Australian Government
Australian Institute of Health and Welfare

Australian Burden of Disease Study

Fatal burden of disease in Aboriginal and Torres Strait Islander people

2010

Australian Government
Australian Institute of
Health and Welfare

*Authoritative information and statistics
to promote better health and wellbeing*

AUSTRALIAN BURDEN OF DISEASE STUDY SERIES
Number 2

Australian Burden of Disease Study: Fatal burden of disease in Aboriginal and Torres Strait Islander people 2010

Australian Institute of Health and Welfare

Canberra

Cat. no. BOD 2

The Australian Institute of Health and Welfare is a major national agency which provides reliable, regular and relevant information and statistics on Australia's health and welfare. The Institute's mission is *authoritative information and statistics to promote better health and wellbeing*.

© Australian Institute of Health and Welfare 2015

This product, excluding the AIHW logo, Commonwealth Coat of Arms and any material owned by a third party or protected by a trademark, has been released under a Creative Commons BY 3.0 (CC-BY 3.0) licence. Excluded material owned by third parties may include, for example, design and layout, images obtained under licence from third parties and signatures. We have made all reasonable efforts to identify and label material owned by third parties.

You may distribute, remix and build upon this work. However, you must attribute the AIHW as the copyright holder of the work in compliance with our attribution policy available at <www.aihw.gov.au/copyright/>. The full terms and conditions of this licence are available at <http://creativecommons.org/licenses/by/3.0/au/>.

Enquiries relating to copyright should be addressed to the Head of the Digital and Media Communications Unit, Australian Institute of Health and Welfare, GPO Box 570, Canberra ACT 2601.

This publication is part of the Australian Institute of Health and Welfare's Australian Burden of Disease Study series. A complete list of the Institute's publications is available from the Institute's website <www.aihw.gov.au>.

ISSN 2204-4108
ISBN 978-1-74249-696-2

Suggested citation

Australian Institute of Health and Welfare 2015. Australian Burden of Disease Study: fatal burden of disease in Aboriginal and Torres Strait Islander people 2010. Australian Burden of Disease Study series no. 2. Cat. no. BOD 2. Canberra: AIHW.

Australian Institute of Health and Welfare

Board Chair
Dr Mukesh C Haikerwal AO

Director
Ms Kerry Flanagan PSM

Any enquiries about or comments on this publication should be directed to:
Digital and Media Communications Unit
Australian Institute of Health and Welfare
GPO Box 570
Canberra ACT 2601
Tel: (02) 6244 1000
Email: info@aihw.gov.au

Published by the Australian Institute of Health and Welfare
This publication is printed in accordance with ISO 14001 (Environmental Management Systems) and ISO 9001 (Quality Management Systems). The paper is sourced from sustainably managed certified forests.

FSC
www.fsc.org
MIX
From responsible sources
FSC® C017269

Please note that there is the potential for minor revisions of data in this report. Please check the online version at <www.aihw.gov.au> for any amendments.

Contents

Acknowledgments v

Abbreviations vi

Preface viii

Summary ix

1 Introduction 1

1.1 What is burden of disease? 1

1.2 Previous burden of disease studies 2

1.3 Australian Burden of Disease Study 2011 2

1.4 Purpose and structure of this report 4

2 Methods, data sources and data quality 7

2.1 Years of life lost 7

2.2 Data sources and inputs 7

2.3 Methods for redistribution of deaths 10

2.4 Methods specific to Indigenous fatal burden estimates 11

3 National results: Indigenous YLL 15

3.1 Overall Indigenous fatal burden by age and sex 15

3.2 Indigenous fatal burden by disease group 17

3.3 Do the leading causes of fatal burden differ by sex? 18

3.4 Do the leading causes of fatal burden differ by age group? 22

3.5 Age patterns in YLL for selected disease groups 27

4 National results: Mortality gap 30

4.1 What is the overall gap in fatal burden? 30

4.2 Which age groups contribute the most to the mortality gap? 31

4.3 What diseases are the leading contributors to the mortality gap? 32

4.4 Do the leading contributors to the mortality gap differ by age? 33

4.5 Do the leading contributors to the mortality gap differ by sex? 34

5 Sub-national results 36

5.1 State/territory 36

5.2 Remoteness 43

5.3 Socioeconomic disadvantage 50

6 International comparisons 54

6.1 New Zealand Burden of Diseases, Injuries and Risk Factors Study, 2006–2016 54

6.2 Results.....57
7 Discussion.....61
Appendix A: Burden of disease studies.....66
Appendix B: Data sources and standard life table.....67
Appendix C: Measures of socioeconomic disadvantage.....72
Appendix D: Cause list and redistribution.....76
Appendix E: Methods for adjusting Indigenous mortality data.....85
Appendix F: Measuring the gap.....95
Glossary.....98
References.....100
List of tables.....103
List of figures.....105
List of boxes.....107

Acknowledgments

This report was authored by Michelle Gourley, Jessica Zhang, Ilona Brockway, Michael McGrath and Nancy Stace-Winkles of the Indigenous Modelling and Reporting Unit at the Australian Institute of Health and Welfare (AIHW). Expert input from Karen Bishop and Lynelle Moon (AIHW) is gratefully acknowledged. Fadwa Al-Yaman, Head of the Indigenous and Children's Group, AIHW, provided valuable guidance and advice throughout the project. Louise York, Dinesh Indraharan, David Whitelaw and Justine Boland from the AIHW also provided constructive reviews and general advice.

Independent consultants Ken Tallis and Anthony Barnes provided valuable methodological advice throughout the project. Nicholas Biddle (Centre for Aboriginal Economic Policy Research) provided expert advice on using indexes of socioeconomic disadvantage in reporting rates of fatal burden in the Indigenous and non-Indigenous populations.

The report was prepared under the guidance of the Australian Burden of Disease Indigenous Reference Group, comprising Len Smith (Chair), Jahan Ara (Department of Health), Anthony Barnes (Independent), Lisa Briggs (National Aboriginal Community Controlled Health Organisation), Alex Brown (South Australian Health and Medical Research Institute), Daniel Christensen (Telethon Kids Institute), Steven Guthridge (Northern Territory Department of Health), Kirrily Harrison (Department of the Prime Minister and Cabinet), Wendy Hoy (Queensland Health), Vanessa Lee (University of Sydney), Julie Nankervis (Australian Bureau of Statistics), Debra Reid (University of Sydney), Shahidullah (Australian Bureau of Statistics), Daniel Williamson (Queensland Health) and Yuejen Zhao (Northern Territory Department of Health).

Expert mortality advice was provided by Ian Ring (University of Wollongong), Paul Jelfs (Australian Bureau of Statistics) and Richard Madden (University of Sydney).

Funding for the project was provided by the Australian Government Department of Health and the (former) Australian National Preventive Health Agency. The authors acknowledge the valuable comments provided by these agencies.

Abbreviations

ABDS	Australian Burden of Disease Study
ABS	Australian Bureau of Statistics
ACT	Australian Capital Territory
AIHW	Australian Institute of Health and Welfare
BoD	Burden of Disease
CAEPR	Centre for Aboriginal Economic Policy Research
CDE	Census Data Enhancement
CKD	chronic kidney disease
COAG	Council of Australian Governments
CODURF	cause of death unit record files
DALY	disability-adjusted life year
EMD	Enhanced Mortality Database
ERP	estimated resident population
GBD	Global Burden of Disease Study
GGB	general growth balance
ICD	International Classification of Diseases
IHME	Institute for Health Metrics and Evaluation
IRG	Indigenous Reference Group
IRSEO	Indigenous Relative Socioeconomic Outcomes
MCOD	multiple causes of death
NSW	New South Wales
NT	Northern Territory
NZBD	New Zealand Burden of Diseases, Injuries and Risk Factors Study
PNIRSEO	Pooled Non-Indigenous Relative Socioeconomic Outcomes index
Qld	Queensland
SA	South Australia

SA2	Statistical Area Level 2
SEIFA	Socio-Economic Indexes for Areas
Tas	Tasmania
UCOD	underlying cause of death
Vic	Victoria
WA	Western Australia
WHO	World Health Organization
YLD	years lived with disability
YLL	years of life lost

Symbols

. .	not applicable
n.a.	not available
n.p.	not publishable because of small numbers, confidentiality or other concerns about the quality of the data
<	less than

Preface

Burden of disease analysis is a way of simultaneously counting and comparing the fatal and non-fatal impacts of different diseases and injuries. It uses information from multiple data sources to quantify the impact, on a population, of premature death and illness from all diseases and injuries.

This report presents estimates of fatal burden for Aboriginal and Torres Strait Islander Australians for 2010 produced as part of the Indigenous component of the Australian Burden of Disease Study (ABDS) at the Australian Institute of Health and Welfare (AIHW).

The last burden of disease study that provided estimates for Aboriginal and Torres Strait Islander Australians was published in 2007, using 2003 data (Vos et al. 2007). This current study builds on the methodological developments in recent global and country burden of disease studies, modified for the Australian context. As a result of these methodological advancements, the fatal burden estimates presented in this report cannot be compared directly to the 2003 burden of disease estimates for Indigenous Australians.

Fatal burden is measured in years of life lost (YLL), which is the sum of the number of years of life lost due to premature death from disease and injury. Fatal burden estimates presented in this report are described for the Aboriginal and Torres Strait Islander population for broad disease groups, by age and sex. Estimates of the 'gap' in fatal burden between Indigenous and non-Indigenous Australians are also reported, together with selected sub-national estimates (selected states and territories, remoteness and socioeconomic disadvantage).

Fatal burden estimates presented in this report are based on mortality data adjusted for Indigenous under-identification. Non-Indigenous estimates presented in this report are not the same as estimates for the total Australian population and should not be used as such. Please refer to the AIHW's report 'Australian Burden of Disease Study: fatal burden of disease 2010' (AIHW 2015) for estimates of fatal burden in the total Australian population.

The AIHW will release a more comprehensive report on the burden of disease for Aboriginal and Torres Strait Islander peoples in 2016. It will update and extend this report with 2011 estimates of fatal and non-fatal burden for more specific causes, as well as the burden attributable to selected risk factors.

Summary

This report presents estimates of fatal burden for Aboriginal and Torres Strait Islander Australians for 2010. Estimates of the 'gap' in fatal burden between Indigenous and non-Indigenous Australians are also reported, together with selected sub-national estimates (selected states and territories, remoteness and socioeconomic disadvantage).

Key findings

- There were around 2,950 deaths of Indigenous Australians in 2010, resulting in almost 100,000 years of life lost to premature mortality (YLL).
- In 2010, the rate of fatal burden experienced by Indigenous Australians was 2.6 times the rate of fatal burden experienced by non-Indigenous Australians.
- Injuries and cardiovascular diseases contributed the most fatal burden for Indigenous Australians (22% and 21% respectively), followed by cancer (17%), infant and congenital conditions (10%), gastrointestinal diseases (6%) and endocrine disorders (5%). These disease groups accounted for 82% of all Indigenous YLL in 2010.
- Indigenous males had a higher proportion of YLL from injuries than Indigenous females (representing 26% compared to 16% of total YLL). In contrast, cancer represented a higher proportion of total YLL for Indigenous females than for Indigenous males (21% compared to 15% respectively).
- Deaths in infants (under 1 year) contributed the most to Indigenous YLL (12% for males and 11% for females). This reflects the influence of age at death on the measure of fatal burden. The remaining majority of fatal burden in the Indigenous population is in the middle aged; however, the highest YLL rates per 1,000 population are in the older age groups (aged 70 and over), reflecting higher death rates in these age groups.
- Infant and congenital conditions accounted for the majority of the fatal burden among Indigenous infants (80% for males and 85% for females). Injuries accounted for the majority of fatal burden among those aged 1–34. Cardiovascular diseases and cancer were the two biggest contributors to total YLL for Indigenous people aged 45 and over. Endocrine disorders (which include diabetes) were also in the top 5 causes of fatal burden for Indigenous people aged 45 and over.
- The diseases contributing most to the gap in fatal burden between Indigenous and non-Indigenous Australians were cardiovascular diseases (responsible for 27% of the gap), cancer (15%), injuries (14%) and endocrine disorders (10%). Together, these disease groups accounted for almost two-thirds of the gap in fatal burden of disease in 2010.
- Endocrine disorders, and kidney and urinary diseases, had the highest relative disparities in fatal burden, with YLL rates for Indigenous Australians being 8 and 7 times the rates for non-Indigenous Australians for these 2 disease groups respectively.
- Rates of fatal burden among the Indigenous population were highest in the Northern Territory and Western Australia (of the 4 jurisdictions for which YLL estimates are reported: New South Wales, Queensland, Western Australia and the Northern Territory); and were higher in *Remote* and *Very remote* areas compared to *Major cities* and regional areas. Indigenous YLL rates were highest in areas where the Indigenous population was most socioeconomically disadvantaged and fell with decreasing levels of disadvantage.

1 Introduction

This report presents estimates of the fatal burden of disease and injury for Aboriginal and Torres Strait Islander people, as well as estimates of the 'gap' in fatal burden between Indigenous and non-Indigenous Australians. Estimates of the non-fatal burden of disease will be included in a final report from the Australian Burden of Disease Study (ABDS) 2011 for the Aboriginal and Torres Strait Islander population, expected to be released in 2016.

This chapter provides an overview of burden of disease analyses, previous burden of disease studies, the ABDS 2011, and the purpose and structure of this report.

1.1 What is burden of disease?

Burden of disease analysis is a technique used to assess and compare the impact of different diseases, conditions or injuries (referred to collectively as causes) on a population. It uses information from a range of sources to quantify the fatal and non-fatal effects of diseases and injuries and combine them into a summary measure of health called the DALY—a disability-adjusted life year. The DALY extends the concept of years of life lost (YLL) due to premature death to include equivalent years of 'healthy' life lost from living with diseases or injuries (quantified as years lived with disability, YLD). Burden of disease analysis also allows the contributions of various risk factors to be calculated, with each risk factor contribution known as its 'attributable burden'. (Definitions of key terms used in burden of disease studies are in Box 1.1.)

Burden of disease analysis has become the global standard for collating all useable data on causes of health loss to produce comparable and concise policy-relevant evidence. The ability to use data from a range of sources to construct a comparable measure for all diseases is a key strength of this approach. As such, it is possible to estimate the relative contribution of each disease to the total burden of disease.

Burden of disease analysis provides a useful evidence base to support the following:

- **Monitoring of population health**. Burden of disease analysis is particularly valuable for monitoring population health because it simultaneously quantifies the fatal and non-fatal effects of causes of ill health. The metrics used also enable comparability across disease groups, individual causes and population groups. The contributions of various risk factors can also be quantified using the same metrics.
- **Health policy and health services planning**. Burden of disease studies can provide valuable information to inform health policy formation and health services planning. For example, BoD data can show the diseases or injuries most likely to have an impact on the health system and health services through resulting doctor visits, hospital admissions or dental care. In addition, estimates of the burden attributable to specific risk factors can be used to develop and implement better-targeted prevention policies.
- **Assessment of the broader impact of diseases and the cost effectiveness of interventions**. Burden of disease information can be used to measure the health impact of interventions and, by extension, their cost-effectiveness. It can also be useful to compare burden of disease information for particular diseases or risk factors with expenditure on treating or preventing those diseases or risk factors.

Box 1.1: Key terms used in burden of disease analysis

Attributable burden: The disease burden attributed to a particular risk factor. It is the reduction in burden that would have occurred if exposure to the risk factor had been avoided.

DALY (Disability-adjusted life year): One (1) year of healthy life lost, either through premature death or, equivalently, through living with ill health due to illness or injury.

Incidence: The number of new cases (of an illness or event) occurring during a given period.

Prevalence: The number of cases of a disease or injury in a population at a given time.

YLD (Years lived with disability): A measure of the years of what could have been a healthy life that were instead spent in states of less than full health.

YLL (Years of life lost): Years of life lost due to premature mortality. It is calculated by counting the number of deaths at each age, multiplied by the remaining life expectancy at this age according to a standard life table.

Fatal burden: Burden of disease caused by mortality. Represented by YLL measure.

Non-fatal burden: Burden of disease caused by morbidity. Represented by YLD measure.

1.2 Previous burden of disease studies

The first global BoD study—for the reference year 1990—developed the DALY metric and quantified the disease burden (and attribution to risk factors) for 8 regions of the world (Murray & Lopez 1996). Since then, additional global and country studies have been undertaken and methods have been further developed. The Global Burden of Disease Study 2010 (hereafter referred to as GBD 2010), conducted by the Institute for Health Metrics and Evaluation (IHME) and other academic partners, was published in December 2012 (The Lancet 2012). It used updated methods to generate DALYs for 2010 and revised estimates for 1990 and 2005. More recently, the World Health Organization (WHO) applied these methods (with some modifications) to revise and update global health estimates for 2000–2012 (WHO 2014a). When preparing this current report as part of the Australian Burden of Disease Study (ABDS), the IHME was also updating its estimates for the 2013 reference year.

To date in Australia, there have been two major national burden of disease studies—the first was published by AIHW in 1999 using 1996 data, and the second was published by AIHW and the University of Queensland in 2007 using 2003 data. There has also been one national study for Aboriginal and Torres Strait Islander people published in 2007 using 2003 data (Vos et al. 2007). Some states and territories have also completed burden of disease work (a summary of global and Australian burden of disease studies is at Appendix A).

1.3 Australian Burden of Disease Study 2011

In 2013, the Department of Health and the former Australian National Preventive Health Agency funded the AIHW to update burden of disease estimates for Australia. The Australian Burden of Disease Study 2011 will have several outputs, and builds on the AIHW's previous burden of disease work, including providing burden of disease estimates for both the total Australian and Aboriginal and Torres Strait Islander populations. Where valid, and where capacity allows, sub-national estimates will also be produced.

The study will use and adapt the methods of the GBD 2010 study to quantify burden of disease, but using Australian data sources. The resulting estimates will thus be better aligned to the Australian health policy context. Methods used in other recently published burden of disease studies— notably the WHO's Global Health Estimates 2012 (WHO 2014b), and the New Zealand Ministry of Health's Burden of Diseases, Injuries and Risk Factors Study, 2006–2016 (MOH 2012) are also being reviewed and incorporated into the Australian study where appropriate.

Aboriginal and Torres Strait Islander disease burden

Aboriginal and Torres Strait Islander people as a population group experience a very different disease burden to non-Indigenous Australians; both a higher burden as well as some differences in the pattern and age distribution of diseases. Indigenous Australians also experience much higher mortality rates than non-Indigenous Australians across all age groups and for all leading causes of death, and Indigenous mortality has consequently become a major focus of policy attention. Two of the six Council of Australian Governments (COAG) Closing the Gap targets for Indigenous disadvantage are mortality-related—to close the gap in life expectancy within a generation, and to halve the gap in mortality rates for Indigenous children under five by 2018.

Burden of disease estimates for the Aboriginal and Torres Strait Islander population will provide evidence on the diseases and injuries currently contributing most to Indigenous mortality and ill health, and on the largerst gaps in health outcomes between Indigenous and non-Indigenous Australians. This information will be important in assisting Governments to develop and target interventions that can reduce the incidence of risk factors and other main contributors to the burden of disease and injury in the Indigenous population.

Comparability to previous burden of disease studies

A principle of the ABDS is to maintain as much international comparability as possible, with clarity around any differences, while being relevant to the Australian context. This report therefore draws on many of the methodological advances of recent global studies (in particular GBD 2010)—which differ from the methods used in the previous Indigenous burden of disease study in Australia (Vos et al. 2007) (refer to Box 1.2 for the main differences).

This current report includes a number of improvements to methods relating specifically to the calculation of Indigenous fatal burden of disease estimates. Such improvements include adjusting for Indigenous under-identification in mortality data using direct methods based on national data linkage studies; reporting of two key measures of the mortality gap between Indigenous and non-Indigenous Australians (rate ratios and rate differences) using the direct age-standardisation method, which will enable future comparisons over time; and using an Indigenous-specific index of socioeconomic outcomes (Biddle 2013) to examine YLL estimates by socioeconomic disadvantage.

As a consequence of these methodological differences, the fatal burden estimates presented in this report cannot be compared with estimates produced in the previous Indigenous burden of disease study. Therefore, comparisons over time are currently not available.

Box 1.2: Comparing YLL estimates with those in previous (2003) Indigenous Australian Burden of Disease (BoD) Study

The YLL estimates for Indigenous Australians in the ABDS will differ to those produced in the 2003 Indigenous burden of disease study due to differences in the following factors:

Cause list and ICD code allocation: The cause list provides a framework for which estimates of fatal and non-fatal burden are calculated. The cause list for the ABDS has been tailored to suit the Australian context and definitions for national reporting. Hence, the causes used may not align with those used in the previous Indigenous BoD study; in some cases the cause labels may be the same or similar, but the component causes may differ. In addition, ICD code selections for each cause often differ between the two studies.

Redistribution methods: In burden of disease studies, deaths that are not coded to causes defined in the study's cause list are reassigned to other causes to ensure the burden from these deaths is included. In this study, these are referred to as redistribution codes; in some other studies, they are known as 'garbage codes'. The current Australian study uses a similar approach for redistribution to that used in other studies, but the algorithms (or exact specifications for the reassignment) are different.

Standard life table: The current study uses the GBD 2010 standard life table to quantify the remaining years of life expectancy at any age. This life table has a higher life expectancy than the life table used in the previous Indigenous BoD study, which will contribute to higher estimates of YLL.

Methods of calculating YLL: The previous Indigenous study applied age weighting and discounting. To be consistent with current GBD methodology, estimates in the current study do not apply age weighting or discounting (see Glossary).

Adjustment for under-identification: The previous Indigenous BoD study used an indirect method (the generalised growth balance) to adjust Indigenous adult mortality rates. The current Indigenous BoD study uses direct methods to adjust for Indigenous under-identification based on national data linkages studies. Direct methods that use data linkage to derive Indigenous deaths have been found to be superior to indirect methods (Barnes et al. 2008) and are now recommended by the Australian Bureau of Statistics (ABS 2009).

The 'gap': Estimates of the Indigenous health gap in the previous Indigenous BoD study were produced using an indirect standardisation approach, in which the comparison population was the total Australian population. The current study calculated estimates of the mortality gap using direct age-standardisation methods in which the comparison population is the non-Indigenous population. Direct age-standardisation enables multiple comparisons and can be used for time series analyses. Two measures of the gap are reported (rate differences and rate ratios) which provide different information—causes that have the largest absolute disparities, and those that have the greatest relative disparities.

More details on the cause list, redistribution of deaths, standard life table, adjustment for Indigenous under-identification and measures of the mortality gap are described in Chapter 2, 'Methods, data sources and data quality', and in the Appendixes.

1.4 Purpose and structure of this report

This is the first report of results produced for the Aboriginal and Torres Strait Islander population from the Australian Burden of Disease Study. It presents estimates of the fatal burden of disease for Aboriginal and Torres Strait Islander people, as well as the 'gap' in fatal burden between Indigenous and non-Indigenous Australians for the 2010 reference year. The 2010 fatal burden estimates use the average of three years of deaths data combined—2009, 2010 and 2011. The fatal burden is measured in years of life lost (YLL), which is the sum of the number of years of life lost due to premature death from disease and injury.

A report presenting estimates of the fatal burden for the Australian population has already been published—*Australian Burden of Disease Study: fatal burden of disease 2010* (AIHW 2015). Reports covering estimates of fatal and non-fatal burden in the Australian population and Aboriginal and Torres Strait Islander population will be prepared for the 2011 reference period, and will be published in 2016.

Note that the terms 'Indigenous Australians' and 'Indigenous population' have been used interchangeably throughout this report to refer to the Aboriginal and Torres Strait Islander population in Australia.

This report includes estimates and rankings for disease groups, by age and sex. Estimates for specific causes are not included in this report as the cause list and methods may be further refined before full estimates for 2011, including for specific causes, are published. Any changes to the cause list may result in changes to the number of deaths and patterns of YLL estimates by both disease group and specific cause. But the changes will be less apparent at the disease group level than at the finer specific cause level—which is why this report presents YLL estimates by disease group.

The importance of social determinants of health (such as income/poverty, education and employment) to both the health of the Aboriginal and Torres Strait Islander population, as well as to the health 'gap' and health inequalities between the Indigenous and non-Indigenous populations, is well recognised. In this report (see Chapter 5), results are disaggregated by a socioeconomic disadvantage as a way of showing disparities in Indigenous fatal burden across different social and economic groups. The importance of social determinants of health for Indigenous burden of disease (and for burden of disease analysis more broadly) will be discussed further in the forthcoming (2016) final report published from the ABDS on the burden of disease in the Indigenous population.

This report on the fatal burden of disease for Aboriginal and Torres Strait Islander people is structured as follows:

Chapter 2: Methods and data sources used to derive YLL estimates reported, including methods for redistributing causes of death, adjusting for Indigenous under-identification in mortality data and measuring the mortality gap.

Chapter 3: National estimates of the fatal burden (YLL) of disease and injury for Indigenous Australians by age group, sex and disease group.

Chapter 4: National estimates of the gap in the fatal burden of disease between Indigenous and non-Indigenous Australians by age group, sex and disease group.

Chapter 5: Sub-national estimates of Indigenous YLL and the gap for selected states and territories, by remoteness and by quintile of socioeconomic disadvantage.

Chapter 6: International comparisons of fatal burden (YLL) for the Aboriginal and Torres Strait Islander population in Australia and the Māori population in New Zealand from the recent New Zealand Burden of Diseases, Injuries and Risk Factors Study, 2006–2016.

The Appendixes in this report include more detailed information on various components of the methodology and data sources, including the standard life table, cause list, redistribution methods, methods used to adjust Indigenous deaths, and methods used to measure the gap between Indigenous and non-Indigenous Australians.

Supplementary tables used to support the analyses and figures presented in this report are provided under the 'Additional materials' tab for this report on the AIHW website <www.aihw.gov.au>.

2 Methods, data sources and data quality

A complete set of mortality data (by age, sex, Indigenous status and other key attributes, such as cause of death) and a standard life table are the key requirements for producing estimates of years of life lost (YLL).

This chapter summarises information on the data sources and methods used for estimating YLL presented in this report, including methods specific to estimating fatal burden of disease and injury for the Aboriginal and Torres Strait Islander population. Detailed information on data sources, methods and technical notes are included in the Appendixes of this report.

2.1 Years of life lost

YLL estimates measure the impact of dying prematurely; that is, the fatal component of burden of disease. A critical step for estimating YLL is to first compile the total number of deaths in a specific year, by age and sex. Each death record is then weighted according to the remaining life expectancy at that age of death, which is derived from the standard life table used (see 'Standard life table' in Section 2.2 below). The weighted deaths are summed and the result is the total number of YLL from all deaths.

YLL = *number of deaths* × *remaining life expectancy at the age of death* (according to the standard life table)

The calculation of YLL in this report used deaths tabulated by single year of age at death and a terminal age of 104 years (which was the oldest age of death recorded for Indigenous Australians in mortality data for the reference period of this study).

2.2 Data sources and inputs

Deaths data

Analysis of burden of disease takes into account all deaths that occur in a population during a specified period. This report provides YLL estimates for the reference period 2010. It is based on the annual average number of deaths that occurred over the 2009–2011 period.

Mortality data come from the AIHW's National Mortality Database. This database comprises information about the causes of death for, and other characteristics of, individuals who have died, such as sex, age at death, Indigenous status and area of usual residence. The cause-of-death data are sourced from the Registrars of Births, Deaths and Marriages in each state and territory and the National Coronial Information System, and are coded to the WHO's International Classification of Diseases (ICD) by the Australian Bureau of Statistics (ABS).

Indigenous deaths from all states and territories are included in national burden of disease estimates presented in this report, adjusted for Indigenous under-identification in mortality data (see 'Adjusting Indigenous deaths for under-identification' in Section 2.4).

For more information on deaths data and the National Mortality Database, see Appendix B.

Population data

Aboriginal and Torres Strait Islander population estimates as at 30 June 2009, 2010 and 2011 (based on the 2011 Census), were used to calculate Indigenous YLL rates presented in this report. Non-Indigenous population estimates were calculated by subtracting the Aboriginal and Torres Strait Islander population estimates from the total Australian population estimates for the same years.

For the calculation of Indigenous YLL rates by remoteness, experimental Indigenous population estimates calculated by the AIHW were used (for 5 remoteness categories, by 5-year age group and sex, as at 30 June 2009, 2010 and 2011). These estimates were calculated based on the ABS's 2011 Census Estimated Resident Population (ERP) for the Aboriginal and Torres Strait Islander population. The ABS has released the 2011 ERP for the Indigenous population for only 3 remoteness categories (*Major cities*, *Inner/Outer regional* combined, and *Remote/Very remote* combined)—therefore these data could not be used to calculate Indigenous YLL rates for the 5 remoteness categories individually.

For the calculation of Indigenous YLL rates by socioeconomic disadvantage, the 2011 Aboriginal and Torres Strait Islander Estimated Resident Population (ERP) at the Statistical Area 2 (SA2) level was used.

For the calculation of age-standardised YLL rates, the Australian Estimated Residential Population as at 30 June 2001 (based on the 2001 Census) was used as the standard population (current standard in Australia).

Standard life table

The standard life table is a key component of burden of disease studies. A standard life table corresponds to the aspirational or maximum life span for an individual in good health—it is not necessarily the actual life table of the population being studied. It is used to produce estimates of life expectancy at each age to indicate the number of years of life that are lost from dying at a specific age.

A standard life table is used to enable comparisons between population groups and across time. The ABDS uses the standard life table used in GBD 2010 (Murray et al. 2012) in calculating YLL. This life table is used for both national and Indigenous estimates to maintain comparability. The GBD 2010 standard life table is based on the lowest observed age-specific death rates, capturing mortality patterns in all countries except those with very small populations, and covering all age ranges. The result is a hypothetical life table giving life expectancy at birth to be 86.0 years for both males and females. This is higher than the estimated life expectancy at birth for Indigenous Australians in 2010–2012 (that is, 69.1 and 73.7 years for Indigenous males and females, respectively).

(See Appendix B for more information on the standard life table, comparisons of different standard life tables used in global and previous Australian studies, and analysis of the impact of using these different standard life tables on resulting Indigenous YLL.)

Index of socioeconomic disadvantage

The 2011 Indigenous Relative Socioeconomic Outcomes (IRSEO) index was used in this report to examine variation in the fatal burden of disease for the Indigenous population by level of socioeconomic disadvantage (Biddle 2013). The index incorporates nine variables from the 2011 Census of Population and Housing that measure employment, occupation, education, income and housing. The IRSEO index was originally calculated at the Indigenous Area level (following the ABS's Australian Statistical Geography Standard) and has been converted to Statistical Area Level 2 (SA2) using a population-weighted concordance.

The IRSEO index is considered to be more suitable for use for the Indigenous population than traditional measures of socioeconomic disadvantage used in Australia such as the Socio-Economic Indexes for Areas (SEIFA). SEIFA scores for each geographical unit are calculated based on the socioeconomic characteristics of the entire population and thus they may not accurately reflect levels of socioeconomic disadvantage in the Indigenous population.

Indigenous population numbers by SA2 and age group are needed to calculate age-standardised YLL rates by socioeconomic disadvantage. However, these numbers were not available to the AIHW at the time of writing this report. As a result, only crude YLL rates are presented.

Despite these difficulties, it is still possible to examine differences in the general pattern and variation by socioeconomic disadvantage in the fatal burden of disease for the two population groups. A non-Indigenous specific index of socioeconomic outcomes has been developed by Biddle (2013) which has been used to calculate crude YLL rates by socioeconomic disadvantage for the non-Indigenous population. The 2011 re-scaled Pooled Non-Indigenous Relative Socioeconomic Outcomes index (PNIRSEO) uses a ranking for the socioeconomic disadvantage of non-Indigenous Australians in each Indigenous Area, which is then converted to SA2 values using population weighted concordances (Biddle 2013). While not directly comparable to the IRSEO Index, it enables an examination of variation in fatal burden by socioeconomic advantage in the non-Indigenous population.

See Appendix C for more information on the various socioeconomic disadvantage indexes available and the rationale for those used in this report to examine socioeconomic disparities within the Indigenous population, as well as comparisons with the non-Indigenous population.

Cause list

All deaths, regardless of their causes, are counted when estimating fatal burden. The cause list details the specific diseases and injuries for which estimates of the number of YLL, YLD and DALYs will be made. The cause list is a classification which, in principle, is a set of mutually exclusive and collectively exhaustive categories of disease and injury.

An Australian cause list was developed specifically for this report, with disease and cause groups being tailored to meet Australian and Indigenous health policy needs, and fit with the current health monitoring environment.

The resulting cause list is hierarchical and has two levels. The highest level contains 17 disease groups under which around 175 causes are classified. This report presents YLL estimates by disease group rather than by cause. A list of disease groups can be found in Appendix D (Table D.1), including short labels for each disease group (e.g. 'Cancer' for 'Cancer and other neoplasms') which are used in some parts of this report.

Consistent with previous burden of disease studies, the ABDS used the underlying cause of death (UCOD) to classify each death to a cause in the cause list. Use of the UCOD as the sole source of cause of death information assigns the entire fatal burden for each death to a single cause. This does not explicitly account for situations where more than one disease contributed to the death. Further development work may be undertaken to assess the use of associated causes of death or other information to account for this more complex situation.

More information about the cause list is provided in Appendix D.

2.3 Methods for redistribution of deaths

There are several ICD-10 codes that are not valid or appropriate causes of death for burden of disease analysis. Some examples are:

- causes that can be considered as implausible as the underlying cause of death, such as hypertension and paraplegia
- intermediate causes: casuses that have a precipitating cause such as septicaemia and pneumonitis
- immediate causes of death that occur in the final stages of dying, such as cardiac arrest and respiratory failure
- causes that are ill-defined or unspecified; for example, ill-defined digestive cancer and ill-defined digestive diseases.

Despite their high quality, the Australian deaths data are affected by these codes.

To quantify their contribution to the fatal burden, deaths coded to these codes must be reallocated to one or more of the conditions defined on the cause list (target causes) according to what would be a more probable underlying cause. This process is referred to as 'redistribution'.

Some simple redistribution methods were applied in the previous Australian burden of disease studies; these methods were further developed for GBD 2010, and in some cases were used in calculating YLL estimates.

The AIHW recently investigated four redistribution algorithms based on, respectively, direct evidence, direct multiple causes of death (MCOD) analysis, indirect MCOD analysis, and proportionate allocation. Three of these methods (the exception being direct MCOD analysis) have been used to redistribute both Indigenous and non-Indigenous deaths in the ABDS. Using the three redistribution methods for the Australian redistribution causes (Appendix Table D.4), approximately 8% of Indigenous deaths and 10% of all Australian deaths were identified for redistribution. This compares with 18% of Australian deaths that were identified for redistribution using GBD 2010 methods. The difference is largely due to the cause list: some of the causes of death that were redistributed in GBD 2010 were directly allocated to a cause in the ABDS.

A detailed description of these redistribution methods, their application to Indigenous deaths, and the impact on resulting YLL, is provided in Appendix D.

2.4 Methods specific to Indigenous fatal burden estimates

Adjusting Indigenous deaths for under-identification

Over the last decade, a number of studies have been undertaken aimed at improving the quality of Indigenous status information in Australian health and vital statistics collections. Under the National Indigenous Reform Agreement, the ABS has made improvements to Indigenous enumeration procedures for the Census, and the AIHW has published best practice guidelines for the collection of Indigenous status in health data collections (AIHW 2010). States and territories agreed to improve the collection of Indigenous status information in key health data sets, including through implementing the best practice guidelines, and adopting the standard Indigenous status question and recording categories in health data collection and information systems (COAG 2008).

Despite these improvements, limitations still remain with the quality of Indigenous status data. Every year, a number of deaths of Aboriginal and Torres Strait Islander people are not identified as such when they are registered (ABS 2013c). This may arise from the non-reporting of a deceased person's Indigenous status on the death registration form, or from incorrect identification of a deceased person's Indigenous status (recording a person as non-Indigenous when they are Indigenous, and vice versa). The degree of under-identification can vary by age, state/territory, remoteness and over time. This under-identification means the number of deaths recorded as Indigenous is an underestimate of the true levels of mortality in that population, and consequently is also an underestimate of the mortality gap between Indigenous and non-Indigenous Australians.

Since the last Indigenous Australian burden of disease study, the AIHW and ABS have made advances in the assessment of under-identification in mortality data using data linkage methods. The ABS's Census Data Enhancement Indigenous Mortality Study (2011–12) linked Census records with death registration records. The AIHW's Enhanced Mortality Database project (2008–2010) linked registered deaths with Indigenous death records from administrative data sources including residential aged care data, hospital data and perinatal data. Both of these studies produced mortality correction factors that can be used to adjust for Indigenous under-identification in Australian mortality data.

The ABS and AIHW data linkage studies have strengths and weaknesses (see Appendix E). While both studies calculate age-specific adjustment factors at the national level, adjustment factors produced by state/territory and remoteness do not include an age adjustment (due to small numbers). In addition, both studies do not include cause-of-death information or socioeconomic data items, and thus were not able to yield adjustment factors by cause of death or socioeconomic disadvantage.

The AIHW study produced adjustment factors for all 8 states and territories and 5 remoteness categories; the ABS study produced state/territory adjustment factors for New South Wales, Queensland, Western Australia and the Northern Territory individually, and a combined adjustment factor for the other four jurisdictions (Victoria, South Australia, Tasmania and the Australian Capital Territory). Remoteness adjustment factors from the ABS study are only available for 2 combined categories: *Major cities/Inner regional* combined, and *Outer regional/Remote/Very remote* combined.

Based on advice from the Indigenous Reference Group (IRG) and the ABS, adjustment factors from the 2011–12 ABS Census Data Enhancement Indigenous Mortality Study have been used to adjust Indigenous deaths for the calculation of YLL estimates presented in this report, with the exception of YLL estimates by remoteness, which are based on adjustment factors from the AIHW's Enhanced Mortality Database study (2008–10).

The ABS national and state/territory adjustment factors were chosen as they take into account under-identification in both mortality data and population data, and therefore, in theory, provide consistency in the numerator and denominator used in Indigenous YLL calculations. The ABS adjustment factors are also the official estimates of Indigenous mortality coverage in Australia. Furthermore, sensitivity analyses undertaken by the AIHW looking at the impact of using the different adjustment factors available (ABS compared to AIHW) on the resulting Indigenous YLL estimates and measures of the gap showed that at the national level, the age patterns and disease rankings remained consistent using either set of adjustment factors (see Appendix E for more detail).

AIHW remoteness adjustment factors have been used to calculate YLL estimates by remoteness due to a number of limitations with the ABS remoteness adjustment factors. The ABS combined adjustment factors for *Major cities*/*Inner regional* and *Outer regional/Remote/Very remote* are not considered useful to policymakers for examining mortality disparities by remoteness, given the wide variation between the five remoteness categories, and because the chosen groupings of remoteness (in particular, the combining of *Outer regional* with *Remote* and *Very remote*) mask any mortality disparities by remoteness—they do not follow the typical categories of non-remote and remote.

It is important to note that YLL estimates by remoteness presented in Section 5.2 of this report are not comparable to YLL estimates presented in other sections. This is because the former have been adjusted using factors from the AIHW Enhanced Mortality Database study, while the latter were adjusted using factors from the ABS CDE Indigenous Mortality Study. Total numbers of adjusted deaths and YLL should be sourced from tables for national results which are based on the ABS adjustment factors.

State and territory Indigenous YLL estimates are not presented for Victoria, South Australia, Tasmania or the Australian Capital Territory, due to the small number of Indigenous deaths reported for these jurisdictions, and because individual state/territory adjustment factors are not available from the ABS for these states and territories. In addition, use of the ABS combined adjustment factor for these states and territories results in an implausibly high Indigenous YLL estimate for the four jurisdictions combined, and disaggregation of the combined adjustment factor to produce individual jurisdictional estimates also produces somewhat implausible YLL results.

Despite the attempt to remove bias in YLL results through adjustments made to Indigenous deaths, there is still a degree of uncertainty around the true level of mortality among Indigenous Australians. The adjustments themselves inherently introduce a degree of uncertainty. A long-term strategy to improve Indigenous mortality estimates is through improvements to the data at the collection phase so that fewer adjustments will be necessary for Indigenous mortality reporting in the future.

Further information about the methods used to adjust Indigenous deaths for under-identification in this report, including the adjustment factors used and sensitivity analyses undertaken by the AIHW to inform the choice of adjustment factors for this study, can be found in Appendix E.

Measuring the mortality gap between Indigenous and non-Indigenous Australians

There is strong interest in measuring the health 'gap' between Indigenous and non-Indigenous Australians for the ABDS, given the gap in the life expectancy between these two populations. As a general principle, in the ABDS, the methods used to produce Indigenous burden-of-disease estimates will be as consistent and comparable as possible with the methods used to produce national estimates. For fatal BoD estimates, as presented in this report, the same data source, methods and years of data have been used for both the Indigenous and total populations. The only difference is in the reporting age groups presented for YLL.

For the most accurate estimation of the gap, comparisons should be made with the non-Indigenous population rather than the total Australian population (which includes the Indigenous population). Consequently, for the ABDS, estimates of fatal and non-fatal burden will be calculated where possible for the Indigenous and non-Indigenous populations separately. This report presents preliminary results for the gap in fatal burden between Indigenous and non-Indigenous Australians at the disease group level.

As the Indigenous population has a younger age profile than the non-Indigenous population, YLL rates must be age-standardised to adjust for differences in age structure between the two populations being compared. The YLL gap has been measured using direct age-standardisation, which applies the age-specific YLL rates of the Indigenous and non-Indigenous populations to the current Australian standard population (the Australian Estimated Residential Population as at 30 June 2001, based on the 2001 Census). The direct method has been used as it enables multiple comparisons (for example, cause by sex or cause by state/territory) and can be used for time series analyses. A limitation of this method is that the direct method can become less stable when based on a small number of deaths and consequently produce less reliable results—this should be kept in mind when interpreting gap results for less common causes of death.

For reporting of the gap in YLL between the Indigenous and non-Indigenous populations, rate differences, as well as 'rate ratios' (based on directly age-standardised rates), are presented. Rate differences provide a measure of the absolute gap (or difference) between two populations, while rate ratios take scale into account and are a measure of the relative gap (or difference) between two population groups. Both measures are considered useful when examining health inequalities because they provide different information—rate differences tell us which leading causes of the gap should be targeted in order to reduce the overall mortality gap, whereas rate ratios tell us which causes have the greatest relative disparities between the Indigenous and non-Indigenous populations.

The primary statistics presented in this report on the leading causes of the mortality gap are therefore based on rate differences (using the measure of percentage contribution of each disease to the total rate difference). In addition, information is presented on the diseases with the highest rate ratios, representing the largest relative disparities in fatal burden between the Indigenous and non-Indigenous populations. When interpreting results, please note that a large rate ratio does not necessarily imply that a disease has a large absolute impact. Diseases that are rare in one population can produce large rate ratios in the comparative population, irrespective of the level of mortality.

More information about the methods used to measure the gap for YLL estimates presented in this report can be found in Appendix F.

Overcoming small numbers

An important consideration for Indigenous burden of disease is the robustness and reliability of estimates produced, and the level of disaggregation that the data will support given the small size of the Indigenous population and consequently the relatively small raw number of Indigenous deaths each year compared with the very much larger non-Indigenous population. To ensure validity of the results, the AIHW has aggregated several years of mortality data, age groups, and disease groups in producing Indigenous YLL estimates. In some cases the level of disaggregation used to report Indigenous estimates is broader than that reported for the total Australian population. This is discussed further below.

Combining years of deaths data

The number of deaths due to any particular cause varies from year to year. These fluctuations are more noticeable for causes that are less common and in Indigenous deaths that are often small in number. To reduce the impact of random fluctuations, three years of deaths data were summed, then divided by three, to produce average annual YLL estimates.

This provides greater stability in Indigenous estimates of YLL and rates for:

- causes of death that are rare
- causes that occur episodically
- reporting at disaggregated levels (for example, by the level of cause group, and for sub-national estimates).

Mortality and YLL estimates presented in this report are based on deaths that occurred from 2009 to 2011.

Reporting age groups

The standard reporting age groups used for reporting Indigenous YLL estimates at the disease group level in this report are: less than 1; 1–14; 15–24; 25–34; 35–44; 45–54; 55–64; 65–74; and 75 and over. These age groups are slightly different to those reported for the total Australian population (where the 1–14 group is split into 1–4 and 5–14, and the highest age group is 85 and over) in order to minimise the number of small cells. However, where numbers support the use of more detailed age groups (such as figures presenting total YLL rather than YLL by disease group), Indigenous YLL estimates are reported using the same age groups as reported for the total Australian population.

Reporting disease groups

Of the 17 disease groups included in the Australian cause list, 14 disease groups are reported separately, and the remaining 3 disease groups (reproductive and maternal conditions, sense organ disorders and oral disorders) have been combined under 'other disease groups' due to the small number of deaths reported for these diseases. For sub-national estimates, only the top 10 disease groups are presented in most figures and tables due to small numbers.

3 National results: Indigenous YLL

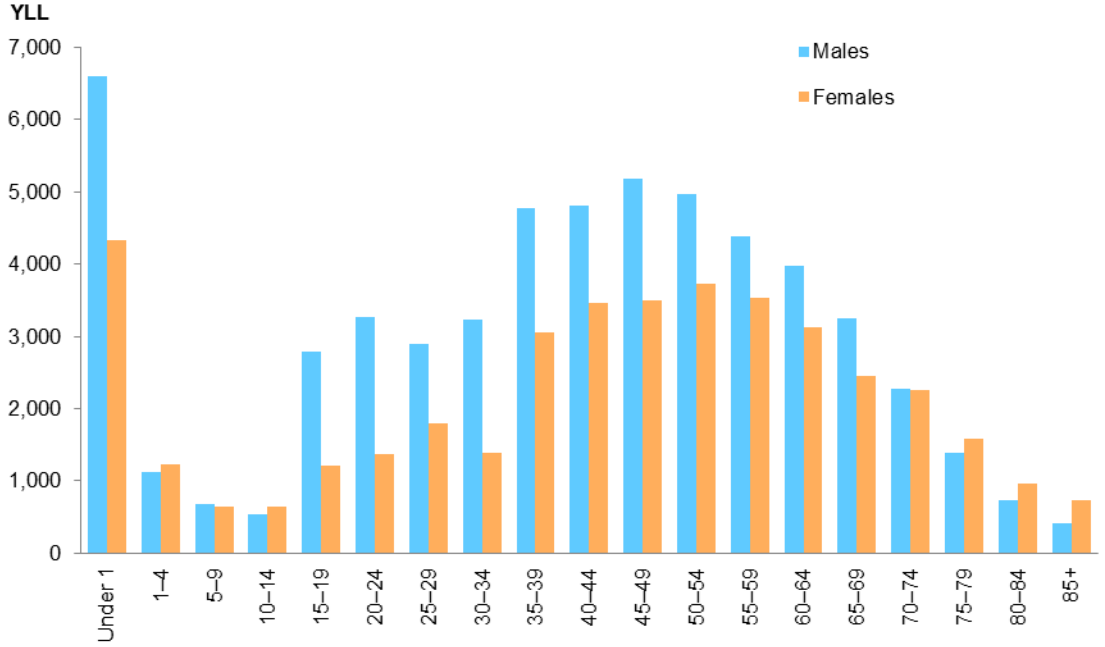
This chapter presents YLL estimates for the Aboriginal and Torres Strait Islander population for the reference year 2010 (based on the average annual number of deaths for the 3-year period 2009–2011). Comparisons with the non-Indigenous population are primarily included in Chapter 4. National estimates presented in this chapter include deaths from all states and territories and have been adjusted to account for Indigenous under-identification in mortality data (see Appendix E for further information).

3.1 Overall Indigenous fatal burden by age and sex

- In 2010, there were 2,950 deaths of Aboriginal and Torres Strait Islander people in Australia (after adjustment for Indigenous under-identification in mortality data). This resulted in a total of around 98,282 YLL; that is, the total fatal burden experienced from premature death.
- Indigenous males experienced the majority of the total fatal burden (58%), equating to 57,259 YLL, compared with 41,024 YLL for Indigenous females. This reflects both the higher number of deaths of Indigenous males compared to Indigenous females, and also the fact that Indigenous males tend to die at younger ages than Indigenous females, thus resulting in more years of life lost due to premature mortality.

Fatal burden also differs across age groups, being influenced by both the number of deaths and life expectancy (in the standard life table) at that age. Analysis of the number and proportion of YLL for the Indigenous population by age group (Figure 3.1) shows that:

- Deaths in infants (under 1 year) contributed the largest number of YLL for the Indigenous population (12% of total male YLL and 11% of total female YLL). This reflects the relatively high number of deaths occurring in infancy—which incur the largest number of potential years of life lost.
- After infancy, a considerable component of the fatal burden in the Indigenous population is experienced in the middle-aged, also due to the high number of deaths occurring in these ages. YLL was highest for Indigenous males aged 45–49 (5,187 YLL) and for Indigenous females aged 50–54 (3,736 YLL).
- This pattern is quite different to that observed in the total Australian population, in which there is a general increase in the number of YLL with increasing age (to around 84 years) (AIHW 2015). Despite the years of life remaining at older ages being smaller than at younger ages, this increase is due to the much higher number of deaths occurring in the older ages in the non-Indigenous population, giving rise to the greater fatal burden in the older age groups.
- Overall, these patterns in YLL by age group drive observed differences in life expectancy between Indigenous and non-Indigenous Australians (that is, Aboriginal and Torres Strait Islander people tend to die at much younger ages than non-Indigenous Australians).



Notes

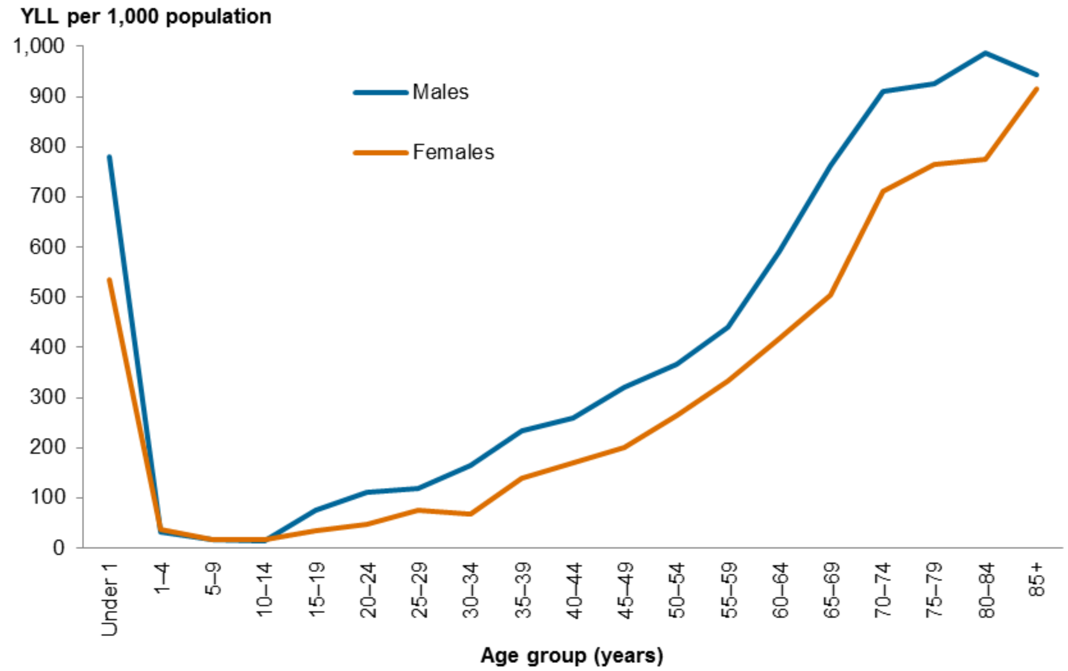
1. This figure is based on data in a supplementary table available online—Table S3.1.
2. YLL for 2010 is the annual average of 2009–2011. Deaths have been adjusted using ABS adjustment factors (see Appendix E).

Source: AIHW analysis of the AIHW National Mortality Database.

Figure 3.1: YLL for Indigenous Australians, by age and sex, 2010

Figure 3.2 shows the YLL rates for Indigenous males and females; that is the YLL per 1,000 population in each age-sex group. With the exception of infants (mentioned below), it predominantly shows that from age 10–14, YLL rates generally increased with age. In particular:

- The YLL rate among Indigenous infants was high (781 per 1,000 population for males and 534 per 1,000 for females), consistent with the relatively high number of deaths in this age group.
- For Indigenous males, the rate of fatal burden increased steadily to ages 80–84 where it peaked at 988 YLL per 1,000 population.
- For Indigenous females, the rate of fatal burden was consistently lower than the rate for Indigenous males except between the ages of 1 and 14. The YLL rate for Indigenous females increased with age, peaking at 916 YLL per 1,000 population for those aged 85 and over. The small number of Indigenous deaths occurring in those aged 75 and over may make estimates for these older age groups less reliable.



Notes

1. This figure is based on data in a supplementary table available online—Table S3.1.
2. YLL for 2010 is the annual average of 2009–2011. Deaths have been adjusted using ABS adjustment factors (see Appendix E).

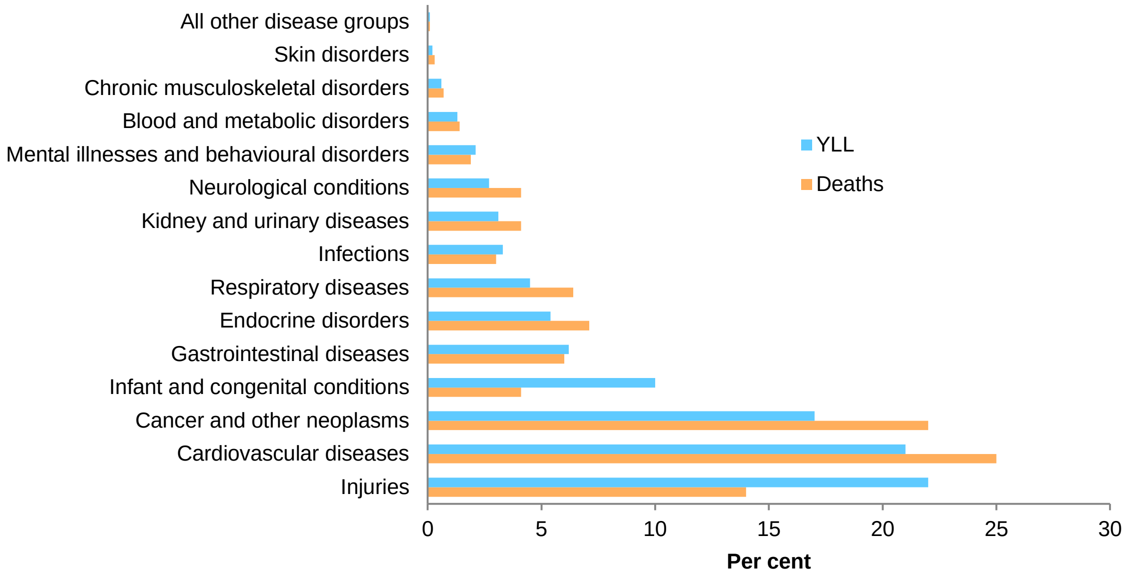
Source: AIHW analysis of the AIHW National Mortality Database.

Figure 3.2: Age-specific rates of YLL for Indigenous Australians, by age and sex, 2010

3.2 Indigenous fatal burden by disease group

Analysis of YLL for the Indigenous population by disease group for 2010 (Figure 3.3 and Table 3.2) shows that:

- Injuries and cardiovascular diseases contributed most to the fatal burden for Indigenous Australians in 2010 (22% and 21% of YLL respectively). These were followed by cancer (17%), infant and congenital conditions (10%), gastrointestinal diseases (6%) and endocrine disorders (5%). These disease groups accounted for 82% of all YLL in 2010.
- These results differ when the contribution of each disease group is examined by number of deaths alone. The highest number and proportion of deaths were due to cardiovascular diseases (25%), followed by cancer (22%) and injuries (14%). This reflects the fact that individuals largely die from injuries at a young age.



Notes

1. This figure is based on data in Table 3.2.
2. YLL for 2010 is the annual average of 2009–2011. Deaths have been adjusted using ABS adjustment factors (see Appendix E).

Source: AIHW analysis of the AIHW National Mortality Database.

Figure 3.3: Proportion of deaths and YLL for Indigenous Australians, by disease group, 2010

3.3 Do the leading causes of fatal burden differ by sex?

- In 2010, for most disease groups, Indigenous males experienced a greater share of fatal burden (YLL) than Indigenous females (Table 3.1).
- Indigenous males contributed to 70% of the total fatal burden due to injuries and 65% of the fatal burden due to mental illnesses and behavioural disorders.
- Indigenous females contributed more of the fatal burden than Indigenous males for chronic musculoskeletal disorders (66%) and kidney and urinary disease (57%).

Table 3.1: Number and proportion of YLL for Indigenous Australians, by disease group and sex, 2010

	Males		Females		Persons	
Disease group	**Number**	**Per cent**	**Number**	**Per cent**	**Number**	**Per cent**
Injuries	15,129	69.8	6,558	30.2	21,687	100.0
Cardiovascular diseases	12,366	60.1	8,208	39.9	20,574	100.0
Cancer and other neoplasms	8,540	50.4	8,420	49.6	16,960	100.0
Infant and congenital conditions	5,853	57.9	4,264	42.1	10,117	100.0
Gastrointestinal diseases	3,372	55.8	2,673	44.2	6,045	100.0
Endocrine disorders	2,601	49.1	2,695	50.9	5,295	100.0
Respiratory diseases	2,225	50.0	2,223	50.0	4,448	100.0
Infections	2,019	62.3	1,224	37.7	3,243	100.0
Kidney and urinary diseases	1,315	43.4	1,713	56.6	3,029	100.0
Neurological conditions	1,492	55.6	1,192	44.4	2,684	100.0
Mental illnesses and behavioural disorders	1,359	64.8	737	35.2	2,096	100.0
Blood and metabolic disorders	665	54.0	566	46.0	1,231	100.0
Chronic musculoskeletal disorders	196	34.4	374	65.7	569	100.0
Skin disorders	113	55.4	92	45.1	204	100.0
All other disease groups	16	15.8	85	84.2	101	100.0
All diseases	**57,259**	**58.3**	**41,024**	**41.7**	**98,282**	**100.0**

Notes

1. YLL for 2010 are the annual average of 2009–2011 and are adjusted using ABS adjustment factors (see Appendix E).
2. The numbers may not add to totals for all diseases due to rounding.

Source: AIHW analysis of the AIHW National Mortality Database.

In terms of the ranking of disease groups contributing the most to Indigenous YLL in 2010 (Table 3.2):

- For Indigenous males, injuries contributed most to the fatal burden (26%), followed by cardiovascular diseases (22%) and cancer (15%).
- The same three disease groups were also the largest contributors to the fatal burden for Indigenous females, although ranked differently. For females, cancer ranked first and contributed 21% to the total fatal burden, followed by cardiovascular diseases (20%) and injuries (16%).
- Injuries contributed a much higher proportion of YLL for Indigenous males compared to Indigenous females (26% compared to 16%), while cancer contributed a much higher proportion of YLL for Indigenous females (21% compared to 15% for Indigenous males).
- The proportions of YLL for Indigenous males and females were similar for most other disease groups.

Table 3.2: Number and proportion of deaths and YLL for Indigenous Australians, by disease group and sex, 2010

	Males				Females				Persons			
	Deaths		YLL		Deaths		YLL		Deaths		YLL	
Disease group	**Number**	**Per cent**	**Number**	**Per cent**	**Number**	**Per cent**	**Number**	**Per cent**	**Number**	**Per cent**	**Number**	**Per cent**
Injuries	280	17.4	15,129	26.4	124	9.2	6,558	16.0	404	13.7	21,687	22.1
Cardiovascular diseases	419	26.0	12,366	21.6	328	24.4	8,208	20.0	746	25.3	20,574	20.9
Cancer and other neoplasms	333	20.7	8,540	14.9	313	23.3	8,420	20.5	646	21.9	16,960	17.3
Infant and congenital conditions	70	4.3	5,853	10.2	51	3.8	4,264	10.4	121	4.1	10,117	10.3
Gastrointestinal diseases	96	6.0	3,372	5.9	82	6.1	2,673	6.5	178	6.0	6,045	6.2
Endocrine disorders	98	6.1	2,601	4.5	110	8.2	2,695	6.6	208	7.1	5,295	5.4
Respiratory diseases	91	5.7	2,225	3.9	99	7.4	2,223	5.4	190	6.4	4,448	4.5
Infections	50	3.1	2,019	3.5	38	2.8	1,224	3.0	88	3.0	3,243	3.3
Kidney and urinary diseases	48	3.0	1,315	2.3	72	5.4	1,713	4.2	120	4.1	3,029	3.1
Neurological conditions	54	3.3	1,492	2.6	68	5.1	1,192	2.9	122	4.1	2,684	2.7
Mental illnesses and behavioural disorders	36	2.3	1,359	2.4	19	1.4	737	1.8	55	1.9	2,096	2.1
Blood and metabolic disorders	23	1.4	665	1.2	19	1.4	566	1.4	42	1.4	1,231	1.3
Chronic musculoskeletal disorders	7	0.4	196	0.3	13	1.0	374	0.9	21	0.7	569	0.6
Skin disorders	4	0.2	113	0.2	4	0.3	92	0.2	8	0.3	204	0.2
All other disease groups	<3	<0.1	16	<0.1	<3	<0.1	85	0.2	<3	<0.1	101	0.1
All diseases	**1,608**	**100.0**	**57,259**	**100.0**	**1,342**	**100.0**	**41,024**	**100.0**	**2,950**	**100.0**	**98,282**	**100.0**

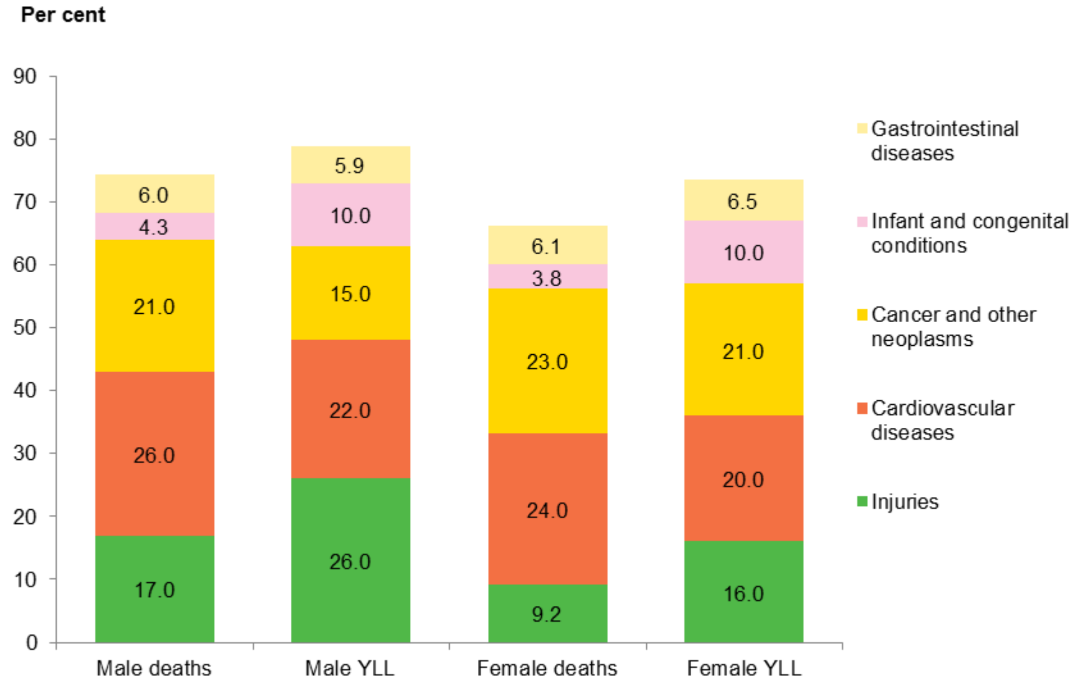
Notes

1. Number of deaths and YLL for 2010 are the annual average of 2009–2011, and are adjusted using ABS adjustment factors (see Appendix E).
2. The numbers may not add to totals for all diseases due to rounding.
3. At the time of writing this report AIHW guidelines, to ensure confidentiality, required the suppression of cells based on less than three deaths. In this table these cells are represented by <3.

Source: AIHW analysis of the AIHW National Mortality Database.

As we saw in section 3.2, the proportion of deaths due to a disease group may not always equate to the proportion of YLL caused by the disease group. This reflects the influence of age at death on the measure of fatal burden—deaths at young ages contribute more years of life lost per death. Differences between proportion of Indigenous YLL and proportion of Indigenous deaths are shown in Figure 3.4 for the five leading causes of fatal burden in the Indigenous population. In particular:

- Deaths due to infant and congenital conditions contributed a substantial proportion of Indigenous YLL (10% for both males and females), however, they made up only 4% of Indigenous male and female deaths.
- Similarly, while 26% of YLL for Indigenous males and 16% of YLL for Indigenous females were due to injuries, they only accounted for 17% and 9% of deaths respectively.



Notes

1. This figure is based on data in Table 3.2.
2. YLL for 2010 is the annual average of 2009–2011. Deaths have been adjusted using ABS adjustment factors (see Appendix E).

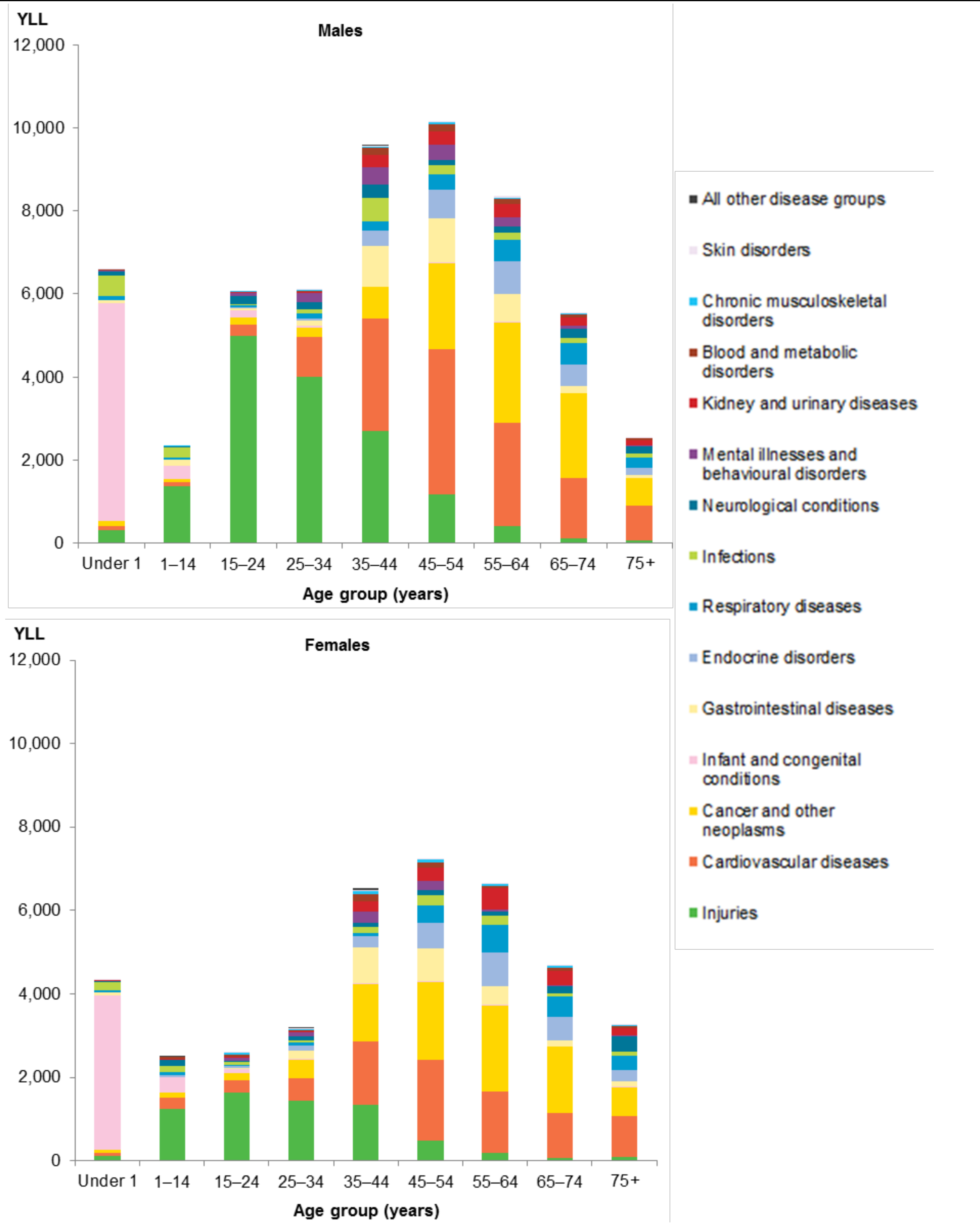
Source: AIHW analysis of the AIHW National Mortality Database.

Figure 3.4: Proportion of deaths and YLL for top five disease groups (as ranked by Indigenous male YLL), Indigenous Australians, by sex, 2010

3.4 Do the leading causes of fatal burden differ by age group?

This section presents the number, proportion and ranking of Indigenous YLL by disease group and age group in 2010 (figures 3.5 to 3.8).

- The disease group contributing the majority of fatal burden among Indigenous infants (aged less than 1 year) was infant and congenital conditions (which includes causes such as pre-term birth complications, birth trauma and congenital defects). This disease group was also the second leading contributor to fatal burden among Indigenous Australians aged 1–14.
- The leading cause of fatal burden among Indigenous males and females aged 1–34 was injuries. Injuries was also a leading cause of YLL among Indigenous males aged 35–44 (contributing a similar proportion of YLL as cardiovascular diseases in this age group).
- Cardiovascular diseases contributed the most YLL among Indigenous males aged 35–64 and Indigenous females aged 35–54.
- Cancer and other neoplasms was the leading cause of fatal burden among Indigenous males aged 65–74 and Indigenous females aged 55–74.
- Endocrine disorders were in the top 5 causes of fatal burden for Indigenous males and females aged 45 and over.
- For Indigenous females, kidney and urinary conditions were in the top 5 conditions for those aged 55–74.
- Mental and behavioural disorders featured in the top 5 leading causes of fatal burden for Indigenous males aged 25–34 and Indigenous females aged 35–44. However, these rankings are based on a relatively small number of Indigenous deaths (less than 10).
- The conditions ranked highly for fatal burden were broadly similar for both Indigenous and non-Indigenous Australians in all age groups; however there were some differences in the top rankings for the 35–64 age groups. While cardiovascular diseases was the leading contributor to fatal burden among Indigenous males and females aged 35–54, cancer was the leading contributor for non-Indigenous females aged 35–54 and non-Indigenous males aged 45–54, with injuries the leading contributor for non-Indigenous males aged 35–44. Kidney and urinary diseases were ranked fifth for Indigenous females aged 55–74, but were not apparent in the top five for non-Indigenous women in this age range (see supplementary tables online—tables S3.8 and S3.9).

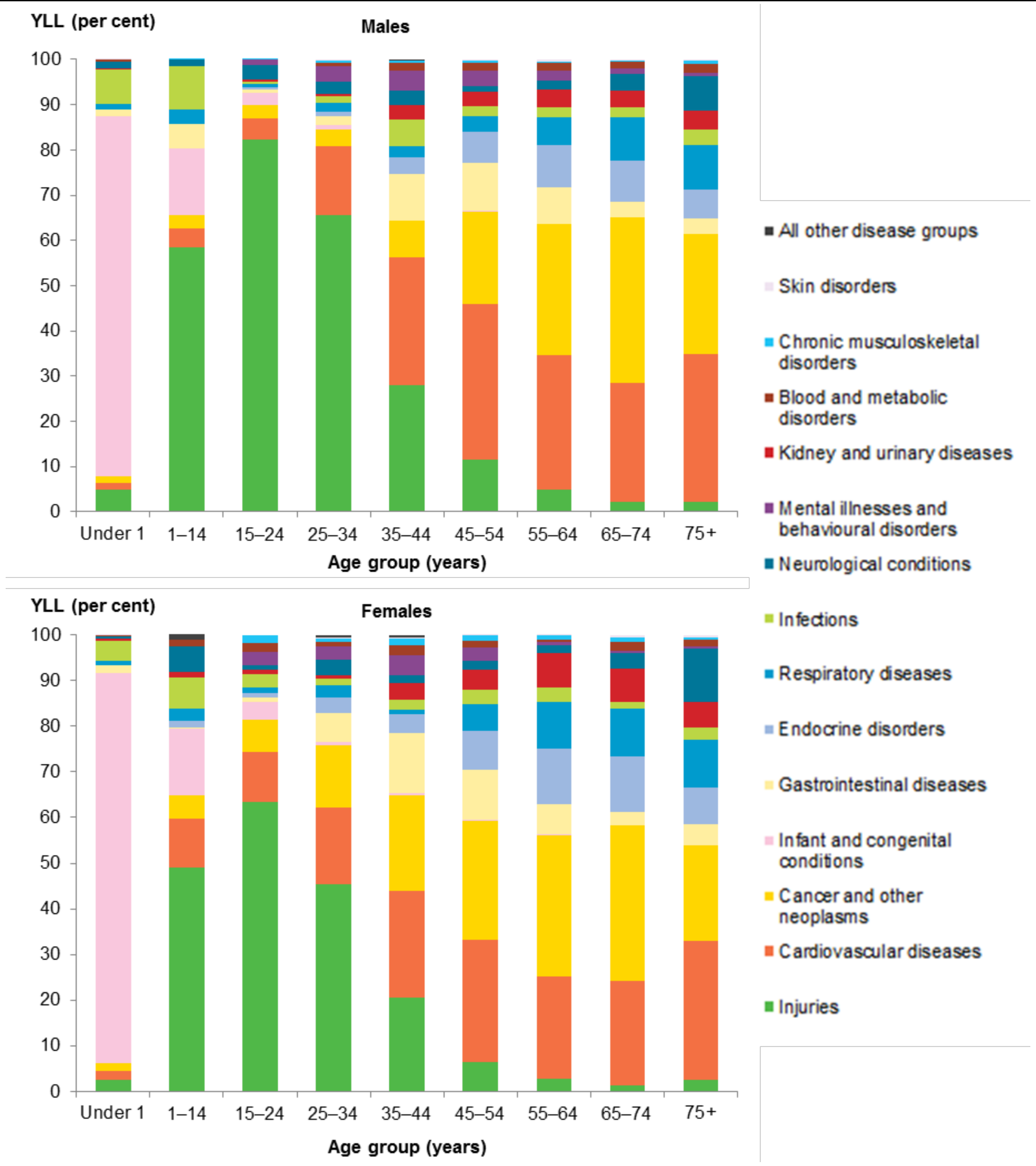


Notes

1. This figure is based on data in supplementary tables available online—tables S3.2 and S3.3.
2. YLL for 2010 is the annual average of 2009–2011. Deaths have been adjusted using ABS adjustment factors (see Appendix E).

Source: AIHW analysis of the AIHW National Mortality Database.

Figure 3.5: YLL for Indigenous Australians, by age, disease group and sex, 2010

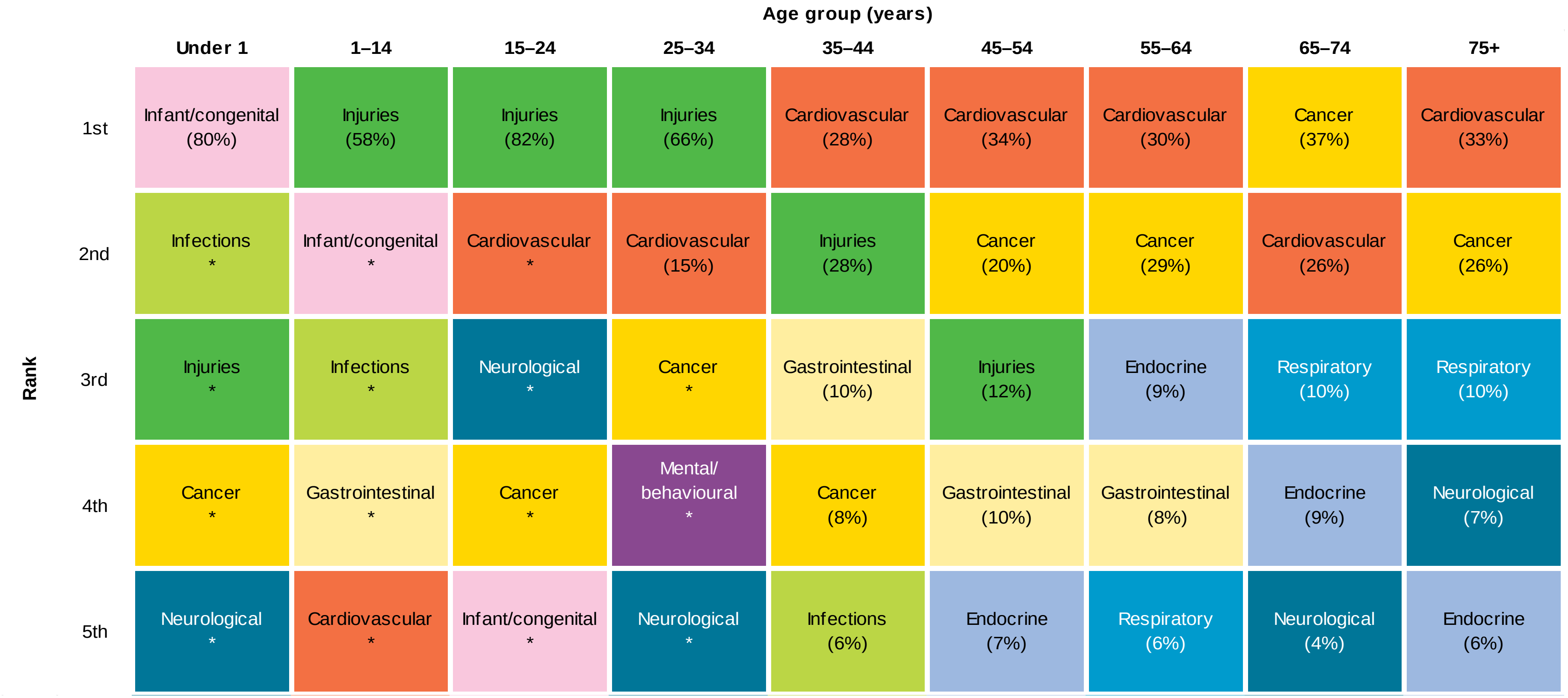


Notes

1. This figure is based on data in supplementary tables available online—tables S3.4 and S3.5.
2. YLL for 2010 is the annual average of 2009–2011. Deaths have been adjusted using ABS adjustment factors (see Appendix E).

Source: AIHW analysis of the AIHW National Mortality Database.

Figure 3.6: Proportion of YLL for Indigenous Australians, by age, disease group and sex, 2010



Rank	Under 1	1–14	15–24	25–34	35–44	45–54	55–64	65–74	75+
1st	Infant/congenital (80%)	Injuries (58%)	Injuries (82%)	Injuries (66%)	Cardiovascular (28%)	Cardiovascular (34%)	Cardiovascular (30%)	Cancer (37%)	Cardiovascular (33%)
2nd	Infections *	Infant/congenital *	Cardiovascular *	Cardiovascular (15%)	Injuries (28%)	Cancer (20%)	Cancer (29%)	Cardiovascular (26%)	Cancer (26%)
3rd	Injuries *	Infections *	Neurological *	Cancer *	Gastrointestinal (10%)	Injuries (12%)	Endocrine (9%)	Respiratory (10%)	Respiratory (10%)
4th	Cancer *	Gastrointestinal *	Cancer *	Mental/ behavioural *	Cancer (8%)	Gastrointestinal (10%)	Gastrointestinal (8%)	Endocrine (9%)	Neurological (7%)
5th	Neurological *	Cardiovascular *	Infant/congenital *	Neurological *	Infections (6%)	Endocrine (7%)	Respiratory (6%)	Neurological (4%)	Endocrine (6%)

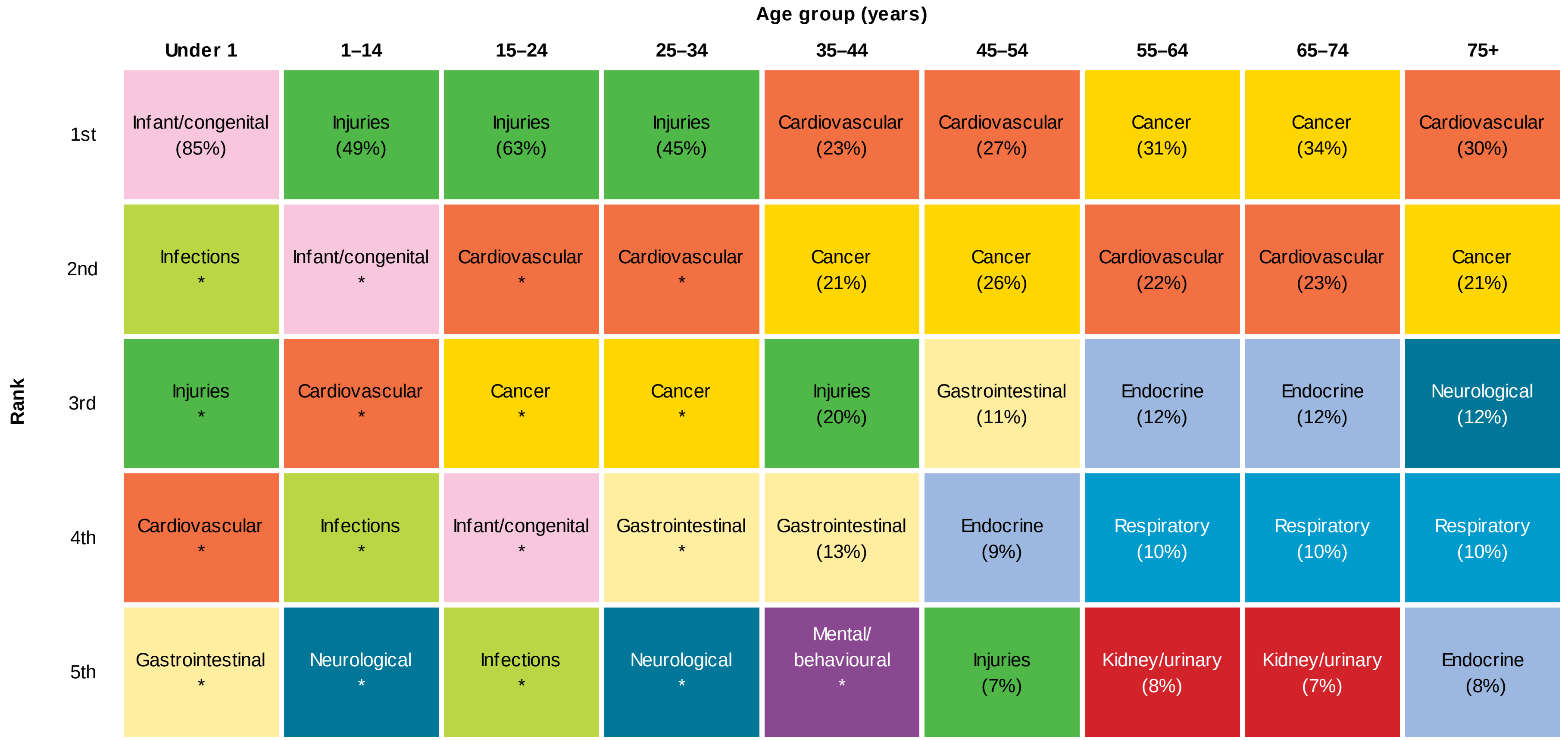
* Number of Indigenous deaths used in YLL calculations is less than 10.

Notes

1. YLL for 2010 is the annual average of 2009–2011.
2. Deaths have been adjusted using ABS adjustment factors (see Appendix E).

Source: AIHW analysis of the AIHW National Mortality Database.

Figure 3.7: Leading causes of fatal burden for Indigenous males, by age group, 2010



Rank	Under 1	1–14	15–24	25–34	35–44	45–54	55–64	65–74	75+
1st	Infant/congenital (85%)	Injuries (49%)	Injuries (63%)	Injuries (45%)	Cardiovascular (23%)	Cardiovascular (27%)	Cancer (31%)	Cancer (34%)	Cardiovascular (30%)
2nd	Infections *	Infant/congenital *	Cardiovascular *	Cardiovascular *	Cancer (21%)	Cancer (26%)	Cardiovascular (22%)	Cardiovascular (23%)	Cancer (21%)
3rd	Injuries *	Cardiovascular *	Cancer *	Cancer *	Injuries (20%)	Gastrointestinal (11%)	Endocrine (12%)	Endocrine (12%)	Neurological (12%)
4th	Cardiovascular *	Infections *	Infant/congenital *	Gastrointestinal *	Gastrointestinal (13%)	Endocrine (9%)	Respiratory (10%)	Respiratory (10%)	Respiratory (10%)
5th	Gastrointestinal *	Neurological *	Infections *	Neurological *	Mental/ behavioural *	Injuries (7%)	Kidney/urinary (8%)	Kidney/urinary (7%)	Endocrine (8%)

* Number of Indigenous deaths used in YLL calculations is less than 10.

Notes

1. YLL for 2010 is the annual average of 2009–2011.
2. Deaths have been adjusted using ABS adjustment factors (see Appendix E).

Source: AIHW analysis of the AIHW National Mortality Database.

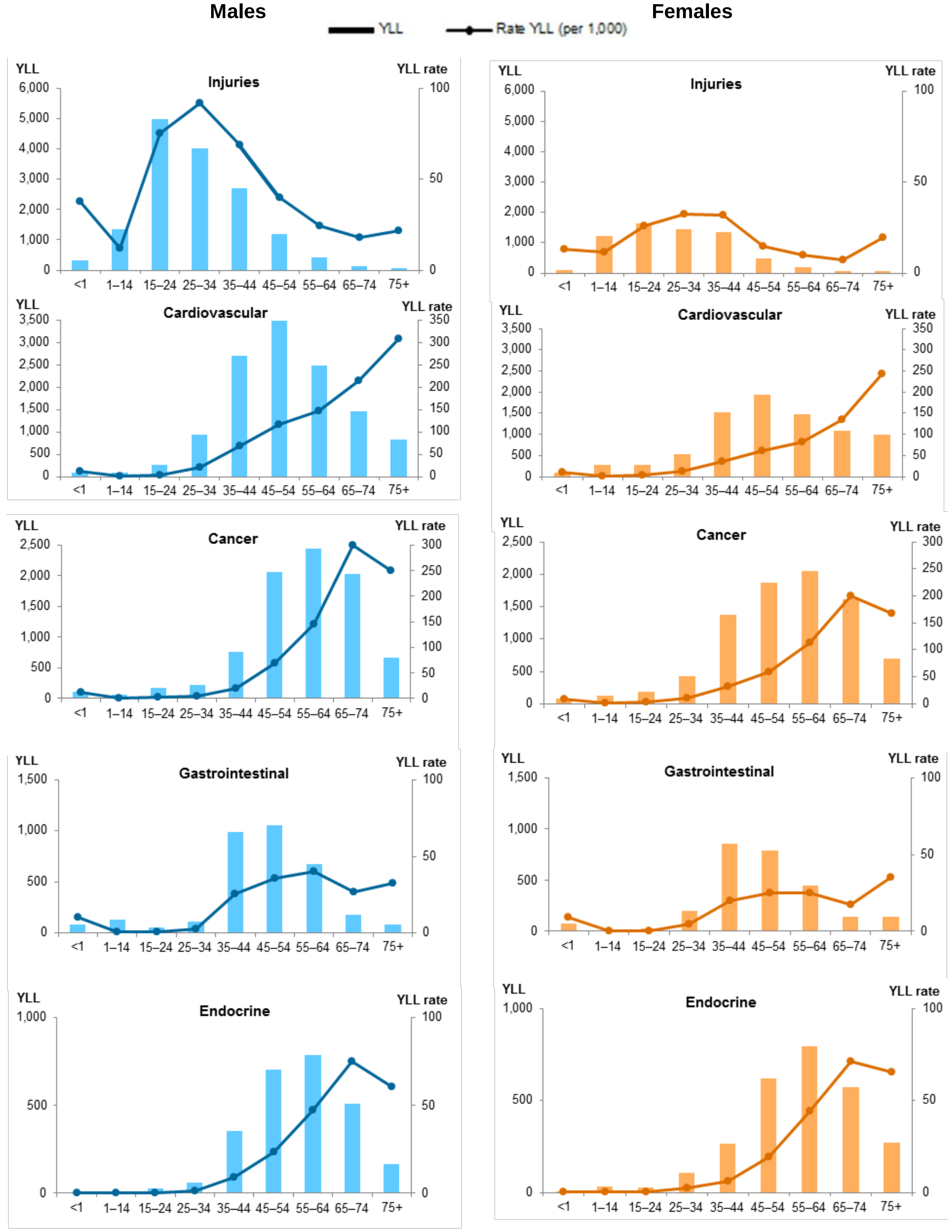
Figure 3.8: Leading causes of fatal burden for Indigenous females, by age group, 2010

3.5 Age patterns in YLL for selected disease groups

This section describes the age patterns in Indigenous YLL results in more detail for selected disease groups. Figure 3.9 provides a visual comparison of the fatal burden (YLL) and age-specific rates (YLL per 1,000 population) by age and sex for these selected disease groups. These figures can be used to compare rates of fatal burden between age groups and between males and females, or to compare the general shapes of the age patterns among the disease groups. The results depend on the number of deaths, the age at death, and, for rates, the sex and age-specific population. Note that the scales for number of YLL and rate of YLL vary between different disease groups, but are the same for males and females within each disease group.

Some observations from Figure 3.9 include:

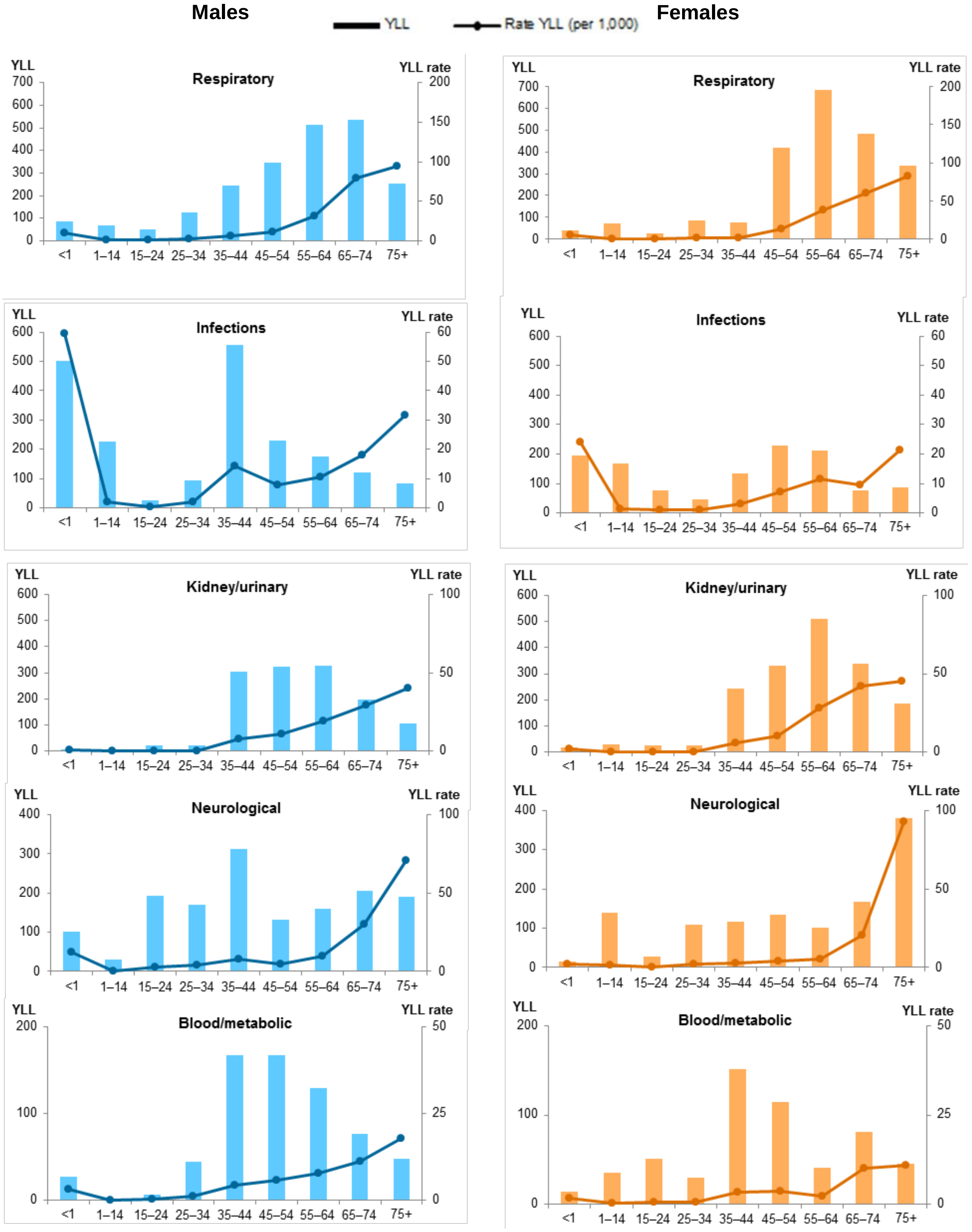
- For some disease groups, Indigenous YLL rates increased consistently with age—for example, cardiovascular diseases, and kidney/urinary diseases.
- For cancer, and for endocrine disorders, YLL rates increased with age to the 65–74 age group, after which they declined.
- While YLL rates were highest in older age groups for most disease groups, the number of YLL often peaked in a younger age group. For example, for cardiovascular diseases the most YLL occurred in the 45–54 age group for both Indigenous males and females, while the rates (YLL per 1,000 population) were highest in the 75 and over age group. This is a reflection of the relatively high number of Indigenous deaths in middle age from diseases such as cardiovascular diseases (in which the age of onset is often earlier than observed in the non-Indigenous population), which gives rise to a greater number of YLL due to more years of potential life lost in these age groups compared to the older age groups.
- For injuries, the rate of fatal burden peaked in the 25–34 age group for Indigenous males and females. YLL rates for injuries were much higher for Indigenous males than females across all age groups except for the 1–14 age group.
- Infections also showed a different pattern, having the highest YLL rates among Indigenous infants aged under 1.



Source: AIHW analysis of the AIHW National Mortality Database.

Figure 3.9: YLL and age-specific YLL rates (YLL per 1,000 population) for Indigenous Australians for selected disease groups, by sex, 2010

(continued)



Notes

1. This figure is based on data in supplementary tables available online—Tables S3.6 and S3.7.
2. YLL for 2010 is the annual average of 2009–2011. Deaths have been adjusted using ABS adjustment factors (see Appendix E).

Source: AIHW analysis of the AIHW National Mortality Database.

Figure 3.9 (continued): YLL and age-specific YLL rates (YLL per 1,000 population) for Indigenous Australians for selected disease groups, by sex, 2010

4 National results: Mortality gap

Measuring the 'gap' in the fatal burden between Indigenous and non-Indigenous Australians (commonly referred to as the 'mortality gap' hereafter) is of key interest to current policy makers, as reflected in the COAG commitment to close the gap in Indigenous life expectancy within a generation (COAG 2009).

Indigenous and non-Indigenous YLL rates presented in this report are based on direct age-standardisation and have been adjusted for Indigenous under-identification in mortality data. Rate ratios as well as rate differences are presented as measures of the gap in fatal burden, as both provide useful information (see 'Measuring the mortality gap between Indigenous and non-Indigenous Australians' in section 2.4, and Appendixes E and F for further information).

National estimates of the gap in the fatal burden between Indigenous and non-Indigenous Australians presented in this chapter include deaths from all Australian states and territories.

Please note that non-Indigenous YLL estimates presented in this chapter are not the same as estimates for the total Australian population and should not be used as such. Refer to the AIHW report *Australian Burden of Disease Study: fatal burden of disease 2010* (AIHW 2015) for estimates of fatal burden in the total Australian population.

4.1 What is the overall gap in fatal burden?

- In 2010, the total gap (as measured by the YLL rate difference) in fatal burden between Indigenous and non-Indigenous Australians was 152 YLL per 1,000 population. The gap was greater for males than for females (175 compared to 132 YLL per 1,000 population).
- The rate of fatal burden experienced by Indigenous Australians was 2.6 times the rate of fatal burden experienced by non-Indigenous Australians in 2010. For males, the rate ratio was 2.5, and for females, the rate ratio was 2.8 (Table 4.1).

Table 4.1: Age-standardised YLL rates (per 1,000 population), rate ratios and rate differences, by Indigenous status and sex, 2010

	Indigenous YLL rate	Non-Indigenous YLL rate	Rate ratio	Rate difference
Males	291.6	116.2	2.5	175.4
Females	204.8	72.9	2.8	131.9
Persons	245.8	93.7	2.6	152.2

Notes

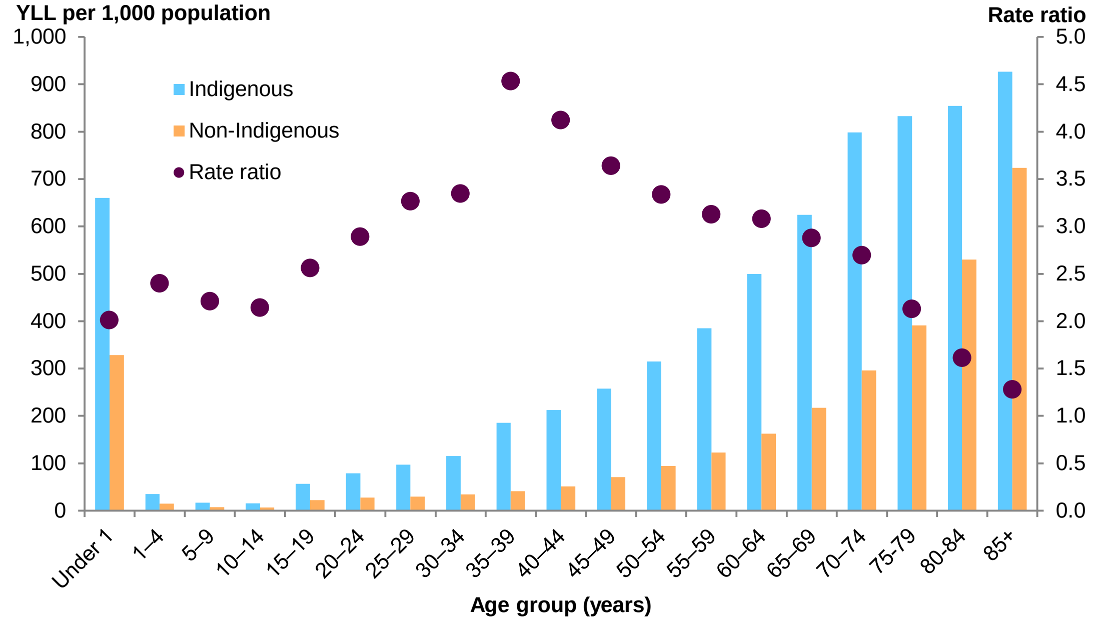
1. YLL for 2010 is the annual average of 2009–2011. Deaths have been adjusted using ABS adjustment factors (see Appendix E).
2. Rates are directly age-standardised to the 2001 Australian ERP as at 30 June 2001 (based on the 2001 Census).

Source: AIHW analysis of the AIHW National Mortality Database.

4.2 Which age groups contribute the most to the mortality gap?

Figure 4.1 presents age-specific YLL rates for the Indigenous and non-Indigenous populations, as well as rate ratios. This provides a picture of the age groups that have the largest absolute disparity in YLL between the two population groups (based on the rate difference), as well as the age groups which have the largest relative disparity (based on rate ratios).

- The largest absolute differences in YLL rates between Indigenous and non-Indigenous Australians in 2010 were observed for infants (rate difference of 332 per 1,000 population) and between the ages of 60 and 79, with the greatest difference being in the 70–74 age group (rate difference of 502 per 1,000).
- The largest relative differences between Indigenous and non-Indigenous YLL rates were observed for those aged 35–39 and 40–44; Indigenous people experienced fatal burden at over 4 times the rate of non-Indigenous people in these age groups.
- This suggests that while YLL rates are much higher in Indigenous populations in the middle age groups compared to non-Indigenous populations, the age groups that are contributing the most to YLL, and consequently to the absolute gap in YLL, are infants and the older age groups (60–79).



Notes

1. This figure is based on data in a supplementary table available online—Table S4.1.
2. YLL for 2010 is the annual average of 2009–2011. Deaths have been adjusted using ABS adjustment factors (see Appendix E).

Source: AIHW analysis of the AIHW National Mortality Database.

Figure 4.1: Age-specific YLL rates (per 1,000 population) and rate ratios, by Indigenous status and age group, 2010

4.3 What diseases are the leading contributors to the mortality gap?

In 2010, across all disease groups, Indigenous Australians experienced a higher rate of fatal burden than non-Indigenous Australians. The leading disease groups contributing to this gap were cardiovascular diseases (responsible for 27% of the gap), cancer and other neoplasms (15%), injuries (14%) and endocrine disorders (which includes diabetes) (10%). Together, these disease groups accounted for almost two-thirds of the total gap in fatal burden of disease and injury (Table 4.2).

What diseases have the greatest relative disparities between the Indigenous and non-Indigenous populations?

- When looking at rate ratios, the fatal burden caused by endocrine disorders for Indigenous Australians was 8 times the rate for non-Indigenous Australians, and the fatal burden caused by kidney and urinary diseases was 7 times the non-Indigenous rate. While these rate ratios are much higher than for cardiovascular diseases, cancer and injuries, their contribution to the total mortality gap was lower (10% for endocrine disorders and 6% for kidney and urinary disorders).
- The diseases that will make the most difference to closing the gap in fatal burden between Indigenous and non-Indigenous Australians are cardiovascular diseases, cancer, injuries and endocrine disorders (which includes diabetes). Kidney and urinary diseases should also be considered as important due to their high relative disparity in fatal burden between the Indigenous and non-Indigenous populations.

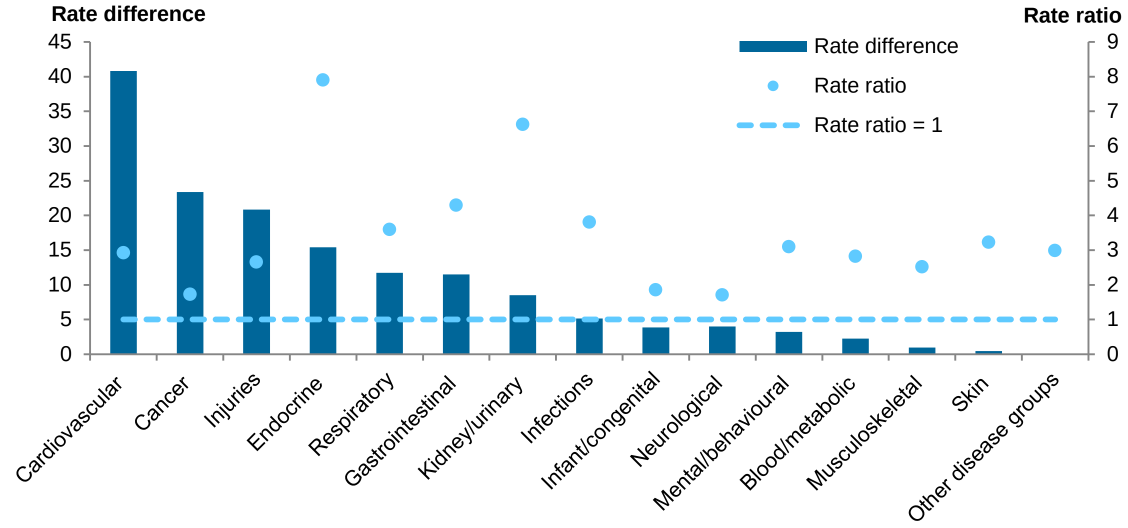
Table 4.2: Age-standardised YLL rates (per 1,000 population), rate ratios and rate differences, by Indigenous status and disease group, 2010

	YLL per 1,000[(a)]				
Disease group	**Indigenous**	**Non-Indigenous**	**Rate ratio**	**Rate difference**	**Contribution to total rate difference (%)**
Cardiovascular	62.0	21.2	2.9	40.8	26.8
Cancer and other neoplasms	55.8	32.4	1.7	23.4	15.4
Injuries	33.4	12.6	2.7	20.8	13.7
Endocrine	17.7	2.2	7.9	15.4	10.1
Respiratory	16.3	4.5	3.6	11.7	7.7
Gastrointestinal	15.0	3.5	4.3	11.5	7.6
Kidney and urinary	10.0	1.5	6.6	8.5	5.6
Infections	7.0	1.8	3.8	5.1	3.4
Infant and congenital	8.4	4.5	1.9	3.9	2.5
Neurological	9.7	5.7	1.7	4.0	2.6
Mental illnesses and behavioural	4.7	1.5	3.1	3.2	2.1
Blood and metabolic	3.5	1.2	2.8	2.2	1.5
Chronic musculoskeletal	1.6	0.6	2.5	1.0	0.6
Skin	0.7	0.2	3.2	0.5	0.3
Other disease groups	0.2	0.1	3.0	0.1	0.1
All diseases	**245.8**	**93.7**	**2.6**	**152.2**	**100.0**

(a) Rates are directly age-standardised to the 2001 Australian ERP as at 30 June 2001 (based on the 2001 Census).

Note: Number of deaths and YLL for 2010 are the annual average of 2009–2011 and deaths have been adjusted using ABS adjustment factors (see Appendix E).

Source: AIHW analysis of the AIHW National Mortality Database.



Notes

1. This figure is based on data in Table 4.2.

2. YLL for 2010 is the annual average of 2009–2011. Deaths have been adjusted using ABS adjustment factors (see Appendix E).

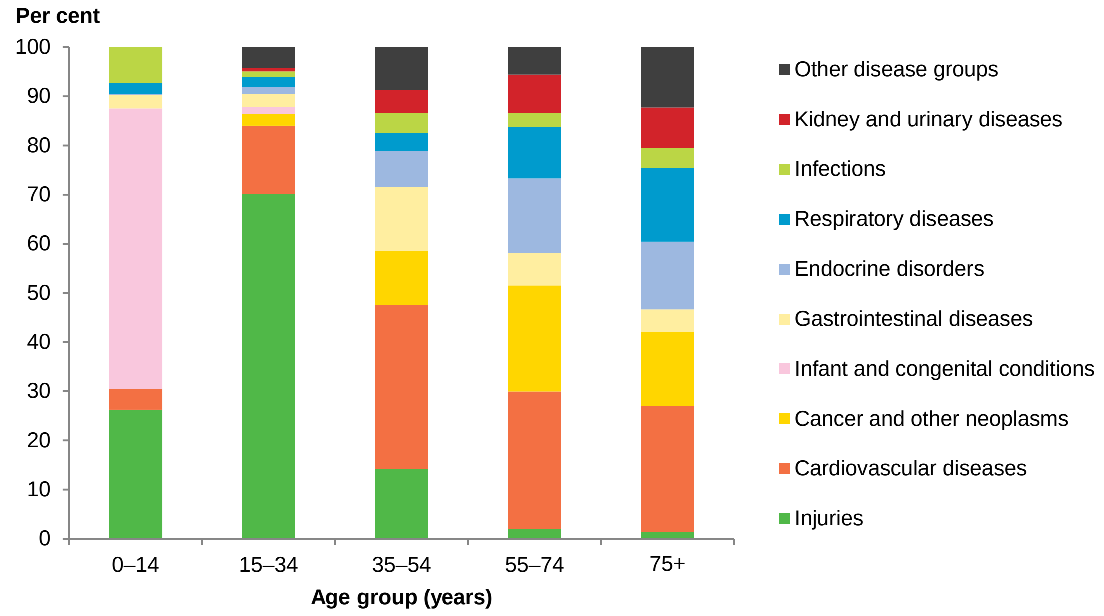
Source: AIHW analysis of the AIHW National Mortality Database.

Figure 4.2: YLL rate ratios and rate differences between Indigenous and non-Indigenous Australians, by disease group, 2010

4.4 Do the leading contributors to the mortality gap differ by age?

The contribution of different diseases to the mortality gap between Indigenous and non-Indigenous Australians varies by age group (Figure 4.3). For example:

- Infant and congenital conditions, injuries and infections were the greatest contributors to the mortality gap among those aged 0–14 in 2010.
- Injuries was the single largest contributor to the mortality gap among those aged 15–34.
- Among those aged 35–54, chronic diseases such as cardiovascular diseases and cancer start to emerge as important contributors to the mortality gap, as well as gastrointestinal diseases, although injuries is still the second largest contributor.
- Respiratory diseases and endocrine disorders start to become more evident in their contribution to the gap among those aged 55–74 and 75 and over. Around 80% of the mortality gap was explained by chronic diseases among those aged 55 and over in 2010.



Notes

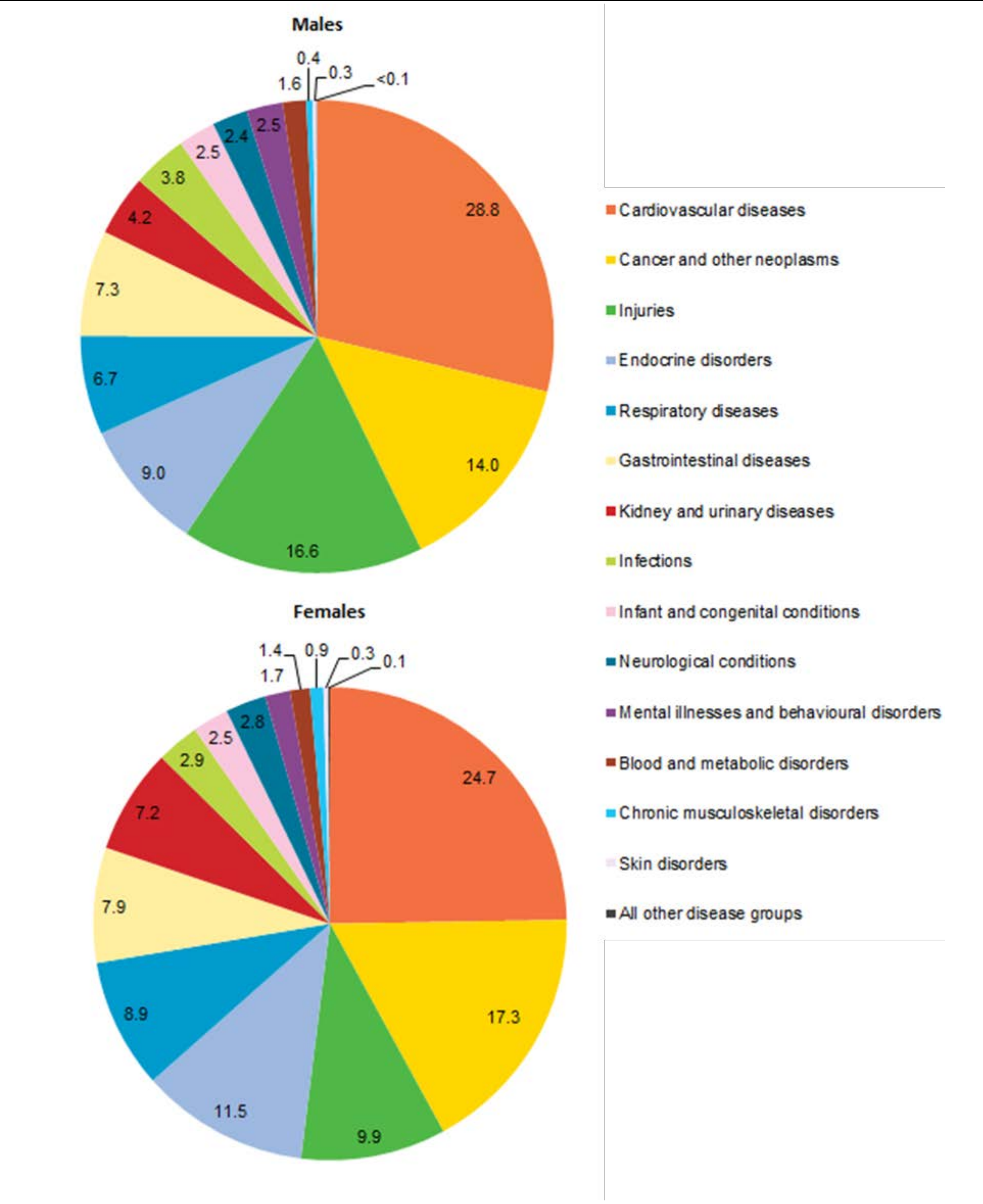
1. This figure is based on data in a supplementary table available online—Table S4.2.
2. YLL for 2010 is the annual average of 2009–2011. Deaths have been adjusted using ABS adjustment factors (see Appendix E).

Source: AIHW analysis of the AIHW National Mortality Database.

Figure 4.3: Percentage contribution to the mortality gap (based on YLL rate difference) between Indigenous and non-Indigenous Australians, by age and disease group, 2010

4.5 Do the leading contributors to the mortality gap differ by sex?

- Cardiovascular diseases were the largest contributor to the gap in fatal burden between Indigenous and non-Indigenous Australians for both males and females in 2010, accounting for 29% and 25% of the gap for males and females respectively (Figure 4.4). Indigenous males and females experienced a rate of fatal burden from this disease group of around 3 times the rate of non-Indigenous males and females.
- While the injuries group was ranked as the second leading contributor to the gap for males (17%), it was ranked fourth for females (10%), with rate ratios of 2.6 and 2.9 respectively.
- Cancer and other neoplasms was ranked second for females and third for males in terms of their percentage contribution to the total gap in fatal burden (17% and 14% of the gap respectively).
- Kidney and urinary diseases were responsible for a larger proportion of the gap for females than males (7% compared to 4%). This disease group had high Indigenous to non-Indigenous rate ratios for both males and females (5.3 and 8.0 respectively), behind endocrine disorders which had the highest relative disparities for both males and females (rate ratios of 6.7 and 9.6).



Notes

1. This figure is based on data in a supplementary table available online—Table S4.3.
2. YLL for 2010 is the annual average of 2009–2011. Deaths have been adjusted using ABS adjustment factors (see Appendix E).

Source: AIHW analysis of the AIHW National Mortality Database.

Figure 4.4: Percentage contribution to the mortality gap (based on YLL rate difference) between Indigenous and non-Indigenous Australians, by disease group and sex, 2010

5 Sub-national results

This chapter presents estimates of the fatal burden of disease and injury for Indigenous Australians for selected states and territories, by remoteness and by level of socioeconomic disadvantage. Comparisons to the non-Indigenous population and estimates of the mortality gap are also presented where relevant.

Please note that non-Indigenous YLL estimates presented in this chapter are not the same as estimates for the total Australian population and should not be used as such.

5.1 State/territory

Indigenous YLL estimates are presented in this section for four states and territories: New South Wales, Queensland, Western Australia and the Northern Territory. Indigenous YLL estimates are not presented for the other four states and territories due to the small number of Indigenous deaths reported for these jurisdictions each year and because individual state/territory ABS mortality adjustment factors are not available for Victoria, South Australia, Tasmania or the Australian Capital Territory separately (see Appendix E for further information).

What is the overall fatal burden experienced by Indigenous Australians in selected states and territories?

Table 5.1 presents the number of deaths, YLL and age-standardised YLL rates per 1,000 population in 2010 for Indigenous Australians living in New South Wales, Queensland, Western Australia and the Northern Territory.

Differences in the estimated number of YLL in each state and territory reflect the different sizes and age structures of Indigenous populations living in these jurisdictions and consequently, the number of deaths reported. Age-standardised YLL rates take both population size and age structure into account and are therefore a better measure of state and territory differences in fatal burden.

- In 2010, among the four jurisdictions for which YLL estimates have been calculated, age-standardised Indigenous YLL rates were the highest in the Northern Territory (349 per 1,000 population) and Western Australia (319 per 1,000 population), followed by Queensland and New South Wales (247 and 233 per 1,000 population respectively).

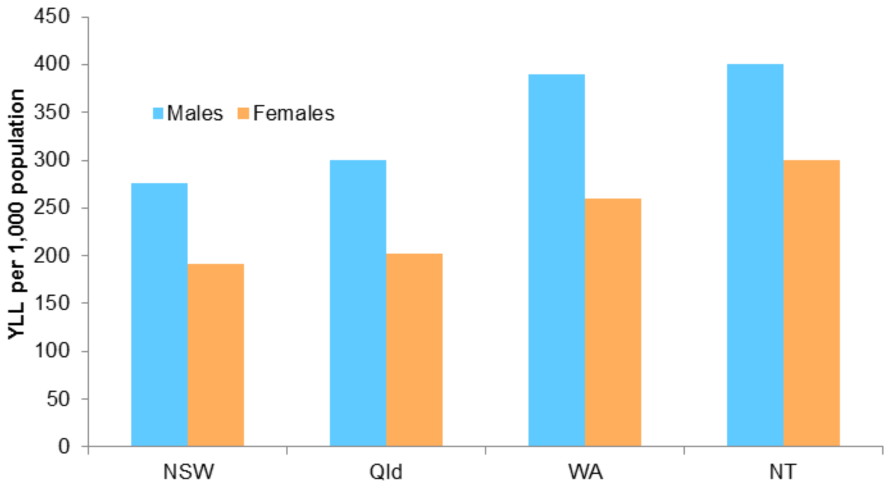
Table 5.1: Number of adjusted deaths and YLL, and age-standardised YLL rates for Indigenous Australians, NSW, Qld, WA and the NT, 2010

State/territory	Deaths	YLL	Age-standardised YLL rate per 1,000 population
NSW	920	27,809	232.7
Qld	785	27,220	246.7
WA	482	17,183	318.6
NT	428	16,321	348.5

Note: Number of deaths and YLL for 2010 is the annual average of 2009–2011. Deaths have been adjusted using ABS adjustment factors (see Appendix E).

Source: AIHW analysis of the AIHW National Mortality Database.

- The same general pattern in YLL rates by state and territory was evident for Indigenous males and females (Figure 5.1).



Notes

1. This figure is based on data in a supplementary table available online—Table S5.1.
2. YLL for 2010 is the annual average of 2009–2011. Deaths have been adjusted using ABS adjustment factors (see Appendix E).

Source: AIHW analysis of the AIHW National Mortality Database.

Figure 5.1: Age-standardised YLL rates for Indigenous Australians, by sex and state/territory (NSW, Qld, WA and the NT), 2010

Are there differences in the main diseases contributing to fatal burden for Indigenous Australians by state/territory?

- In 2010, injuries were the leading cause of fatal burden for Indigenous Australians in Queensland, Western Australia and the Northern Territory, contributing 21%, 27% and 24% of YLL respectively. Cardiovascular diseases were the leading cause of fatal burden for Indigenous Australians in New South Wales (contributing 23% of total YLL) (Table 5.2).
- Cancer ranked higher and contributed more to Indigenous fatal burden in New South Wales (ranked second and contributing 21% of YLL) than in Queensland, Western Australia, and the Northern Territory (ranked third and contributing 17%, 16%, and 13% respectively).
- Infant and congenital conditions contributed a larger proportion of the total fatal burden for Indigenous Australians in Queensland (14% of YLL) compared to New South Wales, Western Australia and the Northern Territory (9%, 6% and 10% of YLL, respectively).
- Endocrine disorders ranked lower and contributed less to Indigenous fatal burden in New South Wales (ranked seventh and contributing 4% of YLL) than in the other 3 jurisdictions (ranked fifth or sixth and contributing more than 6% of YLL).

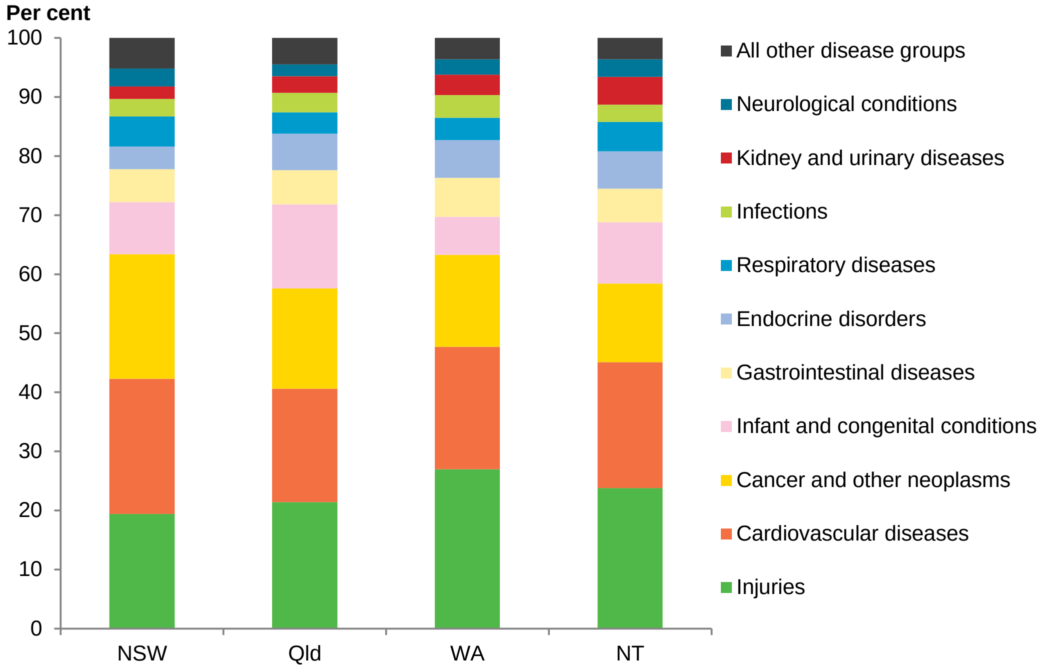
Table 5.2: Leading causes of fatal burden (YLL) for Indigenous Australians, by state/territory (NSW, Qld, WA and the NT) 2010

	NSW		Qld		WA		NT	
	Rank	%	Rank	%	Rank	%	Rank	%
Injuries	3	19.4	1	21.4	1	27.0	1	23.8
Cardiovascular diseases	1	22.9	2	19.2	2	20.7	2	21.3
Cancer and other neoplasms	2	21.1	3	17.0	3	15.6	3	13.3
Infant and congenital conditions	4	8.8	4	14.2	5	6.4	4	10.4
Gastrointestinal diseases	5	5.6	6	5.8	4	6.6	6	5.7
Endocrine disorders	7	3.8	5	6.2	6	6.4	5	6.3
Respiratory diseases	6	5.1	7	3.6	7	3.8	7	5.0
Infections	10	3.0	8	3.3	8	3.8	10	2.9
Kidney and urinary diseases	11(a)	2.1	9	2.8	9	3.5	8	4.7
Neurological conditions	9	3.0	10	2.0	10	2.6	9	3.0

(a) Mental and behavioural disorders was ranked 8th in NSW; however is not presented in this table due to the small number of Indigenous deaths reported for this disease group for the other three states and territories.

Note: YLL for 2010 is the annual average of 2009–2011. Deaths have been adjusted using ABS adjustment factors (see Appendix E).

Source: AIHW analysis of the AIHW National Mortality Database.



Notes

1. This figure is based on data in Table 5.2.
2. YLL for 2010 is the annual average of 2009–2011. Deaths have been adjusted using ABS adjustment factors (See Appendix E).

Source: AIHW analysis of the AIHW National Mortality Database.

Figure 5.2: Leading causes of fatal burden (YLL) for Indigenous Australians, by state/territory (NSW, Qld, WA and the NT), 2010

What is the overall gap in fatal burden between Indigenous and non-Indigenous Australians by state/territory?

- In Western Australia and the Northern Territory, Indigenous Australians experienced fatal burden at more than 3 times the rate of non-Indigenous Australians (rate ratios of 3.6 and 3.1 respectively). The greatest absolute disparity in fatal burden between Indigenous and non-Indigenous Australians was in the Northern Territory (rate difference of 236 YLL per 1,000 population) (Table 5.3; Figure 5.3).
- Indigenous Australians in New South Wales and Queensland experienced fatal burden at 2.5 times the rate of non-Indigenous Australians.

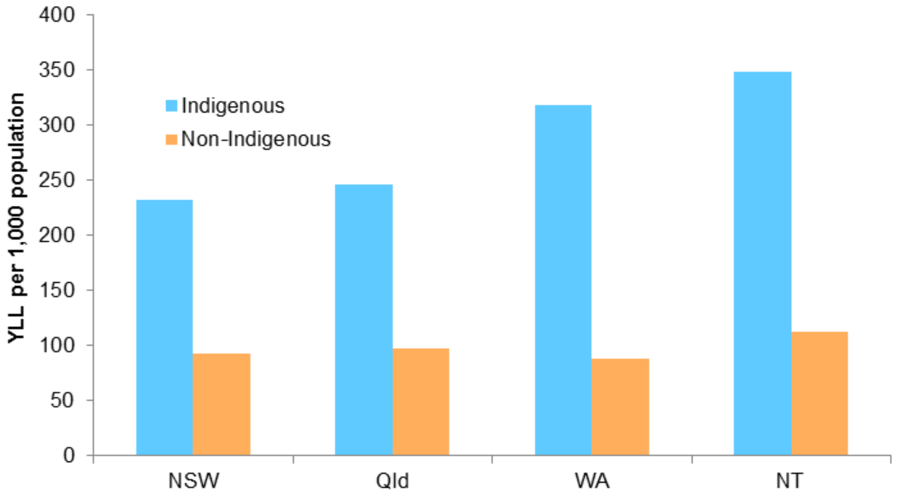
Table 5.3: Age-standardised YLL rates (per 1,000 population), rate ratios and rate differences by Indigenous status and state/territory (NSW, Qld, WA and the NT), 2010

	Age-standardised YLL per 1,000 population		Mortality gap	
State/territory	**Indigenous**	**Non-Indigenous**	**Rate difference**	**Rate ratio**
NSW	232.7	92.4	140.3	2.5
Qld	246.7	97.6	149.1	2.5
WA	318.6	88.5	230.2	3.6
NT	348.5	112.2	236.3	3.1

Notes

1. YLL for 2010 is the annual average of 2009–2011. Deaths have been adjusted using ABS adjustment factors (see Appendix E).
2. Rates are directly age-standardised to the 2001 Australian ERP as at 30 June 2001 (based on the 2001 Census).

Source: AIHW analysis of the AIHW National Mortality Database.



Notes

1. Data for this figure are in Table 5.3.
2. YLL for 2010 is the annual average of 2009–2011. Deaths have been adjusted using ABS adjustment factors (see Appendix E).

Source: AIHW analysis of the AIHW National Mortality Database.

Figure 5.3: Age-standardised YLL rates, by Indigenous status and state/territory (NSW, Qld, WA and the NT), 2010

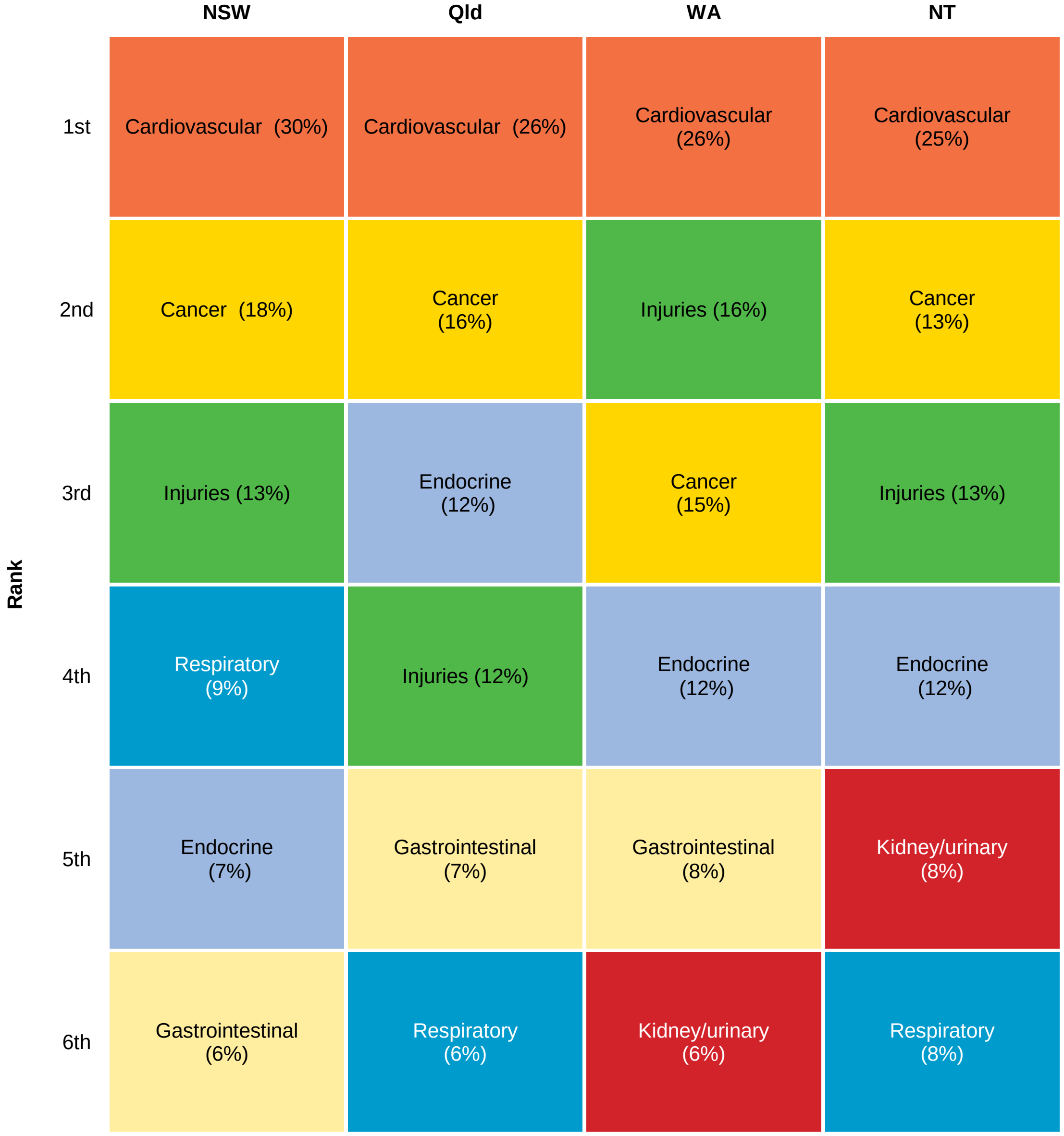
Are there differences by state/territory in the main disease groups contributing to the gap in fatal burden?

Figure 5.4 shows the top six diseases contributing to the gap in fatal burden between Indigenous and non-Indigenous Australians in 2010 for each of the four states and territories for which YLL estimates are reported (New South Wales, Queensland, Western Australia and the Northern Territory).

- Cardiovascular diseases and cancer were among the top three disease groups contributing to the gap in all four states and territories (although the percentage contribution to the gap varied between the states and territories; for example cardiovascular diseases contributed 30% of the gap in New South Wales and 25% of the gap in the Northern Territory).
- Injuries were the second leading contributor to the gap in Western Australia (16%), while cancer ranked second in New South Wales, Queensland and the Northern Territory.
- Respiratory diseases ranked higher in New South Wales (fourth) than in the other three jurisdictions.
- Kidney and urinary diseases contributed more to the gap in fatal burden in Western Australia and the Northern Territory (ranked sixth and fifth, and contributing 6% and 8% respectively), than in New South Wales and Queensland.

Figure 5.5 presents rate differences as well as rate ratios by disease group to provide, respectively, a picture of the diseases with the largest absolute differences contributing to the gap, and the largest relative disparities. Note that estimates for skin disorders and 'other disease groups' are not included in Figure 5.5 due to the very small number of Indigenous deaths reported for these in each jurisdiction, making the rate ratio estimates for them unreliable.

- In New South Wales, Queensland and Western Australia, Indigenous to non-Indigenous rate ratios were highest for endocrine disorders (5.8, 9.9 and 14.0 respectively), while in the Northern Territory, kidney and urinary diseases had the highest rate ratio (11.9).



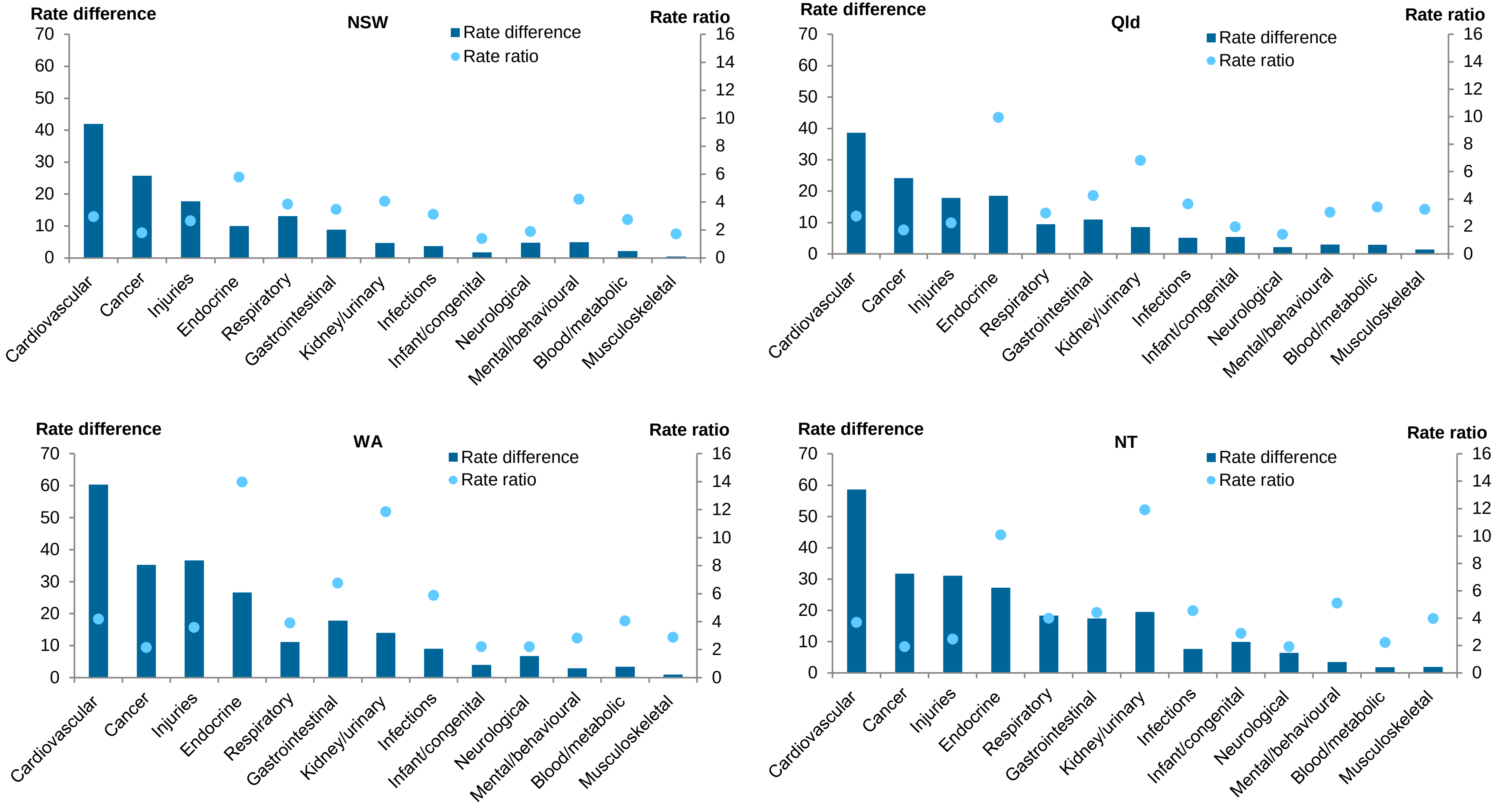
Rank	NSW	Qld	WA	NT
1st	Cardiovascular (30%)	Cardiovascular (26%)	Cardiovascular (26%)	Cardiovascular (25%)
2nd	Cancer (18%)	Cancer (16%)	Injuries (16%)	Cancer (13%)
3rd	Injuries (13%)	Endocrine (12%)	Cancer (15%)	Injuries (13%)
4th	Respiratory (9%)	Injuries (12%)	Endocrine (12%)	Endocrine (12%)
5th	Endocrine (7%)	Gastrointestinal (7%)	Gastrointestinal (8%)	Kidney/urinary (8%)
6th	Gastrointestinal (6%)	Respiratory (6%)	Kidney/urinary (6%)	Respiratory (8%)

Notes

1. This figure is based on data in a supplementary table available online—Table S5.3.
2. YLL for 2010 is the annual average of 2009–2011. Deaths have been adjusted using ABS adjustment factors (see Appendix E).

Source: AIHW analysis of the AIHW National Mortality Database.

Figure 5.4: Leading causes of the gap in fatal burden between Indigenous and non-Indigenous Australians (based on YLL rate difference), by state/territory (NSW, Qld, WA and the NT), 2010



Note: This figure is based on data in a supplementary table available online—Table S5.3. YLL for 2010 is the annual average of 2009–2011. Deaths have been adjusted using ABS adjustment factors (see Appendix E).

Source: AIHW analysis of the AIHW National Mortality Database.

Figure 5.5: YLL rate ratios and rate differences, by disease group and state/territory (NSW, Qld, WA and the NT), 2010

5.2 Remoteness

This section presents Indigenous YLL estimates by remoteness for the five remoteness categories *Major cities*, *Inner regional*, *Outer regional*, *Remote* and *Very remote*. Unlike results presented in other sections of this report, which use ABS mortality adjustment factors, these estimates have been adjusted using AIHW adjustment factors.

AIHW adjustment factors have been used as there are a number of limitations with the ABS remoteness adjustment factors. As discussed in Chapter 2, the ABS remoteness adjustment factors are only available for the two combined remoteness categories *Major cities*/*Inner regional* combined and *Outer regional/Remote/Very remote* combined. These combined remoteness categories are not considered the most useful to policymakers for examining mortality disparities by remoteness, given the wide variation between the five remoteness categories, and because the chosen groupings of remoteness (in particular, the combining of *Outer regional* with *Remote* and *Very remote*) mask any mortality disparities by remoteness—they do not follow the typical categories of non-remote and remote. Furthermore, Indigenous YLL estimates based on the ABS adjustment factors for these two grouped remoteness categories were very similar, which is somewhat counter intuitive given the known higher rates of Indigenous mortality in remote areas, raising further questions about their usefulness.

It is important to note that YLL estimates by remoteness presented in this section of the report are not comparable to YLL estimates presented in the rest of this report, as the two sets of estimates are based on differing adjustment factors as outlined above. Total numbers of adjusted deaths and YLL should be sourced from tables for national results, which are based on the ABS adjustment factors.

For more information on the remoteness adjustment factors applied, see Appendix E.

What is the overall fatal burden experienced by Indigenous Australians in each remoteness area?

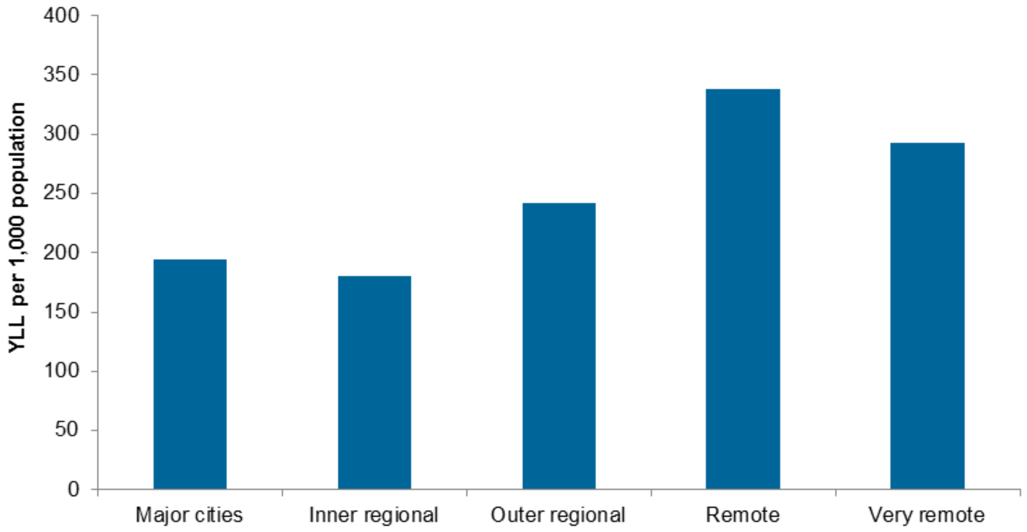
- In 2010, the highest number of Indigenous deaths and YLL were in in *Major cities* and the lowest number of deaths and YLL were in *Remote* areas (Table 5.4).
- When examining age-standardised YLL rates, *Remote* areas had the highest rate of fatal burden in the Indigenous population (339 YLL per 1,000 population), followed by *Very remote* areas (293 YLL per 1,000 population) (Figure 5.6).

Table 5.4: Number of adjusted deaths and YLL for Indigenous Australians, by remoteness, 2010

Remoteness	Deaths	YLL	Age-standardised YLL rate
Major cities	775	25,248	194.7
Inner regional	463	14,792	180.5
Outer regional	651	21,718	242.0
Remote	348	12,157	338.6
Very remote	503	18,900	292.8

Note: Number of deaths and YLL for 2010 is the annual average of 2009–2011. Deaths have been adjusted using AIHW remoteness adjustment factors (see Appendix E). As a result, estimates by remoteness will not match other estimates in this report which have been adjusted using ABS adjustment factors.

Source: AIHW analysis of the AIHW National Mortality Database.



Notes

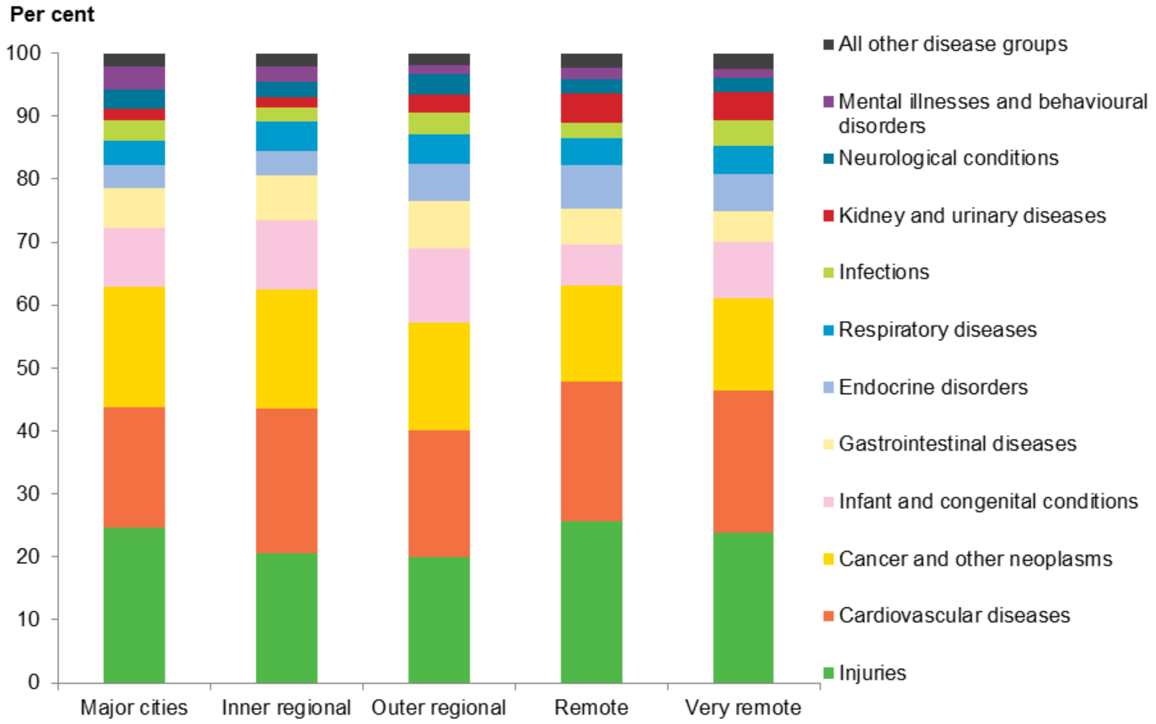
1. This figure is based on data in Table 5.4.
2. YLL for 2010 is the annual average of 2009–2011. Deaths have been adjusted using AIHW remoteness adjustment factors (see Appendix E). As a result, estimates by remoteness will not match other estimates in this report which have been adjusted using ABS adjustment factors.

Source: AIHW analysis of the AIHW National Mortality Database.

Figure 5.6: Age-standardised YLL rates for Indigenous Australians, by remoteness, 2010

Are there differences by remoteness in the main disease groups contributing to fatal burden for Indigenous Australians?

- In 2010, injuries, cardiovascular diseases and cancer were among the biggest 3 contributors to fatal burden among Indigenous Australians in all five remoteness categories; however there were some minor differences in the rankings and percentage contributions to total YLL. For example, injuries was the leading contributor to fatal burden in *Major cities* and *Remote* and *Very remote* regions, while it ranked second to cardiovascular diseases in *Inner regional* and *Outer regional* areas (Figure 5.7).
- Infant and congenital conditions was the fourth largest contributor to fatal burden among Indigenous Australians in all remoteness categories except for *Remote* areas, where it was ranked fifth and representing 7% of total YLL, slightly less than endocrine disorders (also 7%).
- Kidney and urinary diseases was a larger contributor to Indigenous YLL in *Remote* and *Very remote* areas (ranked 7th and 8th respectively, and representing 5% of total YLL) compared to *Major cities* (ranked 12th and representing 2% of total YLL).
- Gastrointestinal diseases were ranked higher and contributed to a greater proportion of Indigenous YLL in non-remote areas than in remote areas.



Notes

1. This figure is based on data in supplementary table online—Table S5.4.
2. YLL for 2010 is the annual average of 2009–2011. Deaths have been adjusted using AIHW remoteness adjustment factors (see Appendix E). As a result, estimates by remoteness will not match other estimates in this report which have been adjusted using ABS adjustment factors.

Source: AIHW analysis of the AIHW National Mortality Database.

Figure 5.7: Leading causes of fatal burden (YLL) for Indigenous Australians, by remoteness, 2010

What is the overall gap in YLL between Indigenous and non-Indigenous Australians by remoteness area?

- When examining age-standardised YLL rates for the five remoteness categories, the greatest disparity between Indigenous and non-Indigenous Australians was in *Remote* areas (rate difference of 236 YLL per 1,000 population; rate ratio of 3.3), followed by *Very remote* areas (rate difference of 185 per 1,000 population; rate ratio of 2.7) (Table 5.5).
- The gap between Indigenous and non-Indigenous Australians was lowest in *Inner regional* areas (rate difference of 77 YLL per 1,000 population; rate ratio of 1.7) (Table 5.5).

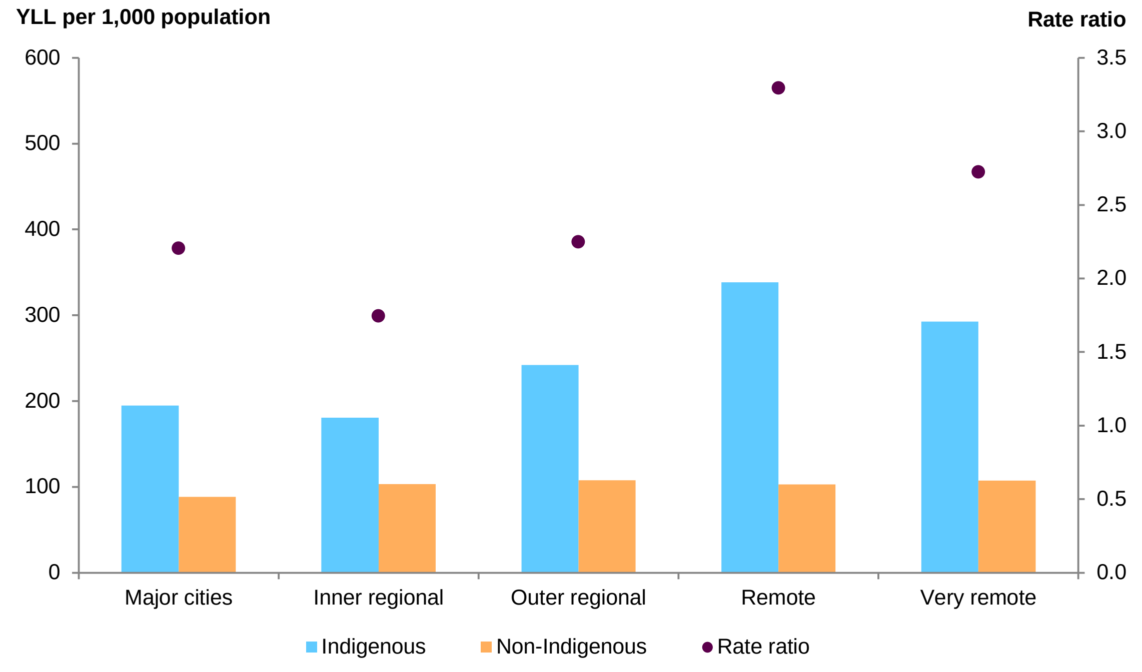
Table 5.5: Age-standardised YLL rates (per 1,000 population), rate ratios and rate differences, by Indigenous status and remoteness, 2010

	YLL per 1,000			
Remoteness	Indigenous	Non-Indigenous	Rate ratio	Rate difference
Major cities	194.7	88.3	2.2	106.4
Inner regional	180.5	103.4	1.7	77.1
Outer regional	242.0	107.6	2.2	134.4
Remote	338.6	102.8	3.3	235.8
Very remote	292.8	107.5	2.7	185.3

Notes

1. Rates are directly age-standardised to the 2001 Australian ERP as at 30 June 2001 (based on the 2001 Census).
2. YLL for 2010 is the annual average of 2009–2011. Deaths have been adjusted using AIHW remoteness adjustment factors (see Appendix E). As a result, estimates by remoteness will not match other estimates in this report which have been adjusted using ABS adjustment factors.

Source: AIHW analysis of the AIHW National Mortality Database.



Notes

1. This figure is based on data in Table 5.5.
2. YLL for 2010 is the annual average of 2009–2011. Deaths have been adjusted using AIHW remoteness adjustment factors (see Appendix E). As a result, estimates by remoteness will not match other estimates in this report which were adjusted using ABS adjustment factors.

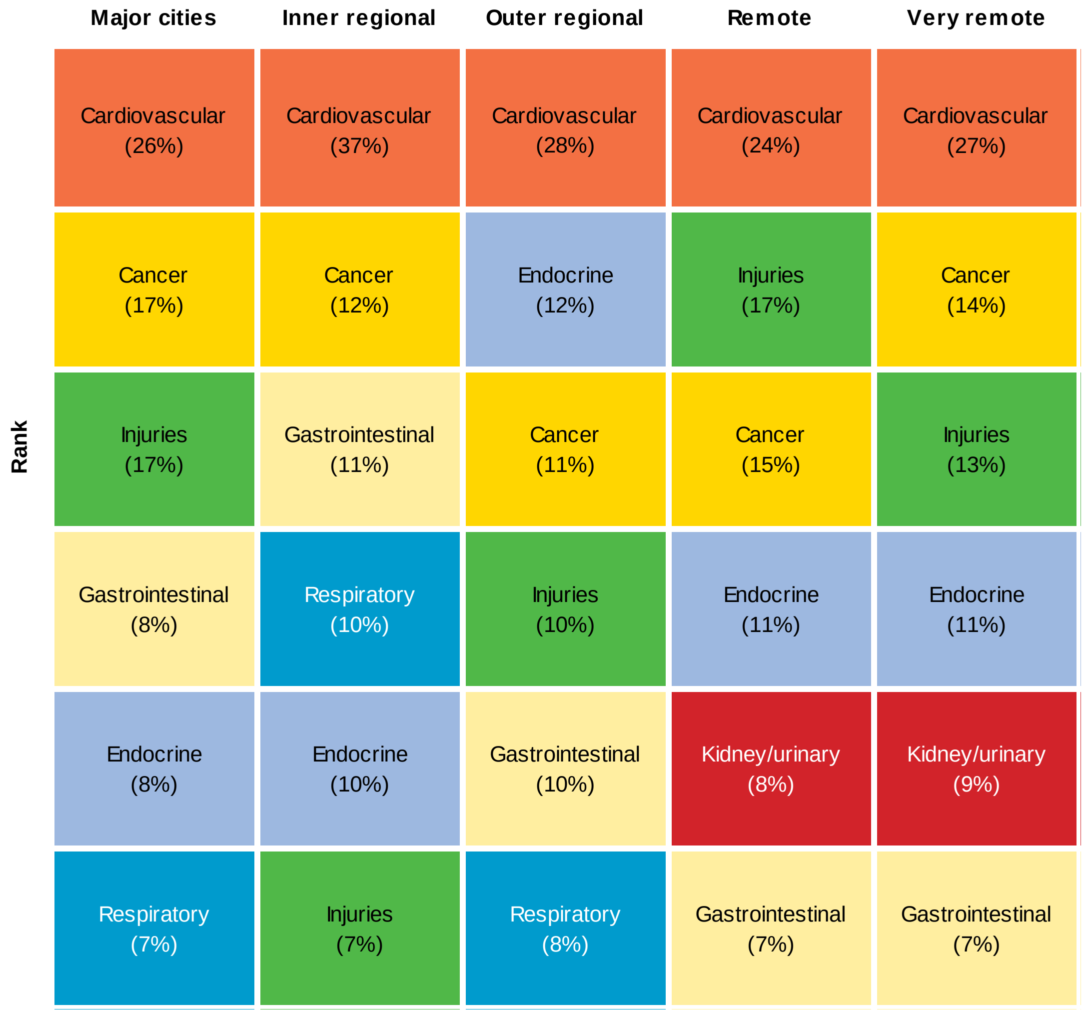
Source: AIHW analysis of the AIHW National Mortality Database.

Figure 5.8: Age-standardised YLL rates and rate ratios, by Indigenous status and remoteness, 2010

Are there differences by remoteness in the main disease groups contributing to the gap in fatal burden?

Figure 5.9 shows the top six disease groups contributing to the gap in fatal burden between Indigenous and non-Indigenous Australians in 2010 in each of the five remoteness categories.

- Cardiovascular diseases were the biggest contributor to the gap in all five remoteness categories (24% of the total rate difference in *Remote* areas to 37% of the total rate difference in *Inner regional* areas).
- Injuries were the second leading contributor to the gap in *Remote* areas (17%) and third in *Major cities* (17%) and *Very remote* areas (13%); however injuries ranked sixth in *Inner regional* areas (7% of the gap).
- Kidney and urinary diseases featured in the top five disease groups contributing to the gap in *Remote* and *Very remote* areas (ranked fifth, and contributing 8% and 9% of the YLL rate difference, respectively).
- Gastrointestinal diseases ranked higher and contributed to a greater proportion of the gap in YLL in non-remote areas than in remote areas.



Major cities	Inner regional	Outer regional	Remote	Very remote
Cardiovascular (26%)	Cardiovascular (37%)	Cardiovascular (28%)	Cardiovascular (24%)	Cardiovascular (27%)
Cancer (17%)	Cancer (12%)	Endocrine (12%)	Injuries (17%)	Cancer (14%)
Injuries (17%)	Gastrointestinal (11%)	Cancer (11%)	Cancer (15%)	Injuries (13%)
Gastrointestinal (8%)	Respiratory (10%)	Injuries (10%)	Endocrine (11%)	Endocrine (11%)
Endocrine (8%)	Endocrine (10%)	Gastrointestinal (10%)	Kidney/urinary (8%)	Kidney/urinary (9%)
Respiratory (7%)	Injuries (7%)	Respiratory (8%)	Gastrointestinal (7%)	Gastrointestinal (7%)

Notes

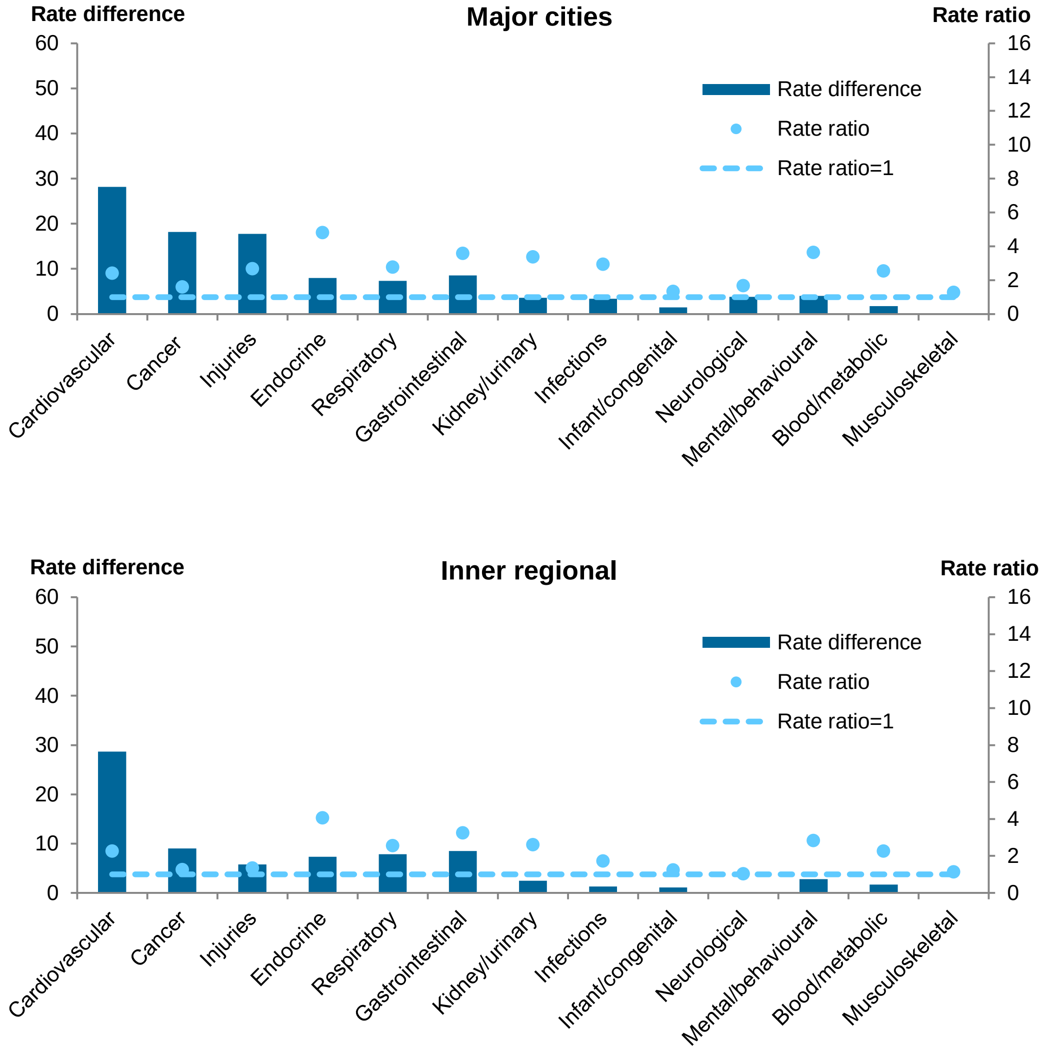
1. This figure is based on data in a supplementary table available online—Table S5.5.
2. YLL for 2010 is the annual average of 2009–2011. Deaths have been adjusted using AIHW remoteness adjustment factors (see Appendix E). As a result, estimates by remoteness will not match other estimates in this report which were adjusted using ABS adjustment factors.

Source: AIHW analysis of the AIHW National Mortality Database.

Figure 5.9: Leading causes contributing to the gap in fatal burden between Indigenous and non-Indigenous Australians (based on YLL rate difference), by disease group and remoteness, 2010

Figure 5.10 presents two measures of the gap—rate differences and rate ratios—by disease group, to provide a picture of the diseases with the largest absolute disparities in fatal burden between the Indigenous and non-Indigenous populations (based on rate differences) and the disease groups with the largest relative disparities (based on rate ratios).

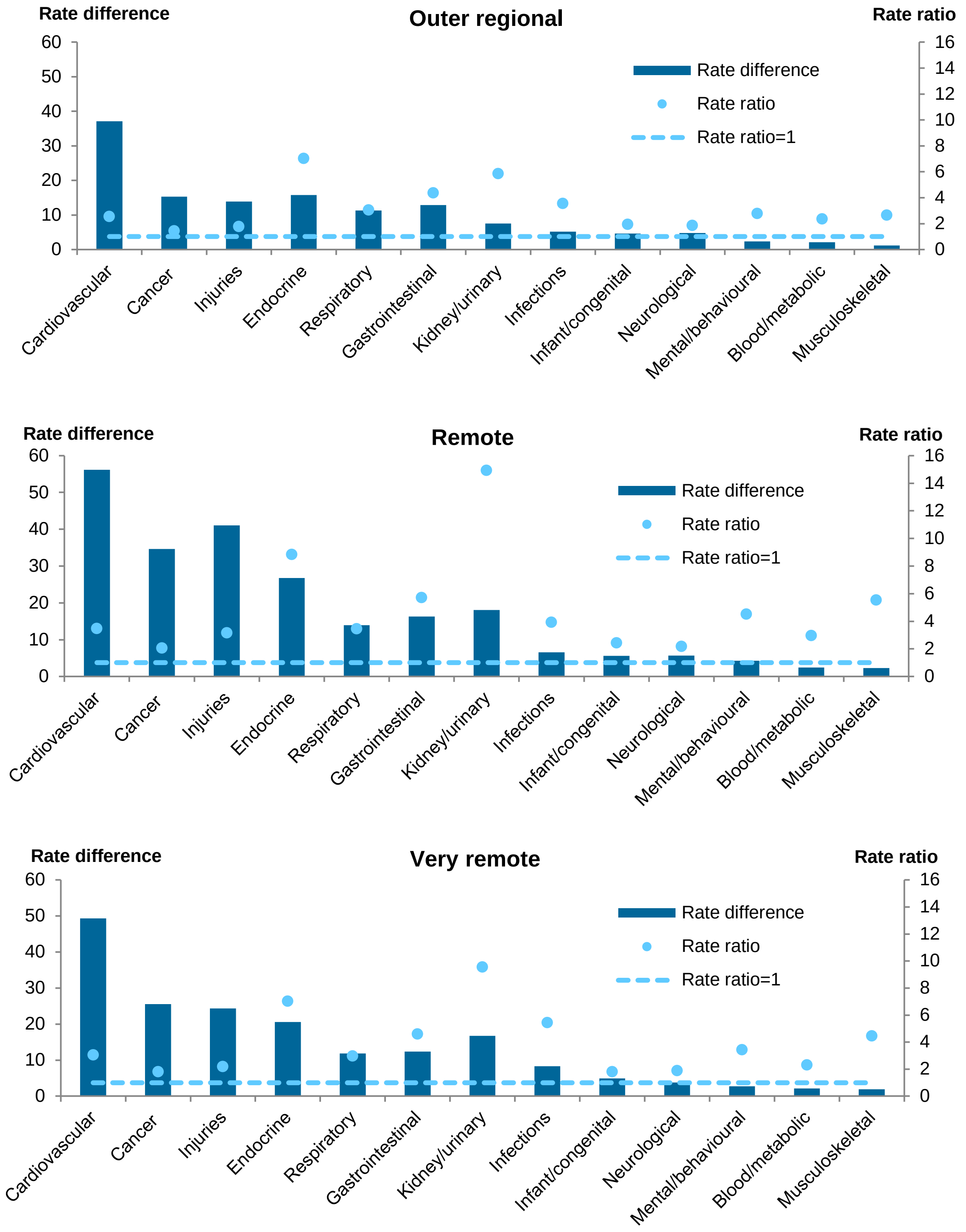
- The largest rate ratio in *Major cities* was for endocrine disorders (4.8). Endocrine disorders also had high rate ratios in the other remoteness categories. In *Remote* and *Very remote* areas, kidney and urinary diseases had the highest rate ratio (14.9 in *Remote* and 9.5 in *Very remote*).



Source: AIHW analysis of the AIHW National Mortality Database.

Figure 5.10: YLL rate ratios and rate differences, by disease group and remoteness, 2010

(continued)



Notes

1. This figure is based on data in a supplementary table available online—Table S5.5.

2. YLL for 2010 is the annual average of 2009–2011. Deaths have been adjusted using AIHW remoteness adjustment factors (see Appendix E). As a result, estimates by remoteness will not match other estimates in this report which were adjusted using ABS adjustment factors.

Source: AIHW analysis of the AIHW National Mortality Database.

Figure 5.10 (continued): YLL rate ratios and rate differences, by disease group and remoteness, 2010

5.3 Socioeconomic disadvantage

This section presents the number and crude rate of YLL for the Indigenous population by Indigenous Relative Socioeconomic Outcomes (IRSEO) index quintile (Biddle 2009; Biddle 2013). This is an Indigenous-specific index of socioeconomic disadvantage, developed by Dr Nicholas Biddle of the Centre for Aboriginal Economic Policy Research (CAEPR), which reflects the level of socioeconomic disadvantage experienced by Indigenous Australians living in each Indigenous Area in Australia. The 1st quintile is the most disadvantaged and the 5th quintile is the least disadvantaged.

Crude YLL rates for the non-Indigenous population are also presented in this section using a rescaled Pooled Non-Indigenous Relative Socioeconomic Outcomes index (PNIRSEO) (Biddle 2013), which uses a ranking for the socioeconomic disadvantage of non-Indigenous Australians living in each area. While not directly comparable to the IRSEO Index, it enables an examination of differences in the general pattern and variation by socioeconomic disadvantage in the fatal burden of disease for the two population groups.

Further information on socioeconomic disadvantage indexes available, and those used in this report, can be found in Appendix C.

What is the overall fatal burden experienced by Indigenous Australians in each quintile of socioeconomic disadvantage?

Table 5.6 shows the number of deaths, number of YLL and the percentage of total Indigenous YLL observed in 2010 by socioeconomic disadvantage quintile (based on the IRSEO index). As the ISREO index quintiles are based on the number of regions, rather than the number of individuals within each region, differences in the number of deaths and YLL in each quintile may reflect differences in the size of the population within each quintile.

Table 5.6: Number of adjusted deaths and YLL for Indigenous Australians, by socioeconomic disadvantage quintile (IRSEO index), 2010

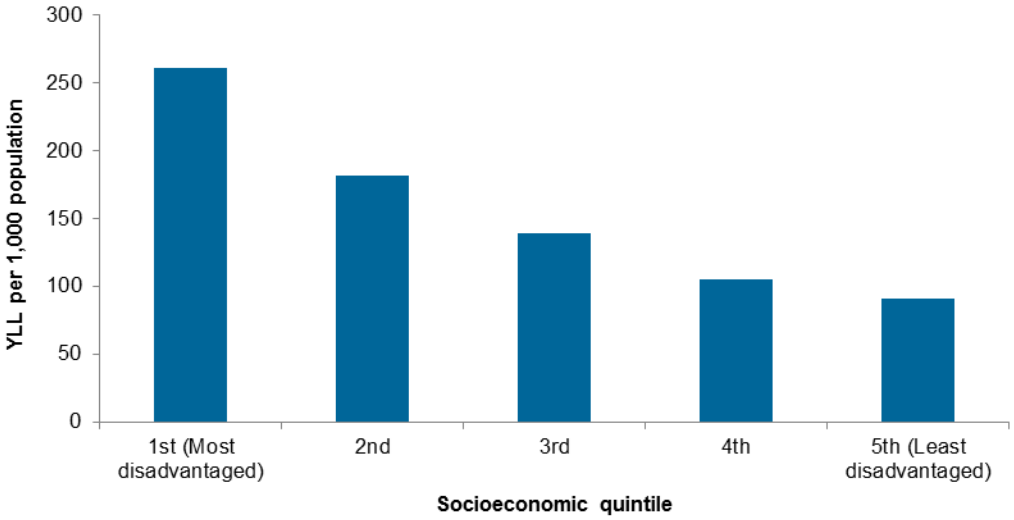
		YLL		
Socioeconomic disadvantage quintile (IRSEO index)	**Deaths**	**Number**	**% of total Indig. YLL[(a)]**	**Crude YLL rate per 1,000 population**
1st (Most disadvantaged)	624	22,723	23.7	261.2
2nd	558	18,402	19.2	181.7
3rd	760	24,679	25.7	139.1
4th	557	18,310	19.1	105.1
5th (Least disadvantaged)	387	11,625	12.1	90.6

(a) Excluding deaths with unknown IRSEO quintile.

Note: Number of deaths and YLL for 2010 is the annual average of 2009–2011. Deaths have been adjusted using ABS adjustment factors (see Appendix E).

Source: AIHW analysis of the AIHW National Mortality Database.50

When examining crude YLL rates per 1,000 Indigenous population, a consistent gradient was observed by socioeconomic disadvantage quintile (Figure 5.11). Indigenous people living in areas with the most socioeconomic disadvantage experienced the highest rate of YLL (261 per 1,000 population) and those in areas with the least socioeconomic disadvantage experienced the lowest rate of YLL (91 per 1,000 population).



Notes

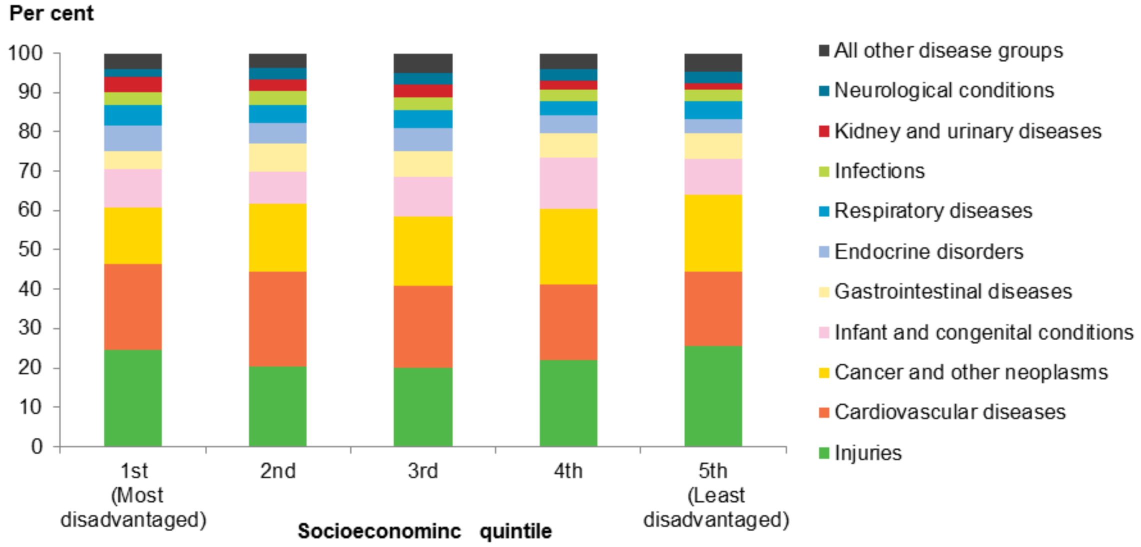
1. ERP by Indigenous status and SA2 are only available in Census years. As a result the rates are calculated using 2011 Indigenous ERP at SA2 level.
2. This figure is based on data in Table 5.6.
3. YLL for 2010 is the annual average of 2009–2011. Deaths have been adjusted using ABS adjustment factors (see Appendix E).

Source: AIHW analysis of the AIHW National Mortality Database.

Figure 5.11: Crude YLL rates (per 1,000 population) for Indigenous Australians, by socioeconomic disadvantage quintile (IRSEO index), 2010

Are there differences by socioeconomic disadvantage in the main disease groups contributing to fatal burden for Indigenous Australians?

- In 2010, injuries, cardiovascular diseases and cancer were among the top three contributors to fatal burden among Indigenous Australians in each socioeconomic disadvantage quintile. There were some minor differences, however, in the ranking and percentage contribution to Indigenous YLL (Figure 5.12; Table 5.7). For example, cancer contributed a larger proportion of YLL for Indigenous Australians living in the least socioeconomically disadvantaged quintile (20%) compared to the most disadvantaged quintile (14%), and cardiovascular diseases contributed a larger proportion of YLL in the two most disadvantaged quintiles (4th and 5th).
- Endocrine disorders ranked higher and contributed a larger proportion of YLL for Indigenous Australians living in the most disadvantaged quintile (ranked 5th and contributing 6% of YLL), compared to the least disadvantaged quintile (ranked 7th and contributing 4% of YLL).



Notes

1. This figure is based on data in Table 5.7 and a supplementary table available online—Table S5.8.
2. YLL for 2010 is the annual average of 2009–2011. Deaths have been adjusted using ABS adjustment factors (see Appendix E).

Source: AIHW analysis of the AIHW National Mortality Database.

Figure 5.12: Proportion of disease groups contributing to YLL for Indigenous Australians, by socioeconomic disadvantage quintile (IRSEO index), 2010

Table 5.7: Ranking and percentage contribution of leading disease groups to total YLL, by socioeconomic disadvantage quintile (IRSEO index), 2010

	1st (Most dis-advantaged)		2nd		3rd		4th		5th (Least dis-advantaged)	
Disease group	**Rank**	**%**	**Rank**	**%**	**Rank**	**%**	**Rank**	**%**	**Rank**	**%**
Injuries	1	24.6	2	20.4	2	20.0	1	22.0	1	25.6
Cardiovascular diseases	2	21.9	1	23.9	1	20.9	2	19.3	3	18.8
Cancer and other neoplasms	3	14.3	3	17.3	3	17.6	3	19.2	2	19.6
Infant and congenital conditions	4	9.7	4	8.3	4	10.2	4	12.8	4	9.2
Gastrointestinal diseases	7	4.7	5	7.1	5	6.5	5	6.4	5	6.4
Endocrine disorders	5	6.3	6	5.3	6	5.9	6	4.4	7	3.5
Respiratory diseases	6	5.2	7	4.6	7	4.4	7	3.8	6	4.8
Infections	9	3.3	8	3.4	8	3.4	9	2.9	10	2.9
Kidney and urinary diseases	8	3.9	9	3.2	9	3.2	10	2.3	(b)	1.5
Neurological conditions	10	2.2	10	2.8	(a)	2.8	8	3.0	8	3.0

(a) Neurological conditions fell outside the top 10 leading causes in the 3rd quintile as Mental and behavioural disorders ranked 10th.

(b) Kidney and urinary diseases fell outside the top 10 leading causes in the 5th quintile as Mental and behavioural disorders was ranked 9th.

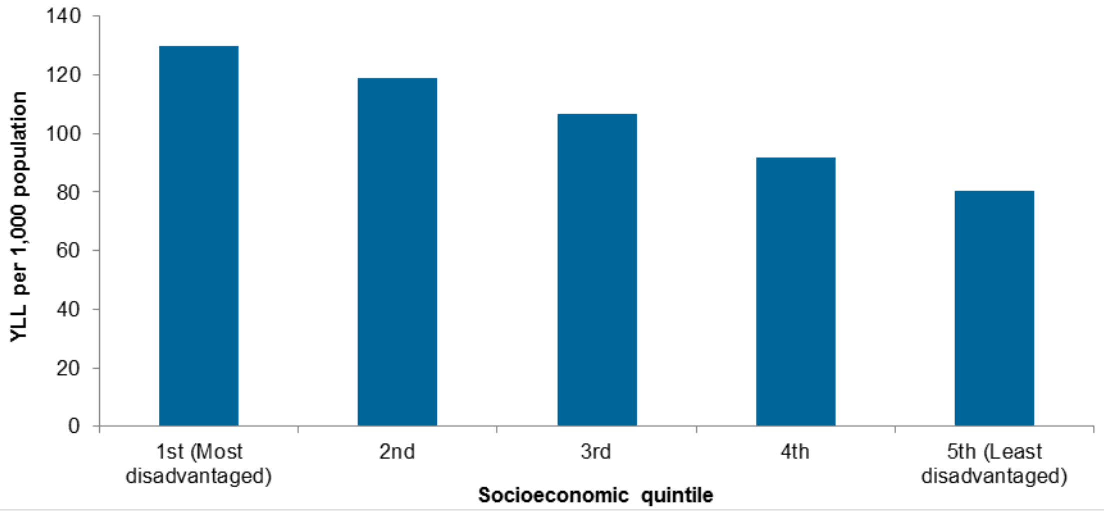
Note: YLL for 2010 is the annual average of 2009–2011. Deaths have been adjusted using ABS adjustment factors (see Appendix E).

Source: AIHW analysis of the AIHW National Mortality Database.

How does the pattern in fatal burden by socioeconomic disadvantage for the Indigenous population compare to that observed for the non-Indigenous population?

Figure 5.13 presents crude YLL rates for non-Indigenous Australians by socioeconomic disadvantage quintile based on the rescaled PNIRSEO index.

- In 2010, the highest YLL rates were observed for non-Indigenous persons living in the most socioeconomically disadvantaged areas (130 YLL per 1,000 population) and the lowest YLL rates were observed for non-Indigenous persons living in the least disadvantaged areas (80 YLL per 1,000 population) (Figure 5.13).
- While not directly comparable to Indigenous YLL rates based on the IRSEO index due to the different indexes used, examination of YLL rates by socioeconomic disadvantage for the non-Indigenous population (based on the PNIRSEO index) show the same general pattern as seen in the Indigenous population (increasing rates of YLL with increasing level of disadvantage). However the gradient by socioeconomic disadvantage was not as steep as seen in the Indigenous population.



Notes

1. ERP by Indigenous status and SA2 are only available in Census years. As a result the rates are calculated using 2011 non-Indigenous ERP at SA2 level.
2. This figure is based on data in a supplementary table available online—Table S5.9.
3. YLL for 2010 is the annual average of 2009–2011. Deaths have been adjusted using ABS adjustment factors (see Appendix E).

Source: AIHW analysis of the AIHW National Mortality Database.

Figure 5.13: Crude YLL rates for non-Indigenous Australians, by socioeconomic disadvantage quintile (PNIRSEO index), 2010

6 International comparisons

International comparisons are important in order to benchmark Australia against countries that share similar health goals and face similar challenges, such as those relating to the health needs of indigenous populations.

Burden of disease estimates are available for the Māori population of New Zealand from the recent *New Zealand Burden of Diseases, Injuries and Risk Factors Study, 2006–2016* (NZBD) which is described below. This chapter presents high level comparisons of YLL estimates for the Aboriginal and Torres Strait Islander population compared to the Māori population, as well as comparisons of the mortality gap (differences in rates of fatal burden) between the indigenous and non-indigenous populations in the two countries. Methodological differences between the ABDS and the New Zealand study should be taken into consideration when interpreting the results presented in this chapter (for further details see 'Comparability between the ABDS and NZBD' in section 6.1 below).

6.1 New Zealand Burden of Diseases, Injuries and Risk Factors Study, 2006–2016

The NZBD included burden of disease estimates (including YLL estimates) for both major ethnic groups (Māori and non-Māori) in New Zealand. Apart from the previous and current Indigenous Australian burden of disease studies, this is the only national study to have produced estimates for an indigenous population. Estimates for the Māori population (and estimates of the gap between Māori and non-Māori) can therefore potentially be used for international comparisons with estimates produced for the Aboriginal and Torres Strait Islander population in Australia.

While Māori make up a much greater proportion of the total New Zealand population (15% in 2013) compared to the proportion of the Indigenous population in Australia (3% in 2011), the age structures of the two populations are quite similar. For example, just over one-third of the Indigenous Australian and Māori populations are aged under 15 (36.5% and 34.5%, respectively), whereas only 3.3% of the Indigenous Australian population and 4.1% of the Māori population are aged 65 or over.

Comparability between the ABDS and NZBD

The ABDS and NZBD studies have similarities in methodologies used for estimating YLL. For example, both studies use the same standard life table, use a single high quality data source for mortality data, and do not use age-weighting or discounting. There are differences in cause lists, reporting periods and redistribution methods used, but these differences are unlikely to affect broad comparisons between the ABDS and NZBD results presented here (see below for more details).

One methodological difference between the two studies that could affect comparability of the results is the standard population used to directly age-standardise YLL rates to allow for comparability between indigenous and non-indigenous populations. The standard population used for the ABDS is the Australian population at 30 June 2001 (based on the 2001 Census), whereas the standard population used for NZBD was the WHO World Population. To increase the comparability of results between the ABDS and NZBD in this section, YLL rates for Australia have been recalculated using the WHO World Population as the standard population.

Table 6.1 provides a comparison of the key methodological approaches for the ABDS and NZBD for the calculation of YLL estimates.

Table 6.1: Comparison of key methodological differences for YLL estimates between the ABDS and NZBD

Component	ABDS (Aboriginal and Torres Strait Islander estimates)	NZBD (Māori estimates)
Cause list	195 diseases grouped into 17 broad disease groups	217 diseases and injuries grouped into 16 broad disease groups
Standard life table	GBD 2010[(a)]	GBD 2010[(a)]
Age groups	16 age groups (0–4, 5–9,…70–74, 75+ years)	19 age groups (0–1,1–4,5–9,…80–84, 85+ years)
Data sources[(b)]	Single source— AIHW's National Mortality Database	Single source—New Zealand Mortality collection
Standard population (for ethnicity group comparisons)[(c)]	2001 total Australian population (based on 2001 Census ERP) [(c)]	WHO World Population
Discounting	None	None
Age weighting	None	None
Period reported	2010	2006
Time period for mortality data analyses	2009–2011	2005–2007

(a) Aspirational life table developed as part of the GBD 2010 study.

(b) By international standards both Australia and New Zealand are regarded as having high-quality systems of death registration, with relatively few deaths coded to problematic underlying causes of death.

(c) For this section of the report, to increase comparability with the NZBD, YLL rates for Australia have been recalculated using the WHO World Population as the standard population.

Cause list

The ABDS and NZBD have similar, but not identical, lists of conditions and sequelae, and the case definitions sometimes differ. The disease groups do not always include the same list of causes and in some circumstances, different ICD-10 codes are used to count causes of death. Differences in ICD code allocation creates potential differences between studies, but those variations mostly impact at the cause level rather than disease group level so have less impact on the results presented in this chapter. However, there are some coding differences that do impact at the disease group level. An example is chronic viral hepatitis C, which is included in the *Infections disease* group in NZBD, but is included in the *Gastrointestinal diseases* group in the ABDS.

A corresponding NZBD disease group can be identified for 16 of the 17 broad condition groups used in the ABDS (see Table 6.2). The main difference is the inclusion of a separate disease group *Blood and metabolic disorders* in the Australian Study. In NZBD the disease group *Diabetes and other endocrine disorders* included metabolic disorders, and *Vascular and blood disorders* included blood disorders. Only a small number of total YLL are attributed to the *Blood and metabolic disorders* disease group for Indigenous Australians in the ABDS (1.3% of total YLL, see Table 3.2). Comparatively, a much larger number of YLL are attributed to 'Cardiovascular diseases' and 'Endocrine disorders' (21.0% and 5.4% of total YLL for Indigenous Australians, respectively). Hence, the decision was made to exclude the ABDS disease group 'Blood and metabolic disorders' from the comparison analysis in this chapter. The ABDS disease groups *Cardiovascular diseases* and *Endocrine disorders* were deemed comparable to the NZBD disease groups *Vascular and blood disorders* and *Diabetes and other endocrine disorders*.

As the ABDS disease group *Blood and metabolic disorders* only accounts for a small number of YLL (3.5 YLL per 1,000 population, see Table 4.2), the impact of excluding this disease group from the analyses is likely to be minimal. When *Blood and metabolic disorders* was included in the ABDS rankings for YLL rates per 1,000 population at the preliminary analyses stage for this chapter it ranked 12th for Indigenous Australian males and 11th for Indigenous Australian females.

Table 6.2: Broad disease group comparison for the ABDS and NZBD

ABDS broad disease groups	NZBD broad condition groups
Cancer and other neoplasms	Cancers and other neoplasms
Cardiovascular diseases	Vascular and blood disorders
Chronic musculoskeletal disorders	Musculoskeletal disorders
Respiratory diseases	Respiratory disorders
Endocrine disorders	Diabetes and other endocrine disorders
Gastrointestinal diseases	Gastrointestinal disorders
Infant and congenital conditions	Infant conditions and birth defects
Infections	Infections
Injuries	Injury
Kidney and urinary diseases	Genitourinary disorders
Mental illnesses and behavioural disorders	Mental disorders
Neurological conditions	Neurological conditions
Oral disorders	Dental disorders
Reproductive and maternal conditions	Reproductive and gestational disorders
Sense organ disorders	Sense organ disorders
Skin disorders	Skin disorders
Blood and metabolic disorders	. .

Reporting periods

The ABDS and NZBD have different reporting periods: 2010 for the ABDS (based on analyses of data from 2009–2011) and 2006 for NZBD (based on data from 2005–2007). This difference in reporting periods is expected to have minimal impact on the international comparisons made in this chapter.

Redistribution methods

The ABDS uses a similar approach for redistribution to other burden of disease studies, but the algorithms or exact specifications for the reassignment are different (see Appendix D). Three methods for redistribution of Indigenous and total Australian deaths were used in the ABDS; the application of redistribution algorithms based on direct evidence, indirect multiple cause of death analysis, and proportionate allocation within age-by-sex strata. Using the Australian cause list, approximately 10% of total Australian deaths, 8% of total YLL and about 8% of Indigenous deaths were identified for redistribution.

The NZBD used three different types of redistribution algorithms for both the Māori and non-Māori populations; simple proportionate redistribution within age-by-sex strata, statistical modelling and expert judgement. In all, 10.4% of deaths (7.1% of YLL) were redistributed in NZBD (MOH 2012).

Although it is not possible to quantify the exact impact of the different redistribution methods used by the two studies, the NZBD redistribution proportions (10% of deaths, 7% of YLL) are very similar to those in the ABDS (10% of deaths, 8% of YLL).

6.2 Results

Total YLL and rate difference (gap measure)

When directly age-standardised to the WHO World Population, the total YLL per 1,000 population were slightly higher for Aboriginal and Torres Strait Islander males and females (243 and 166 per 1,000 respectively) than for Māori males and females (223 and 148 per 1,000 respectively) (Table 6.3).

The gap (measured as the rate difference between the indigenous and non-indigenous populations in each country) was also higher for males and females in Australia than in New Zealand (rate difference for males of 151 compared to 119, and for females of 110 compared to 82, in Australia and New Zealand respectively).

For both countries, indigenous YLL rates and rate differences were higher for males than for females.

Table 6.3: Age-standardised YLL rates (per 1,000), rate ratios and rate differences, for the Australian Aboriginal and Torres Strait Islander population (2010) and New Zealand Māori (2006)[(a)(b)]

	Males			Females		
	Indigenous YLL per 1,000[(a)]	Rate ratio	Rate difference	Indigenous YLL per 1,000[(a)]	Rate ratio	Rate difference
Australia Indigenous	242.5	2.6	150.9	165.9	2.9	109.6
New Zealand Māori	222.6	2.2	119.3	148.1	2.2	82.3

(a) Rates directly age-standardised to the WHO World Population.

(b) Analyses for Indigenous Australians based on 2009–2011 mortality data and adjusted deaths using ABS adjustment factors.

Source: AIHW analysis of the AIHW National Mortality Database; AIHW analysis of NZBD results.

Broad disease groups

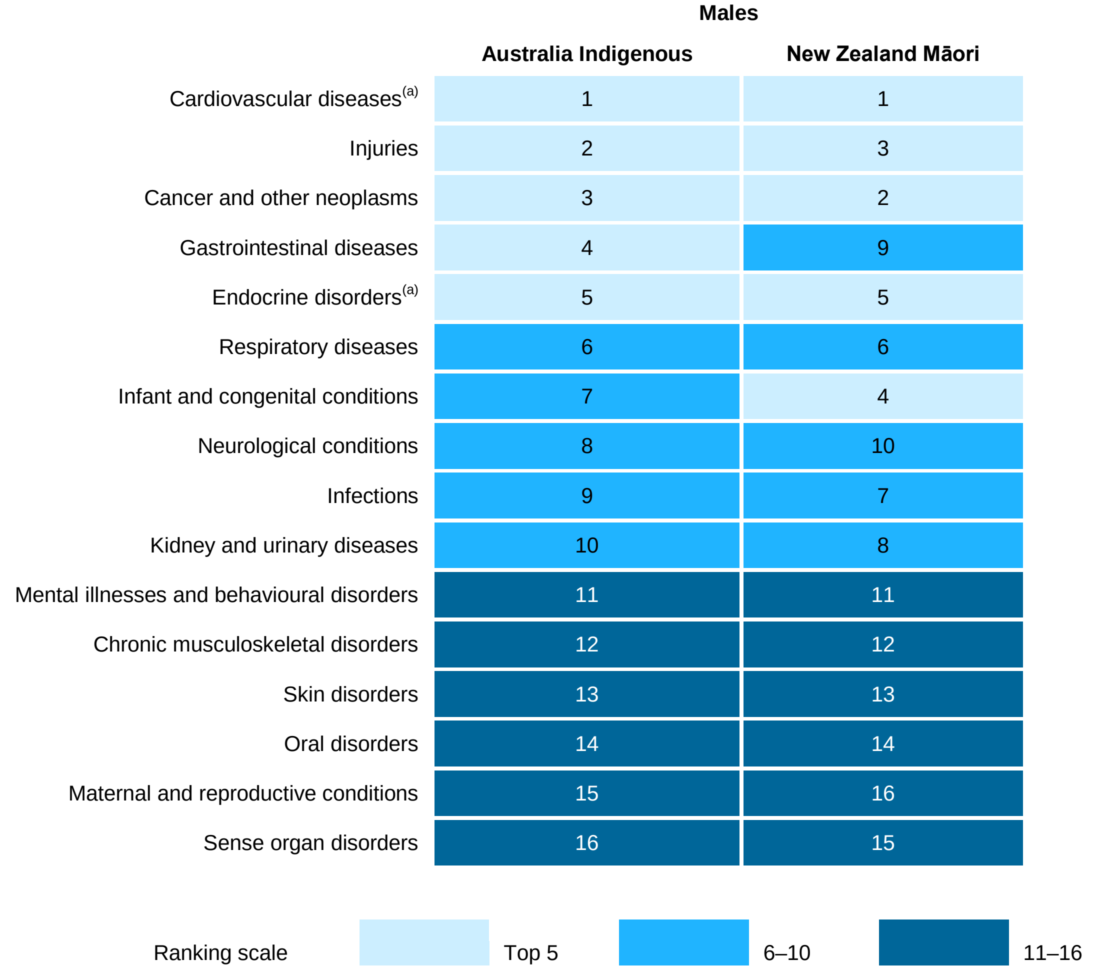
Rankings

Figures 4.1 and 4.2 compare the rankings of the 16 broad disease groups by fatal burden for Indigenous Australians and Māori by sex. Different colours are used to represent disease rankings within each country; for example, the lightest colour indicates the five disease groups with the highest YLL rate per 1,000 population. The numbers indicate the rank (based on YLL rate) of that disease group in each country.

Overall, there was reasonable agreement between the rankings of disease groups by their contribution to the fatal burden for Indigenous Australians and Māori. Cardiovascular diseases, cancer and injuries were the top three contributors to the fatal burden for

Indigenous males and females in both Australia and New Zealand. And the lowest six of the 16 contributing disease groups were the same in Australia and New Zealand for both males and females.

The largest disparities between the Indigenous Australian and Māori YLL rankings were for gastrointestinal diseases, infant and congenital conditions and infections. Gastrointestinal diseases ranked higher for Indigenous Australian males and females (4th and 6th, respectively) than for Māori males and females (9th and 10th, respectively). Comparatively, infant and congenital conditions and infections ranked lower for Indigenous Australian males and females (7th and 9th/10th) than for Māori males and females (4th and 7th) (figures 6.1 and 6.2).



Males

	Australia Indigenous	New Zealand Māori
Cardiovascular diseases[(a)]	1	1
Injuries	2	3
Cancer and other neoplasms	3	2
Gastrointestinal diseases	4	9
Endocrine disorders[(a)]	5	5
Respiratory diseases	6	6
Infant and congenital conditions	7	4
Neurological conditions	8	10
Infections	9	7
Kidney and urinary diseases	10	8
Mental illnesses and behavioural disorders	11	11
Chronic musculoskeletal disorders	12	12
Skin disorders	13	13
Oral disorders	14	14
Maternal and reproductive conditions	15	16
Sense organ disorders	16	15

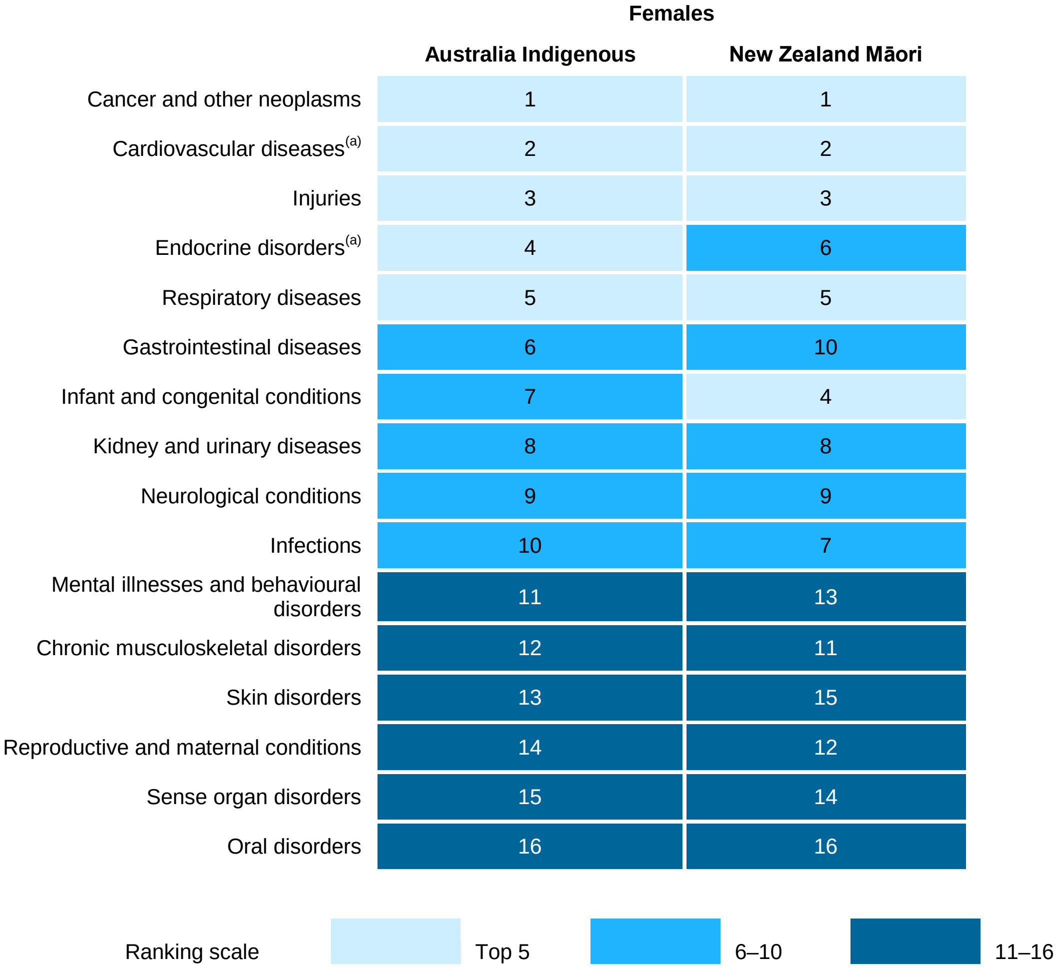
Ranking scale ▢ Top 5 ▨ 6–10 ■ 11–16

(a) In the NZBD, 'Endocrine disorders' include metabolic disorders, and 'Cardiovascular diseases' include blood disorders. In the ABDS there was a separate broad disease group for 'Blood and metabolic disorders' that has been excluded from this comparison analysis. For Indigenous Australian males, 'Blood and metabolic disorders' accounted for a small number of YLL (4.2 YLL per 1,000 population) and a small proportion of the total gap (1.6%) (see supplementary table available online—Table S4.3).

Note: This figure is based on data in a supplementary table available online—Table S6.1.

Source: AIHW analysis of the AIHW National Mortality Database; AIHW analysis of NZBD results.

Figure 6.1: Ranking of broad disease groups by YLL for Indigenous Australian (2010) and Māori males (2006)



Females	Australia Indigenous	New Zealand Māori
Cancer and other neoplasms	1	1
Cardiovascular diseases[(a)]	2	2
Injuries	3	3
Endocrine disorders[(a)]	4	6
Respiratory diseases	5	5
Gastrointestinal diseases	6	10
Infant and congenital conditions	7	4
Kidney and urinary diseases	8	8
Neurological conditions	9	9
Infections	10	7
Mental illnesses and behavioural disorders	11	13
Chronic musculoskeletal disorders	12	11
Skin disorders	13	15
Reproductive and maternal conditions	14	12
Sense organ disorders	15	14
Oral disorders	16	16

(a) In the NZBD 'Endocrine disorders' include metabolic disorders and 'Cardiovascular diseases' include blood disorders. In the ABDS there was a separate broad disease group for 'Blood and metabolic disorders' which has been excluded from this comparison analysis. For Indigenous Australian females, 'Blood and metabolic disorders' accounted for a small number of YLL (2.9 YLL per 1,000 population) and a small proportion of the total gap (1.4%) (see supplementary table available online—Table S4.3).

Note: This figure is based on data in a supplementary table available online—Table S6.2.

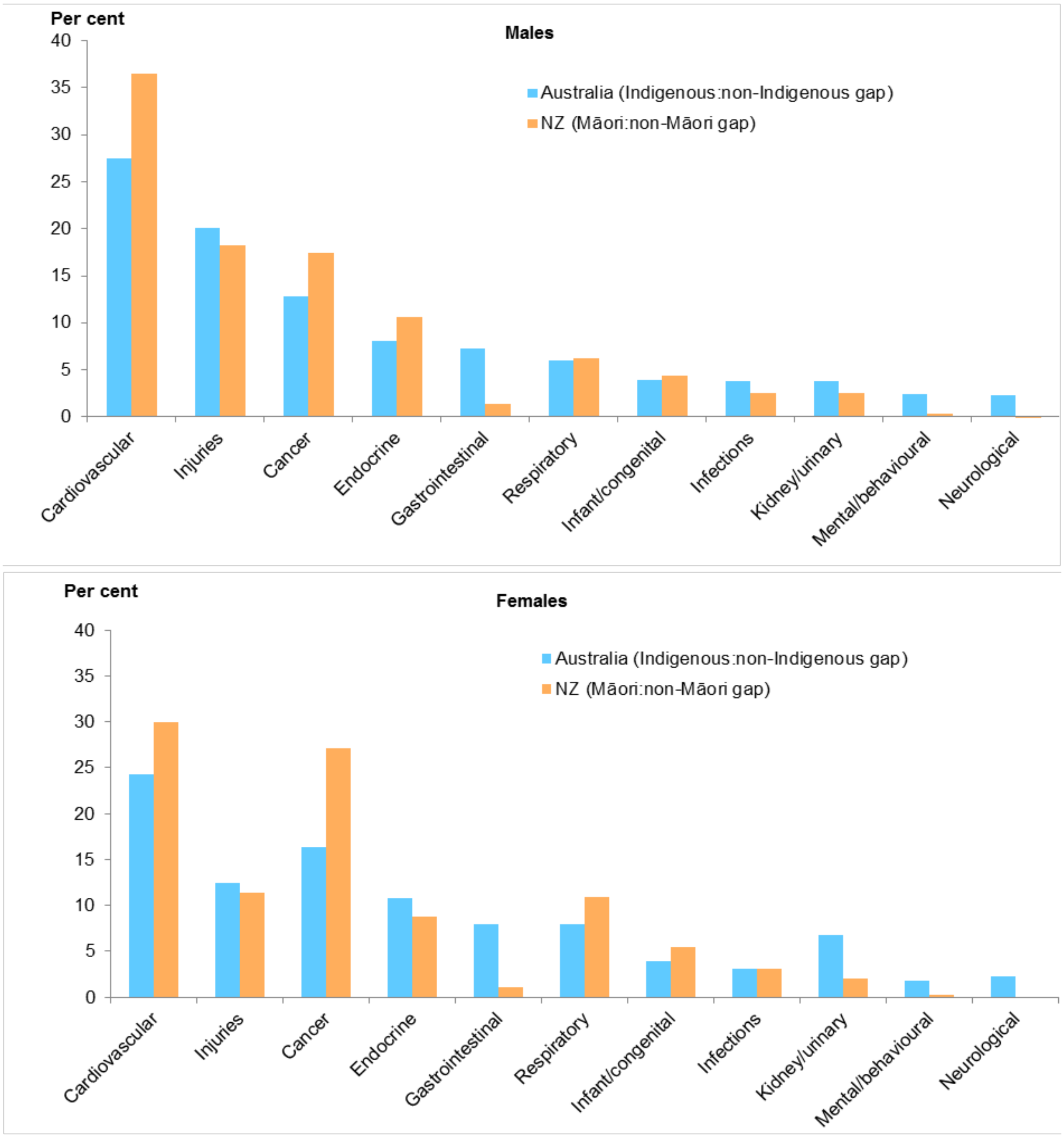
Source: AIHW analysis of the AIHW National Mortality Database; AIHW analysis of NZBD results.

Figure 6.2: Ranking of broad disease groups by YLL for Indigenous Australian (2010) and Māori females (2006)

Contribution to total gap

Figure 6.3 presents the percentage contributions of each disease group to the gap in fatal burden (based on the YLL rate difference) between Indigenous and non-Indigenous Australians compared to the gap between Māori and non-Māori in New Zealand.

- Cardiovascular diseases, cancer and injuries were the top three contributors to the gap in fatal burden for males and females in both Australia and New Zealand. These three disease groups accounted for over half the total YLL gap between Indigenous and non-Indigenous Australian males and females ((60% and 53% respectively), and over two-thirds of the total YLL gap between Māori and non-Māori males and females (72% and 69% respectively).



Notes

1. In the NZBD the equivalent 'Endocrine disorders' condition group ('Diabetes and other endocrine disorders') included metabolic disorders and the equivalent 'Cardiovascular diseases' condition group ('Vascular and blood disorders') included blood disorders. In the ABDS there was a separate broad disease group for 'Blood and metabolic disorders' which has been excluded from this comparison analysis. For Indigenous Australian males and females 'Blood and metabolic disorders' accounted for a small number of YLL (4.2 and 2.9 YLL per 1,000 population, respectively) and a small proportion of the total gap (1.6% and 1.4%, respectively) (see supplementary table available online—Table S4.3).
2. Rates directly age-standardised to the WHO World Population.
3. This figure is based on data in supplementary tables available online—tables S6.1 and S6.2.

Source: AIHW analysis of the AIHW National Mortality Database; AIHW analysis of NZBD results.

Figure 6.3: Percentage contributions to the gap (based on YLL rate difference), by disease group and sex, Australia Indigenous:non-Indigenous (2010) and New Zealand Māori: non-Māori (2006)

7 Discussion

This report provides estimates of fatal burden among the Aboriginal and Torres Strait Islander population in Australia at the disease group level. Estimates of the gap in fatal burden between Indigenous and non-Indigenous Australians are also presented, as well as estimates for selected state/territories, remoteness and socioeconomic disadvantage where valid.

In recent decades improvements have been made to both the quality and availability of data on the health of Indigenous Australians. However, a number of limitations need to be considered when interpreting the results of this report. Firstly, national data linkage studies have provided adjustment factors that can be used to correct for under-identification of Indigenous status in death registrations. While using these factors improves the accuracy of YLL estimates presented in this report, uncertainty still exists around the true level of mortality among Indigenous Australians. A long-term strategy to improve Indigenous mortality estimates is through improvements to the data at the collection phase so that fewer adjustments will be necessary for Indigenous mortality reporting in the future.

A second limitation is that the Indigenous population is very small relative to the non-Indigenous population, accounting for 3% of the total Australian population. Small numbers in either the population or deaths data can affect the reliability of results, particularly when data are compared across disease groups, age groups or jurisdictions.

Two key methodological issues in producing estimates of fatal burden for the Indigenous population were therefore to determine the most suitable approach for adjusting deaths for Indigenous under-identification in mortality data, and assessing the number of years of mortality data to combine to produce robust YLL estimates to overcome small numbers.

In addition, a number of other methodological considerations specific to Indigenous estimates were examined. These included deciding on the best means of measuring the mortality gap between Indigenous and non-Indigenous Australians (including considering the benefits of using either direct or indirect age-standardisation, and rate differences compared to rate ratios); determining the most appropriate measure of socioeconomic disadvantage for the Indigenous population, and assessing the impact of using different standard life tables on resulting Indigenous YLL estimates. In consultation with the Indigenous Reference Group (IRG), a significant amount of work was undertaken to test the sensitivity of results to differing methodological choices.

As a result, AIHW authors and the IRG agreed to:

- Adopt the GBD 2010 standard life table for calculation of Indigenous YLL. While using this life table results in a greater YLL for Indigenous Australians than using life tables with a lower life expectancy (as used in previous burden of disease studies), sensitivity analyses shows no difference in the ranking of diseases in terms of both Indigenous YLL and the 'gap' in fatal burden.
- Aggregate three years of mortality data, and combine age groups and disease groups where needed in order to overcome issues with small numbers and improve the reliability of the estimates.
- Apply ABS mortality adjustment factors to correct Indigenous under-identification in mortality data, with the exception of estimates by remoteness, for which AIHW

adjustment factors were used due to limitations with the available ABS remoteness adjustment factors.

- Report state/territory results for New South Wales, Queensland, Western Australia and the Northern Territory only. Indigenous YLL estimates are not presented for Victoria, South Australia, Tasmania or the Australian Capital Territory due to the small number of Indigenous deaths reported for these jurisdictions, and because individual state/territory adjustment factors are not available from the ABS for these states and territories.
- Use direct age-standardisation to calculate YLL rates for comparing the Indigenous and non-Indigenous populations.
- Use YLL rate differences as the primary measure of the gap in fatal burden, and rate ratios as a secondary measure where appropriate.
- Use the Indigenous Relative Socioeconomic Outcomes (IRSEO) index to examine variation in the fatal burden of disease for the Indigenous population by level of socioeconomic disadvantage.

Key findings and policy implications

A considerable component of the fatal burden in the Aboriginal and Torres Strait Islander population is experienced in infancy (12% of total YLL for males and 11% for females) and in middle age. This reflects the relatively high number of deaths occurring in these age groups, as well as a larger number of potential years of life lost per individual compared to deaths occurring in the older age groups.

Injuries and cardiovascular diseases were the leading causes of fatal burden among the Indigenous population in 2010 (22% and 21% of total YLL respectively), followed by cancer (17%). Injuries ranked ahead of cardiovascular diseases and cancer, despite having a lower number of deaths. The higher burden from injuries relative to the proportion of deaths is primarily due to Indigenous people dying (on average) at younger ages from injuries than from cardiovascular diseases or cancer and therefore having more years of life lost (injuries were the leading cause of death among Indigenous people aged 1 to 34 years).

Across all disease groups, Indigenous males contributed an equal or greater share of the fatal burden than Indigenous females, with the exception of chronic musculoskeletal disorders and kidney and urinary diseases. Disparities between the sexes, when measured as a proportion of total years of life lost, were greatest for mental illnesses and behavioural disorders (65% male), injuries (70% male) and chronic musculoskeletal disorders (66% female).

Two measures were used in this report to estimate the gap in fatal burden between Indigenous and non-Indigenous Australians: rate differences and rate ratios. Rate differences (primary gap measure) provide a measure of the absolute disparity or mortality gap between the two populations. Using rate differences, the total gap in fatal burden between Indigenous and non-Indigenous Australians in 2010 was 152 YLL per 1,000 population. The diseases that made the largest contribution to the gap in fatal burden were cardiovascular diseases (responsible for 27% of the gap), cancer and other neoplasms (15%), injuries (14%), and endocrine disorders (10%). Chronic diseases accounted for around 80% of the total gap in fatal burden between Indigenous and non-Indigenous persons aged 55 years and over in 2010.

A useful secondary measure, the rate ratio, provides a measure of the relative disparity or gap in fatal burden between the Indigenous and non-Indigenous populations. After adjusting for differences in age structure, the rate of fatal burden of disease in 2010 in the Indigenous population was 2.6 times the rate in the non-Indigenous population. Endocrine disorders (which include diabetes), and kidney and urinary disease, had the highest Indigenous to non-Indigenous mortality rate ratios (7.9 and 6.6 respectively). While these rate ratios are much higher than for cardiovascular diseases, cancer and injuries, their contribution to the total mortality gap was lower (10% for endocrine disorders and 6% for kidney and urinary diseases).

The diseases that will make the most difference to closing the gap in fatal burden between Indigenous and non-Indigenous Australians are cardiovascular diseases, cancers, injuries and endocrine disorders (which includes diabetes). Kidney and urinary diseases should also be considered as important due to their high relative disparity in fatal burden between the Indigenous and non-Indigenous populations. Continued effort in reducing Indigenous deaths from chronic diseases and injuries, through a combination of risk factor prevention, primary prevention and chronic disease management, is key to reducing Indigenous mortality in the future.

The gap in the fatal burden between Indigenous and non-Indigenous Australians is seen across all disease groups, ages, both sexes, and the geographical classifications examined (state/territory and remoteness). Of the four states and territories for which Indigenous YLL estimates could be reliably calculated, Indigenous YLL rates were highest in the Northern Territory and Western Australia. In the Northern Territory and Western Australia, Indigenous Australians experienced fatal burden at more than 3 times the rate of non-Indigenous Australians, and in Queensland and New South Wales, Indigenous Australians experienced fatal burden at 2.5 times the rate of non-Indigenous Australians. Across all four states and territories, cardiovascular diseases were the largest contributor to the gap in fatal burden between Indigenous and non-Indigenous Australians. Cancer ranked second in New South Wales, Queensland and the Northern Territory, while in Western Australia injuries were the second largest contributor to the gap.

The rate of fatal burden of disease among Indigenous Australians was higher in *Remote* and *Very remote* areas compared to *Major cities* and regional areas. Disaggregating results by remoteness revealed differences in the diseases contributing the most to the fatal disease burden in the Aboriginal and Torres Strait Islander population. Kidney and urinary diseases ranked higher and contributed to a greater proportion of YLL in remote areas compared to non-remote areas. On the other hand, gastrointestinal diseases ranked higher and contributed to a greater proportion of YLL in non-remote areas.

In this report, results are disaggregated by a measure of socioeconomic disadvantage as a way of showing disparities in Indigenous fatal burden across different social and economic groups and to highlight the importance of the social determinants of health. An Indigenous-specific index of socioeconomic outcomes is used (Biddle 2013) which reflects the level of socioeconomic disadvantage experienced by Indigenous Australians living in each Indigenous Area in Australia. This showed a consistent gradient in YLL rates by socioeconomic quintile, with Indigenous persons living in the most socioeconomically disadvantaged areas experiencing the highest rate of YLL (261 per 1,000 population) and those in the least disadvantaged areas experiencing the lowest rate of YLL (91 per 1,000 population).

Analyses presented in this report capture only the fatal burden of disease, and results will therefore overemphasise the relative importance of those conditions with a significant proportion of the fatal burden (for example, cancer) compared to largely non-fatal conditions (for example, mental disorders). Estimates produced in later stages of the ABDS (full report expected to be published in 2016) will combine the impact of premature death (YLL) with the illness or disability caused by a given disease or injury (YLD) into disability-adjusted life years (DALYs), and will also include the contribution of various risk factors to total burden of disease. This information will be critical to disease monitoring and health service planning, and could serve as the foundation for assessments of the economic impact of diseases and the cost-effectiveness of interventions targeting key risk factors for the Aboriginal and Torres Strait Islander population.

Future work

As discussed in Chapter 2, the ABS remoteness adjustment factors are only available for the two remoteness categories of *Major cities/Inner regional* combined, and *Outer regional/Remote/Very remote* combined. These combined remoteness categories are not considered the most useful to policymakers for examining mortality disparities by remoteness, given the wide variation between the five remoteness categories, and because the chosen groupings of remoteness (in particular, the combining of *Outer regional* with *Remote* and *Very remote*) masks any mortality disparities by remoteness—they do not follow the typical categories of non-remote and remote. Furthermore, Indigenous YLL estimates based on the ABS adjustment factors for these two grouped remoteness categories were very similar, which is somewhat counter-intuitive given the known higher rates of Indigenous mortality in remote areas—raising further questions about their usefulness.

In early 2015, the ABS re-examined data collected as part of the 2011–12 Census Data Enhancement (CDE) Indigenous Mortality Study. The ABS confirmed that there are too few deaths in the Census to deaths linked dataset to calculate reliable adjustment factors for alternative grouped categories of remoteness, including *Remote* and *Very Remote* combined.

The ABS undertook additional analyses to estimate Indigenous identification adjustment factors by the two grouped remoteness categories (*Major cities/Inner regional* combined, *Outer regional/Remote/Very remote* combined) for:

- the four jurisdictions which are considered to have better quality Indigenous mortality data (New South Wales, Queensland, Western Australia and the Northern Territory); and
- the other four jurisdictions which are considered to have poorer quality Indigenous mortality data primarily due to small population size (Victoria, South Australia, Tasmania and the Australian Capital Territory).

These alternative adjustment factors were compared to the current ABS remoteness adjustment factors based on data from all states and territories. These analyses suggested that Indigenous identification in mortality data in New South Wales, Queensland, Western Australia and the Northern Territory combined is close to complete (99%) in *Outer regional/Remote/Very remote* areas compared to only 72% complete for the same regions in the remaining four jurisdictions combined. Furthermore, at 66%, Indigenous identification is estimated to be twice as high in mortality data for *Major cities/Inner regional* areas of the four jurisdictions combined with better quality mortality data, compared to just 33% for the other four jurisdictions combined (Victoria, South Australia, Tasmania and the ACT). Such low levels of Indigenous identification (and therefore high adjustment factors) in the urban areas of Victoria, South Australia, Tasmania and the ACT combined leave some doubts about the reliability of YLL estimates derived from them. These alternative adjustment factors may be useful for more detailed future analyses and reporting of Indigenous mortality and fatal burden by remoteness.

Consistent with previous burden of disease studies, the ABDS used the underlying cause of death (UCOD) to classify each death to a cause in the cause list. Use of the UCOD alone (that is, without associated causes) assigns the entire fatal burden to one cause, and thus cannot reflect more complex situations where more than one disease contributed to the death. For example, chronic kidney diseases and diabetes have causal pathways that are complex and interwoven with many other diseases, and are often listed as associated causes of death rather than as a UCOD. This may mean that the total fatal burden of these diseases cannot be fully ascertained from burden of disease estimates alone. Further development work may assess the use of associated causes of death to account for more complex situations. Another potential approach is to use 'diseases-as-risks' in the risk factor component of the analysis, an approach used in the most recent New Zealand burden of disease study (New Zealand Ministry of Health 2012).

Appendix A: Burden of disease studies

Table A.1 provides a summary of global and Australian burden of disease studies undertaken. Some states and territories have also undertaken burden of disease studies based on the methods used in the 2003 Australian study, including the Northern Territory, South Australia, Victoria, Queensland and Western Australia.

Table A.1: Summary of global burden of disease studies and Australian country studies

Study	Reference year	Differences in methodologies	Reference
Global study: Harvard School of Public Health in collaboration with The World Bank and World Health Organization (WHO)	1990	Life table represented highest observed life expectancies for females in mid-1990s. Discounting and age weighting. 100+ diseases and injuries. Incident YLD.	Murray & Lopez 1996
First Australian study: AIHW	1996	3% discounting of YLL. No age weighting. 175 causes. Incident YLD.	AIHW: Mathers et al.1999
Global study: World Bank	2000–2002	Discounting and age weighting. 136 causes. Incident YLD.	Lopez et al. 2006
Global study: WHO-conducted global study	2004 with projections to 2030	Discounting and age weighting . 136 causes. Incident YLD.	WHO 2009
Second Australian study: AIHW	2003	3% discounting of YLL. No age weighting. 186 diseases. Incident YLD.	AIHW: Begg et al. 2007
First Indigenous Australian study: University of Queensland	2003	3% discounting of YLL. No age weighting. Adjustment for under-identification for deaths and population statistics. Incident YLD.	Vos et al. 2007
Global study: IHME	2010	New standard life table. No discounting or age weighting. 241 diseases. Prevalent YLD. Major revision to disability weights. Change in definition of health to include health loss only. Uncertainty intervals calculated.	Lancet 2012
Global study: WHO	2011	No discounting or age weighting. Standard life table based on projections. 163 diseases. Prevalent YLD. Some revisions to GBD 2010 disability weights.	WHO 2014a
Global Study: IHME	2013	Same methods as GBD 2010, with some minor revisions to disability weights.	IHME 2014—not yet published

Appendix B: Data sources and standard life table

Mortality data sources

Mortality data come from the AIHW's National Mortality Database. This is a historical register of all deaths in Australia since 1964. The database comprises information about the causes of death and other characteristics about the person, such as sex, age at death, Indigenous status and area of usual residence. The cause-of-death data are sourced from the Registrars of Births, Deaths and Marriages in each state and territory and the National Coronial Information System, and are coded to the ICD by the Australian Bureau of Statistics (ABS).

Australian deaths data are collected through vital registrations. This is a system for collecting and maintaining records of life events (such as births, deaths and marriages) by a government authority. The AIHW website <http://www.aihw.gov.au/deaths/about-deaths-data/> provides detailed information on the registration of deaths and the coding of causes of death in Australia (AIHW 2013). The completeness, accuracy and coding of these data are also described elsewhere (ABS 2014; AIHW 2013). The deaths data are collated into an administrative data set for statistical analysis. Given the high quality of these data, no adjustment needs to be made to account for completeness for national estimates. Some transformation of the data has been undertaken to reassign some deaths to fit the purposes of burden of disease analysis (see Appendix D Redistribution).

Versions of the mortality dataset

The analyses for this report include all deaths that occurred during 2009–2011 that were captured in the four cause of death unit record files (CODURFs) for 2009–2012 (corresponding to deaths registered during 2009–2012). The version of these CODURFs is final for 2009 and 2010, revised for 2011 and preliminary for 2012. This methodology ensures that the latest and most accurate versions of the CODURFs are used for analysis. The process of revisions and the resulting versions of the CODURFs are described elsewhere (ABS 2014; AIHW 2013). Further revisions to the 2011 and 2012 CODURFs can result in changes to the estimates of causes of death, although these changes are expected to have only a small impact on estimates included in this report.

Accounting for late registrations

Using the CODURFs to 2012 for counting deaths that occurred in or before 2011 ensures that a sufficient number of late registrations are captured. On average, 95% of deaths are registered in the year in which they occur. Of the deaths that occurred in 2011, 5% were not registered until 2012 (ABS 2014). The inclusion of the 2012 CODURF enables these late registrations for 2011 to be used in calculating YLL estimates. A similar rationale applies to other years of data. This maximises inclusion of any very late registrations, such as those registered in Queensland in 2010, as described by ABS (2012).

Standard life table

Life expectancy at birth and life tables

Life expectancy measures how long, on average, a person is expected to live, based on current age- and sex-specific death rates in the population. It is a summary measure commonly used to describe the health of a population. It specifies the remaining life expectancy at each age, with life expectancy at birth being the most commonly used—the number of years of life that a person born today can expect to live. These estimates of life expectancy are derived from a life table, which summarises the pattern of mortality and survival in the population.

As YLL is a 'health gap' measure, it requires definition of an aspirational life span to be able to quantify the gap between the current mortality and the counterfactual scenario where all mortality is averted until very old age. This is done using a standard life table—a key component of burden of disease studies. A standard life table corresponds to the aspirational or maximum life span for an individual in good health—it is not necessarily the actual life table of the population being studied. It is used to produce estimates of life expectancy at each age to indicate the number of years of life that are lost from dying at a specific age. For example, if the remaining life expectancy of a person aged 55 is 30 years (that is, at age 55 a person can expect to live to 85), a death at age 55 represents a loss of 30 YLL.

Choice of standard life table

The choice of standard life table will impact on burden of disease estimates. In general, a life table with longer life expectancy will result in greater YLL.

A standard life table is used to enable comparisons between population groups and across time. The ABDS uses the standard life table used in GBD 2010 in the calculation of YLL. This life table represents a longer life span than the Australian life tables produced by the ABS, which are based on the mortality experience in the Australian population (see further information in the following section). The GBD standard life table is also used for Indigenous and sub-national estimates to maintain comparability with national estimates.

Standard life tables used in global studies

GBD standard life table

The GBD 2010 standard life table was derived rigorously using mortality rates from multiple countries (Murray et al. 2012). It is based on the lowest observed age-specific death rates, capturing mortality patterns in all countries except those with very small populations, and covering all age ranges. The life expectancy estimates were assessed for predictive validity, including for countries with different levels of mortality. The result is a hypothetical life table giving estimates of life expectancy at birth to be 86.0 years for both males and females. Table B.1 shows an abridged version of the GBD 2010 standard life table.

Some other features of this life table are that it:

- is a standard; that is, it can be applied across multiple settings to enable comparisons between population groups and across time
- is aspirational; that is, it reflects the lowest observed death rates to construct a measure of currently observed maximum life span

- applies to all population groups: that is, it assumes the same aspirational life expectancy for any population group. Importantly, it is the same for males and females, and thus assumes no male–female 'biological' differences in survival potential.

The estimates of life expectancy in the GBD 2010 standard life table are, as expected, different from the estimates of life expectancy for the Australian population derived by the ABS. The latter are derived from actual mortality rates based on death registrations and the estimated resident population.

Comparisons of the GBD 2010 standard life table values with life expectancies for the Australian population for the period 2008–2010 and for the Aboriginal and Torres Strait Islander population for the period 2010–2012, are shown for selected ages in Table B1. The life expectancies for Australian males and females at birth in 2008–2010 were 79.5 and 84.0 years respectively, and 69.1 and 73.7 years for Indigenous males and females respectively (for 2010–12). These life expectancies are lower than the aspirational age of 86.0 years in the standard life table used for GBD 2010 estimates.

Table B.1: Expected years of life remaining at selected ages using GBD standard and Australian life tables for 2008–2010 (Australia) and 2010–2012 (Indigenous)

	Expected years of life remaining					
Age	GBD 2010 standard	Australia males	Australia females	Age and age (grouped)	Indigenous males	Indigenous females
0	86.0	79.5	84.0	0	69.1	73.7
1	85.2	78.9	83.3	1	68.7	73.2
15	71.3	65.1	69.4	15–19	55.0	59.4
25	61.4	55.4	59.6	25	45.7	49.8
45	41.8	36.3	40.1	45–49	28.4	31.5
65	23.3	18.9	21.8	65	13.9	15.8
85	7.6	6.0	7.1	85 and over	4.2	4.4
95	3.3	3.1	3.4	95	n.a.	n.a.
100	2.2	2.5	2.7	100	n.a.	n.a.
105	1.6	n.a.	n.a.	105	n.a.	n.a.

n.a. not available.

Note: Australian life expectancy has been calculated using three years of data (2008–2010) for the total population, and 2010–2012 for the Indigenous population.

Sources: Murray et al. 2012; ABS 2011; ABS 2013b.

WHO standard life table

The World Health Organization (2012) uses a different standard life table, with a higher aspirational life expectancy than the life table used for GBD2010 and Australian life tables (Table B.2). WHO argued that the GBD aspirational life expectancy was too low, as it is known that some level of preventable disease or injury still exists in populations; they also noted that the GBD aspirational life expectancy at birth has already been achieved in some populations (see WHO 2014b). Table B.2 compares Australian life expectancies for 2008–2010 and Indigenous Australian life expectancies for 2010–2012 with those in the WHO standard life table for 2012.

Table B.2: Expected years of life remaining at selected ages using WHO 2012 standard and Australian life tables for 2008–2010 (Australia) and 2010–2012 (Indigenous)

	Expected years of life remaining					
Age	WHO 2012 standard	Australia males	Australia females	Age, and age (grouped)	Indigenous males	Indigenous females
0	91.9	79.5	84.0	0	69.1	73.7
1	91.0	78.9	83.3	1	68.7	73.2
15	77.0	65.1	69.4	15–19	55.0	59.4
25	67.0	55.4	59.6	25	45.7	49.8
45	47.0	36.3	40.1	45–49	28.4	31.5
65	27.9	18.9	21.8	65	13.9	15.8
85	10.7	6.0	7.1	85 and over	4.2	4.4
95	5.1	3.1	3.4	95	n.a.	n.a.
100	2.8	2.5	2.7	100	n.a.	n.a.
105	1.0	n.a.	n.a.	105	n.a.	n.a.

n.a. not available.

Note: Australian life expectancy has been calculated using three years of data (2008–2010) for the total population, and 2010–2012 for the Indigenous population.

Sources: WHO 2014a; ABS 2011; ABS 2013a.

Impact of choice of standard life table

As mentioned above, the standard life table from GBD 2010 has been adopted in the calculations of YLL for both Australian YLL estimates and Indigenous YLL estimates for the ABDS.

The GBD 2010 standard life table has higher life expectancies than the life tables used in previous Australian and Indigenous burden of disease studies that were based on a standard life table that was internationally recognised and used in most other burden of disease studies at that time (the life expectancy at birth was 80.0 years for males and 82.5 years for females). As a result, estimates of YLL using the GBD 2010 standard life table will be greater than those produced for previous studies because the GBD life table estimates more years of life remaining at all ages to 85 years. The increase in life expectancy at birth to 86 years for both males and females in GBD 2010 also alters the YLL:YLD ratio by increasing the relative significance of fatal conditions.

The GBD 2010 standard life table also has remarkably higher life expectancies than estimates based on recent Indigenous life tables (that is, 69.1 and 73.7 years at birth for Indigenous Australian males and females respectively in 2010–2012; ABS 2013b). Using the GBD 2010 standard life table will emphasise deaths at younger ages and will result in substantially greater YLL, particularly for the Indigenous population, given that they tend to have more deaths at younger ages, and very small numbers of deaths at older ages. This may also impact on the gap in YLL between Indigenous and non-Indigenous Australians.

The AIHW undertook sensitivity analyses to look at the impact of using different standard life tables on resulting Indigenous and non-Indigenous YLL, and the gap. The life tables examined included: the GBD 2010 standard life table, the life table used in the previous Australian and Indigenous BoD studies, the most recent ABS Indigenous and non-

Indigenous life tables for 2010–2012, and the standard life table used in the WHO's recent global burden of disease report (which has an even higher life expectancy than GBD 2010 standard life table). This analysis supported the above discussions that life tables with longer life expectancies will lead to higher YLL. For example, using the WHO 2012 standard life table resulted in the highest number and rate of Indigenous YLL of all the life tables examined. Using the GBD 2010 life table results in a 12% higher number of Indigenous YLL than using the life table used in the 2003 Australian study, and a 23% higher number of Indigenous YLL than using the 2010–12 Indigenous life table (proportions calculated by dividing the difference in the number of Indigenous YLL calculated using the different life tables by the number of Indigenous YLL calculated using the GBD 2010 life table).

In terms of the gap between Indigenous and non-Indigenous Australians, the WHO 2012 standard life table, followed by the GBD 2010 standard life table, resulted in the largest age-standardised rate differences in YLL between the Indigenous and non-Indigenous populations; however, the rate ratio measure remained stable at between 2.1 and 2.2 regardless of which life table was used (Table B3). Note that these estimates are based on unadjusted Indigenous deaths and therefore are not comparable to the YLL rates presented in the body of this report, which have been adjusted for Indigenous under-identification in mortality data.

Table B.3: Age-standardised gap measures of YLL in 2006–2010 (unadjusted for Indigenous under-identification), based on different standard life tables

	Age-standardised rate of YLL (per 1,000 population per year)			
Standard life table used	**Indigenous**	**Non-Indigenous**	**Rate difference**	**Rate ratio**
GBD 2010	211.3	98.0	113.2	2.2
Aus BoD 2003	178.0	80.3	97.6	2.2
Non-Indigenous life table 2010–12	193.3	88.7	104.5	2.2
Indigenous life table 2010–12	156.5	72.8	83.8	2.2
WHO 2012	250.0	120.0	130.0	2.1

Source: AIHW analysis of AIHW National Mortality Database.

In terms of policy and planning, the pattern and ranking of YLL across disease groups is more important than the absolute value of YLL. Sensitivity analyses undertaken by the AIHW using the same set of life tables as the above analyses showed that the ranking of disease groups did not change for the Indigenous or non-Indigenous populations depending on the life table used. Similarly, the ranking of diseases by their contribution to the gap (as measured by the rate difference) did not change. This suggests that the ranking of diseases is robust whichever standard life table is used.

Appendix C: Measures of socioeconomic disadvantage

Census data have typically been used to create area-based measures of socioeconomic disadvantage in Australia. Area-based measures rely on the assumption that if an index is calculated at a low enough geographical level, the households within that area will be relatively homogenous. A particular limitation of all area-based measures is that they are prone to the 'ecological fallacy', that is, using aggregate data from a larger group of people to make inferences about a subpopulation of people within that group. This bias is of particular concern when measuring the socioeconomic characteristics of Indigenous Australians because in most geographical regions, measures of socioeconomic disadvantage are dominated by the non-Indigenous population due to its size relative to the Indigenous population (Biddle 2009).

Socio-Economic Indexes for Areas (SEIFA)

The Socio-Economic Indexes for Areas (SEIFA) are the most commonly used measures of socioeconomic advantage and disadvantage in Australia, and have been calculated by the ABS since 1991. However, as SEIFA scores for each geographical unit are calculated based on the socioeconomic characteristics of the entire population, they may not accurately reflect levels of socioeconomic disadvantage in the Indigenous population.

Analysis conducted by Kennedy and Firman (2004) found that across Queensland, Indigenous residents consistently had lower SEIFA scores than the total population of the same geographical unit. They concluded that applying area-based measures calculated using total population data to a smaller sub-population, in particular the Indigenous population, could under-estimate the magnitude of disparity between the populations. Among the four SEIFA indexes, the Index of Relative Socio-economic Disadvantage (IRSD) summarises a range of information about the economic and social conditions of people and households within an area, based on 15 variables including information on language, education, employment, living conditions, family composition, and so on (see Table C.1).

Table C.1: Variables used in constructing IRSD, 2011

Variables based on Census data
% of people who do not speak English well
% of people aged 15 years and over who have no educational attainment
% of employed people classified as low skill Community and Personal Service workers
% of employed people classified as Machinery Operators and Drivers
% of occupied private dwellings requiring one or more extra bedrooms
% of people aged 15 years and over who are separated or divorced
% of occupied private dwellings with no cars
% of people under the age of 70 who have a long-term health condition or disability and need assistance with core activities
% of one parent families with dependent offspring only
% of occupied private dwellings paying rent less than $166 per week (excluding $0 per week)

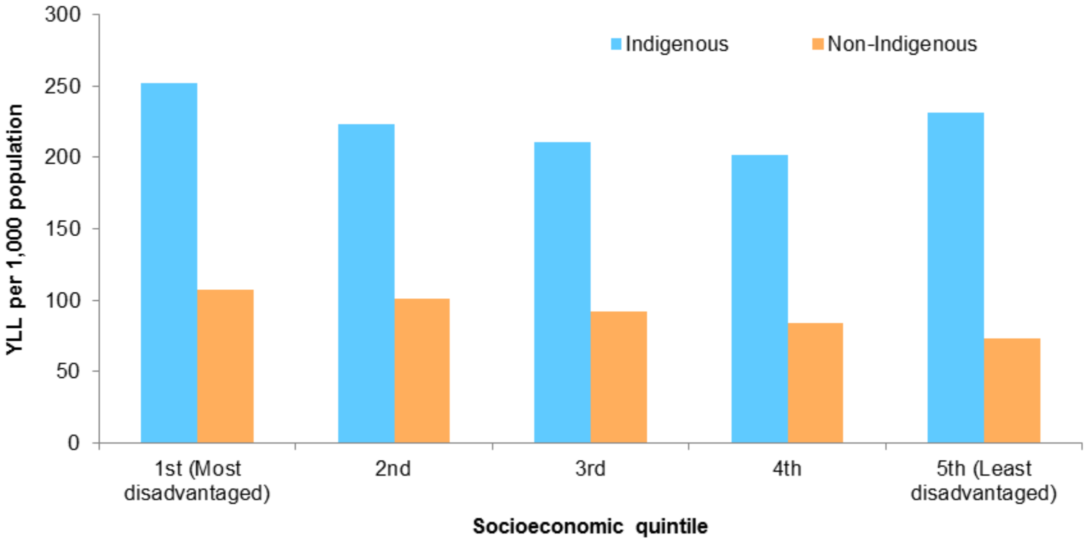
(continued)

Table C.1 (continued): Variables used in constructing IRSD, 2011

Variables based on Census data
% of people (in the labour force) who are unemployed
% of people aged 15 years and over whose highest level of education is Year 11 or lower
% of employed people classified as Labourers
% of occupied private dwellings with no internet connection
% of families with children under 15 years of age who live with jobless parents
% of people with stated household equivalised income between $1 and $20,799 per year

Source: ABS 2013a.

The AIHW has conducted experimental work to look at the pattern of age-standardised YLL rates for both the Indigenous and non-Indigenous populations if SEIFA (IRSD quintiles) is used to classify their level of socioeconomic disadvantage. As shown in Figure C.1, while non-Indigenous YLL rates show a clear downward gradient with decreasing socioeconomic disadvantage, Indigenous YLL rates show a different pattern, with rates declining until the 4th socioeconomic quintile, and then rising in the least disadvantaged quintile. This pattern is contrary to other available evidence on disparities by socioeconomic disadvantage in the Indigenous population (shown clearly when using an Indigenous–specific socioeconomic index). It is therefore likely that SEIFA, although it captures the socioeconomic characteristics of the general Australian population, is inappropriate for the Indigenous population.



Note: ERP by Indigenous status and IRSD quintile are only available in Census years. As a result the rates are calculated using 2011 Indigenous and non-Indigenous ERP by IRSD quintile.

Source: AIHW analysis of the AIHW National Mortality Database.

Figure C.1: Age-standardised YLL rates by Indigenous status and SEIFA (IRSD) quintile, 2010

Indigenous Relative Socioeconomic Outcomes (IRSEO) Index

As an alternative, this report uses the Indigenous Relative Socioeconomic Outcomes (IRSEO) index to analyse Indigenous fatal burden by socioeconomic disadvantage. This index was developed by Dr Nicholas Biddle of the Centre for Aboriginal Economic Policy Research (CAEPR). The index was constructed from 2011 Census data based on only the Indigenous population in each Indigenous Area (Biddle 2013). Compared to SEIFA, the IRSEO index is based on a reduced list of nine variables taken from five domains: education, employment, occupation, income and housing (Table C.2).

The index has been shown to be stable across the 2001, 2006 and 2011 censuses in terms of the socioeconomic disadvantage ranking of Indigenous areas over time.

Table C.2: Variables used in constructing IRSEO, 2011

Variables based on Census data
% of population 15 years and over employed
% of population 15 years and over employed as a manager or professional
% of population 15 years and over employed full-time in the private sector
% of population 15 years and over who have completed Year 12
% of population 15 years and over who have completed a qualification
% of population 15 to 24 years old attending an educational institution
% of population 15 years and over with an individual income above half the Australian median
% of population who live in a house that is owned or being purchased
% of population who live in a house with at least one bedroom per usual resident

Source: Biddle 2013.

Pooled Index of Relative Socioeconomic Outcomes (PIRSEO) for Indigenous and non-Indigenous populations

Due to the way it was constructed, the IRSEO index contains information on the relative socioeconomic position of Indigenous Australians in one area compared to another. However, it has no information on the difference between Indigenous and non-Indigenous outcomes in the area. However, a Pooled Index of Relative Socioeconomic Outcomes (PIRSEO) for the Indigenous and non-Indigenous populations has been designed to facilitate such comparisons.

This index is based on the same nine variables as the IRSEO index. However, following the analysis presented for the 2006 Indigenous population in Biddle (2009), a separate index value is created for the Indigenous population in an area, as well as the non-Indigenous population. These are described below.

- w_PIRSEO_Non_Indigenous—This is a ranking of the level of socioeconomic disadvantage of non-Indigenous Australians in the area. In essence, the Indigenous and non-Indigenous populations in the Indigenous Areas were treated as two separate observations. The two sets of areas were then pooled and ranked accordingly. They have been converted into SA2 data using the same population weighted concordances.
- w_PIRSEO_Indigenous—This is the pooled ranking for the Indigenous population. This should only really be used when comparing with the non-Indigenous population.

In essence, the two populations are treated as separate observations and pooled together into a single dataset. The index is constructed for 368 Indigenous Areas with a population count of at least 100 Indigenous and 100 non-Indigenous usual residents of age 15 years and over. It is created by pooling Indigenous and non-Indigenous area outcomes based on 736 observations (one for Indigenous population and one for non-Indigenous population in each area). These are then ranked into percentiles with ‘1’ the most advantaged area, and ‘100’ the most disadvantaged (Biddle 2013). All non-Indigenous observations fall into the percentiles of 1 to 60 (the three less disadvantaged quintiles) in this pooled dataset. This is because non-Indigenous Australians as a whole experience less socioeconomic disadvantage than non-Indigenous Australians. When their socioeconomic outcomes are measured by the same metrics as those of Indigenous Australians, the result show no areas where the non-Indigenous population is in the bottom of the pooled distribution (percentiles 61–100).

The AIHW has undertaken analyses to look at the pattern of crude YLL rates by socioeconomic disadvantage for the Indigenous and non-Indigenous populations when using the PIRSEO index values for the Indigenous and non-Indigenous populations. This shows a U-shaped pattern for the Indigenous population, with the highest YLL rates being in the most disadvantaged and least disadvantaged quintiles. For the non-Indigenous population, a downward slope in YLL rates by decreasing socioeconomic disadvantage was observed for the top three quintiles, with no YLL occurring in the bottom 2 quintiles (for reasons outlined above).

Rescaled PIRSEO_non_Indigenous

Due to the results described above using the PIRSEO index values not being particularly useful for examining disparities in fatal burden between the two population groups, and based on advice received from Dr Biddle, a rescaled set of index values for the non-Indigenous population has been used in order to look at the distribution of YLL for the non-Indigenous population by socioeconomic disadvantage of the non-Indigenous population in the area. While not directly comparable to the Indigenous rates on the IRSEO index, this enables an examination of differences in the general pattern and variation by socioeconomic disadvantage in the fatal burden of disease for the two population groups.

For the purposes of this report, we have named this rescaled set of index values, the rescaled Pooled Non-Indigenous Relative Socioeconomic Outcomes index (PNIRSEO). YLL rates by level of socioeconomic disadvantage for the non-Indigenous population use the PINIRSEO index applied to non-Indigenous deaths, using a ranking for the socioeconomic characteristics of non-Indigenous Australians in each Indigenous area, which is then converted to SA2 using population weighted concordances.

Appendix D: Cause list and redistribution

Development of the cause list

All deaths, regardless of their cause, are counted when estimating fatal burden. The cause list details the specific diseases and injuries for which estimates of the number of YLL, YLD and DALYs will be made. It is a classification which, in principle, is a set of mutually exclusive and collectively exhaustive categories of disease and injury. Accordingly, it covers all fatal and non-fatal health outcomes (for which health loss is measured).

An Australian cause list was developed specifically for this study to fit with Australian and Indigenous Australian contexts; that is, the disease and cause groups are tailored to meet the needs of the Australian health-policy and health-monitoring environment. The cause list used in this study was developed with the following considerations:

- coverage of Australian and Indigenous policy interests
- inclusion of specific causes with a potentially large or rapidly increasing burden
- feasibility of measuring mortality and prevalence for each cause.

To help refine the categories, the cause list for this study was developed with reference to the cause lists used for GBD 2010 (Lozano et al. 2012), the recent New Zealand Burden of Disease study (MOH 2012) and the previous Australian study (Begg et al. 2007).

Structure of the cause list

The resulting cause list is hierarchical and has two levels. The highest level contains 17 disease groups under which around 175 causes are classified. The disease groups and some examples of the types of causes in each disease group are shown in Table D.1.

For estimating YLL, all categories in the cause list have been mapped to the *International Statistical Classification of Diseases and Related Health Problems*, Tenth Revision (2006 version) (ICD-10) (WHO 1992). Table D2 provides a list of ICD-10 codes for each disease group used for the 2010 fatal burden estimates in this report.

The cause list plays a pivotal role in developing burden of disease estimates, and its structure and content may have an impact on some components such as data compilation, the application of some disability weights (in estimating YLD) and risk factor attribution. Importantly, when this report was prepared, the cause list was being further refined, with additional input from disease experts. Any future refinements to the cause list may result in changes to the number of deaths and to patterns of YLL by disease group and cause. Changes would be more noticeable at finer levels of disaggregation, such as the specific cause level, than at the disease group level. As a result, this report presents YLL estimates by disease group rather than by cause. The full report produced from the ABDS (scheduled for 2016) will present estimates for fatal and non-fatal burden at the cause level.

In this report, the disease group *Injuries* was constructed based on the external cause of the injury (for example, a fall or road traffic accident), and not the type of injury sustained (for example, a fractured femur or spinal cord injury). The final structure of the cause list for *Injuries* is still being determined, and may change for the full ABDS report. However, as the scope of injury deaths is not likely to differ, whether reporting by nature of injury or by external cause, the disease group results are expected to be very similar regardless of the cause list structure.

It is also important to note that the Australian cause list does not fully align with cause lists used in other studies. For example, the disease groups do not always include the same set of causes—in some circumstances, this can lead to different ICD-10 codes being used to count the same specific cause of death.

Table D.1: Disease groups in the ABDS cause list with examples of causes in the disease group

Disease group	Short label	Examples of causes
Infections	Infections	HIV/AIDS, tuberculosis, gastrointestinal infections, pertussis
Infant and congenital conditions	Infant / congenital	Pre-term birth complications, birth trauma and asphyxia, neural tube defects, congenital cardiovascular defects
Cancer and other neoplasms	Cancer	Breast cancer, bowel cancer, lung cancer, prostate cancer
Cardiovascular diseases	Cardiovascular	Coronary heart disease, stroke, rheumatic heart disease, peripheral vascular disease
Respiratory diseases	Respiratory	Asthma, chronic obstructive pulmonary disease, interstitial pulmonary disease, pneumoconiosis
Gastrointestinal diseases	Gastrointestinal	Upper gastrointestinal disorders, appendicitis, chronic liver disease, pancreatitis, non-infective inflammatory bowel disease
Neurological conditions	Neurological	Dementia, Parkinson disease, motor neurone disease
Mental illnesses and behavioural disorders	Mental/behavioural	Unipolar depressive disorders, schizophrenia, alcohol use disorders, drug use disorders, eating disorders
Endocrine disorders	Endocrine	Type 1 and Type 2 diabetes mellitus
Kidney and urinary diseases	Kidney/urinary	Chronic kidney disease, urinary incontinence
Reproductive and maternal conditions	Reproductive/maternal	Maternal haemorrhage, obstructed labour, genital prolapse, infertility
Chronic musculoskeletal disorders	Musculoskeletal	Osteoarthritis, gout, rheumatoid arthritis, chronic musculoskeletal pain syndromes
Sense organ disorders	Sense organs	Cataract and other lens disorders, glaucoma, age-related macular degeneration, hearing loss
Skin disorders	Skin	Psoriasis, acne, dermatitis and eczema, ulcers
Oral disorders	Oral	Dental caries, periodontal disease
Blood and metabolic disorders	Blood/metabolic	Haemophilia, iron deficiency anaemia, cystic fibrosis
Injuries	Injuries	Road traffic accidents, suicide, drowning, falls

Notes

1. The causes shown here are examples; each disease group comprises a broader range of causes than is shown here.
2. For the 2010 estimates, the disease group *Injuries* reflects deaths that had an external cause as the underlying cause (that is, deaths that implicitly involve injury).
3. The short label for the disease group is used in some parts of this report for convenience.

Table D.2: Disease group and ICD-10 codes used for this report

Disease group	ICD-10 codes
Infections	A00–A39, A42–A46, A481, A482, A484, A488, A49–A99, B00–B17, B19–B92, B940, B941, B948, B949, B95–B97, B99, D849, G00–G07, G09, H65–H66, H70, J00–J22, J85, J86, N290, N330, N740, N741, N742, N743, N744, O98, P23, P350, P353, P370, P373, P374
Infant and congenital conditions	G80, P00–P22, P24–P29, P351, P352, P358, P359, P36, P371, P372, P375, P378, P379, P38–P96, Q00–Q07, Q20–Q28, Q35–Q37, Q380, Q382, Q383, Q384, Q385, Q386, Q387, Q388, Q39–Q60, Q62–Q64, Q75–Q81, Q85–Q87, Q890, Q891, Q892, Q893, Q894, Q897, Q898, Q90–Q98, Q990, Q991, Q992, Q998, R95
Cancer and other neoplasms	C00–C25, C30–C75, C77–C79, C81–C85, C88–C96, D00–D24, D26–D48
Cardiovascular diseases	G45, I00–I09, I11, I20–I45, I47–I48, I491–I499, I51–I52, I60–I69, I700–I702, I708, I71–I84, I86–I99
Respiratory diseases	D860, D862, D869, J30–J68, J70–J84, J90–J95, J98–J99
Gastrointestinal diseases	B18, I85, K20–K63, K67–K70, K710, K711, K713, K714, K715, K716, K717, K718, K719, K72–K91, K928, K93
Neurological conditions	F00–F03, G08, G10–G13, G20–G44, G46–G73, G90–G99
Mental illnesses and behavioural disorders	F04–F33, F340, F341, F40–F98, X41–X42, X45
Endocrine disorders	E03–E07, E100, E101, E103–E109, E110–E111, E113–E119, E120–E121, E123–E129, E130–E131, E133–E139, E140–E141, E143–E149, E15–E27, E280, E281, E283, E288, E289, E29–E35, E89, O240, O241, O242, O243
Kidney and urinary diseases	E102, E112, E122, E132, E142, I12, N00–N16, N18, N20–N28, N291, N298, N30–N32, N338, N34–N42, Q61
Reproductive and maternal conditions	D25, E282, N43–N50, N62–N64, N75–N83, N91–N99, O00–O23, O244, O249, O25–O92, O95–O97, O99
Chronic musculoskeletal disorders	M00–M99
Sense organ disorders	H25–H27, H30–H35, H40, H43–H47, H48–H54, H60–H61, H68–H69, H71–H74, H80–H83, H90, H91, H92–H93
Skin disorders	L00–L05, L08, L10–L14, L20–L30, L40, L41–L45, L50–L60, L62–L68, L70–L75, L80–L95, L97–L99
Oral disorders	K00–K14
Blood and metabolic disorders	D50–D64, D66–D83, D840, D841, D848, D861, D863, D868, D89, E00–E02, E40–E67, E70–E84, E850–E852, E88, E90
Injuries	V01–V99, W00–W99, X00–X40, X43, X44, X46–X58, X60–X99, Y00–Y09, Y35–Y86, Y870, Y871, Y88, Y890, Y891

Notes

1. The ICD-10 codes used for allocating deaths to a disease group are presented here in ranges of ICD-10 codes. These code ranges may include a ICD-10 code that is not used for coding the UCOD (that is, an asterisk code). All analyses in this report are based on the UCOD only and therefore there will be no YLL reflecting causes with an asterisk code.
2. The disease group *Cancer and other neoplasms* includes some malignant, in situ and benign neoplasms. For some cancers, such as breast and bowel cancer, this group covers malignant neoplasms only.
3. The disease group *Reproductive and maternal conditions* includes causes of ill health that affect males and females. Consequently, some burden for this disease group will be apparent for males. However, due to the nature of maternal conditions, burden will be noticeably larger for females than for males.
4. The disease group *Injuries* uses the external cause of death to identify deaths that implicitly involve injury.

How are deaths redistributed in the ABDS?

The AIHW undertook a series of analyses investigating four methods for redistribution:

- **Direct evidence**—this approach uses direct evidence about the particular deaths identified for redistribution (that is, those with a particular UCOD) from data linkage studies or sources other than the National Mortality Database.
- **Direct MCOD method**—this method uses the tabulation of associated causes of death for death records where the redistribution code is the underlying cause. As the associated causes of death for redistribution causes are often also redistribution codes, this is likely to limit the usefulness of this method.
- **Indirect MCOD method**—this method uses the tabulation of the UCOD where the redistribution code is reported as an associated cause of death. The corresponding UCODs and their proportional distribution provide the redistribution algorithm.
- **Proportional redistribution**—this method reassigns deaths across a specified range of target causes according to the existing distribution of causes in the selected disease groups. This has the advantage of being a conceptually simple approach; however, it is a relatively blunt method as the distribution of existing causes may not necessarily reflect more probable underlying causes of death for the particular situation. Because of this, it was considered to be appropriate only for selected cases, such as low-volume redistribution causes.

As a general guide, where direct evidence was available and expert advice had been sought, the algorithm from the direct evidence was applied. Failing this, where the redistribution cause was a frequently occurring cause of death, the indirect MCOD method was applied. Where the indirect MCOD did not suit the redistribution purposes, or where the redistribution cause was infrequent, a proportionate allocation was carried out using the GBD algorithms to guide the target cause categories. The direct MCOD method was not used for any redistribution in this report.

Identifying potential direct evidence for redistribution causes is being assisted by the expert panels for the disease groups. Similarly, further application of the indirect MCOD and other redistribution approaches will be reviewed by disease experts before the full reports from this study are published.

As described in Chapter 2, refining the cause list may change the number of deaths and patterns of YLL by disease group and cause. A similar effect can arise from changing the set of causes of death marked for redistribution and the range of causes selected as target causes. Changes would be more noticeable at finer levels of disaggregation, such as at the specific cause level rather than at the disease group level.

The redistribution causes and the methods applied for this report are described in Table D.3, and the ICD-10 codes used to identify deaths for redistribution are in Table D.4.

Table D.3: Summary of redistribution methods by cause

Redistribution methods and cause groups	Target disease groups and causes
Proportional allocation	
All cardiac conduction disorders, disorders of electrolyte and fluid imbalance, all encephalopathy and cerebral oedema, all hydrocephalus, cardiogenic shock and other shock, cardiac arrest, respiratory failure, different paralytic and palsy syndromes, fever, malaise, febrile convulsion, unknown origin, gastrointestinal signs and symptoms, other ill-defined causes, peritonitis, senility, sequelae of different diseases and injury, unspecified liver disease	All
Events of undetermined intent, exposure to unspecified factor	Injuries
Amyloidosis, cachexia, respiratory signs and symptoms	Non-communicable and communicable disease groups
Atherosclerosis, cardiac signs and symptoms, unspecified congenital malformations, unspecified chromosomal abnormality	Non-communicable disease groups excluding Cancer
Ill-defined cancers	Cancer
Direct evidence	
Disease of digestive system unspecified	Digestive diseases—selected causes only
Ill-defined digestive cancers	Cancer—selected digestive cancers
Unspecified site cancer	Cancer
Indirect MCOD methods	
Septicaemia, pneumonitis	All
Hypertension, heart failure	All excluding Injuries
Renal failure	2-step method: Unspecified renal failure to acute and chronic renal failure and then acute renal failure over all disease groups excluding Injuries

Table D.4: ICD-10 codes used to identify deaths for redistribution

	ICD-10 codes
Redistribution	A40, A41, A480, A483, B942, C26, C76, C80, C97, D65, E68, E853–E859, E86–E87, F348, F349, F38–F39, F99, G81–G83, H00–H05, H06–H22, H28, H36, H42, H55–H59, H62, H67, H75, H94–H95, I10, I13–I15, I46, I490, I50, I709, J30, J69, J96, K65–K66, K712, K920, K921, K922, K929, N17, N19, N51, N60–N61, N70–N73, N748, N84–N90, O94, Q10–Q18, Q30–Q34, Q381, Q65–Q74, Q82–Q84, Q899, Q999, R00–R94, R96–R99, X59, Y10–Y34, Y872, Y899, Y90–Y98

Note: Injury-related redistribution causes are identified on the basis of the external cause of injury.

Testing of redistribution methods for Indigenous deaths

The AIHW undertook analyses to ascertain whether the same redistribution algorithms derived for the total Australian population would be suitable to apply to Indigenous deaths, and to assess the stability in algorithms derived based on Indigenous deaths at the age group and sex levels.

Results from these analyses showed that the total-population algorithms developed remain stable across time, both in terms of the types of underlying conditions reported and their respective proportions. For Indigenous deaths, however, results showed much more variability in the types of underlying causes reported and their respective proportions, depending on the years examined. This is due to the much smaller numbers of Indigenous deaths reported for each of the redistribution codes.

As a result, the same redistribution methods and algorithms have been used to redistribute total Australian deaths and Indigenous deaths. Using the same algorithms for Indigenous and non-Indigenous deaths provides comparability in the YLL estimates produced.

Redistribution results

In this report, the 2009–2011 deaths data were combined to produce deaths and YLL estimates. Results for 2010 are reported as annual average number of deaths, or YLL for 2009–2011. This can reduce year-to-year fluctuations and provide greater stability for YLL estimates. Redistribution was undertaken for deaths that occurred in 2009–2011, and the results shown here reflect the annual average, referred to as the 2010 reference period.

Deaths identified for redistribution were classified to one of the redistribution cause groups shown in Table D1. The classification of causes to these groups followed as closely as possible the GBD 2010 classification of redistribution codes.

In 2010, a total of 208 Indigenous deaths were identified for redistribution (Table D.5). That is, they were coded with a cause that could not be ascribed to a burden of disease cause for one of the reasons outlined in Chapter 2. These deaths represented 8% of all Indigenous deaths used in the mortality analysis, which was slightly lower than the proportion of deaths identified for redistribution for the total Australian population (10%).

Indigenous deaths identified for redistribution equated to 6,824 YLL in 2010, or 8% of total YLL.

Table D.5: Number of Indigenous deaths and YLL from deaths identified for redistribution, 2009–2011 (and average annual for 2010)

	Deaths			YLL		
Age group	**Males**	**Females**	**Persons**	**Males**	**Females**	**Persons**
2009–2011						
0–14	34	19	53	2,904	1,622	4,526
15–24	15	4	19	1,002	269	1,272
25–44	56	40	96	2,755	2,009	4,764
45–64	102	84	186	3,370	2,800	6,170
65–84	105	115	220	1,722	1,767	3,488
85–94	n.p.	n.p.	39	78	147	225
95+	n.p.	n.p.	10	5	23	28
All ages	327	296	623	11,836	8,637	20,473
2010 (average annual), all ages	**109**	**99**	**208**	**3,945**	**2,879**	**6,824**

Note: Some cells in this table are not published due to small numbers. Totals may not add due to rounding.

Source: AIHW analysis of the AIHW National Mortality Database.

Impact of redistribution

This section describes the changes in the number of Indigenous deaths and YLL at the disease group level pre- and post-redistribution (Table D.6, Figure D.1). The biggest absolute change in the number of Indigenous deaths from redistribution was for *Cancer and other* *neoplasms* (79 deaths), followed by *Cardiovascular diseases* (36 deaths) and *Injuries* (31 deaths). The biggest proportional change in the number of deaths from redistribution was for *Skin disorders* (although this was an increase of only 1 death), as well as for *Cancer and other neoplasms*, which both increased by around 18%. This was followed by *Infant and congenital conditions*, for which deaths rose by 12%. These increases in the number of deaths were similarly reflected in the change in the number of YLL pre- and post-redistribution.

Figure D.1 provides a visual representation of these differences (for number of deaths and YLL) for each disease group pre- and post-redistribution.

It is interesting to note that patterns of deaths pre- and post- redistribution were different for the total Australian population. The largest absolute change in the number of deaths and YLL pre- and post-redistribution was for *Kidney and urinary diseases*, which increased by 23% for males and 28% for females (AIHW 2015).

Table D.6: Number of deaths and YLL for Indigenous Australians, pre- and post-redistribution, by disease group, 2010

	Pre		Post			
Disease group	**Number**	**%**	**Number**	**%**	**Absolute change (number)**	**% change**
			Deaths			
Infections	69	2.8	73	3.0	4	6.2
Infant and congenital	90	3.7	101	4.1	11	12.2
Cancer and other neoplasms	451	18.4	530	21.6	79	17.5
Cardiovascular diseases	582	23.7	618	25.2	36	6.2
Respiratory diseases	146	5.9	153	6.2	7	4.7
Gastrointestinal diseases	140	5.7	152	6.2	12	8.6
Neurological conditions	91	3.7	98	4.0	7	7.7
Mental illnesses and behavioural disorders	46	1.9	48	2.0	2	4.2
Endocrine disorders	166	6.8	171	7.0	5	3.0
Kidney and urinary diseases	90	3.7	98	4.0	9	9.8
Chronic musculoskeletal disorders	15	0.6	17	0.7	2	11.2
Skin disorders	5	0.2	6	0.2	1	18.2
Blood and metabolic disorders	32	1.3	35	1.4	3	8.3
Injuries	324	13.2	355	14.4	31	9.4
All other disease groups	<3	n.p.	<3	n.p.	0	0.0
Redistribution	*208*	*8.5*	*0*	*0.0*	*–208*	*–100.0*
All diseases	**2,457**	**100.0**	**2,457**	**100.0**	**0**	**0.0**

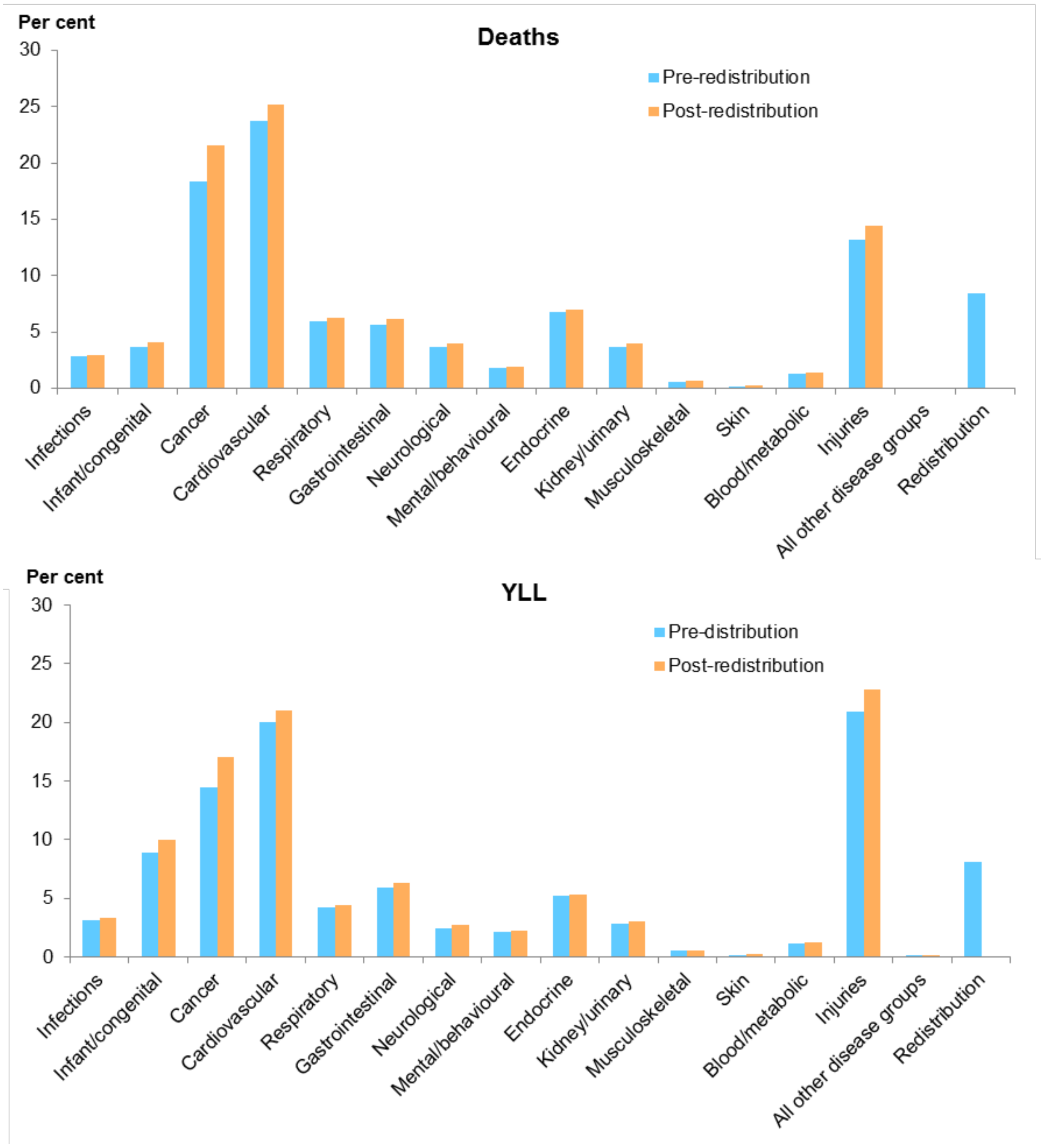
(continued)

Table D.6 (continued): Number of deaths and YLL for Indigenous Australians, pre- and post-redistribution, by disease group, 2010

Disease group	Pre Number	Pre %	Post Number	Post %	Absolute change (number)	% change
			YLL			
Infections	2,598	3.1	2,763	3.3	166	6.4
Infant and congenital	7,497	8.9	8,392	10.0	895	11.9
Cancer and other neoplasms	12,103	14.4	14,278	17.0	2,175	18
Cardiovascular diseases	16,797	20.0	17,593	20.9	795	4.7
Respiratory diseases	3,519	4.2	3,684	4.4	165	4.7
Gastrointestinal diseases	4,947	5.9	5,264	6.3	317	6.4
Neurological conditions	2,065	2.5	2,254	2.7	189	9.1
Mental illnesses and behavioural disorders	1,768	2.1	1,844	2.2	76	4.3
Endocrine disorders	4,336	5.2	4,455	5.3	119	2.7
Kidney and urinary diseases	2,335	2.8	2,552	3.0	217	9.3
Chronic musculoskeletal disorders	443	0.5	490	0.6	47	10.6
Skin disorders	49	0.1	173	0.2	24	15.8
Blood and metabolic disorders	943	1.1	1,050	1.3	107	11.4
Injuries	17,568	20.9	19,100	22.7	1,532	8.7
All other disease groups	89	0.1	89	0.1	0	0.0
Redistribution	*6,824*	*8.1*	*0*	*0.0*	*–6,824*	*–100.0*
All diseases	**83,980**	**100.0**	**83,980**	**100.0**	**0**	**0.0**

Note: At the time of writing this report AIHW guidelines, to ensure confidentiality, required the suppression of cells based on less than three deaths. In this table these cells are represented by <3.

Source: AIHW analysis of the AIHW National Mortality Database.



Source: AIHW analysis of the AIHW National Mortality Database.

Figure D.1: Percentage of deaths and YLL for Indigenous Australians, pre- and post-redistribution, by disease group, 2010

Appendix E: Methods for adjusting Indigenous mortality data

What is Indigenous under-identification?

Despite improvements in recent years, there are continuing problems with the under-identification of Aboriginal and Torres Strait Islander people in many health-related data collections. Under-identification occurs when Indigenous status is not correctly collected or accurately recorded for all persons. Incorrect or inconsistent data collection can lead to the Indigenous status of Aboriginal and Torres Strait Islander clients being incorrectly reported as non-Indigenous, or as 'not stated'.

The degree of under-identification in data sets can vary across different jurisdictions, sectors and service providers, due to varying standards of data collection practices and systems. However, it is important to note that Indigenous people (or their families) may choose to identify themselves as such in one situation and not in another, and thus identification can be thought of as a social construct underpinned by self-identification.

Overall under-identification, and variations in the degree of under-identification across collections, can create difficulties for measuring the gap in health outcomes between Indigenous and non-Indigenous Australians, and for monitoring progress in closing the gap.

Indigenous identification in mortality data

It is likely that most deaths of Aboriginal and Torres Strait Islander people are registered in Australia's vital registration system. However, a proportion of deceased persons are not identified as Aboriginal or Torres Strait Islander people by the family, health worker or funeral director during the death registration process. The incompleteness of Indigenous identification means the number of deaths recorded as Indigenous result in underestimates of the true levels of mortality in this population, and consequently an underestimate of the mortality gap between Indigenous and non-Indigenous Australians. The under-identification of Indigenous status at death has been shown to vary by age, state/territory, remoteness and over time.

Indigenous mortality data can be adjusted to take account of under-identification in order to provide more reliable estimates of the fatal burden experienced by Aboriginal and Torres Strait Islander people.

The 2003 Indigenous burden of disease study adjusted Indigenous mortality data using the general growth balance (GGB) method. This is an indirect mortality estimation method that compares population counts from two successive censuses with the deaths recorded in the period between censuses, while taking into consideration the change in Census coverage. Indirect methods are no longer considered a suitable method for Indigenous mortality estimation as they rely on high quality data of population census counts, and require a number of assumptions to be made about the characteristics of the Indigenous population to measure the under-reporting of Indigenous deaths (AIHW 2011). Instead, direct methods which use data linkage to derive Indigenous deaths have been found to be superior (Barnes et al. 2008) and are now recommended by the ABS (2009).

The ABDS uses direct methods based on data linkage studies to adjust for under-identification in Indigenous deaths for YLL calculations. These studies and methods are described below.

Indigenous mortality identification studies

There have been a number of national and state/territory data linkage studies recently undertaken to ascertain levels of under-identification of Aboriginal and Torres Strait Islander deaths in death registration records. These have each produced adjustment factors which can be applied to Indigenous mortality data.

The ABDS has drawn on two national studies undertaken by the ABS and AIHW to adjust Indigenous deaths for under-identification, which are described below.

ABS Census Data Enhancement (CDE) Indigenous Mortality Study

The ABS CDE Indigenous Mortality Study (referred to as the CDE Study hereafter) involved probabilistically linking Census records with death registration records to examine differences in the reporting of Indigenous status across the two datasets in order to estimate the 'true' number of Indigenous deaths. The expected number of Indigenous deaths in the year following the Census was estimated by adjusting linked Indigenous deaths according to propensities of being Indigenous in the Post Enumeration Survey (PES), given Indigenous status in the Census. This adjustment was made to ensure that the classification of records as Aboriginal and Torres Strait Islander occurs in a consistent manner in both the population data and the deaths data.

The first ABS CDE Study was completed in 2008 using data from the 2006 Census. The 2011–12 CDE Study linked 2011 Census records with all registered deaths that occurred from 10 August 2011 to 27 September 2012 and produced a linked dataset consisting of 142,697 deaths.

Indigenous identification rates were computed by dividing the number of registered deaths reported as Indigenous by the expected number of Indigenous deaths in the Census. The resulting identification rates were used to derive factors for adjusting Indigenous deaths.

The 2011–12 CDE Study produced three sets of adjustment factors (see Table E.1 below):

1. Headline estimates, which include a national estimate and estimates for three broad age groups.
2. Selected state and territory-specific estimates (individual estimates for New South Wales, Queensland, Western Australia and the Northern Territory, and a combined estimate for Victoria/South Australia/Tasmania/Australian Capital Territory).
3. Remoteness area estimates (two broad categories at the national level).

Table E.1: Indigenous adjustment factors based on the ABS's CDE Study 2011–12

	Disaggregation	Adjustment factor
Headline estimates	0–14 years	1.21
	15–59 years	1.12
	60 years +	1.29
	Total	1.21
State/territory estimates	NSW	1.42
	Qld	1.24
	WA	1.14
	NT	0.96
	Vic/SA/Tas/ACT/Other Territories combined	2.49
	Total[(a)]	1.39
Remoteness area estimates	Major cities and Inner regional	1.77
	Outer regional, Remote and Very remote	1.04
	Total[(a)]	1.39

(a) These estimates are not the headline estimates for Australia, because they are calculated without an age-adjustment, but are provided to enable effective comparison with state and territory estimates and remoteness area estimates.

Source: ABS 2009; ABS 2013b.

The headline adjustment factors from the 2011–12 CDE Study were calculated using an improved methodology from the previous Study undertaken in 2006 which takes into account age-specific identification rates. The adjustment factors by state/territory and by remoteness area were estimated using a similar method, but without the age-specific adjustment. Due to small numbers of Indigenous people in Victoria, South Australia, Tasmania and the Australian Capital Territory, the ABS derived a combined adjustment factor for those four jurisdictions. Similarly, due to the small number of Indigenous deaths recorded for some remoteness categories, the ABS derived 2 combined adjustment factors for remoteness (*Major cities/Inner regional* combined, and *Outer regional/Remote/Very remote* combined).

An adjustment factor below 1.0 indicates that a higher number of people identified as Indigenous at death registration compared with the number identified as Indigenous through linkage to the Census (with PES adjustment).

The headline estimates show an Indigenous identification rate of 82% in the death registration data, and a corresponding adjustment factor of 1.21 for total deaths. Therefore, multiplying the registered number of Indigenous deaths by 1.21 will result in a 21% increase in the number of Indigenous deaths.

AIHW Enhanced Mortality database project

The AIHW Enhanced Mortality Database (EMD) project (referred to as EMD Study hereafter) links registered deaths in the AIHW National Mortality Database with Indigenous death records from alternative data sources, including a residential aged care data set, hospitals data, and neonatal deaths from the National Perinatal Data Collection. This study includes deaths registered during the period 2001–2010.

An ‘ever-Indigenous’ approach is used in determining Indigenous status from the various data sets, included in the linkage. This approach accepts that the deceased was Indigenous if indicated by any of the data sets included in the linkage. Adjustment factors produced from the AIHW’s EMD study take into account under-identification in mortality data only. They do not take into account under-identification in Indigenous population estimates as the ABS’s CDE Indigenous Mortality Study does.

The first phase of the project was completed in 2010 which linked deaths for the period 2001–2006 (AIHW 2012b). The linkage of the additional data sets to the death registration data set identified 10% more deaths than the 10,547 originally recorded on the death registration data set as ‘Indigenous’.

The second phase of the project has involved linking deaths for the period 2001 to 2010, for which results are currently being reviewed. To closely approximate the years of mortality data used for reporting YLL estimates for the ABDS, adjustment factors have been calculated for the three-year period 2008–2010 for which there were 8,426 Indigenous deaths identified based on the ‘ever-Indigenous’ approach. In terms of sample size, this is larger than the 2,156 Indigenous deaths identified in the Census data and included in the ABS’s 2011–12 CDE Study.

Preliminary adjustment factors have been estimated for two sets of age groups by sex (the three broad age groups used in the 2011–12 CDE Study and 5 narrower age groups), as well as for all states and territories and all five remoteness categories (see Table E.2).

Results from the EMD project for the period 2008–2010 identified 13% more Indigenous deaths than the number recorded in death registrations data, corresponding with an overall adjustment factor of 1.13. This is slightly higher than the 10% additional deaths identified from the AIHW EMD study for the period 2001–2006, and lower than the 21% additional deaths identified from the ABS 2011–12 CDE Study.

Table E.2: Indigenous mortality adjustment factors based on the AIHW EMD (2008–2010)

	Age group	Males	Females	Persons
Three age groups	0–14	1.16	1.10	1.13
	15–59	1.06	1.08	1.07
	60+	1.20	1.18	1.19
	Total	1.12	1.14	1.13
Five age groups	0–14	1.16	1.10	1.13
	15–34	1.02	1.05	1.03
	35–54	1.07	1.09	1.08
	55–69	1.14	1.11	1.13
	70+	1.24	1.22	1.23
	Total	1.12	1.14	1.13
State/territory	NSW			1.21
	Qld			1.12
	WA			1.06
	NT			1.01
	Vic			1.34
	SA			1.13
	Tas			1.57
	ACT			1.34
Remoteness(a)	Major cities			1.25
	Inner regional			1.22
	Outer regional			1.12
	Remote			1.04
	Very remote			1.02

(a) Concordance was done to derive remoteness categories based on SLA information in the AIHW EMD data. Since some SLA information in the dataset cannot be mapped to remote categories, there are 5% of Indigenous mortality records (based on the 'ever-Indigenous' approach) with a missing or unassigned remoteness category. These records have been excluded from the calculation.

Source: AIHW Enhanced Mortality Data study (forthcoming).

Sensitivity analyses—impacts of using AIHW and ABS adjustment factors on YLL estimates

The AIHW undertook a series of sensitivity analyses using 2008–2010 mortality data to examine the impact of different adjustment factors on resulting Indigenous YLL and gap measures. In particular we wanted to see whether the same general patterns held regardless of which adjustment factors were used. Estimates based on the ABS adjustment factors from the 2011–12 CDE Study were compared to estimates based on the AIHW adjustment factors from the EMD study.

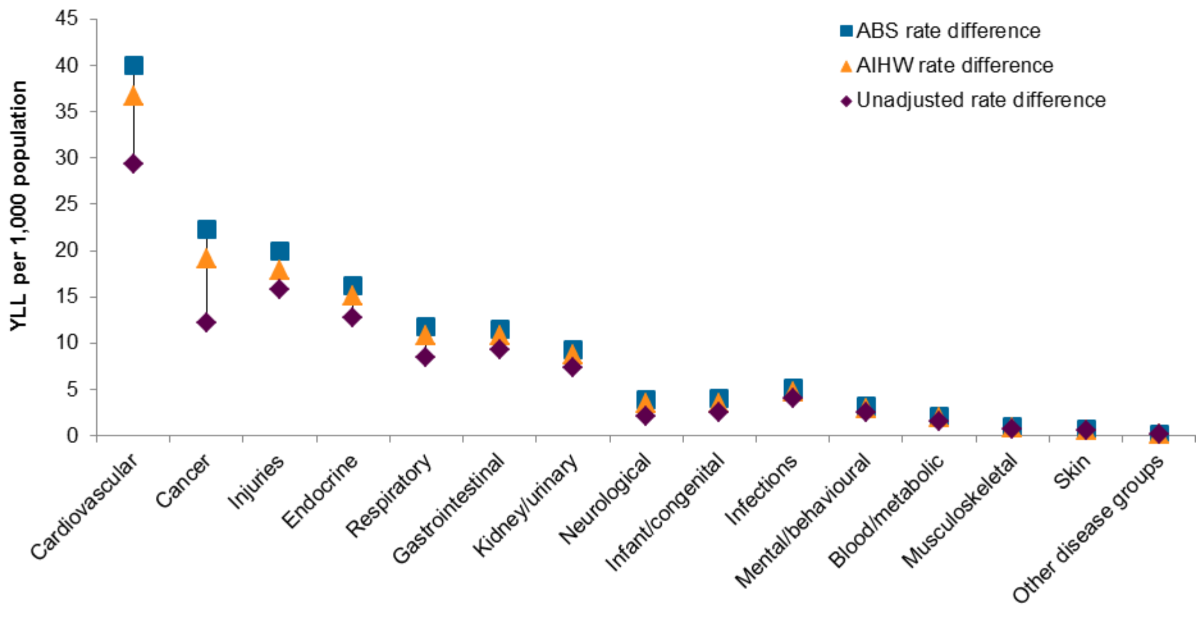
These analyses suggested that the absolute magnitude of the number and rate of Indigenous YLL was greater when using the ABS adjustment factors compared to the AIHW adjustment factors. For example the total average annual Indigenous YLL for 2008–2010 was 95,732 (17%

increase from unadjusted YLL) when using the ABS adjustment factors compared to 90,184 (10% increase from unadjusted YLL) when using the AIHW adjustment factors.

However, the general pattern for YLL rates by age group and the ranking of disease groups remained the same when using both sets of adjustment factors. Similarly, the percentage contribution to total fatal burden in the Indigenous population was almost identical when using AIHW and ABS adjusted estimates. For example, injuries and cardiovascular diseases were the leading contributors to fatal burden in the Indigenous population (both 21% based on AIHW adjustment factors and 21–22% based ABS adjustment factors), followed by cancer (17% for both sets of estimates).

In regards to estimates of the gap between Indigenous and non-Indigenous fatal burden, the ABS adjusted estimates produced slightly higher rate ratios than the AIHW adjusted estimates (2.6 compared to 2.4); however both sets of estimates show the same general ranking and pattern in terms of the leading causes of the gap (based on rate differences as the gap measure) at the national level (see Figure E.1 below).

Note that because these sensitivity analyses were undertaken using deaths for the three-year period 2008–2010, the number and rates of YLL will differ slightly to the results presented in Chapter 3 of this report which use deaths for 2009–2011.



Source: AIHW analysis of the AIHW National Mortality Database.

Figure E.1: Age-standardised YLL rate differences between Indigenous and non-Indigenous Australians, by disease group and adjustment factor, 2008–2010 (average annual figures)

Differences between the estimates produced based on ABS adjustment factors compared to AIHW adjustment factors are likely to be due to key differences between the ABS and AIHW data linkage studies from which the adjustment factors were derived. For example, the ABS CDE study probabilistically linked Census records with death registration records, and the adjustment factors were developed based on the 'gold standard' of people's Indigenous status in the ABS's Post-Enumeration Survey. Using these factors to adjust Indigenous deaths, in theory, ensures consistency between numerator (death numbers or YLL) and denominator (Indigenous Estimate Resident Population). The AIHW's EMD Study was based on an 'ever Indigenous' approach, which itself is based on four administrative data sets and does not take into account under-identification in ERP calculations. Another difference is that the two studies use slightly different time frames for examining Indigenous deaths—the ABS study relates to the period 2011–12, while the AIHW study relates to the period 2008–2010. As Indigenous identification can legitimately change over a short period, this may also partly contribute to the differences observed between the adjusted estimates derived using the ABS and AIHW linkage studies.

Strengths and limitations of the ABS and AIHW adjustment factors

The key strengths of the ABS CDE Study and adjustment factors are: consistency in adjustments for under-identification in both the numerator and denominator used in Indigenous YLL calculations; and authority—the ABS adjustment factors are the official estimates of Indigenous mortality coverage in Australia (used to produce the ABS's Indigenous life expectancy estimates).

A key strength of the AIHW EMD Study is that it was able to produce Indigenous mortality adjustment factors for all eight states and territories and five remoteness categories, due to the larger sample size included in the study.

Common limitations of both the ABS and AIHW data linkage studies include:

- While age-specific adjustment factors were calculated at the national level, adjustment factors produced by state/territory and remoteness do not include an age-specific adjustment for under-identification (as the sample sizes of the studies were insufficient to accurately calculate age-specific identification rates at these levels of disaggregation).
- Cause-of-death information was not included in the data linkage, and thus any differences in identification by cause of death are not taken into account in adjustment factors produced (other than those that are due to differences in the age-profile of the disease, which are captured in national adjustment factors only).
- No adjustment factors are available by any measure of socioeconomic disadvantage.

The ABS CDE Study and available adjustment factors have a number of additional limitations, including:

- State/territory adjustment factors are only available for New South Wales, Queensland, Western Australia and the Northern Territory individually. A combined adjustment factor was calculated for the other four jurisdictions (Victoria, South Australia, Tasmania and the Australian Capital Territory). However, application of this combined adjustment factor results in an implausibly high Indigenous YLL estimate for the four combined jurisdictions, and disaggregation of the combined factor to produce individual jurisdictional estimates also produces somewhat implausible YLL results.
- Adjustment factors for remoteness are currently only available for 2 combined remoteness categories (*Major cities*/*Inner regional* combined and *Outer regional*/*Remote*/*Very remote* combined). Reporting YLL estimates for these combined remoteness categories is not considered useful to policymakers for examining mortality disparities by remoteness, given the wide variation between the five remoteness categories, and because the chosen groupings of remoteness (in particular, the combining of *Outer regional* with *Remote* and *Very remote*) mask any mortality disparities by remoteness—they do not follow the typical categories of non-remote and remote.

It is important to note that despite the attempt to remove bias in the results through adjustments made to Indigenous deaths for calculating YLL estimates presented in this report, there is still a degree of uncertainty around the true level of mortality among Indigenous Australians, and the adjustments themselves inherently introduce a degree of uncertainty around the YLL estimates produced.

Future national data linkage studies would benefit from including a larger Indigenous sample size as well as cause of death information in order to overcome some of the limitations outlined above in adjustment factors produced.

Adjustment factors used in this report

Following extensive sensitivity analyses of Indigenous mortality data using the adjustment factors available from the ABS and AIHW studies described above, and after advice from the IRG and other experts, the agreed approach for the ABDS was to use mortality adjustment factors from the ABS 2011–12 CDE Study to adjust Indigenous deaths for YLL estimates and gap measures presented in the report, except for estimates by remoteness, for which adjustment factors from the AIHW EMD Study would be used.

The ABS adjustment factors were chosen as they take into account under-identification in both mortality data and population data and therefore, in theory, provide consistency in the numerator and denominator used in Indigenous YLL calculations. Also, as noted earlier, the ABS adjustment factors are the official estimates of Indigenous mortality coverage in Australia. Further, sensitivity analyses undertaken by the AIHW examining the impact of using the different adjustment factors available (ABS compared to AIHW) showed that at the national level, the age patterns and disease rankings remained consistent using either set of adjustment factors.

The ABS adjustment factors have been used to adjust Indigenous deaths for YLL estimates reported at the national level (comprising data from all states and territories), as well as sub-national estimates by state/territory for the four jurisdictions with the highest number of Indigenous deaths (New South Wales, Queensland, Western Australia and the Northern Territory only). Indigenous YLL estimates are not presented for Victoria, South Australia, Tasmania or the Australian Capital Territory due to the small number of Indigenous deaths reported for these jurisdictions each year and because individual state/territory adjustment factors are not available from the ABS for these states and territories.

AIHW remoteness adjustment factors have been used to calculate YLL estimates by remoteness due to a number of limitations with the ABS remoteness adjustment factors outlined in the section above.

For estimates by socioeconomic disadvantage, as no adjustment factors are available at this level, the ABS adjustment factors used to adjust Indigenous deaths at the national level (which include an age-adjustment) have been applied to each socioeconomic disadvantage quintile used. This assumes that there are no differences in Indigenous identification between the Indigenous persons living in each socioeconomic disadvantage quintile other than those resulting from age. However, differences in identification by remoteness and geographical area are also likely to impact on the YLL estimates by socioeconomic disadvantage quintile and this should be kept in mind when interpreting the estimates presented by socioeconomic disadvantage in this report.

The mortality adjustment factors used to adjust Indigenous deaths in the calculation of YLL estimates presented in this report are provided in Table E.3.

Table E.3: Indigenous mortality adjustment factors used for YLL estimates in this report

Level of reporting	Disaggregation	ABS CDE Study adjustment factor	AIHW EMD Study adjustment factor
National and SEIFA estimates	0–14 years	1.21	. .
	15–59 years	1.12	. .
	60 years and over	1.29	. .
State/territory estimates	NSW	1.42	. .
	Qld	1.24	. .
	WA	1.14	. .
	NT	0.96	. .
Remoteness estimates	Major cities	. .	1.25
	Inner regional	. .	1.22
	Outer regional	. .	1.12
	Remote	. .	1.04
	Very remote	. .	1.02

Process of adjusting Indigenous deaths for under-identification for YLL calculations

Adjusting for Indigenous under-identification in YLL calculations consists of three steps, described below.

First, the number of Indigenous deaths recorded in the AIHW's National Mortality Database for each age, sex and cause of death is multiplied by the relevant adjustment factor to obtain an adjusted number of Indigenous deaths. This reflects the expected, 'real' number of Indigenous deaths that occurred during the period of analysis.

Second, adjusted Indigenous deaths for each age, sex and disease group are subtracted from the total number of deaths for the same age, sex and disease group, to obtain an adjusted number of non-Indigenous deaths. This step is based on the assumption that the relevant adjustment factor provides a sufficient level of adjustment; therefore the adjusted data will contain no deaths with a 'not stated' Indigenous status. It also ensures that the total number of deaths recorded in Australia remains the same following adjustment for Indigenous under-identification. The adjusted number of non-Indigenous deaths, together with the adjusted number of Indigenous deaths, is used in gap calculations (see Attachment F for details on methods used to calculate the YLL gap).

Lastly, adjusted Indigenous death numbers for each age, sex and disease group are multiplied by the standard life expectancy and then summed to calculate the total YLL for the Indigenous population. The same step is undertaken for non-Indigenous deaths to calculate YLL for the non-Indigenous population for use in gap calculations.

The adjustment factors were applied to all three years of Indigenous deaths included in the YLL estimates presented in this report (2009–2011). This assumes that the level of Indigenous identification in deaths data estimated for the period for which the ABS CDE Study (2011–12) and AIHW EMD Study (2008–2010) were undertaken applies to the reference year of 2010 used for the burden of disease estimation. While this is a reasonable assumption given that the ABS and AIHW adjustment factors align closely to the reference period of this study, Indigenous identification can change slightly over time periods such as these in both mortality data and in population data. For example, Indigenous identification in the Census was shown to increase quite substantially between the 2006 and 2011 Censuses, and Indigenous identification in mortality data is believed to have improved over time. However, this is expected to have a minimal impact on the estimates reported and on the interpretation of results presented in this report.

The adjustment factors were also applied equally to all causes of death. This was because national adjustment factors by cause of death are not available from either the ABS or AIHW data linkage studies. Applying the adjustment factors equally to all causes of death assumes that there are no major differences in Indigenous identification by cause of death above what would be captured through applying age-specific adjustment factors (which should, in part, take account of differences in identification for diseases that are largely associated with age). While some states and territories have recently undertaken data linkage studies which have included cause-of-death information (WA Health unpublished; NSW Health 2012) and have suggested there may be some variance in Indigenous identification by cause of death, the levels and pattern of identification by cause of death were somewhat different between the studies. These studies also had a number of limitations, which led to a decision by the AIHW, in consultation with the IRG, not to use their results to generate additional adjustment factors by cause of death to be used for Indigenous YLL estimates for the ABDS.

The discussion above highlights the need for national and/or state and territory data linkage studies to include an examination of Indigenous identification by cause of death using a consistent approach. This will enable disease-specific adjustments to be made in future burden of disease studies.

Appendix F: Measuring the gap

Measuring the mortality 'gap' between Indigenous and non-Indigenous Australians is of key interest to current policymakers, as reflected in the COAG commitment to close the gap in Indigenous life expectancy within a generation (COAG 2009). This Appendix details the methods and metrics used to measure and report on the gap in fatal burden (YLL) between the Indigenous and non-Indigenous populations in this report.

Age-standardisation

As the risk of some conditions or injuries is strongly correlated with age, crude rates are not suitable for comparing rates of mortality or fatal burden (YLL) for different populations or groups. More meaningful comparisons can be made using age-standardised rates, with such rates adjusted for age in order to facilitate comparisons between populations that have different age structures, such as between Indigenous Australians and non-Indigenous Australians. This standardisation process effectively removes the influence of age structure on the overall summary rate.

There are two main approaches to age-standardisation: direct age-standardisation and indirect age-standardisation. Both consist of taking a weighted average of the age-specific rates.

In this report, direct age-standardisation has been used to calculate age-standardised YLL rates for the Indigenous and non-Indigenous populations. These were derived by multiplying the age-specific YLL rates observed in the population of interest (in this case the Indigenous and non-Indigenous populations) by the age-specific population numbers for the standard population (in this case, the Australian ERP as at 30 June 2001, based on the 2001 Census). The next step was to sum across the age groups and divide this sum by the total of the standard population to give an age-standardised rate for the population of interest. Finally, this is expressed as a rate per 1,000 population.

The direct age-standardisation method was used as it enables rates to be compared over time (needed for time series analyses), and can also be used for making multiple comparisons (for example, cause by sex or cause by state/territory). This is because directly age-standardised rates can be compared to each other as they are based on the same standard population. These comparisons are not possible using the indirect method of age-standardisation as indirectly age-standardised rates can only be compared to the standard, and not to each other. A disadvantage of the direct method, however, is that it can be sensitive to small numbers of cases. Consequently, calculating directly age-standardised rates for small populations where there can be large fluctuations in age-specific rates can result in adjusted rates that are less precise or stable than adjusted rates produced using the indirect method of age-standardisation.

Gap (inequality) measures

There are two measures available for comparing rates between two populations based on the direct age-standardisation method. These are the rate ratio and the rate difference, and are described below.

The rate ratio measures the relative difference between two population groups (for example, Indigenous and non-Indigenous Australians) and is calculated by dividing one age-standardised rate by the other. Ratios greater than 1 indicate a higher rate of fatal burden in the population of interest (in this case, the Aboriginal and Torres Strait Islander population), while ratios less than 1 indicate a lower rate of fatal burden in the population of interest.

The rate difference provides a measure of the absolute difference in age-standardised rates between two populations and is calculated by subtracting one from the other.

In this report, both rate differences and rate ratios are provided as a means to more readily compare YLL rates for Indigenous and non-Indigenous people, as they both provide different information which is considered useful to examine mortality inequalities. For an explanation of how to interpret these statistics, see Box F.1.

Box F.1: Interpreting rate differences and rate ratios

Both rate differences and rate ratios measure the relationship between the rates of two populations, but they do it in different ways.

Rate differences are calculated as 'Rate 1' minus 'Rate 2'. This statistic measures the literal, or absolute, gap between populations without respect to their relative size. In this report, rate differences are shown as the Indigenous age-standardised YLL rate minus the non-Indigenous age-standardised YLL rate, expressed per 1,000 population.

The rate difference is also used in this report to calculate the proportion of the total gap in YLL that each disease group contributes (calculated by dividing the YLL rate difference for each respective disease group by the total rate difference for all causes of death).

Rate ratios are calculated as 'Rate 1' divided by 'Rate 2'. This statistic takes scale into account—a difference of 5 is more noteworthy if the comparative figure is 10 rather than 1,000. In this report, rate ratios are shown as the Indigenous age-standardised YLL rate divided by the non-Indigenous age-standardised YLL rate.

Rate ratios are often used to describe the degree of inequality. But, in some situations the ratio can be misinterpreted. A large rate ratio does not necessarily imply that an event has a large absolute impact. Events that are rare in one population can produce large rate ratios in the comparative population, irrespective of the level of prevalence or mortality. In addition, a decline in the rate ratio can sometimes be observed when rates of disease (and rate differences between two populations) are on the rise.

Sensitivity analyses using different standardisation methods

The AIHW undertook sensitivity analyses to examine the impact and robustness of using the direct method of age-standardisation (especially when applied to rates based on small numbers of deaths) by comparing these results to results using the indirect method of age-standardisation.

These analyses showed that both methods of age-standardisation produced similar results for the overall gap, as measured by the rate ratio, and the disease groups with the highest rate ratios. The indirect method, however, produced slightly higher rate ratios in most cases. For example, the direct method of age-standardisation resulted in a total YLL rate ratio of 2.6 compared to 2.8 using the indirect method. *Endocrine disorders* and *Kidney and urinary diseases* were the two conditions with the largest rate ratios derived from both direct and indirect age-standardisation, although the order switched depending on which method was used—

Kidney and urinary diseases was slightly higher based on the indirect method, while *Endocrine disorders* was slightly higher based on direct age-standardisation.

Both methods of age-standardisation also produced somewhat similar results for the leading contributors to the gap by disease group, as measured by the percentage contribution of each disease to the total gap. For example, *Cardiovascular diseases* was the largest contributor to the gap in the fatal burden between Indigenous and non-Indigenous Australians using both the direct and indirect methods of age-standardisation (representing 26.5% and 24.3% of the gap respectively). *Injuries* and *Cancer and other neoplasms* were both also among the top three leading causes of fatal burden using the two methods of age-standardisation. However, *Cancer and other neoplasms* was ranked second using the direct method and *Injuries* was ranked second using the indirect method.

Although rankings were similar using the two methods of standardisation, there were some notable differences in the relative contributions of selected causes to the gap, such as for *Injuries* (contributing to 13% of the gap using direct age-standardisation compared to 21% using indirect age-standardisation); *Cancer and other neoplasms* (15% compared to 11%), *Endocrine disorders* (11% compared to 8%) and *Infant and congenital conditions* (3% compared to 8%).

These differences are likely to be due to differing age-profiles for these diseases and the concentration of most deaths in certain age groups only—for example, deaths from injuries are largely concentrated in the young and middle age groups, while deaths from infant and congenital conditions are concentrated almost entirely in the infant and 1–4 year age groups. As mentioned earlier, the direct age-standardisation method is more sensitive than the indirect method to having a small number of deaths (or no deaths) in some age groups. However, as also discussed earlier in this Appendix, the direct method of standardisation has been used for estimates presented in this report as it enables multiple comparisons (such as state/territory by sex, which is important for sub-national estimates) as well as comparisons over time (which will become important for future updates to Indigenous burden of disease estimates and for backcasting or revising estimates for earlier years.

Glossary

Aboriginal and/or Torres Strait Islander: A person of Aboriginal and/or Torres Strait Islander descent who identifies as an Aboriginal and/or Torres Strait Islander. See also Indigenous.

Age weighting: A method used to adjust the relative value of years lived at different ages, for example, to value a year lived by a young adult more highly than a year lived at older ages. Age weighting means that events in some age groups will have greater influence on the results than others.

Associated cause(s) of death: All causes listed on the death certificate, other than the **underlying cause of death**.

Attributable burden: The burden attributed to a particular risk factor. It is the reduction in burden that would have occurred if exposure to the risk factor had been avoided.

Burden of disease and injury: Term referring to the quantified impact of a disease or injury on an individual or population, using the **disability-adjusted life year** (DALY) measure.

Cause list: The cause list details the specific diseases and causes of injury for which the estimates of the number of deaths, YLL, YLD and DALYs will be made.

Cause of death: The causes of death entered on the Medical Certificate of Cause of Death are all diseases, morbid conditions or injuries that either resulted in or contributed to death, and the circumstances of the accident or death. See also **underlying cause(s) of death** and **associated cause(s) of death**.

Closing the gap: A commitment made by Australian governments in 2008 to improve the lives of Aboriginal and Torres Strait Islander Australians. See also **Gap**.

Condition (health condition): A broad term that can be applied to any health problem, including symptoms, disease, and certain risk factors, such as high blood cholesterol and obesity. Often used synonymously with disorder or problem.

Data linkage (also referred to as data integration or record linkage): The bringing together (linking) of information from two or more different data sources that are believed to relate to the same entity, for example, the same individual or the same institution.

Disability: In burden of disease analysis, any departure from an ideal health state.

Disability-adjusted life year (DALY): A year of healthy life lost, either through premature death or equivalently through living with disability due to illness or injury. It is the basic unit used in burden of disease and injury analysis.

Disability weight: A factor that reflects the severity of health loss from a particular health state on a scale from 0 (perfect health) to 1 (equivalent to death).

Discounting: A method used to adjust the relative value of years lived (or lost) in the future. It is based on the assumption that a year lived in the future is of less 'value' than a year lived now. 'Discounting for future benefits' is standard practice in economic analysis.

Disease group: Broader groupings of the specific diseases and causes of injury detailed in the cause list.

Estimated resident population (ERP): The official Australian Bureau of Statistics estimate of the Australian population. The ERP is derived from the 5-yearly Census counts, and is updated quarterly between censuses. It is based on the usual residence of the person. Rates are calculated per 1,000 or 100,000 mid-year (30 June) ERP.

Fatal burden: Burden of disease caused by mortality. Represented by the **years of life lost** measure.

Gap: The difference between Indigenous rates and non-Indigenous rates for a particular health measure.

Health states: Groups of **sequelae** reflecting key differences in symptoms and functioning.

Incidence: The number of new cases (of an illness or event, and so on) occurring during a given period.

Indigenous: A person of Aboriginal and/or Torres Strait Islander descent who identifies as an Aboriginal and/or Torres Strait Islander. See also **Aboriginal or Torres Strait Islander**.

Life expectancy: How many years a person can expect to live, on average, given prevailing mortality rates.

Life table: A table that shows, for each age, the probability that a person of that age will die before their next birthday.

Mortality: Death.

Mortality gap: The difference between age-standardised YLL rates for the Indigenous and non-Indigenous populations.

Multiple causes of death: All causes listed on the death certificate. This includes the **underlying cause of death** and the **associated cause(s) of death**. See also **cause of death**.

Non-fatal burden: Burden of disease caused by morbidity (ill health). Represented by the **years lived with disability** measure.

Prevalence: The number (of cases, instances) in a population at a given time.

Redistribution causes: Causes of death that require allocation to other causes because the original **underlying cause of death** does not suit burden of disease analysis.

Risk factor: Any factor which represents a greater risk of a health disorder or other unwanted condition or event. Some risk factors are regarded as causes of disease, others are not necessarily so. Along with their opposites, protective factors, risk factors are known as determinants.

Sequelae: Consequences of diseases and injuries.

Under-identification: This arises when a person's Indigenous status is not collected or accurately recorded.

Underlying cause of death: The disease or injury that initiated the chain of events leading directly to death, or the circumstances of the accident or violence that produced the fatal injury.

Years of life lost (YLL): Years of life lost due to premature mortality, calculated as the difference between the age at death and the standard **life expectancy** at that age.

Years lived with disability (YLD): A measure of non-fatal disease burden, weighted for the severity of the condition.

References

ABS (Australian Bureau of Statistics) 2008. Discussion paper: assessment of methods for developing life tables for Aboriginal and Torres Strait Islander Australians, 2006. ABS cat. no. 3302.0.55.002. Canberra: ABS. Viewed 3 November 2014, <http://www.abs.gov.au/ausstats/abs@.nsf/mf/3302.0.55.002>.

ABS 2009. Experimental life tables for Aboriginal and Torres Strait Islander Australians, 2005–2007. ABS cat. no. 3302.055.003. Canberra: ABS.

ABS 2011. Life tables, Australia, 2008–2010. ABS cat. no. 3302.0.55.001. Canberra: ABS.

ABS 2013a. Census of Population and Housing: Socio-Economic Indexes for Areas (SEIFA), Australia, 2011. ABS cat. no. 2033.0.55.001. Canberra: ABS.

ABS 2013b. Life tables for Aboriginal and Torres Strait Islander Australians 2010–2012. ABS cat. no. 3302.0.55.003. Canberra: ABS.

ABS 2013c. Causes of death, Australia, 2011. ABS cat. no. 3303.0. Canberra: ABS. Viewed 3 November 2014, <http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/E8402CEA79A62C3BCA257B2E000D78CC?opendocument>.

ABS 2014. Causes of death, Australia, 2012. ABS cat. no. 3303.0. Canberra: ABS. Viewed 19 August 2014, <http://www.abs.gov.au/AUSSTATS/abs@.nsf/allprimarymainfeatures/47E19CA15036B04BCA2577570014668B?opendocument>.

AIHW (Australian Institute of Health and Welfare) 2010. National best practice guidelines for collecting Indigenous status in health data sets. Cat. no. IHW 29. Canberra: AIHW.

AIHW 2011. Life expectancy and mortality of Aboriginal and Torres Strait Islander people. Cat. no. IHW 51. Canberra: AIHW.

AIHW 2012a. Multiple causes of death in Australia: an analysis of all natural and selected chronic disease causes of death 1997–2007. Cat. no. AUS 159. Canberra: AIHW.

AIHW 2012b. A working guide to international comparisons of health. Cat. no. PHE 159. Canberra: AIHW.

AIHW 2012c. An enhanced mortality database for estimating Indigenous life expectancy: a feasibility study. Cat. no. IHW 75. Canberra: AIHW.

AIHW 2013. About deaths data. Viewed 3 November 2014, <http://www.aihw.gov.au/deaths/about-deaths-data/>.

AIHW 2014. Assessment of Global Burden of Disease 2010 methods for the Australian context: Australian burden of disease study working paper no. 1. Canberra: AIHW.

AIHW 2015. Australian burden of disease study: fatal burden of disease 2010. Australian burden of disease study series no. 1. Cat. no. BOD 1. Canberra: AIHW.

Barnes A, Smith L, Zhao Y & Guthridge S 2008. A comparative analysis of indirect methodologies for estimating Indigenous life expectancy. Darwin: Charles Darwin University.

Begg S, Vos T, Barker B, Stevenson C, Stanley L & Lopez A 2007. The burden of disease and injury in Australia 2003. Cat. no. PHE 82. Canberra: AIHW.

Biddle N 2009. Ranking regions: revisiting an index of relative Indigenous socioeconomic outcomes. CAEPR working paper no. 50. Canberra: Centre for Aboriginal Economic Policy Research.

Biddle N 2013. Socioeconomic outcomes. Paper 13. Indigenous population project: 2011 census report. Canberra: Centre for Aboriginal Economic Policy Research.

COAG (Council of Australian Governments) 2008. National Indigenous Reform Agreement (Closing the Gap). Viewed 10 December 2014, <http://www.federalfinancialrelations.gov.au/content/npa/health_indigenous/indigenous-reform/national-agreement_sept_12.pdf>.

COAG 2009. National Partnership Agreement on Closing the Gap in Indigenous Health Outcomes. National health care. Canberra:COAG.

IHME (Institute of Health Metrics and Evaluation) 2014. About GBD. Viewed 3 November 2014,< http://www.healthdata.org/gbd/about>.

Kennedy B & Firman D 2004. Indigenous SEIFA—revealing the ecological fallacy. Paper presented at the 12th Biennial Conference of the Australian Population Association, Canberra, September 2004. Canberra: Australian Population Association.

Lopez A, Mathers C, Ezzati M, Jamison D & Murray CJL (eds) 2006. Global burden of disease and risk factors. Washington DC: World Bank.

Lozano R, Naghavi M, Foreman K et al. 2012. Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010. The Lancet 380: 2095–128.

Mathers C, Vos T & Stevenson C 1999. The burden of disease and injury in Australia (1996). Cat. no. PHE 17. Canberra: AIHW. Viewed 3 November 2014, <http://www.aihw.gov.au/publication-detail/?id=6442467088>.

MOH (Ministry of Health) 2012. Ways and means: a report on methodology from the New Zealand burden of disease, injuries and risk factors study, 2006–2016. Wellington: Ministry of Health.

Murray CJL, Ezzati M, Flaxman AD, Lim S, Lozano R, Michaud C et al. 2012. GBD 2010: design, definitions, and metrics. The Lancet 380: 2063–66.

Murray C & Lopez A 1996. The global burden of disease: a comprehensive assessment of mortality and disability from disease, injuries, and risk factors in 1990 and projected to 2020. Harvard: Harvard School of Public Health.

NSW Ministry of Health 2012. Improved reporting of Aboriginal and Torres Strait Islander peoples on population datasets in New South Wales using record linkage: a feasibility study, 2012. Sydney: NSW Ministry of Health.

The Lancet 2012. Global burden of disease study 2010. Viewed 3 November 2014, <http://www.thelancet.com/themed/global-burden-of-disease>.

Vos T, Barker B, Stanley L & Lopez AD 2007. The burden of disease and injury in Aboriginal and Torres Strait Islander peoples 2003. Brisbane: The University of Queensland. Viewed 3 November 2014, <http://www.sph.uq.edu.au/docs/BODCE/Indigenous_BoD_Report.pdf>.

WHO (World Health Organization) 2009. Global health risks: mortality and burden of disease attributable to selected major risks. Geneva: WHO.

WHO 2014a. Disease and injury regional estimates, 2000–2011. Viewed 3 November 2014, <http://www.who.int/healthinfo/global_burden_disease/estimates_regional_2000_2011/en/>.

WHO 2014b. International Statistical Classification of Diseases and Related Health Problems 10th revision (ICD-10). Viewed 3 November 2014, <http://apps.who.int/classifications/icd10/browse/2010/en>.

List of tables

Table 3.1: Number and proportion of YLL for Indigenous Australians, by disease group and sex, 2010 19

Table 3.2: Number and proportion of deaths and YLL for Indigenous Australians, by disease group and sex, 2010 20

Table 4.1: Age-standardised YLL rates (per 1,000 population), rate ratios and rate differences, by Indigenous status and sex, 2010 30

Table 4.2: Age-standardised YLL rates (per 1,000 population), rate ratios and rate differences, by Indigenous status and disease group, 2010 32

Table 5.1: Number of adjusted deaths and YLL, and age-standardised YLL rates for Indigenous Australians, NSW, Qld, WA and the NT, 2010 36

Table 5.2: Leading causes of fatal burden (YLL) for Indigenous Australians, by state/territory (NSW, Qld, WA and the NT) 2010 38

Table 5.3: Age-standardised YLL rates (per 1,000 population), rate ratios and rate differences by Indigenous status and state/territory (NSW, Qld, WA and the NT), 2010 39

Table 5.4: Number of adjusted deaths and YLL for Indigenous Australians, by remoteness, 2010 43

Table 5.5: Age-standardised YLL rates (per 1,000 population), rate ratios and rate differences, by Indigenous status and remoteness, 2010 46

Table 5.6: Number of adjusted deaths and YLL for Indigenous Australians, by socioeconomic disadvantage quintile (IRSEO index), 2010 50

Table 5.7: Ranking and percentage contribution of leading disease groups to total YLL, by socioeconomic disadvantage quintile (IRSEO index), 2010 52

Table 6.1: Comparison of key methodological differences for YLL estimates between the ABDS and NZBD 55

Table 6.2: Broad disease group comparison for the ABDS and NZBD 56

Table 6.3: Age-standardised YLL rates (per 1,000), rate ratios and rate differences, for the Australian Aboriginal and Torres Strait Islander population (2010) and New Zealand Māori (2006) 57

Table A.1: Summary of global burden of disease studies and Australian country studies 66

Table B.1: Expected years of life remaining at selected ages using GBD standard and Australian life tables for 2008–2010 (Australia) and 2010–2012 (Indigenous) 69

Table B.2: Expected years of life remaining at selected ages using WHO 2012 standard and Australian life tables for 2008–2010 (Australia) and 2010–2012 (Indigenous) 70

Table B.3: Age-standardised gap measures of YLL in 2006–2010 (unadjusted for Indigenous under-identification), based on different standard life tables 71

Table C.1: Variables used in constructing IRSD, 2011 72

Table C.2: Variables used in constructing IRSEO, 2011 74

Table D.1: Disease groups in the ABDS cause list with examples of causes in the disease group 77

Table D.2: Disease group and ICD-10 codes used for this report 78

Table D.3: Summary of redistribution methods by cause 80

Table D.4: ICD-10 codes used to identify deaths for redistribution 80

Table D.5: Number of Indigenous deaths and YLL from deaths identified for redistribution, 2009–2011 (and average annual for 2010) 81

Table D.6: Number of deaths and YLL for Indigenous Australians, pre- and post-redistribution, by disease group, 2010 82

Table E.1: Indigenous adjustment factors based on the ABS's CDE Study 2011–12 87

Table E.2: Indigenous mortality adjustment factors based on the AIHW EMD (2008–2010) 89

Table E.3: Indigenous mortality adjustment factors used for YLL estimates in this report 93

List of figures

Figure 3.1: YLL for Indigenous Australians, by age and sex, 2010 16

Figure 3.2: Age-specific rates of YLL for Indigenous Australians, by age and sex, 2010 17

Figure 3.3: Proportion of deaths and YLL for Indigenous Australians, by disease group, 2010 18

Figure 3.4: Proportion of deaths and YLL for top five disease groups (as ranked by Indigenous male YLL), Indigenous Australians, by sex, 2010 21

Figure 3.5: YLL for Indigenous Australians, by age, disease group and sex, 2010 23

Figure 3.6: Proportion of YLL for Indigenous Australians, by age, disease group and sex, 2010 24

Figure 3.7: Leading causes of fatal burden for Indigenous males, by age group, 2010 25

Figure 3.8: Leading causes of fatal burden for Indigenous females, by age group, 2010 26

Figure 3.9: YLL and age-specific YLL rates (YLL per 1,000 population) for Indigenous Australians for selected disease groups, by sex, 2010 28

Figure 4.1: Age-specific YLL rates (per 1,000 population) and rate ratios, by Indigenous status and age group, 2010 31

Figure 4.2: YLL rate ratios and rate differences between Indigenous and non-Indigenous Australians, by disease group, 2010 33

Figure 4.3: Percentage contribution to the mortality gap (based on YLL rate difference) between Indigenous and non-Indigenous Australians, by age and disease group, 2010 34

Figure 4.4: Percentage contribution to the mortality gap (based on YLL rate difference) between Indigenous and non-Indigenous Australians, by disease group and sex, 2010 35

Figure 5.1: Age-standardised YLL rates for Indigenous Australians, by sex and state/territory (NSW, Qld, WA and the NT), 2010 37

Figure 5.2: Leading causes of fatal burden (YLL) for Indigenous Australians, by state/territory (NSW, Qld, WA and the NT), 2010 38

Figure 5.3: Age-standardised YLL rates, by Indigenous status and state/territory (NSW, Qld, WA and the NT), 2010 39

Figure 5.4: Leading causes of the gap in fatal burden between Indigenous and non-Indigenous Australians (based on YLL rate difference), by state/territory (NSW, Qld, WA and the NT), 2010 41

Figure 5.5: YLL rate ratios and rate differences, by disease group and state/territory (NSW, Qld, WA and the NT), 2010 42

Figure 5.6: Age-standardised YLL rates for Indigenous Australians, by remoteness, 2010 44

Figure 5.7: Leading causes of fatal burden (YLL) for Indigenous Australians, by remoteness, 2010 ... 45

Figure 5.8: Age-standardised YLL rates and rate ratios, by Indigenous status and remoteness, 2010 ... 46

Figure 5.9: Leading causes contributing to the gap in fatal burden between Indigenous and non-Indigenous Australians (based on YLL rate difference), by disease group and remoteness, 2010 ... 47

Figure 5.10: YLL rate ratios and rate differences, by disease group and remoteness, 2010 ... 48

Figure 5.11: Crude YLL rates (per 1,000 population) for Indigenous Australians, by socioeconomic disadvantage quintile (IRSEO index), 2010 ... 51

Figure 5.12: Proportion of disease groups contributing to YLL for Indigenous Australians, by socioeconomic disadvantage quintile (IRSEO index), 2010 ... 52

Figure 5.13: Crude YLL rates for non-Indigenous Australians, by socioeconomic disadvantage quintile (PNIRSEO index), 2010 ... 53

Figure 6.1: Ranking of broad disease groups by YLL for Indigenous Australian (2010) and Māori males (2006) ... 58

Figure 6.2: Ranking of broad disease groups by YLL for Indigenous Australian (2010) and Māori females (2006) ... 59

Figure 6.3: Percentage contributions to the gap (based on YLL rate difference), by disease group and sex, Australia Indigenous:non-Indigenous (2010) and New Zealand Māori: non-Māori (2006) ... 60

Figure C.1: Age-standardised YLL rates by Indigenous status and SEIFA (IRSD) quintile, 2010 ... 73

Figure D.1: Percentage of deaths and YLL for Indigenous Australians, pre- and post-redistribution, by disease group, 2010 ... 84

Figure E.1: Age-standardised YLL rate differences between Indigenous and non-Indigenous Australians, by disease group and adjustment factor, 2008–2010 (average annual figures) ... 90

List of boxes

Box 1.1: Key terms used in burden of disease analysis 2

Box 1.2: Comparing YLL estimates with those in previous (2003) Indigenous Australian Burden of Disease (BoD) Study 4

Box F.1: Interpreting rate differences and rate ratios..........96

This is the second report in the Australian Burden of Disease Study series. It provides estimates of fatal burden for 2010 for the Aboriginal and Torres Strait Islander population as well as estimates of the gap in fatal burden between Indigenous and non-Indigenous Australians. Injuries and cardiovascular diseases contributed the most fatal burden for Indigenous Australians (22% and 21% respectively), followed by cancer (17%).