diabetes as an associated cause

When diabetes was an associated cause, diseases of the circulatory system was listed as the underlying cause of death in 58.8% of these deaths in 1997 and 1998. Coronary heart disease accounted for almost two-thirds of these deaths and stroke one-in-five of these deaths. Neoplasms were the second most prominent cause of death where diabetes was an associated cause (19.0%), followed by diseases of the respiratory system (8.8%) (Table 3.8).

The pattern between diabetes (as an associated cause) and the underlying causes of death shows some interesting associations when compared with associated causes present when diabetes is the underlying cause of death (Table 3.5). Diseases of the circulatory system accounted for the highest proportion of diabetes deaths when it was both the underlying cause of death and an associated cause of death. The strong association between diabetes-related deaths and diseases of the circulatory system is not surprising, given that diabetes is a known risk factor for macrovascular complications.

The most notable difference between diabetes as the underlying cause or associated cause of death occurred with neoplasms, where the proportion of such deaths increased in ranking from eighth as an associated cause to second as the underlying cause of death (i.e. neoplasms accounted for a higher proportion of deaths when it was the underlying cause of death rather than an associated cause).

However, for diseases of the genito-urinary system the pattern is reversed, with this disease more likely to be recorded as an associated cause (ranked second) than the underlying cause of death (ranked fifth). This may reflect that, the presence of diabetic complications when diabetes is the underlying cause affects the extent to which specific associated causes are listed on the death certificate. For example as shown in section 3.3, when renal manifestations are listed as a specific diabetic complication, diseases of the genito-urinary system are far more likely to be listed as an associated cause of death.

Comparison of each of the underlying causes of death where diabetes is an associated cause and where it is not an associated cause

The pattern of underlying causes of death when diabetes is an associated cause and not an associated cause is presented in Table 3.8. These proportions have not been age-standardised so the differences observed may partially reflect the different age structures of these two groups. Diabetes as an associated cause of death is composed of a slightly older population than when diabetes is not an associated cause—mean age of 75.5 compared with 73.3 years respectively.

Diseases of the circulatory system, neoplasms and diseases of the respiratory system were the three leading causes of death when diabetes was an associated cause and when it was not an associated cause in 1997 and 1998. Diseases of the digestive system and genito-urinary system ranked fourth and fifth in deaths where diabetes was an associated

cause, and injury and poisoning and diseases of the digestive system ranked fourth and fifth when diabetes was not an associated cause of death (Table 3.8).

Table 3.8: Distribution of the underlying causes of death associated and not associated with diabetes, 1997 and 1998

	Males		Females		Persons	
Underlying causes of death	**Associated with diabetes**	**Not associated with diabetes**	**Associated with diabetes**	**Not associated with diabetes**	**Associated with diabetes**	**Not associated with diabetes**
			Proportion of deaths (%)			
Diseases of the circulatory system	56.6	37.2	61.4	43.6	58.8	40.2
Coronary heart disease	*67.3*	*60.0*	*60.3*	*48.8*	*63.9*	*54.3*
Stroke	*18.1*	*19.3*	*22.2*	*27.6*	*20.1*	*23.6*
Heart failure	*3.4*	*4.1*	*4.5*	*6.2*	*4.0*	*5.2*
Hypertensive disease	*1.6*	*1.7*	*3.3*	*2.6*	*2.4*	*2.2*
Peripheral vascular disease	*1.2*	*5.1*	*0.9*	*3.7*	*1.1*	*4.4*
Other	*8.4*	*9.8*	*8.8*	*11.1*	*8.6*	*10.4*
Total	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
Neoplasms	21.5	30.4	16.1	26.2	19.0	28.4
Diseases of the respiratory system	9.3	10.3	8.1	10.3	8.8	10.3
Diseases of the digestive system	3.1	3.0	3.0	3.3	3.1	3.1
Diseases of the genito-urinary system	2.0	1.7	3.1	2.3	2.6	2.0
Renal failure	*72.8*	*58.4*	*56.9*	*53.6*	*63.7*	*55.7*
Other	*27.2*	*41.6*	*43.1*	*46.4*	*36.3*	*44.3*
Total	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
Mental disorders	1.1	2.4	1.7	2.9	1.4	2.6
Injury and poisoning	1.5	8.7	1.4	4.1	1.4	6.5
Infectious and parasitic diseases	1.3	1.2	1.3	1.0	1.3	1.1
Endocrine, nutritional and metabolic diseases and immunity disorders[(a)]	1.3	0.8	1.3	0.9	1.3	0.8
Diseases of the nervous system and sense organs	1.3	2.1	1.4	2.5	1.3	2.3
Diseases of the musculoskeletal systems and connective tissue	0.5	0.3	0.6	0.8	0.6	0.5
Diseases of the blood and blood-forming organs	0.3	0.3	0.3	0.4	0.3	0.3
Other[(b)]	0.3	1.8	0.2	1.7	0.2	1.7
Total deaths (%)	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
Total deaths (number)	**7,187**	**124,789**	**6,199**	**112,781**	**13,386**	**237,570**

(a) Excludes deaths where diabetes is the underlying cause.

(b) Other includes congenital anomalies, diseases of the skin and subcutaneous tissue, complications of pregnancy, childbirth and the puerperium, certain conditions originating in the perinatal period, symptoms, signs and ill-defined conditions.

Source: AIHW National Mortality Database.

Diseases of the circulatory system accounted for a substantially higher proportion of deaths when diabetes was an associated cause than when it was not an associated cause (58.8% compared with 40.2%). Coronary heart disease accounted for almost two-thirds of these deaths and was more prevalent among deaths associated with diabetes than not associated with diabetes (37.6% compared with 21.9%).

Diseases of the genito-urinary system accounted for a greater proportion of deaths when diabetes was an associated cause (2.6%) than when it was not an associated cause (2.0%). Renal failure accounted for nearly two-thirds of these deaths, and was more likely to be associated with diabetes than not associated with diabetes (1.6% compared with 1.1%).

However, neoplasms, diseases of the respiratory system, injury and poisoning and mental disorders accounted for a lower proportion of deaths when diabetes was an associated cause than when it was not an associated cause. Diseases of the digestive system accounted for the same proportion of deaths whether or not diabetes was the associated cause of death (Table 3.8).

A similar pattern was evident for males and females in terms of the ranking of the leading underlying causes of death. However, among females diabetes was associated with a higher proportion of deaths from diseases of the circulatory system and diseases of the genito-urinary system than among males. Neoplasms and diseases of the respiratory system were more likely to be associated with diabetes among males than females (Table 3.8).

Clustering of the underlying and associated causes of death

The analysis so far has been confined to looking at only the underlying causes of death and not any other associated causes when diabetes is an associated cause of death. As previously stated, there are a number of diseases that are known to be more prevalent among people with diabetes, i.e. diseases of the circulatory system, diseases of the genito-urinary system and diseases of the nervous system and sense organs. Table 3.9 investigates the clustering of these diseases.

When diseases of the circulatory system is the underlying cause of death and diabetes is an associated cause, in 85.9% of deaths neither diseases of the genito-urinary system nor diseases of the nervous system and sense organs were listed as associated causes in 1997 and 1998. However, when diseases of the genito-urinary system was the underlying cause of death, diseases of the circulatory system was an associated cause in almost two-thirds of these deaths. For diseases of the nervous system and sense organs as the underlying cause, in half of deaths where diabetes was an associated cause neither diseases of the circulatory system nor diseases of the genito-urinary system were listed as associated causes. Diseases of the circulatory system were, however, listed as an associated cause in 43.7% of these deaths (Table 3.9).

Table 3.9: Clustering of the underlying and associated causes when diabetes is an associated cause of death, 1997 and 1998

Underlying cause by associated cause	Number	Per cent
Diseases of the circulatory system—underlying cause	**7,871**	**100.0**
Neither diseases of the genito-urinary system nor diseases of the nervous system and sense organs as associated causes	6,765	85.9
Diseases of the genito-urinary system as associated cause	758	9.6
Diseases of the nervous system and sense organs as associated cause	319	4.1
Diseases of the genito-urinary system and diseases of the nervous system and sense organs as associated causes	29	0.4
Diseases of the genito-urinary system—underlying cause	**342**	**100.0**
Neither diseases of the circulatory system nor diseases of the nervous system and sense organs as associated causes	105	30.7
Diseases of the circulatory system as associated cause	221	64.6
Diseases of the nervous system and sense organs as associated cause	9	2.6
Diseases of the circulatory system and diseases of the nervous system and sense organs as associated causes	7	2.0
Diseases of the nervous system and sense organs—underlying cause	**174**	**100.0**
Neither diseases of the circulatory system nor diseases of the genito-urinary system as associated causes	87	50.0
Diseases of the circulatory system as associated cause	76	43.7
Diseases of the genito-urinary system as associated cause	4	2.3
Diseases of the circulatory system and diseases of the genito-urinary system as associated causes	7	4.0

Source: AIHW National Mortality Database.

3.5 Discussion

This chapter has highlighted the considerable contribution diabetes makes to all-cause mortality. In 1997 and 1998 diabetes was listed as the underlying or associated cause in 18,982 deaths or 7.4% of all deaths. Diabetes is twice as likely to be reported as an associated cause rather than the underlying cause of death. Although Australian mortality data do not allow distinction between Type 1 and Type 2 diabetes, people with Type 1 diabetes are twice as likely to have diabetes listed as the underlying cause of death than those who develop it later on in life (Geiss et al. 1995). The life expectancy of people with Type 1 diabetes is reduced by at least 15 years (Portuese & Orchard 1995), so diabetes progressively becomes more of an associated cause than the underlying cause of death as age increases. Type 1 diabetes may be relatively more common at younger ages than Type 2 diabetes.

Age distribution

Diabetes-related deaths are substantially higher among older Australians, and given the growing number of elderly Australians this mortality burden is likely to become more pronounced over the next decades. The higher mortality among older Australians is consistent with age-specific prevalence and hospitalisation rates for diabetes, which follow the same pattern. The slight decline in age-specific diabetes-related deaths among the very

old may reflect the higher rate of undiagnosed diabetes among this population which could be due to the complex array of co-morbidities often present in the very old (Glynn et al. 1999).

Strong association with diseases of the circulatory system and genito-urinary system

Diabetes is rarely listed alone as the underlying cause of death with no associated causes, and predominantly occurs with diseases of the circulatory system and to a lesser extent diseases of the genito-urinary system (particularly renal failure). Diseases of the circulatory system also reappears as the leading underlying cause of death when diabetes is an associated cause of death. The presence of diabetic complications when diabetes is the underlying cause appears to affect the extent to which specific associated causes are listed on the death certificate. For example, when renal manifestations are listed as a specific diabetic complication, diseases of the genito-urinary system is more likely to be listed as an associated cause rather than the underlying cause of death in these cases.

The strong association between diabetes and diseases of the circulatory system (predominantly coronary heart disease) and diseases of the genito-urinary system (mainly renal failure) is consistent with numerous studies. Studies in the United States have shown that 75% of the excess mortality among diabetic men and 57% among diabetic women are attributable to deaths from diseases of the circulatory system (Kleinman et al. 1988). Furthermore, the risk of death from coronary heart disease has been shown to be 2–4 times higher in people with diabetes compared with those without diabetes (Geiss et al. 1995). Persons with diabetes have also been shown to be at greater risk of mortality from renal disease (Moss at al. 1991). In Australia, diabetes ranks second behind glomerulonephritis as a cause for end-stage renal disease. Over the period 1988–1996, the incidence of end-stage renal disease in people with Type 2 diabetes increased by 22% per year, compared with 5% per year for other causes of the renal condition (Briganti et al. 1999).

Possible reasons for this strong association

The greater risk of mortality from coronary heart disease and renal disease among people with diabetes can largely be explained by the risk factor profile of this population. Obesity, physical inactivity and poor nutrition in foetal and early infant life are important factors in the development of Type 2 diabetes. The existence of diabetes is also known to magnify the effect of conventional risk factors such as hyperlipdaemia, hypertension and smoking which substantially increase the risk of diseases of the circulatory system (McCann et al. 1994). People with diabetes are also more likely to have a clustering of risk factors—an individual with a high level of one risk factor is also likely to have high levels of other risk factors. However, the excess mortality in persons with diabetes cannot be fully explained by these risk factors. Other factors such as age at onset also contribute to the excess risk of mortality in persons with diabetes (Geiss et al. 1995). It is not surprising then that the life expectancy of middle-aged persons with Type 2 diabetes is 5–10 years lower than for people without Type 2 diabetes.

Data limitations

Although data from death certificates is the most comprehensive mortality data in Australia, it is important to be aware of some of the limitations with using these data to assess the national burden of diabetes. The lack of uniform practice among medical practitioners in completing death certificates for individuals with diabetes makes it difficult to determine the

role of diabetes in specific causes of death (Knuiman et al. 1992). The causal role of diabetes in mortality may therefore be underrecognised. Selection of a single underlying cause of death may be difficult in people with multiple chronic diseases. One Australian study has shown a systematic underreporting of diabetes deaths among people with known diabetes depending on the stated cause of death and on the mode of treatment (Whittall et al. 1990). Diabetes mortality based on death certificates may underestimate the number of deaths, as the presence of diabetes is not always noted on the death certificate (Riley et al. 1995). A further limitation with death certificate data is that these data do not distinguish between Type 1 and Type 2 diabetes. Despite these limitations, the introduction of the coding of multiple causes of death in 1997 has enabled the contribution diabetes makes to all-cause mortality to be more thoroughly explored and understood.

4 Diabetes mortality among Aboriginal and Torres Strait Islander peoples

4.1 Introduction

The previous chapter highlighted the considerable contribution that diabetes may make to all-cause mortality. Among Aboriginal and Torres Strait Islander peoples (Indigenous Australians), diabetes (mainly Type 2) is known to be an even greater cause of morbidity and mortality compared with the general population. Indigenous Australians are considered to have one of the highest rates of Type 2 diabetes in the world (McCarty et al. 1996).

This chapter explores diabetes-related deaths among Indigenous Australians and compares their mortality patterns to those of non-Indigenous Australians. The chapter has three sections:

- diabetes as the underlying cause or an associated cause of death;
- diabetes as the underlying cause of death; and
- diabetes as an associated cause of death.

At present there is considerable variation in the accuracy of identification of Indigenous Australians across the States and Territories within the mortality data. In 1997 and 1998 only mortality data for Western Australia, South Australia and the Northern Territory are considered to be of adequate quality for analysis (over 90% of Indigenous deaths so identified), and so form the basis of the Indigenous analysis in this chapter. For comparability purposes, the non-Indigenous estimates include data from these jurisdictions only.

To allow for more detailed analysis, mortality data for 1997 and 1998 have been combined. Disaggregation by age and sex has been undertaken where the numbers are sufficiently large.

4.2 Diabetes as the underlying cause or an associated cause of death

Diabetes was the underlying or associated cause of death in 16.4% of Indigenous deaths and 7.2% of non-Indigenous deaths in Western Australia, South Australia and the Northern Territory in 1997 and 1998 (Table 4.1).

Among Indigenous Australians the proportion of diabetes-related deaths was considerably higher for females than males (20.6% compared with 13.3%), especially when diabetes was the underlying cause of death (8.6% for females, 4.7% for males). In comparison, among non-Indigenous Australians there was little difference in the proportions between males and females. However, age-standardised death rate comparisons indicate no significant difference between Indigenous males and females (229.3 compared with 238.0 per 100,000),

whereas for non-Indigenous Australians the death rate among males was significantly higher than among females (24.5 compared with 13.5 per 100,000) (Table A1).

The age-standardised death rate comparisons also clearly indicate that diabetes-related deaths among Indigenous males and females were 9 and 18 times those of non-Indigenous males and females respectively.

Table 4.1: Diabetes as a cause of death, Indigenous and non-Indigenous Australians[(a)], 1997 and 1998

	Indigenous			Non-Indigenous		
Cause of death	**Males**	**Females**	**Persons**	**Males**	**Females**	**Persons**
			Proportion of all deaths (%)			
Underlying	4.7	8.6	6.3	2.1	2.2	2.2
Associated	8.6	12.0	10.0	5.1	4.8	5.0
Total diabetes deaths	*13.3*	*20.6*	*16.4*	*7.2*	*7.0*	*7.2*
			Number			
Underlying	50	68	118	504	468	972
Associated	92	95	187	1,208	1,019	2,227
Total diabetes deaths	*142*	*163*	*305*	*1,712*	*1,487*	*3,199*
Total deaths	**1,071**	**790**	**1,861**	**23,631**	**21,096**	**44,727**

(a) Includes deaths only for Western Australia, South Australia and Northern Territory.

Note: One death with diabetes as an associated cause and 16 deaths with diabetes not as an associated cause were unable to be assigned to the Indigenous identifier.

Source: AIHW National Mortality Database.

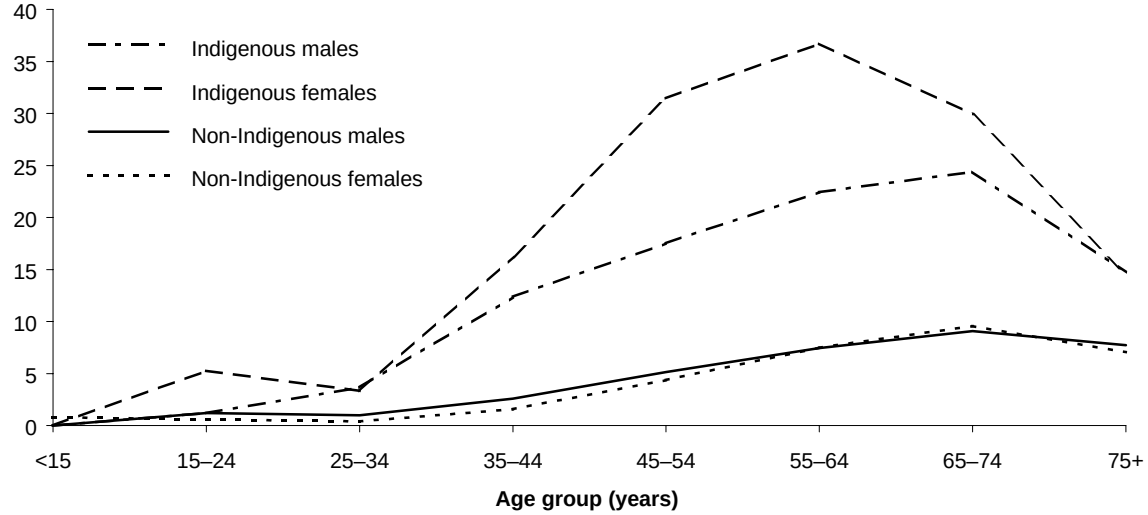
Although the proportion of diabetes-related deaths overall is twice as high among Indigenous Australians compared with non-Indigenous Australians, this varies across each of the age groups. For the 15–64 age range, the proportion of diabetes-related deaths among Indigenous Australians was around four times that of non-Indigenous Australians. The largest difference occurred among 35–44-year-olds where the proportion among Indigenous Australians was 6 times that of non-Indigenous Australians. The magnitude of the difference in proportion between Indigenous and non-Indigenous Australians declined after age 65 (Figure 4.1).

Among non-Indigenous Australians the proportion of diabetes-related deaths for males and females is similar across the different age groups, but among Indigenous Australians there is a noticeable difference, with Indigenous females having a higher proportion of diabetes-related deaths across most age groups.

Diabetes-related deaths (underlying or associated) rise in proportion with increasing age. Over 60% of all Indigenous deaths from diabetes occur among those aged 55 and over. Age-specific proportions increased from 2.5% for 15–24-year-olds to 28.9% for those aged 55–64 years. Proportions declined thereafter to 14.6% among those aged 75 and over (Figure 4.1).

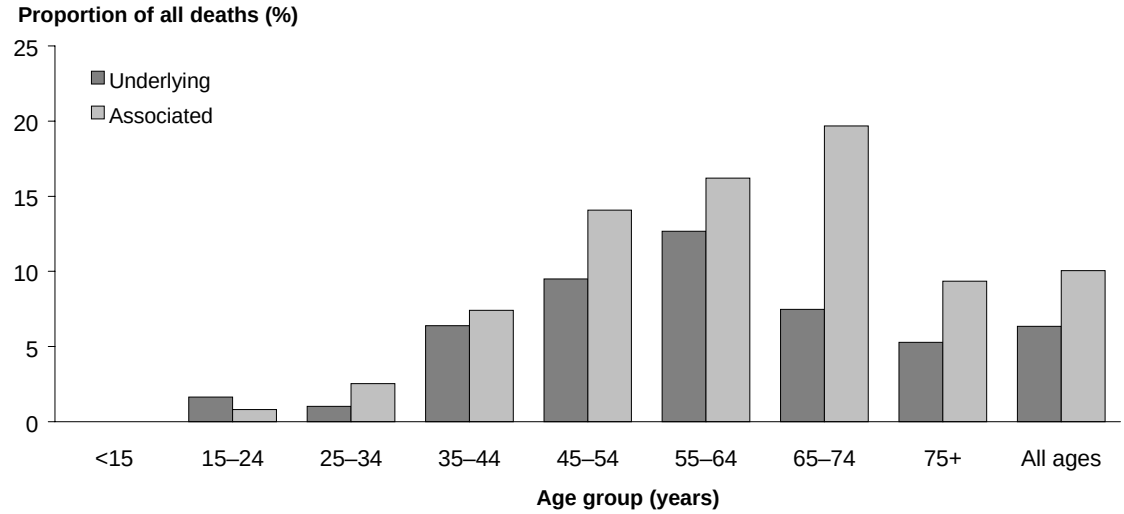
While diabetes is twice as likely to be recorded as the associated cause rather than the underlying cause of death at the national level, among Indigenous Australians the overall difference is not as marked (1.6 times as likely). Across most age groups among Indigenous Australians diabetes was recorded as an associated cause of death more often than it was the underlying cause of death (Figure 4.2). In particular, in the 65–74 age group diabetes was 2.6

times as likely to be recorded as an associated cause of death than as the underlying cause of death.



Note: Includes deaths only for Western Australia, South Australia and Northern Territory.
Source: AIHW National Mortality Database.

Figure 4.1: Diabetes-related deaths, Indigenous and non-Indigenous Australians, 1997 and 1998



Note: Includes Indigenous deaths only for Western Australia, South Australia and Northern Territory.
Source: AIHW National Mortality Database.

Figure 4.2: Diabetes as the underlying or associated cause of death, Indigenous Australians, 1997 and 1998

4.3 Diabetes as the underlying cause of death

Diabetes was recorded as the underlying cause of death almost three times as often among Indigenous Australians (6.3%) as non-Indigenous Australians (2.2%) in 1997 and 1998. Indigenous females were almost twice as likely to have diabetes recorded as the underlying cause of death compared with Indigenous males (8.6% compared with 4.7%), whereas among non-Indigenous Australians the proportion was similar in both sexes (Table 4.1).

The peak age group for diabetes as the underlying cause of death among Indigenous Australians was 55–64 years where it reached 12.7% (Figure 4.2).

Associated causes of death

When diabetes was the underlying cause of death in 1997 and 1998, diseases of the circulatory system was less likely to be recorded as an associated cause among Indigenous Australians compared with non-Indigenous Australians (66.9% compared with 83.8%) (Table 4.2).

Table 4.2: Deaths where diabetes is the underlying cause of death by associated causes of death, Indigenous and non-Indigenous Australians[(a)], 1997 and 1998

	Indigenous			Non-Indigenous		
Associated causes of death	**Males**	**Females**	**Persons**	**Males**	**Females**	**Persons**
	Proportion of diabetes deaths (%)					
Diseases of the circulatory system	68.0	66.2	66.9	85.5	82.1	83.8
Diseases of the genito-urinary system	48.0	55.9	52.5	23.4	23.7	23.6
Diseases of the respiratory system	14.0	13.2	13.6	18.3	16.2	17.3
Mental disorders	14.0	10.3	11.9	8.5	8.8	8.6
Infectious and parasitic diseases	22.0	16.2	18.6	7.9	10.0	9.0
Endocrine, nutritional and metabolic diseases and immunity disorders[(b)]	16.0	14.7	15.3	8.1	11.1	9.6
Diseases of the digestive system	8.0	7.4	7.6	4.2	6.0	5.0
Neoplasms	0.0	0.0	0.0	7.1	5.8	6.5
Injury and poisoning	0.0	4.4	2.5	4.2	4.5	4.3
Diseases of the nervous system and sense organs	6.0	2.9	4.2	4.8	4.7	4.7
Diseases of the musculoskeletal systems and connective tissue	4.0	1.5	2.5	2.6	4.3	3.4
Diseases of the blood and blood-forming organs	4.0	10.3	7.6	2.2	2.6	2.4
Other[(c)]	2.0	1.5	1.7	1.8	1.3	1.5
Total deaths where diabetes is the underlying cause (number)	**50**	**68**	**118**	**504**	**468**	**972**

(a) Includes deaths only for Western Australia, South Australia and Northern Territory.

(b) Excludes deaths where diabetes is an associated cause.

(c) Other includes diseases of the skin and subcutaneous tissue, congenital anomalies, certain conditions originating in the perinatal period, symptoms, signs and ill-defined conditions.

Note: Column percentages do not sum to 100, as more than one disease category may be recorded on the death certificate as an associated cause.

Source: AIHW National Mortality Database.

In comparison, diseases of the genito-urinary system was twice as likely to be recorded as an associated cause among Indigenous Australians compared with non-Indigenous Australians (52.5% and 23.6% respectively). Indigenous Australians were also more likely to have infectious and parasitic diseases, and endocrine, nutritional and metabolic diseases and immunity disorders listed as an associated cause than non-Indigenous Australians.

The pattern of associated causes where diabetes is the underlying cause of death is generally similar for Indigenous males and females (Table 4.2).

When investigating the clustering of certain associated causes when diabetes was the underlying cause, it was found that diseases of the circulatory system and diseases of the genito-urinary system (which includes renal disease) were more likely to be listed together as associated causes among Indigenous Australians compared with non-Indigenous Australians (25.4% compared with 15.8%).

4.4 Diabetes as an associated cause of death

Diabetes was an associated cause of death in 10.0% of Indigenous deaths and 5.0% of non-Indigenous deaths in 1997 and 1998 (Table 4.1).

The peak age group for diabetes as an associated cause of death among Indigenous Australians was 65–74 years where it reached 19.7% (Figure 4.2).

Diabetes as an associated cause of death within each underlying cause of death disease group

Diabetes was an associated cause of death in 187 Indigenous deaths (10.0% of all deaths in Indigenous people) in 1997 and 1998. This number was too small to accurately compare proportions across several of the disease groups. However, the following observations can be made.

For endocrine, nutritional and metabolic diseases and immunity disorders, diseases of the circulatory, genito-urinary and digestive systems, diseases of the musculoskeletal systems and connective tissue, and neoplasms the proportion of deaths where diabetes was an associated cause were at least twice as high among Indigenous Australians compared with non-Indigenous Australians (Table 4.3). The number of deaths is too small to make any reliable comparisons between males and females.

Table 4.3: Deaths associated with diabetes within each underlying cause of death, Indigenous and non-Indigenous Australians[a], 1997 and 1998

Underlying causes of death	Indigenous	Non-Indigenous	Indigenous	Non-Indigenous
	Per cent		Number	
Endocrine, nutritional and metabolic diseases and immunity disorders[b]	19.0	6.9	4	26
Diseases of the circulatory system	20.6	7.2	112	1,276
Diseases of the genito-urinary system	17.0	7.7	9	64
Infectious and parasitic diseases	13.9	6.4	5	30
Diseases of the musculoskeletal systems and connective tissue	33.3	4.4	2	9
Diseases of the digestive system	9.7	4.5	9	64
Diseases of the blood and blood-forming organs	12.5	2.8	1	4
Diseases of the respiratory system	8.4	4.5	18	209
Neoplasms	8.9	3.7	20	461
Diseases of the nervous system and sense organs	2.5	2.8	1	27
Mental disorders	3.4	2.3	2	25
Injury and poisoning	1.0	0.8	3	24
Other[c]	0.7	1.1	1	8
All underlying causes of death[b]	**10.7**	**5.1**	**187**	**2,227**

(a) Includes Indigenous deaths only for Western Australia, South Australia and Northern Territory.

(b) Excludes deaths where diabetes is the underlying cause.

(c) Other includes congenital anomalies, diseases of the skin and subcutaneous tissue, complications of pregnancy, childbirth and the puerperium, certain conditions originating in the perinatal period, symptoms, signs and ill-defined conditions.

Note: One death with diabetes as an associated cause was unable to be assigned to the Indigenous identifier.

Source: AIHW National Mortality Database.

Comparison of each of the underlying causes of death where diabetes is an associated cause and where it is not an associated cause

Among Indigenous Australians where diabetes is an associated cause of death, the most common underlying cause of death in 1997 and 1998 was diseases of the circulatory system (59.9%), followed by neoplasms (10.7%) and diseases of the digestive system (9.6%). Where diabetes was not an associated cause, diseases of the circulatory system still accounted for the highest proportion of Indigenous deaths (27.8%), followed by injury and poisoning (18.9%), neoplasms (13.2%) and diseases of the respiratory system (12.7%). For non-Indigenous Australians the ranking of the underlying causes reflects the national level with diseases of the circulatory system, neoplasms and diseases of the respiratory the three leading causes irrespective of diabetes being an associated cause (Table 4.4).

Among Indigenous Australians, diseases of the circulatory system was recorded twice as often as the underlying cause of death when diabetes was an associated cause than when it was not an associated cause (59.9% compared with 27.8%). Among both Indigenous and non-Indigenous Australians, diabetes was less often associated with injury and poisoning (Table 4.4).

Table 4.4: Distribution of the underlying causes of death associated and not associated with diabetes, Indigenous and non-Indigenous Australians[a], 1997 and 1998

Underlying causes of death	Indigenous		Non-Indigenous	
	Associated with diabetes	Not associated with diabetes	Associated with diabetes	Not associated with diabetes
	Proportion of deaths (%)			
Diseases of the circulatory system	59.9	27.8	57.3	39.4
Neoplasms	10.7	13.2	20.7	28.6
Diseases of the respiratory system	9.6	12.7	9.4	10.7
Diseases of the digestive system	4.8	5.4	2.9	3.3
Diseases of the genito-urinary system	4.8	2.8	2.9	1.9
Mental disorders	1.1	3.7	1.1	2.5
Injury and poisoning	1.6	18.9	1.1	6.9
Infectious and parasitic diseases	2.7	2.0	1.3	1.1
Endocrine, nutritional and metabolic diseases and immunity disorders[b]	2.1	1.1	1.2	0.8
Diseases of nervous system and sense organs	0.5	2.5	1.2	2.3
Diseases of the musculoskeletal systems and connective tissue	1.1	0.3	0.4	0.5
Diseases of the blood and blood-forming organs	0.5	0.4	0.2	0.3
Other[c]	0.5	9.3	0.4	1.7
Total deaths (%)	*100.0*	*100.0*	*100.0*	*100.0*
Total deaths (number)	**187**	**1,556**	**2,227**	**41,528**

(a) Includes Indigenous deaths only for Western Australia, South Australia and Northern Territory.

(b) Excludes deaths where diabetes is the underlying cause.

(c) Other includes congenital anomalies, diseases of the skin and subcutaneous tissue, complications of pregnancy, childbirth and the puerperium, certain conditions originating in the perinatal period, symptoms, signs and ill-defined conditions.

Note: One death with diabetes as an associated cause and 16 deaths with diabetes not as an associated cause were unable to be assigned to the Indigenous identifier.

Source: AIHW National Mortality Database.

4.5 Discussion

This chapter has highlighted that diabetes-related deaths are substantially higher among Indigenous Australians than non-Indigenous Australians. In 1997 and 1998, Indigenous Australians were twice as likely to die from diabetes-related deaths compared with their non-Indigenous counterparts. When accounting for the different age structures of the Indigenous and non-Indigenous populations this difference is even greater, with Indigenous males 9 times and Indigenous females 18 times as likely to die from diabetes-related deaths compared with other Australians. Consistent with this finding, numerous studies have shown that Indigenous Australians continue to suffer substantially higher mortality rates and much worse health status than other Australians (Benham & Howe 1994).

Age distribution

For both Indigenous and non-Indigenous Australians, diabetes-related deaths are substantially higher among older Australians. The difference in the proportion of diabetes-related deaths between Indigenous and non-Indigenous Australians varies with age, with the largest difference occurring among 35–44-year-olds, where the proportion among Indigenous Australians is six times that of non-Indigenous Australians. After age 65 the differences in proportions decline. Morbidity associated with diabetes has been shown to appear up to 20–30 years earlier in Aborigines compared with other Australians (Guest 1995).

Diabetes as the underlying cause of death

Diabetes is almost three times as likely to be recorded as the underlying cause of death among Indigenous Australians compared with non-Indigenous Australians. The previous chapter indicated that people with Type 1 diabetes are more likely to have diabetes reported as the underlying cause of death, but this is generally not the case for Indigenous Australians. Type 1 diabetes is relatively less common in Indigenous Australians, but rates of Type 2 diabetes are extremely high (McCarty et al. 1996).

Indigenous females are almost twice as likely as Indigenous males to have diabetes reported as an underlying cause of death. This result is consistent with the findings of a study of Aboriginal people in Western Australia which showed that the age-standardised mortality rates for endocrine, nutritional and metabolic disorders (diabetes accounts for over 90% of these deaths) among Aboriginal females was 1.7 times that among Aboriginal males (Veroni et al. 1994).

Strong association with infectious and parasitic diseases and diseases of the genito-urinary system and circulatory system

Diabetes is predominantly associated with diseases of the genito-urinary system (mainly renal failure) and infectious and parasitic diseases, with these diseases reported twice as often among Indigenous Australians compared with other Australians. A study of Aboriginal people in central Australia has shown that renal disease was the direct cause of death in more than 22% of Aboriginal deaths, infections accounted for almost 21% of Aboriginal deaths and coronary heart disease for almost 14% of deaths (Phillips et al. 1995). The results presented in this chapter also show that diseases of the circulatory system, while still accounting for the largest proportion of deaths, are less prominent as an associated cause among Indigenous Australians compared with non-Indigenous Australians and that diseases of the genito-urinary system are more prominent. A possible explanation for this is that among Indigenous Australians with diabetes as the underlying cause of death, renal disease may be selectively competing with coronary heart disease as an associated cause of death (Phillips et al. 1995).

Among Indigenous Australians, diseases of the circulatory system is recorded twice as often as the underlying cause of death when diabetes is an associated cause than when it is not an associated cause (59.9% compared with 27.8%). As was indicated in the previous chapter, much of the excess mortality among people with diabetes is attributable to deaths from diseases of the circulatory system, a pattern that is reflected perhaps even more strongly among Indigenous Australians. Evidence suggests that Indigenous Australians experience higher mortality rates than the general Australian population, with Indigenous Australians

dying from diseases of the circulatory system at twice the rate of other Australians (AIHW 1999).

Possible reasons for the higher death rates among Indigenous Australians

Indigenous Australians have one of the highest rates of Type 2 diabetes in the world (McCarty et al. 1996). The prevalence of diabetes among Indigenous adults is suspected to be as high as 10–30%, 2–4 times that of other Australians (de Courten et al. 1998). It is not clear why diabetes is more common among Indigenous Australians, but it is thought to be a combination of a genetic basis and the rapid change from a traditional way of life to a more 'westernised' lifestyle. This lifestyle is marked by decreased physical activity and a high-fat, low-fibre diet that promotes obesity, high blood cholesterol and high blood pressure (AIHW 1999).

The risk factor profile of Indigenous Australians is worse than that of non-Indigenous Australians, particularly for physical activity and obesity. Indigenous females are 1.7 times and Indigenous males 1.4 times as likely to be obese as other Australians. Indigenous Australians are also more likely to report no physical activity in their leisure time (AIHW 1999). Increased physical activity is now being recognised as perhaps the most feasible way of modifying glucose intolerance, a risk factor for developing diabetes and macrovascular disease (Guest & O'Dea 1992).

5 Diabetes mortality in other population groups

5.1 Introduction

The previous chapters discussed diabetes as a cause of death at the national level and among Aboriginal and Torres Strait Islander peoples. They highlighted the considerable contribution that diabetes may make to all-cause mortality and that diabetes was more likely to be an associated cause than the underlying cause of death. Deaths from diabetes were shown to increase sharply with age, and the strong association between diabetes and diseases of the circulatory system and diseases of the genito-urinary system was quite evident. Further, the data indicated that diabetes was more likely to be an associated cause of death when coronary heart disease and renal disease were the underlying causes of death. Diabetes-related deaths were shown to be substantially higher among Indigenous Australians compared with non-Indigenous Australians.

This chapter examines and explores mortality differentials among regions and for particular population groups:

- States and Territories;
- urban, rural and remote areas of Australia; and
- socioeconomically disadvantaged Australians.

Within each of these sections mortality data is presented for all diabetes-related deaths, for diabetes as the underlying cause of death and for diabetes as an associated cause of death. To allow for more detailed analysis, mortality data for 1997 and 1998 have been combined. Disaggregation by age has not been undertaken, as the number of deaths across regions and population groups are too small.

5.2 States and Territories

Diabetes as the underlying cause or an associated cause of death

Variation exists across the States and Territories in age-standardised death rates for diabetes-related deaths. The rate in the Northern Territory was substantially higher than that of the other States and Territory—the rate for males was almost twice and for females almost four times the national average (Table 5.1). Diabetes-related death rates were also high in South Australia and Victoria, with the lowest rate in the Australian Capital Territory. The higher death rate in the Northern Territory is attributed mainly to the relatively large proportion of Indigenous Australians in the Territory, among whom death rates from diabetes are considerably higher.

Table 5.1: Age-standardised death rates for diabetes-related deaths, States and Territories, 1997 and 1998

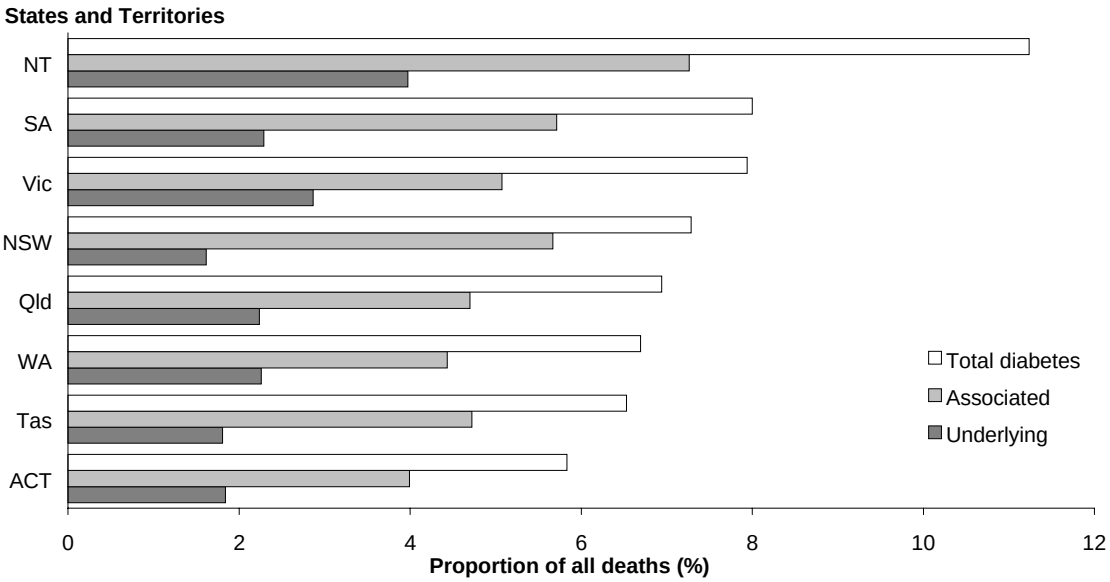
States and Territories	Males		Females	
	Rate per 100,000[(a)]	95% Confidence interval	Rate per 100,000[(a)]	95% Confidence interval
New South Wales	56.7	54.8–58.6	35.8	34.5–37.1
Victoria	61.7	59.4–64.0	37.7	36.2–39.2
Queensland	52.0	49.4–54.5	35.9	34.0–37.8
Western Australia	49.4	45.9–53.0	33.7	31.2–36.3
South Australia	63.5	59.6–67.4	37.1	34.5–39.6
Tasmania	57.5	50.7–64.3	31.9	27.5–36.3
Australian Capital Territory	39.1	29.8–48.4	30.4	23.7–37.1
Northern Territory	97.6	73.9–121.3	136.1	107.9–164.4
Australia	**57.2**	**56.1–58.3**	**36.5**	**35.8–37.3**

(a) Death rates are age-standardised to the 1991 Australian population.

Source: AIHW National Mortality Database.

In 1997 and 1998, the proportion of deaths where diabetes was the underlying or associated cause varied across the States and Territories (Figure 5.1). The Northern Territory had the highest proportion of diabetes-related deaths (11.2%) followed by South Australia (8.0%), Victoria (7.9%) and New South Wales (7.3%), with the lowest proportion in the Australian Capital Territory (5.8%).

Although, nationally, diabetes is twice as likely to be recorded as an associated cause of death rather than as the underlying cause of death, this varied between the States and Territories (Figure 5.1). In New South Wales diabetes was an associated cause of death 3.5 times as often as it was the underlying cause; similarly, in Tasmania and South Australia diabetes was an associated cause 2.6 and 2.5 times as often. For the other States and Territories the corresponding ratios were between 1.8 and 2.2.



Source: AIHW National Mortality Database.

Figure 5.1: Diabetes as a cause of death, States and Territories, 1997 and 1998

Diabetes as the underlying cause of death

The proportion of deaths where diabetes was recorded as the underlying cause of death in 1997 and 1998 varied across the States and Territories. The Northern Territory and Victoria had the highest proportion of deaths (4.0% and 2.9% respectively), which was larger than the national average (2.2%). In New South Wales, Tasmania and the Australian Capital Territory diabetes was less likely to be recorded as the underlying cause of death (1.6–1.8%) compared with the other States and Territory (Figure 5.1).

Associated causes of death

When diabetes was the underlying cause of death in 1997 and 1998, the overall pattern of associated causes was consistent with the national level across most States and Territories (Table 5.2). Diseases of the circulatory system was the highest recorded associated cause of death across all States and Territories, with the smallest proportion recorded in the Northern Territory.

In the Northern Territory, the Australian Capital Territory and Western Australia, diseases of the genito-urinary system was recorded more often as an associated cause than was recorded nationally (48.6%, 33.3% and 28.0% compared with 22.0%). Mental disorders, infectious and parasitic diseases, and endocrine, nutritional and metabolic diseases and immunity disorders were recorded up to twice as often in the Northern Territory when compared with the national figures (18.6%, 22.9%, 20.0% as compared with 9.7%, 9.6%, and 8.3%) The pattern observed in the Northern Territory largely reflects that of Indigenous Australians (Table 5.2).

Table 5.2: Deaths where diabetes is the underlying cause of death by associated causes of death, States and Territories, 1997 and 1998

Associated causes	NSW	Vic	Qld	WA	SA	Tas	ACT	NT
				Proportion of diabetes deaths (%)				
Diseases of the circulatory system	80.4	86.6	81.7	80.4	85.4	76.1	72.9	67.1
Diseases of the genito-urinary system	21.3	19.1	23.1	28.0	22.6	19.4	33.3	48.6
Diseases of the respiratory system	19.5	19.7	19.3	15.3	18.5	19.4	8.3	15.7
Mental disorders	10.2	10.3	8.3	11.3	5.6	11.9	16.7	18.6
Infectious and parasitic diseases	12.0	7.4	9.7	10.7	7.7	11.2	6.3	22.9
Endocrine, nutritional and metabolic diseases and immunity disorders[(a)]	7.7	7.3	9.3	9.5	9.5	9.0	6.3	20.0
Diseases of the digestive system	6.0	4.5	6.8	5.8	5.2	10.4	8.3	2.9
Neoplasms	5.2	4.2	6.0	6.4	6.0	3.7	4.2	0.0
Injury and poisoning	4.2	3.2	6.7	5.4	3.0	6.7	2.1	4.3
Diseases of the nervous system and sense organs	4.9	4.1	3.0	4.7	4.7	4.5	2.1	4.3
Diseases of the musculoskeletal systems and connective tissue	2.7	2.9	2.3	3.3	3.0	1.5	2.1	5.7
Diseases of the blood and blood-forming organs	2.1	2.0	2.0	4.5	1.5	3.0	0.0	2.9
Other[(b)]	2.3	1.0	2.6	1.0	2.1	0.7	0.0	1.4
Total deaths where diabetes is the underlying cause (number)	**1,461**	**1,871**	**991**	**485**	**535**	**134**	**48**	**70**

(a) Excludes deaths where diabetes is an associated cause.

(b) Other includes diseases of the skin and subcutaneous tissue, congenital anomalies, complications of pregnancy, childbirth and the puerperium, certain conditions originating in the perinatal period, symptoms, signs and ill-defined conditions.

Notes

1. Column percentages do not sum to 100, as more than one disease category may be recorded on the death certificate as an associated cause.
2. One death with diabetes as the underlying cause was unable to be assigned to a State or Territory.

Source: AIHW National Mortality Database.

Diabetes as an associated cause of death

Diabetes as an associated cause of death varied across the States and Territories from 4.0% of all deaths in the Australian Capital Territory to 7.3% in the Northern Territory in 1997 and 1998 (Figure 5.1).

Diabetes as an associated cause of death within each underlying cause of death disease category

The pattern of association between diabetes and the leading underlying causes of death varies between the States and Territories (Table 5.3 and Table A2). New South Wales, Queensland and Western Australia reflected the national pattern with endocrine, nutritional, and metabolic diseases and immunity disorders accounting for the highest proportion of deaths with diabetes as an associated cause within these States. In Victoria, diseases of the circulatory system accounted for the highest proportion (7.1%), in South Australia it was diseases of the genito-urinary system (9.3%), and in Tasmania infectious and parasitic diseases (11.5%). Conclusions can not be drawn for the Australian Capital

Territory and the Northern Territory as some proportions are based on a small number of deaths.

Table 5.3: Deaths associated with diabetes within each underlying cause of death, States and Territories, 1997 and 1998

Underlying causes of death	NSW	Vic	Qld	WA	SA	Tas	ACT	NT
				Per cent				
Endocrine, nutritional and metabolic diseases and immunity disorders[(a)]	9.1	6.4	9.3	10.3	5.3	6.8	0.0	7.1
Diseases of the circulatory system	8.2	7.1	7.2	6.6	8.0	6.9	5.9	16.2
Diseases of the genito-urinary system	7.2	6.6	5.0	5.9	9.3	4.6	10.7	21.6
Infectious and parasitic diseases	5.8	5.6	7.0	6.6	5.1	11.5	3.2	20.0
Diseases of the musculoskeletal systems and connective tissue	6.2	5.1	6.7	6.3	4.4	0.0	11.8	0.0
Diseases of the digestive system	5.5	5.5	4.8	4.9	4.5	4.7	2.2	6.8
Diseases of the blood and blood-forming organs	6.5	3.3	3.9	1.6	4.7	14.3	0.0	0.0
Diseases of the respiratory system	5.0	4.6	3.6	5.1	4.1	4.4	3.3	6.9
Neoplasms	3.7	3.9	3.0	2.7	4.9	2.9	2.6	3.4
Diseases of the nervous system and sense organs	3.7	3.4	1.9	3.0	3.0	1.1	4.3	0.0
Mental disorders	2.9	2.9	3.3	3.4	1.4	4.1	4.1	2.4
Injury and poisoning	1.3	1.4	1.3	0.9	0.9	1.3	1.5	0.6
Other[(b)]	0.8	1.2	0.2	1.5	0.7	0.0	1.9	0.0
All underlying causes of death[(a)]	**5.8**	**5.2**	**4.8**	**4.5**	**5.8**	**4.8**	**4.1**	**7.6**

(a) Excludes deaths where diabetes is the underlying cause.

(b) Other includes diseases of the skin and subcutaneous tissue, congenital anomalies, complications of pregnancy, childbirth and the puerperium, certain conditions originating in the perinatal period, symptoms, signs and ill-defined conditions.

Note: Cells with zero proportions reflect no deaths with diabetes as an associated cause in that disease category for the particular State or Territory in 1997 and 1998.

Source: AIHW National Mortality Database.

Comparison of each of the underlying causes of death where diabetes is an associated cause and where it is not an associated cause

The ranking of the underlying causes of death when diabetes is an associated cause and not an associated cause was consistent with the pattern at the national level across most States and Territories. Diseases of the circulatory system, neoplasms and diseases of the respiratory system were the three leading causes of death irrespective of diabetes being an associated cause. In the Northern Territory, however, a slightly different pattern emerged when diabetes was not an associated cause, with the injury and poisoning the second most prominent cause of death, followed by neoplasms and diseases of the respiratory system (Table 5.4).

Across all States and Territories diseases of the circulatory system accounted for a considerably higher proportion of deaths when diabetes was an associated cause than when it was not an associated cause. The magnitude of this difference was similar across most States and Territories, except in the Northern Territory.

Table 5.4: Distribution of the underlying causes of death associated and not associated with diabetes, States and Territories, 1997 and 1998

Underlying causes of death	NSW	Vic	Qld	WA	SA	Tas	ACT	NT
Associated with diabetes				**Proportion of deaths (%)**				
Diseases of the circulatory system	60.3	55.2	62.0	55.1	58.7	61.7	53.8	61.7
Neoplasms	17.4	21.7	17.8	17.1	23.0	16.3	19.2	8.6
Diseases of the respiratory system	9.0	8.9	7.1	11.6	7.8	10.3	7.7	10.2
Diseases of the digestive system	2.9	3.4	3.0	3.6	2.5	2.9	1.9	3.9
Diseases of the genito-urinary system	2.5	2.7	1.9	2.5	3.1	1.7	5.8	6.3
Mental disorders	1.3	1.6	1.4	2.0	0.5	1.7	1.9	0.8
Injury and poisoning	1.4	1.4	1.9	1.5	0.8	1.4	2.9	1.6
Infectious and parasitic diseases	1.3	1.1	1.4	1.5	1.0	2.0	1.0	6.3
Endocrine, nutritional and metabolic diseases and immunity disorders[(a)]	1.2	1.3	1.6	1.9	0.8	0.9	0.0	0.8
Diseases of the nervous system and sense organs	1.4	1.5	0.8	1.8	0.9	0.6	2.9	0.0
Diseases of the musculoskeletal systems and connective tissue	0.5	0.6	0.8	0.6	0.4	0.0	1.9	0.0
Diseases of the blood and blood-forming organs	0.4	0.2	0.2	0.1	0.3	0.6	0.0	0.0
Other[(b)]	0.2	0.3	0.1	0.7	0.1	0.0	1.0	0.0
Total deaths (%)	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
Total deaths (number)	**5,124**	**3,312**	**2,081**	**952**	**1,335**	**350**	**104**	**128**
Not associated with diabetes								
Diseases of the circulatory system	41.1	39.7	40.4	37.1	41.7	41.8	36.3	26.1
Neoplasms	27.8	29.2	28.7	29.2	27.6	27.6	30.3	20.2
Diseases of the respiratory system	10.4	10.1	9.7	10.2	11.3	11.2	9.7	11.2
Diseases of the digestive system	3.1	3.2	3.0	3.3	3.4	2.9	3.6	4.4
Diseases of the genito-urinary system	2.0	2.1	1.8	1.9	1.9	1.8	2.0	1.9
Mental disorders	2.8	3.0	2.0	2.7	2.4	2.0	1.9	2.6
Injury and poisoning	6.1	5.8	7.6	8.1	5.7	5.5	8.2	21.0
Infectious and parasitic diseases	1.3	1.0	0.9	1.0	1.1	0.8	1.2	2.0
Endocrine, nutritional and metabolic diseases and immunity disorders[(a)]	0.8	1.0	0.8	0.8	0.9	0.6	0.7	0.8
Diseases of the nervous system and sense organs	2.3	2.4	2.0	2.7	1.8	2.6	2.7	2.5
Diseases of the musculoskeletal systems and connective tissue	0.5	0.6	0.5	0.4	0.5	0.4	0.6	0.3
Diseases of the blood and blood-forming organs	0.3	0.4	0.3	0.3	0.4	0.2	0.6	0.3
Other[(b)]	1.5	1.5	2.1	2.3	1.4	2.6	2.2	6.6
Total deaths (%)	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
Total deaths (number)	**83,797**	**60,085**	**41,194**	**20,034**	**21,502**	**6,930**	**2,454**	**1,564**

(a) Excludes deaths where diabetes is the underlying cause.

(b) Other includes diseases of the skin and subcutaneous tissue, congenital anomalies, complications of pregnancy, childbirth and the puerperium, certain conditions originating in the perinatal period, symptoms, signs and ill-defined conditions.

Note: Ten deaths with diabetes not as an associated cause were unable to be assigned to a State or Territory.

Source: AIHW National Mortality Database.

In the Northern Territory, diseases of the circulatory system as the underlying cause of death was 2.4 times as likely when diabetes was an associated cause than when it was not an associated cause, compared with 1.4–1.5 times as likely for the other States and Territory. The higher ratio in the Territory can be attributed to the large proportion of Indigenous Australians living in the Northern Territory who are known to have considerable higher death rates from diseases of the circulatory system compared with non-Indigenous Australians (see Chapter 4).

Consistent with the national pattern, diabetes deaths are also more often associated with diseases of the genito-urinary system than when diabetes was not an associated cause across most States and Territories with the exception of Queensland, Western Australia and Tasmania (where the difference is not statistically significant). The proportion of deaths from neoplasms and injury and poisoning were consistently lower when diabetes was an associated cause than when it was not an associated cause across most States and Territories (Table 5.4).

In the Northern Territory, when diabetes was an associated cause of death, diseases of the genito-urinary system and infectious and parasitic diseases were far more likely to be listed as underlying causes of death compared with the national average.

5.3 Urban, rural and remote areas of Australia

Diabetes as the underlying cause or an associated cause of death

In 1997 and 1998, diabetes was more likely to be the underlying or associated cause of death in remote areas than in urban and rural areas of Australia (9.5% of all deaths in remote areas compared with 7.3% and 7.5% in urban and rural areas). The higher proportion in remote areas is attributed to females among whom a significant upward gradient exists with increasing rurality. Among males, the proportion of diabetes-related deaths was similar across urban, rural and remote areas (Table 5.5).

Table 5.5: Diabetes as a cause of death, urban, rural and remote areas, 1997 and 1998

	Males			Females			Persons		
Cause of death	**Urban**	**Rural**	**Remote**	**Urban**	**Rural**	**Remote**	**Urban**	**Rural**	**Remote**
				Proportion of all deaths (%)					
Underlying	2.1	2.1	3.0	2.1	2.4	5.0	2.1	2.3	3.7
Associated	5.4	5.2	5.3	5.0	5.3	6.5	5.2	5.3	5.7
Total diabetes deaths	*7.4*	*7.4*	*8.2*	*7.1*	*7.7*	*11.5*	*7.3*	*7.5*	*9.5*
				Number					
Underlying	1,876	862	111	1,820	809	118	3,696	1,671	229
Associated	4,887	2,104	196	4,282	1,762	155	9,169	3,866	351
Total diabetes deaths	*6,763*	*2,966*	*307*	*6,102*	*2,571*	*273*	*12,865*	*5,537*	*580*
Total deaths	**90,881**	**40,212**	**3,732**	**85,930**	**33,420**	**2,377**	**176,811**	**73,632**	**6,109**

Source: AIHW National Mortality Database.

In remote areas, the proportion of diabetes-related deaths was larger for females than for males, whereas in urban areas the reverse was true. In rural areas there was no significant difference between males and females in the proportion of diabetes-related deaths

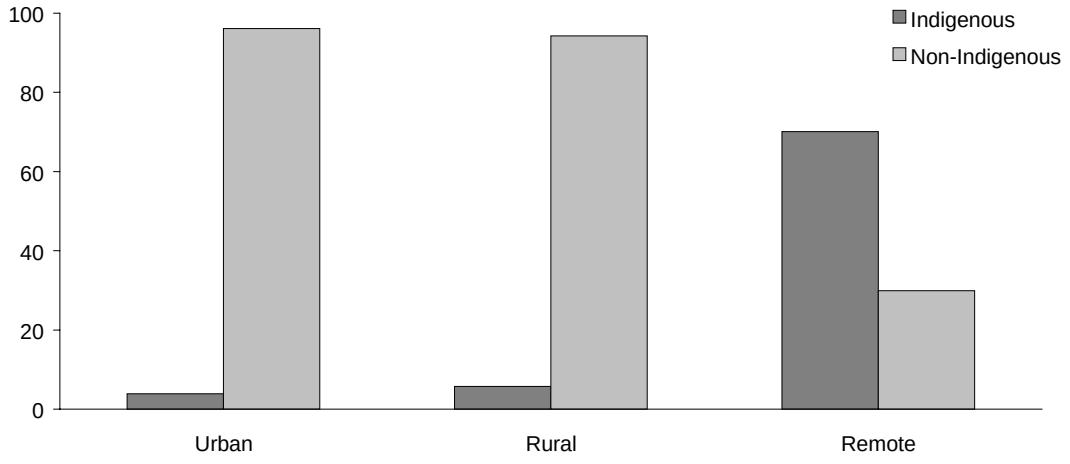
(Table 5.5). A slightly different pattern emerges, however, when the different age structures of urban, rural and remote area populations are taken into account. Age-standardised death rate comparisons clearly indicate a much higher death rate among males than females in urban areas (56.0 compared with 34.8 per 100,000) and in rural areas (58.2 compared with 38.4 per 100,000). In remote areas, however, there was no sex differential. For both males and females, death rates in remote areas were significantly larger than in urban and rural areas and were in the vicinity of 72–73 per 100,000 population (Table A1).

Consistent with the national level, in urban and rural areas diabetes was twice as likely to be recorded as an associated cause rather than as the underlying cause of death. In remote areas, however, the difference was not as marked with diabetes 1.5 times as likely to be recorded as an associated cause rather than as the underlying cause of death (Table 5.5).

Diabetes as the underlying cause of death

There was an upward gradient in diabetes as the underlying cause of death with increasing rurality (2.1%, 2.3% and 3.7% of all deaths). The magnitude of this regional difference is higher among females than males, with the proportion of deaths where diabetes is the underlying cause of death among females in remote areas twice that of those in urban and rural areas (5.0% compared with 2.1% and 2.4% respectively) (Table 5.5).

This pattern is predominantly influenced by the high concentration of Indigenous Australians in remote areas. Within remote areas in Western Australia, South Australia and the Northern Territory, Indigenous Australians accounted for two-thirds of all diabetes-related deaths, with this proportion increasing to around 70% when diabetes is the underlying cause of death. In comparison, Indigenous Australians accounted for less than 6% of deaths in urban and rural areas in these jurisdictions (Figure 5.2). As was evident from the previous chapter Indigenous Australians are almost three times as likely as non-Indigenous Australians to have diabetes recorded as the underlying cause of death.



Note: Includes deaths only from Western Australia South Australia and Northern Territory.
Source: AIHW National Mortality Database.

Figure 5.2: Diabetes as the underlying cause of death, Indigenous status by urban, rural and remote areas, 1997 and 1998

Associated causes of death

When diabetes was the underlying cause of death in 1997 and 1998, there was little difference across urban and rural areas in the pattern of associated causes, and this generally reflected the national average (Table 5.6). In remote areas, however, the pattern was somewhat different and is consistent with that of Indigenous Australians. In remote areas, diseases of the circulatory system were less likely to be reported as an associated cause compared with urban and rural areas, 73.4% compared with 83.5% and 82.6% respectively. Diseases of the genito-urinary system were recorded more often as an associated cause in remote areas (34.1%) than in urban and rural areas of Australia (22.0% and 20.3%).

The sex differentials in associated causes of death across urban, rural and remote areas are generally small. However, in remote areas males were considerably more likely than females to have diseases of the circulatory system listed as an associated cause (80.2% compared with 66.9%) (Table A3).

Table 5.6: Deaths where diabetes is the underlying cause of death by associated causes of death, urban, rural and remote areas, 1997 and 1998

Associated causes of death	Urban	Rural	Remote
	Proportion of diabetes deaths (%)		
Diseases of the circulatory system	83.5	82.6	73.4
Diseases of the genito-urinary system	22.0	20.3	34.1
Diseases of the respiratory system	19.0	18.8	17.9
Mental disorders	9.6	9.9	11.8
Infectious and parasitic diseases	9.7	9.0	12.7
Endocrine, nutritional and metabolic diseases and immunity disorders[(a)]	8.9	7.0	9.6
Diseases of the digestive system	5.5	6.0	4.4
Neoplasms	5.2	5.1	2.6
Injury and poisoning	4.2	4.7	4.4
Diseases of the nervous system and sense organs	4.5	3.5	3.9
Diseases of the musculoskeletal systems and connective tissue	2.9	2.8	1.3
Diseases of the blood and blood-forming organs	2.1	2.4	3.5
Other[(b)]	1.8	1.4	3.1
Total deaths where diabetes is the underlying cause (number)	**3,696**	**1,671**	**229**

(a) Excludes deaths where diabetes is an associated cause.

(b) Other includes diseases of the skin and subcutaneous tissue, congenital anomalies, complications of pregnancy, childbirth and the puerperium, certain conditions originating in the perinatal period, symptoms, signs and ill-defined conditions.

Note: Column percentages do not sum to 100, as more than one disease category may be recorded on the death certificate as an associated cause.

Source: AIHW National Mortality Database.

Diabetes as an associated cause of death

In 1997 and 1998 there was no significant difference in diabetes being recorded as an associated cause of death across urban, rural and remote areas of Australia (5.2%, 5.3% and 5.7% respectively). While this was true when examining male deaths, among females a significant upward gradient exists with increasing rurality. The proportion of deaths where diabetes was an associated cause in urban areas was higher for males than females (5.4%

compared with 5.0%), whereas in remote areas the reverse was true. In rural areas the sex difference was not statistically significant (Table 5.5).

Diabetes as an associated cause of death within each underlying cause of death disease group

The ranking of the underlying causes of death when diabetes is an associated cause varied across urban, rural and remote areas of Australia. In urban areas the ranking reflected the national pattern, with endocrine, nutritional and metabolic diseases and immunity disorders, diseases of the circulatory system, and diseases of the genito-urinary system accounting for the highest proportion of deaths. In rural areas, diseases of the circulatory system accounted for the highest proportion of deaths when diabetes was an associated cause, followed by endocrine, nutritional and metabolic diseases and immunity disorders and diseases of the genito-urinary system. In remote areas, infectious and parasitic diseases and endocrine, nutritional and metabolic diseases and immunity disorders accounted for highest proportion of deaths when diabetes was an associated cause (16.2% and 16.1%) (Table 5.7).

In remote areas, the proportion of deaths was twice as high for endocrine, nutritional and metabolic diseases and immunity disorders and infectious and parasitic diseases when compared with urban and rural areas. The number of deaths in remote areas for several of the disease groups is very small and should be treated with caution (Table 5.7).

Table 5.7: Deaths associated with diabetes within each underlying cause of death, urban, rural and remote areas, 1997 and 1998

Underlying causes of death	Urban	Rural	Remote	Urban	Rural	Remote
		Per cent			Number	
Endocrine, nutritional and metabolic diseases and immunity disorders[(a)]	7.9	7.0	16.1	125	38	10
Diseases of the circulatory system	7.5	7.7	9.6	5,332	2,342	197
Diseases of the genito-urinary system	6.9	6.4	9.5	247	83	12
Infectious and parasitic diseases	6.1	5.4	16.2	132	31	12
Diseases of the musculoskeletal systems and connective tissue	5.7	5.2	13.8	50	22	4
Diseases of the digestive system	5.0	5.5	7.4	266	128	16
Diseases of blood and blood forming organs	4.9	3.8	7.7	28	9	1
Diseases of the respiratory system	4.6	4.3	6.3	823	313	40
Neoplasms	3.5	3.9	3.3	1,720	775	45
Diseases of the nervous system and sense organs	3.5	2.2	3.7	134	36	4
Mental disorders	2.8	3.0	3.0	132	49	4
Injury and poisoning	1.5	0.7	0.6	154	34	5
Other[(b)]	0.9	0.5	0.4	26	6	1
All underlying causes of death[(a)]	**5.3**	**5.4**	**6.0**	**9,169**	**3,866**	**351**

(a) Excludes deaths where diabetes is the underlying cause.

(b) Other includes congenital anomalies, diseases of the skin and subcutaneous tissue, complications of pregnancy, childbirth and the puerperium, certain conditions originating in the perinatal period, symptoms, signs and ill-defined conditions.

Source: AIHW National Mortality Database.

Comparison of each of the underlying causes of death where diabetes is an associated cause and where it is not an associated cause

The ranking of the underlying causes of death when diabetes is an associated cause or not an associated cause across urban and rural areas of Australia is consistent with the pattern at the national level. Diseases of the circulatory system, neoplasms, and diseases of the respiratory system were the three leading causes of death irrespective of diabetes being an associated cause. Diseases of the digestive system and diseases of the genito-urinary system ranked fourth and fifth in those who had diabetes as an associated cause; however, injury and poisoning and diseases of the digestive system ranked fourth and fifth where diabetes was not an associated cause. In remote areas, however, the pattern was slightly different when diabetes was not an associated cause of death; injury and poisoning ranked third after diseases of the circulatory system and neoplasms, and diseases of the respiratory and digestive systems ranked fourth and fifth. The ranking of the underlying causes of death when diabetes is an associated cause of death in remote areas reflected that of urban and rural areas (Table 5.8).

Table 5.8: Distribution of the underlying causes of death associated and not associated with diabetes, urban, rural and remote areas, 1997 and 1998

	Urban		Rural		Remote	
Underlying causes of death	**Associated with diabetes**	**Not associated with diabetes**	**Associated with diabetes**	**Not associated with diabetes**	**Associated with diabetes**	**Not associated with diabetes**
			Proportion of deaths (%)			
Diseases of the circulatory system	58.2	40.1	60.6	41.0	56.1	33.7
Neoplasms	18.8	28.6	20.0	28.3	12.8	23.9
Diseases of the respiratory system	9.0	10.3	8.1	10.3	11.4	10.7
Diseases of the digestive system	2.9	3.1	3.3	3.2	4.6	3.6
Diseases of the genito-urinary system	2.7	2.0	2.1	1.8	3.4	2.1
Mental disorders	1.4	2.8	1.3	2.3	1.1	2.3
Injury and poisoning	1.7	6.2	0.9	6.7	1.4	14.6
Infectious and parasitic diseases	1.4	1.2	0.8	0.8	3.4	1.1
Endocrine, nutritional and metabolic diseases and immunity disorders[(a)]	1.4	0.9	1.0	0.7	2.8	0.9
Diseases of the nervous system and sense organs	1.5	2.3	0.9	2.3	1.1	1.9
Diseases of the musculoskeletal systems and connective tissue	0.5	0.5	0.6	0.6	1.1	0.5
Diseases of the blood and blood-forming organs	0.3	0.3	0.2	0.3	0.3	0.2
Other[(b)]	0.3	1.7	0.2	1.7	0.3	4.4
Total deaths (%)	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
Total deaths (number)	**9,169**	**163,946**	**3,866**	**68,095**	**351**	**5,529**

(a) Excludes deaths where diabetes is the underlying cause.

(b) Other includes congenital anomalies, diseases of the skin and subcutaneous tissue, complications of pregnancy, childbirth and the puerperium, certain conditions originating in the perinatal period, symptoms, signs and ill-defined conditions.

Source: AIHW National Mortality Database.

Across urban, rural and remote areas, diseases of the circulatory system accounted for a higher proportion of deaths when diabetes was an associated cause than when it was not an associated cause. The magnitude of the difference was consistent across urban, rural and remote areas. In urban areas, diabetes was also more often associated with diseases of the genito-urinary system compared with deaths not associated with diabetes, whereas in rural and remote areas there was no significant difference. The proportion of deaths from neoplasms and injury and poisoning were consistently lower when associated with diabetes, than when not associated with diabetes across the three regions (Table 5.8).

5.4 Socioeconomically disadvantaged Australians

In this section diabetes-related deaths are examined in terms of socioeconomic disadvantage. In the absence of reliable data from death certificates on levels of socioeconomic disadvantage, people (i.e. deaths) have been classified according to the average disadvantage of their statistical local area of usual residence. The small area index of socioeconomic disadvantage is derived from social and economic characteristics of the local area such as a low income, low educational attainment, high levels of public sector housing, high unemployment, and jobs in relatively unskilled occupations. Deaths for 1997 and 1998 were classified into quintiles of socioeconomic disadvantage (i.e. each quintile represents approximately 20% of the cases), with quintile 1 representing the least disadvantaged households and quintile 5 the most disadvantaged households (for further details see Chapter 2).

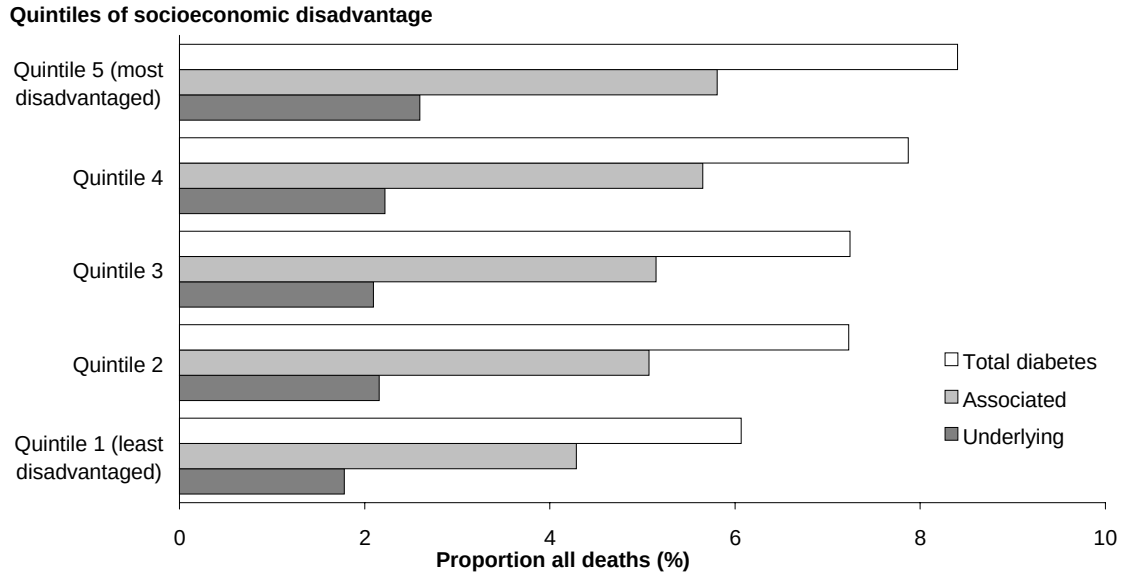
Diabetes as the underlying cause or an associated cause of death

In 1997 and 1998 there was an upward gradient in diabetes as the underlying or associated cause of death with increasing socioeconomic disadvantage. In quintile 1, with the least number of disadvantaged households, diabetes-related deaths accounted for 6.1% of all deaths, with this proportion increasing across each of the quintiles to reach 8.4% in quintile 5 (the most disadvantaged). In other words, diabetes-related mortality in the most disadvantaged quintile was 38% higher than in the least disadvantaged quintile. Inequalities in diabetes mortality would be greater for disadvantaged groups defined in terms of smaller areas or individual circumstances (Figure 5.3).

This increase in the proportion of deaths with socioeconomic disadvantage was also apparent for diabetes both as the underlying cause and as an associated cause of death. The proportional increase between the least and most disadvantaged quintiles is greater for diabetes as the underlying cause of death than for diabetes as an associated cause. Consistent with the national level, diabetes was twice as likely to be reported as an associated cause of death than the underlying cause of death across each of the quintiles (Figure 5.3).

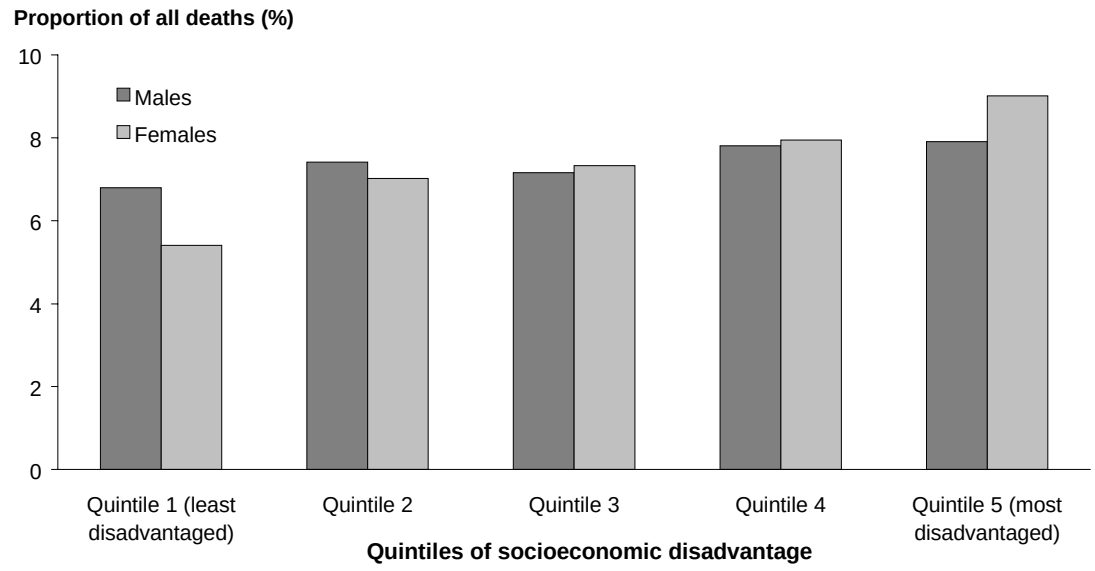
Males in the least disadvantaged quintile had a larger proportion of diabetes-related deaths than females, whereas females in the most disadvantaged quintile had a larger proportion of deaths than males (Figure 5.4). A slightly different pattern emerges, however, when the age structure of each of the quintiles of socioeconomic disadvantage is taken into account. Age-standardised death rate comparisons (for 1997 only) clearly indicate a much higher death rate among males than females across each of the quintiles of socioeconomic disadvantage (Table A1).

Although the proportions increase across the quintiles for both males and females, a steeper continuous gradient was seen among females. For females, diabetes-related mortality in the most disadvantaged quintile was 67% higher than in the least disadvantaged quintile; for males, the corresponding proportion was 16% (Figure 5.4).



Source: AIHW National Mortality Database.

Figure 5.3: Diabetes as a cause of death, quintiles of socioeconomic disadvantage, 1997 and 1998



Source: AIHW National Mortality Database.

Figure 5.4: Diabetes as an underlying or associated cause of death, quintiles of socioeconomic disadvantage, 1997 and 1998

Diabetes as the underlying cause of death

Diabetes was less likely to be recorded as the underlying cause of death in areas with lower socioeconomic disadvantage (1.8% in the first quintile compared with 2.6% in the fifth quintile) in 1997 and 1998. The proportion of deaths where diabetes was the underlying cause of death was 44% higher in the most disadvantaged quintile compared with the least disadvantaged quintile. This proportional increase is greater than for diabetes as an associated cause of death (Figure 5.3).

Associated causes of death

When diabetes is the underlying cause of death, there is little difference in the pattern of associated causes across the different quintiles of socioeconomic disadvantage. The ranking of associated causes generally reflected that found at the national level, with diseases of the circulatory system the leading associated cause of death across all quintiles, 81.7–83.9% of diabetes deaths. Diseases of the genito-urinary system and diseases of the respiratory system accounted for the second and third highest proportion of deaths in all quintiles (Table 5.9).

Table 5.9: Deaths where diabetes is the underlying cause of death by associated causes of death, quintiles of socioeconomic disadvantage, 1997 and 1998

	Quintiles (least to most disadvantaged)				
Associated causes of death	**1**	**2**	**3**	**4**	**5**
	Proportion of all deaths (%)				
Diseases of the circulatory system	82.7	83.1	83.9	83.5	81.7
Diseases of the genito-urinary system	23.5	20.1	20.3	20.9	24.4
Diseases of the respiratory system	18.6	20.7	18.9	19.0	17.9
Mental disorders	9.1	9.1	11.0	10.7	8.9
Infectious and parasitic diseases	9.6	9.4	9.6	10.2	9.1
Endocrine, nutritional and metabolic diseases and immunity disorders[(a)]	8.0	6.8	8.4	8.5	9.3
Diseases of the digestive system	5.4	5.6	4.9	6.7	5.4
Neoplasms	6.2	4.6	5.4	4.3	5.1
Injury and poisoning	4.2	4.1	5.1	4.5	3.8
Diseases of the nervous system and sense organs	5.4	3.7	4.6	3.6	4.1
Diseases of the musculoskeletal systems and connective tissue	2.7	2.9	2.5	3.0	2.9
Diseases of the blood and blood-forming organs	1.6	1.9	2.6	1.4	3.0
Other[(b)]	2.0	1.5	2.2	1.7	1.2
Total deaths where diabetes is the underlying cause (number)	**850**	**1,000**	**1,101**	**1,143**	**1,490**

(a) Excludes deaths where diabetes is an associated cause.

(b) Other includes diseases of the skin and subcutaneous tissue, congenital anomalies, certain conditions originating in the perinatal period, symptoms, signs and ill-defined conditions.

Notes

1. Column percentages do not sum to 100, as more than one disease category may be recorded on the death certificate as an associated cause.
2. Twelve deaths with diabetes as the underlying cause were unable to be matched to the quintiles of socioeconomic disadvantage.

Source: AIHW National Mortality Database.

Diabetes as an associated cause of death

Diabetes was less likely to be recorded as an associated cause of death in areas with lower socioeconomic disadvantage (4.3% in the first quintile compared with 5.8% in the fifth quintile) in 1997 and 1998. The proportion of deaths where diabetes was an associated cause was 35% higher in the most disadvantaged quintile compared with the least disadvantaged quintile (Figure 5.3).

Diabetes as an associated cause of death within each underlying cause of death disease group

For some of the underlying causes of death, there is a marked gradient with socioeconomic disadvantage in the proportion of deaths where diabetes is an associated cause. The gradient was most notable for infectious and parasitic diseases, endocrine, nutritional and metabolic diseases and immunity disorders, diseases of the genito-urinary system and to a lesser extent neoplasms and diseases of the circulatory system. The proportion of deaths when diabetes was an associated cause for these underlying causes in the most disadvantaged quintile were respectively 2.4, 1.8, 1.7, 1.5, and 1.4 times that of the least disadvantaged quintile (Table 5.10 and Table A4).

Table 5.10: Deaths associated with diabetes within each underlying cause of death, quintiles of socioeconomic disadvantage, 1997 and 1998

	Quintile (least to most disadvantaged)				
Underlying causes of death	**1**	**2**	**3**	**4**	**5**
	Per cent				
Endocrine, nutritional and metabolic diseases and immunity disorders[(a)]	5.4	8.9	9.0	6.1	9.9
Diseases of the circulatory system	6.1	7.4	7.6	8.5	8.4
Diseases of the genito-urinary system	5.0	6.4	6.9	7.0	8.7
Infectious and parasitic diseases	3.6	6.0	6.5	6.3	8.5
Diseases of the musculoskeletal systems and connective tissue	4.8	4.5	5.7	5.7	7.2
Diseases of the digestive system	4.4	4.6	5.3	5.6	5.9
Diseases of the blood and blood-forming organs	3.7	2.6	3.2	7.4	5.8
Diseases of the respiratory system	4.1	4.5	4.5	4.8	4.8
Neoplasms	2.9	3.7	3.4	3.8	4.3
Diseases of the nervous system and sense organs	2.4	2.6	3.6	3.7	3.3
Mental disorders	3.1	2.5	2.2	3.4	3.5
Injury and poisoning	1.1	1.4	1.2	0.9	1.5
Other[(b)]	1.3	0.5	1.0	0.8	0.5
All underlying causes of death[(a)]	**4.4**	**5.2**	**5.3**	**5.8**	**6.0**

(a) Excludes deaths where diabetes is the underlying cause.

(b) Other includes congenital anomalies, diseases of the skin and subcutaneous tissue, complications of pregnancy, childbirth and the puerperium, certain conditions originating in the perinatal period, symptoms, signs and ill-defined conditions.

Note: Thirty-six deaths with diabetes as an associated cause were unable to be matched to quintiles of socioeconomic disadvantage.

Source: AIHW National Mortality Database.

Comparison of each of the underlying causes of death where diabetes is an associated cause and where it is not an associated cause

When diabetes is an associated cause of death in 1997 and 1998 there was little difference in the proportion of diabetes deaths and the ranking of the underlying causes across the different quintiles of socioeconomic disadvantage. The pattern of underlying causes generally reflects the national level with diseases of the circulatory system, neoplasms and diseases of the respiratory system the three leading causes of death in all quintiles, irrespective of diabetes being an associated cause (Table 5.11).

Diseases of the digestive system and diseases of the genito-urinary system ranked fourth and fifth in deaths when diabetes was an associated cause of death, whereas injury and poisoning and diseases of the digestive system ranked fourth and fifth when diabetes was not an associated cause. This pattern was consistent across all quintiles and reflected the ranking found at the national level.

Consistent with the national pattern, diseases of the circulatory system accounted for a higher proportion of deaths when diabetes was an associated cause than when it was not an associated cause, across all quintiles. The proportion of deaths from neoplasms was consistently lower across all levels of socioeconomic disadvantage for deaths associated with diabetes than not associated with diabetes. Diabetes was also less often associated with injury and poisoning across all quintiles (Table 5.11).

Table 5.11: Distribution of the underlying causes of death associated and not associated with diabetes, quintiles of socioeconomic disadvantage, 1997 and 1998

	Quintiles (least to most disadvantaged)				
Underlying causes of death	**1**	**2**	**3**	**4**	**5**
	Proportion of deaths (%)				
Associated with diabetes					
Diseases of the circulatory system	58.6	58.1	59.6	60.3	57.3
Neoplasms	18.3	20.1	17.6	19.2	19.6
Diseases of the respiratory system	9.8	8.8	8.8	8.3	8.7
Diseases of the digestive system	2.9	2.7	3.2	3.1	3.3
Diseases of the genito-urinary system	2.5	2.6	2.5	2.2	2.9
Mental disorders	1.9	1.3	1.3	1.3	1.3
Injury and poisoning	1.3	1.7	1.5	1.0	1.7
Infectious and parasitic diseases	1.0	1.3	1.4	1.1	1.6
Endocrine, nutritional and metabolic diseases and immunity disorders[(a)]	1.1	1.6	1.4	0.9	1.4
Diseases of the nervous system and sense organs	1.4	1.1	1.5	1.3	1.2
Diseases of the musculoskeletal systems and connective tissue	0.6	0.4	0.6	0.5	0.6
Diseases of the blood and blood-forming organs	0.3	0.2	0.2	0.4	0.3
Other[(b)]	0.4	0.2	0.3	0.2	0.1
Total deaths (%)	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
Total deaths (number)	**2,046**	**2,353**	**2,706**	**2,911**	**3,334**
Not associated with diabetes					
Diseases of the circulatory system	41.4	39.6	40.3	40.1	39.8
Neoplasms	28.3	28.9	27.7	29.5	27.8
Diseases of the respiratory system	10.3	10.1	10.2	10.0	10.9
Diseases of the digestive system	2.9	3.1	3.2	3.2	3.3
Diseases of the genito-urinary system	2.2	2.1	1.9	1.8	1.9
Mental disorders	2.7	2.7	3.1	2.3	2.4
Injury and poisoning	5.3	6.7	6.7	6.4	7.0
Infectious and parasitic diseases	1.2	1.1	1.1	1.0	1.1
Endocrine, nutritional and metabolic diseases and immunity disorders[(a)]	0.9	0.9	0.8	0.9	0.8
Diseases of the nervous system and sense organs	2.6	2.3	2.2	2.1	2.2
Diseases of the musculoskeletal systems and connective tissue	0.5	0.5	0.5	0.6	0.5
Diseases of the blood and blood-forming organs	0.4	0.3	0.3	0.3	0.3
Other[(b)]	1.4	1.7	1.8	1.9	1.9
Total deaths (%)	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
Total deaths (number)	**44,838**	**43,038**	**48,776**	**47,451**	**52,589**

(a) Excludes deaths where diabetes is the underlying cause.

(b) Other includes congenital anomalies, diseases of the skin and subcutaneous tissue, complications of pregnancy, childbirth and the puerperium, certain conditions originating in the perinatal period, symptoms, signs and ill-defined conditions.

Note: Thirty-six deaths with diabetes as an associated cause and 878 deaths with diabetes not as an associated cause were unable to be matched to quintiles of socioeconomic disadvantage.

Source: AIHW National Mortality Database.

5.5 Discussion

States and Territories

This chapter has highlighted the variation in diabetes-related deaths across the States and Territories of Australia in 1997 and 1998. Diabetes-related deaths are highest in the Northern Territory and lowest in the Australian Capital Territory when the differing age structures of these populations are taken into account.

Consistent with the national level, diseases of the circulatory system are the highest recorded associated cause when diabetes is the underlying cause of death. The proportion is considerably lower in the Northern Territory, which is largely due to a higher proportion of diabetes deaths in the Territory associated with mental disorders, infectious and parasitic diseases, and endocrine, nutritional and metabolic diseases and immunity disorders. Diseases of the genito-urinary system are also more often recorded as an associated cause in the Northern Territory, the Australian Capital Territory and Western Australia than in the other jurisdictions.

The overall pattern across the States and Territories in the underlying causes of death when diabetes is an associated cause and not an associated cause of death (except in the Northern Territory) reflects the national level. Across all States and Territories diseases of the circulatory system accounts for the highest proportion of deaths irrespective of diabetes being an associated cause. In the Northern Territory diseases of the circulatory system are far more likely to be an associated cause (than not an associated cause) compared with the other States and Territory.

The higher diabetes-related mortality in the Northern Territory can partially be explained by the high concentration of Indigenous Australians who live in the Northern Territory (28.3% compared with 2.1% nationally). As was evident from the previous chapter, diabetes-related deaths are twice as high among Indigenous Australians compared with non-Indigenous Australians. The association between diabetes and diseases of the circulatory system and diseases of the genito-urinary system is also shown to be stronger among Indigenous Australians than non-Indigenous Australians, which is also clearly evident for the Northern Territory.

Urban, rural and remote areas of Australia

Diabetes-related deaths are higher in remote areas than in urban and rural areas of Australia. Given that Indigenous Australians account for two-thirds of diabetes-related deaths in remote areas, this pattern is consistent with that observed for Indigenous Australians.

When diabetes is the underlying cause of death, the pattern of associated causes across urban and rural areas is similar and generally reflects that of the national average. In remote areas, however diseases of the circulatory system are less likely to be recorded as an associated cause, and diseases of the genito-urinary system are more often listed as an associated cause compared with urban and rural areas. This reflects the finding among Indigenous Australians.

There is no significant difference in diabetes being recorded as an associated cause of death across urban, rural and remote areas of Australia. The pattern of association between diabetes and the underlying cause of death varies across these three areas. Urban areas

generally reflect the national pattern, whereas in rural areas diseases of the circulatory system account for the highest proportion of deaths associated with diabetes. In remote areas, infectious and parasitic diseases, and endocrine, nutritional and metabolic diseases and immunity disorders account for the highest proportion of deaths associated with diabetes. The ranking of the leading underlying causes of death when diabetes is an associated cause across urban, rural and remote areas and not an associated cause across urban and rural areas generally reflects the national pattern.

Socioeconomically disadvantaged Australians

Socioeconomic disadvantage is an important predictor of premature mortality. Diabetes-related mortality is 38% higher among the most disadvantaged quintile of the Australian population compared with the least disadvantaged quintile. The proportional increase with increasing socioeconomic disadvantage is greater for diabetes as the underlying cause of death than diabetes as an associated cause of death. This finding is consistent with studies in the United Kingdom that have shown that mortality is twice as high in people with diabetes in the most disadvantaged group as in those in the least disadvantaged group (Chaturvedi et al. 1998)

The proportion of diabetes-related deaths increases more rapidly across the quintiles for females than for males—a 67% increase between the least disadvantaged quintile and the most disadvantaged quintile for females compared with a 16% increase for males.

Consistent with the national level, diseases of the circulatory system and to a lesser extent diseases of the genito-urinary and respiratory systems are predominantly associated with diabetes across all levels of socioeconomic disadvantage. There are no marked differences in the proportion of diabetes deaths across the quintiles of socioeconomic disadvantage for each of the associated causes.

Diabetes is more likely to be an associated cause in the most disadvantaged quintile than in the least disadvantaged quintile for infectious and parasitic diseases, endocrine, nutritional and metabolic diseases and immunity disorders, diseases of the genito-urinary system, neoplasms and diseases of the circulatory system.

A possible explanation for the gradient in socioeconomic disadvantage in diabetes-related deaths is diseases of the circulatory system and its risk factors (Chaturvedi et al. 1998). Mortality from diseases of the circulatory system is twice as high in the most disadvantaged quintile compared with the least disadvantaged quintile for those aged 25–64. Further, smoking, high blood pressure, physical inactivity and obesity (all risk factors for diabetes) have been shown to be higher among the most disadvantaged group compared with the least disadvantaged group (AIHW 1999).

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Appendix

Table A1: Age-standardised death rates for diabetes-related deaths, 1997 and 1998

	Males	Females
	Death rate per 100,000 population[(a)]	
Australia	57.2	36.5
Indigenous status[(b)]		
Indigenous	229.3	238.0
Non-Indigenous	24.5	13.5
States and Territories		
New South Wales	56.7	35.8
Victoria	61.7	37.7
Queensland	52.0	35.9
Western Australia	49.4	33.7
South Australia	63.5	37.1
Tasmania	57.5	31.9
Australian Capital Territory	39.1	30.4
Northern Territory	97.6	136.1
Urban, rural and remote areas		
Urban	56.0	34.8
Rural	58.2	38.4
Remote	72.6	71.8
Quintiles of socioeconomic disadvantage[(c)]		
Quintile 1 (least disadvantaged)	46.2	25.8
Quintile 2	54.9	33.8
Quintile 3	58.7	37.1
Quintile 4	62.2	40.5
Quintile 5 (most disadvantaged)	65.9	48.8

(a) Death rates are age-standardised to the 1991 Australian population.

(b) Includes deaths only for Western Australia, South Australia and Northern Territory.

(c) Age-standardised death rates for the quintiles of socioeconomic disadvantage are calculated only for 1997, as 1998 population data could not be mapped to quintiles of socioeconomic disadvantage.

Source: AIHW National Mortality Database.

Table A2: Deaths associated with diabetes within each underlying cause of death, States and Territories, 1997 and 1998

Underlying causes of death	NSW	Vic	Qld	WA	SA	Tas	ACT	NT
				Number				
Endocrine, nutritional and metabolic diseases and immunity disorders[(a)]	64	42	34	18	11	3	0	1
Diseases of the circulatory system	3,092	1,829	1,290	525	784	216	56	79
Diseases of the genito-urinary system	127	91	39	24	41	6	6	8
Infectious and parasitic diseases	67	36	29	14	13	7	1	8
Diseases of the musculoskeletal systems and connective tissue	28	19	16	6	5	0	2	0
Diseases of the digestive system	151	111	63	34	34	10	2	5
Diseases of the blood and blood-forming organs	18	8	5	1	4	2	0	0
Diseases of the respiratory system	463	295	147	110	104	36	8	13
Neoplasms	892	719	371	163	307	57	20	11
Diseases of the nervous system and sense organs	74	50	16	17	12	2	3	0
Mental disorders	68	53	29	19	7	6	2	1
Injury and poisoning	70	48	40	14	11	5	3	2
Other[(b)]	10	11	2	7	2	0	1	0
All underlying causes of death[(a)]	**5,124**	**3,312**	**2,081**	**952**	**1,335**	**350**	**104**	**128**

(a) Excludes deaths where diabetes is the underlying cause.

(b) Other includes diseases of the skin and subcutaneous tissue, congenital anomalies, complications of pregnancy, childbirth and the puerperium, certain conditions originating in the perinatal period, symptoms, signs and ill-defined conditions.

Note: Cells with zero numbers reflect no deaths with diabetes as an associated cause in that disease category for the particular State or Territory in 1997 and 1998.

Source: AIHW National Mortality Database.

Table A3: Deaths where diabetes is the underlying cause of death by associated causes of death, urban, rural and remote areas, 1997 and 1998

	Males			Females		
Associated causes of death	**Urban**	**Rural**	**Remote**	**Urban**	**Rural**	**Remote**
	Proportion of diabetes deaths (%)					
Diseases of the circulatory system	84.6	83.4	80.2	82.5	81.7	66.9
Diseases of the genito-urinary system	22.0	18.6	28.8	22.0	22.2	39.0
Diseases of the respiratory system	21.0	19.7	16.2	17.0	17.8	19.5
Mental disorders	8.2	10.7	13.5	10.9	9.0	10.2
Infectious and parasitic diseases	9.1	8.1	10.8	10.3	10.0	14.4
Endocrine, nutritional and metabolic diseases and immunity disorders[(a)]	8.3	6.8	10.8	9.5	7.2	8.5
Diseases of the digestive system	5.8	5.5	3.6	5.2	6.6	5.1
Neoplasms	5.9	6.4	3.6	4.5	3.7	1.7
Injury and poisoning	4.0	5.5	3.6	4.3	3.8	5.1
Diseases of the nervous system and sense organs	5.2	3.1	5.4	3.9	4.0	2.5
Diseases of the musculoskeletal systems and connective tissue	2.2	2.3	0.9	3.6	3.2	1.7
Diseases of the blood and blood-forming organs	1.7	2.1	1.8	2.4	2.7	5.1
Other[(b)]	1.4	1.3	1.8	2.1	1.5	4.2
Total deaths where diabetes is the underlying cause (number)	**1,876**	**862**	**111**	**1,820**	**809**	**118**

(a) Excludes deaths where diabetes is an associated cause.

(b) Other includes diseases of the skin and subcutaneous tissue, congenital anomalies, complications of pregnancy, childbirth and the puerperium, certain conditions originating in the perinatal period, symptoms, signs and ill-defined conditions.

Note: Column percentages do not sum to 100, as more than one disease category may be recorded on the death certificate as an associated cause.

Source: AIHW National Mortality Database.

Table A4: Deaths associated with diabetes within each underlying cause of death, quintiles of socioeconomic disadvantage, 1997 and 1998

	Quintile (least to most disadvantaged)				
Underlying causes of death	**1**	**2**	**3**	**4**	**5**
			Number		
Endocrine, nutritional and metabolic diseases and immunity disorders[(a)]	22	38	39	27	46
Diseases of the circulatory system	1,199	1,366	1,614	1,755	1,911
Diseases of the genito-urinary system	51	61	68	65	96
Infectious and parasitic diseases	20	30	39	33	53
Diseases of the musculoskeletal systems and connective tissue	12	10	16	16	21
Diseases of the digestive system	60	63	87	91	109
Diseases of the blood and blood-forming organs	6	4	5	12	11
Diseases of the respiratory system	200	207	237	242	289
Neoplasms	375	473	477	558	652
Diseases of the nervous system and sense organs	29	27	41	38	39
Mental disorders	38	30	34	38	45
Injury and poisoning	26	40	40	29	57
Other[(b)]	8	4	9	7	5
All underlying causes of death[(a)]	**2,046**	**2,353**	**2,706**	**2,911**	**3,334**

(a) Excludes deaths where diabetes is the underlying cause.

(b) Other includes congenital anomalies, diseases of the skin and subcutaneous tissue, complications of pregnancy, childbirth and the puerperium, certain conditions originating in the perinatal period, symptoms, signs and ill-defined conditions.

Note: Thirty-six deaths with diabetes as an associated cause were unable to be matched to quintiles of socioeconomic disadvantage.

Source: AIHW National Mortality Database.