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Australian Burden of Disease Study

Impact and causes of illness and death in Australia

2015

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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 (Online)

ISSN 2006-4508 (Print)

ISBN 978-1-76054-546-8 (Online)

DOI 10.25816/5ebca2a4fa7dc

Suggested citation

Australian Institute of Health and Welfare 2019. Australian Burden of Disease Study: impact and causes of illness and death in Australia 2015. Australian Burden of Disease series no. 19. Cat. no. BOD 22. Canberra: AIHW.

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Contents

Summary

Every year in Australia, millions of years of healthy life are lost because of injury, illness or premature deaths in the population. This loss of healthy life is called the 'burden of disease' in epidemiological literature.

Burden of disease analysis combines living with poor health (the non-fatal burden of disease) with dying prematurely (fatal burden). Fatal and non-fatal burden combined is referred to as total burden. Burden of disease is recognised as the best method to measure the impact of different diseases or injuries in a population.

This report provides estimates of the total, non-fatal and fatal burden for the Australian population in 2015, using the disability-adjusted life years (DALY) measure. One disability-adjusted life year (or 1 DALY) represents 1 year of healthy life lost, either through premature death ('years of life lost' or YLL) or from living with an illness or injury ('years lived with disability' or YLD).

DALY estimates are presented for more than 200 diseases, as well as estimates of the burden attributable to more than 30 risk factors, such as tobacco use and physical inactivity. Results are also included for 2003 and 2011 for comparison.

In 2015, Australians lost 4.8 million years of healthy life (DALY) due to:

Living with illness (non-fatal)
50.4% of total burden

Dying prematurely (fatal)
49.6% of total burden

Chronic disease and injury cause most of the burden of disease

The 5 disease groups causing the most burden in 2015 were cancer, cardiovascular diseases, musculoskeletal conditions, mental & substance use disorders, and injuries; together, these accounted for around two-thirds (65%) of the total burden.

Summary of total burden and 5 leading disease groups, 2015

	Cancer	Cardiovascular	Musculoskeletal	Mental	Injuries	Total (all diseases)
Number of DALY ('000)	868	646	611	573	406	4,752
% of total DALY	18	14	13	12	9	100
% of DALY that was fatal	93	79	3	2	82	50
Change between 2003 and 2015[(a)]	↓	↓	↓	—	↓	↓

(a) Based on rate difference; that is, the absolute difference between the age-standardised rate of burden from 2003 to 2015.

Good gains in the health of the population between 2003 and 2015

Overall, the health of the Australian population has improved over the 12-year period from 2003 to 2015. After adjusting for population increase and ageing, between 2003 and 2015 there were decreases of:

More burden for males

Males experienced more health loss than females for most age groups except for those aged 85 and over. In 2015, males suffered 1.6 times the rate of fatal burden (110 YLL per 1,000 population) experienced by females (69).

Over one-third of disease burden is preventable

In 2015, 38% of the burden of disease could have been prevented by reducing the exposure to the modifiable risk factors examined in this study. The risk factors contributing to the most burden were tobacco use (9.3%), overweight & obesity (8.4%), dietary risks (7.3%), high blood pressure (5.8%) and high blood plasma glucose (including diabetes) (4.7%).

Proportion (%) of burden attributable to leading 5 risk factors for selected disease groups, 2015

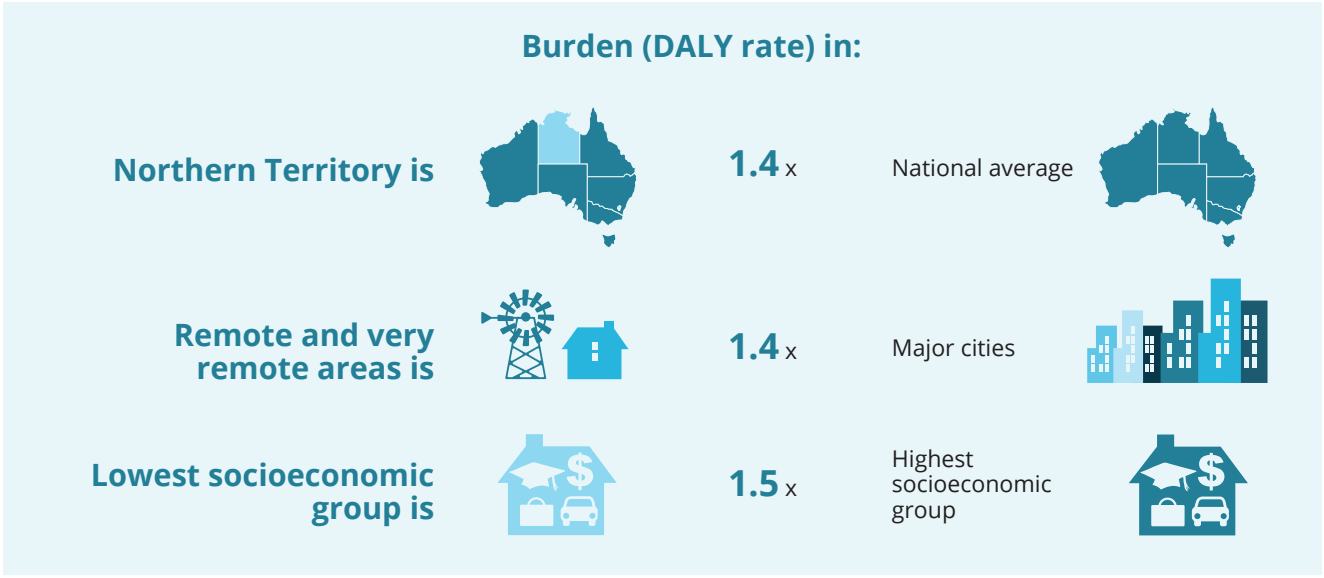
Disease group	Tobacco use	Overweight & obesity	Dietary risks[a]	High blood pressure	High blood plasma glucose
Cancer	22.1	7.8	4.2	. .	2.9
Cardiovascular	11.5	19.3	40.2	38.0	4.9
Respiratory	41.0	8.0	0.3	. .	. .
Endocrine	3.7	44.6	34.2	. .	98.0
Kidney/urinary	. .	35.6	7.7	34.1	53.7

(a) Estimates for diet are based on an analysis of the joint effects of all dietary risk factors included in the study following methods used in recent global burden of disease studies.

Note: Blank cells '. .' indicate that the risk factor has no associated diseases or injuries in the disease group.

Disease burden is not shared equally across Australia

The difference in the disease burden across states and territories was most pronounced in the Northern Territory, which had higher burden rates than the other jurisdictions. Large inequalities were also found across socioeconomic groups and remoteness areas.



A 20% reduction in burden could be achieved if all Australians experienced the same rate of disease burden (DALY) as the most advantaged socioeconomic group. If however, the rate of burden experienced by all Australians was the same as in Major cities, there would be a 4.3% reduction in burden.

Cancer still causes more burden than any other disease group

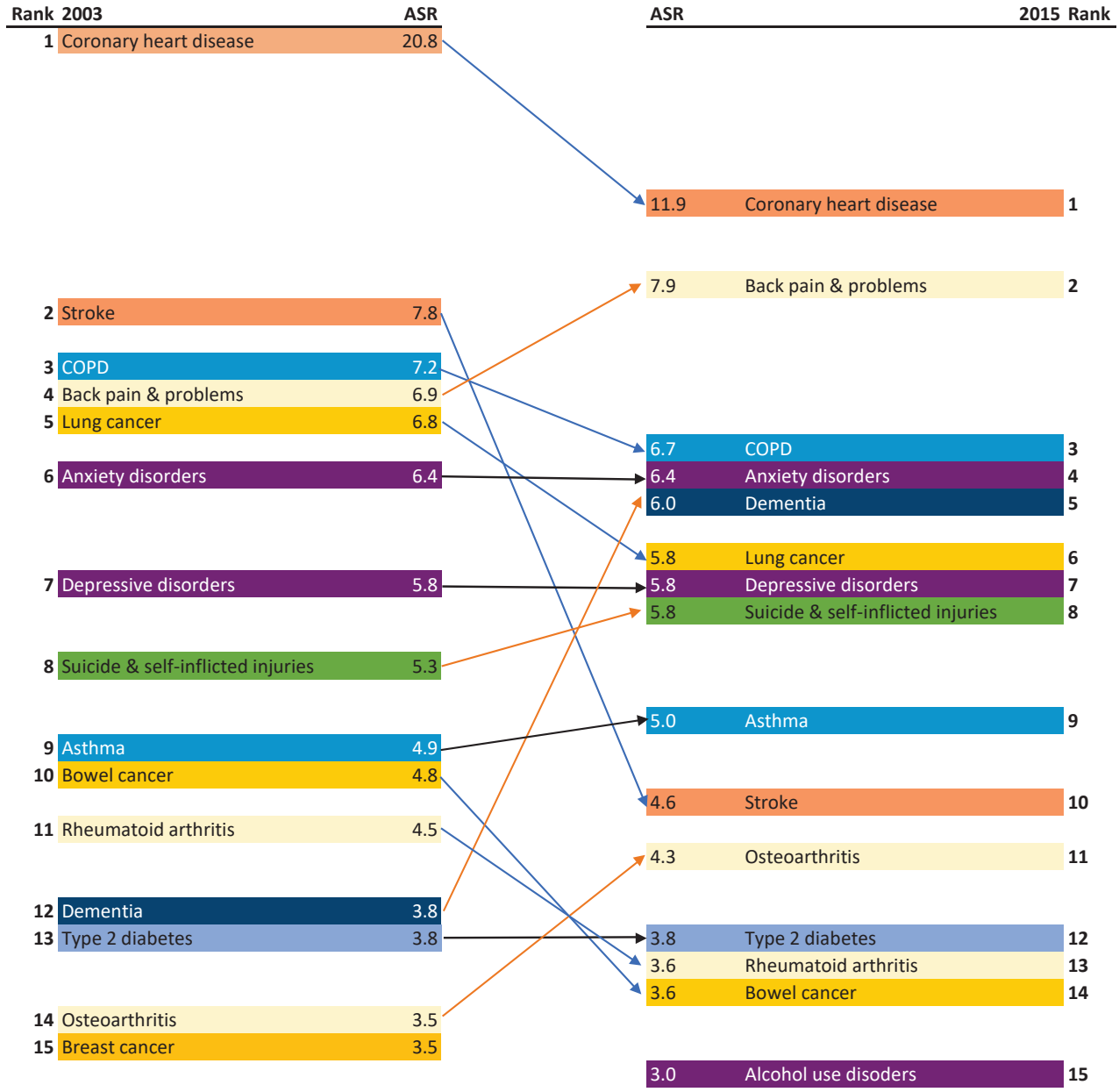
Cancer was the highest ranked disease group (that is, it contributed the most burden) in 2003 and in 2015. Cardiovascular diseases was in second place in 2015, while musculoskeletal conditions was ranked third.

The rate of total burden (after adjusting for age and population changes) fell for cardiovascular diseases (36%, from 37 to 23 DALY per 1,000 population) and infant & congenital conditions (30%, from 6.3 to 4.4) and rose for neurological conditions (18%, from 11 to 13).

Leading cause of burden was coronary heart disease

For specific diseases, coronary heart disease showed the largest reduction (from 21 to 12 DALY per 1,000 population) between 2003 and 2015; but it remained as the leading cause of burden. A decline in total burden was also seen for stroke, chronic obstructive pulmonary disease (COPD), lung and bowel cancer and rheumatoid arthritis. The total burden from dementia rose substantially, the rank for dementia also increased from 12th in 2003 to fifth in 2015.

Change in disease ranking and age-standardised DALY rate (DALY per 1,000 population), 2003 and 2015



ASR = age-standardised rate

Note: There were changes in practices of coding deaths due to dementia; therefore, caution is recommended when interpreting changes over time for dementia burden.

Expected time living in full health is different between population groups

Health-adjusted life expectancy (HALE) was 71.5 years for males and 74.4 years for females born in 2015. HALE reflects the average length of time a person can expect to live in full health and is most meaningful when compared with life expectancy. While the life expectancy of those in the highest and lowest socioeconomic groups increased (or stayed the same) in 2015 compared to 2011, HALE increased in the highest group, but decreased in the lowest group.

1 Introduction

Burden of disease analysis measures the impact of fatal and non-fatal burden; that is, both deaths and living with poor health. More than merely counting deaths or disease prevalence, it takes into account age at death and severity of disease.

High-quality information on the health impacts and distribution of different diseases, injuries and risk factors is important in providing an evidence base to inform both health policy and program and service delivery. Burden of disease studies allow deaths and living with illness to be compared and reported in a consistent manner. Estimates produced from a burden of disease study are the best summary measures of a population's health.

The Australian Burden of Disease Study (ABDS) 2015 uses burden of disease analysis to measure the impact of 216 separate diseases and injuries on the health of the Australian population. The study provides a detailed picture of the burden of disease for the Australian population in 2015, including comparisons with 2011 and 2003. It includes estimates of total, fatal and non-fatal burden for the total Australian population, as well as by state and territory, remoteness areas and socioeconomic groups. It also includes estimates of the contribution made by selected risk factors on the disease burden in Australia, and by socioeconomic groups for some risk factors. A summary report, presenting key findings from the ABDS 2015 study, is available (AIHW 2019b).

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 (often referred to in this report as 'diseases' for simplicity) and risk factors on a population. It uses information from a range of sources to quantify the fatal (for example, dying from cancer) and non-fatal (for example, living with back pain) effects of these diseases in a consistent manner so that they can then be combined into a summary measure of health called disability-adjusted life years, or DALY. Simply put, a DALY combines the impact of dying early and living with illness. It combines the estimates of years of life lost due to premature death (YLL) and years lived in ill health or with disability (YLD) to count the total years of healthy life lost from disease and injury. These and other key terms are defined in Box 1.1 and explained further in Appendix A.

Health loss represents the difference between the current health status of the population and the ideal situation where everyone lived a long life, free of disease. Burden of disease estimates capture both the quantity and quality of life, and reflect the magnitude, severity and impact of disease and injury within a population. The analysis also estimates the contribution of various risk factors to health loss, known as the attributable burden.

Burden of disease analysis is a way of collating the best available data on causes of health loss to produce comparable and concise information. The ability to use data from a range of sources to construct an internally consistent measure for all diseases is a key strength of a burden of disease study. The major benefit is that the impact of a disease that may cause death can be compared with one that may not be fatal but may cause great suffering in a large number of people. Similar comparisons and rankings across different diseases or injuries cannot be produced by using separate studies conducted on a disease-by-disease basis, which may use different survey methods and/or disparate data sources.

Box 1.1: Key terms

Attributable burden: The disease burden attributed to a particular risk factor. It is the reduction in fatal and non-fatal burden that would have occurred if exposure to the risk factor had been avoided (or, more precisely, had been at its theoretical minimum).

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

Disability-adjusted life years (DALY): A measure (in years) of healthy life lost, either through premature death, defined as dying before the ideal life span (YLL) or, equivalently, through living with ill health due to illness or injury (YLD). It is often used synonymously with 'health loss'.

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

Disease: A broad term that, in this report, is applied to any health problem. It is often used synonymously with condition, disorder or problem.

Fatal burden: The burden from dying 'prematurely' as measured by years of life lost. Often used synonymously with YLL, and also referred to as 'life lost'.

Health-adjusted life expectancy (HALE): The number of healthy years a person of a particular age can expect to live.

Health loss: The total number of healthy years lost from living with disease/injury (YLD) and the total number of years lost from dying early from disease/injury (YLL). It is often used synonymously with DALY.

Health state: Consequences of diseases and conditions reflecting key differences in symptoms and functioning.

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

Life expectancy: The number of years a person of a particular age can expect to live.

Non-fatal burden: The burden from living with ill-health as measured by years lived with disability. It is often used synonymously with YLD.

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

Reference life table: A term that corresponds to the maximum life expectancy for an individual in good health.

Risk factor: Any factor that represents a greater risk of a health condition or health event; for example, smoking, alcohol use and high body mass.

Sequela: Consequence of diseases; often used in the plural, **sequelae**.

Theoretical minimum risk exposure distribution (TMRED): The distribution of exposure to a risk factor that would have the lowest associated population risk.

Years lived with disability (YLD): The number of years of what could have been a healthy life but were instead spent in states of less than full health. YLD represent non-fatal burden.

Years of life lost (YLL): The number of years of life lost due to premature death, defined as dying before the ideal life span (see Table A2 in Appendix A). YLL represent fatal burden.

(See Glossary for a full list of definitions).

How can burden of disease studies be used?

Monitoring of population health

Burden of disease analysis is valuable for monitoring population health as it simultaneously quantifies the fatal and non-fatal impact of causes of ill health. It provides summary information on the level and distribution of health in the population, which can be used to measure population health over time and between groups. Further, it maintains comparability of these metrics between diseases and population groups. The contribution of various risk factors can also be described using the same metrics.

Health policy and health service planning

Burden of disease studies provide valuable information to inform health policy formulation and health service planning. By comparing all diseases together, these studies can highlight which diseases and risk factors cause the most burden, which are increasing or decreasing, and which are causing the greatest health inequalities and gaps. For example, they indicate the diseases most likely to have an impact on the health system and services, such as doctor visits, hospital admission or dental care. As well, estimates of the burden attributable to specific risk factors can be used to target prevention policies.

What can't burden of disease studies tell us?

Burden of disease analysis quantifies the size of health problems. It does not take into account broader factors, such as social impacts, economic impacts or the direct impact on the health system. While it can provide some indication of areas of health workforce demand, it needs to be used together with other information to determine where there are gaps.

Since burden of disease analysis quantifies only the size of a health problem, it should not be used on its own for resource allocation, as it does not show what interventions will work or which are most cost effective. However, as outlined earlier, burden of disease analysis helps to identify which diseases and risk factors might need attention, or those conditions for which the cost-effectiveness of interventions should be investigated, to gain the maximum benefit.

How is burden of disease measured?

Burden of disease quantifies the gap between a population's *actual* health and an *ideal* level of health in the given year—that is, every individual living in full health for an ideal life span. To quantify this gap, it uses a summary measure of health called disability-adjusted life years, or DALY. The more DALY associated with a disease or injury, the greater the burden.

Years of life lost (YLL) measure the years lost between the age at which a person dies and an ideal life span. In this study, the ideal remaining life expectancy varies at each age but starts as a life expectancy at birth of 86.0 years for both men and women (see Appendix Table A2 for the full standard life expectancy). This ideal life span is based on the lowest observed death rates at each age group from multiple countries (Murray, Ezzati et al. 2012). Total YLL are influenced by both the total number of deaths and the ages at which those deaths occur.

Years lived with disability (YLD) measure the number of healthy years of life lost due to living with disease at the population level. This is calculated by estimating the amount of time spent with a condition, multiplied by a disability weight indicating the severity of the condition (see Box 1.2). Total YLD are influenced by the number of people with each disease, the time spent in less than full health and the disability weights defined for each disease. The disability weights represent the health loss caused by the consequences of each disease.

Box 1.2: Disability weights

Disability weights attempt to capture the severity of the effects of a disease or injury on a scale from 0 (perfect health) to 1 (equivalent to death). They aim to quantify societal preferences for different health states. The weights do not represent the lived experience of any health state or imply any societal value of the person in a particular health state. Rather, they quantify societal preference for health states in relation to the 'ideal' of good health.

Disability weights are based on various international surveys of people in the general community. Respondents were given descriptions of individuals with different health states and asked to specify which person was more healthy (Salomon et al. 2015).

For example, *Cancer: metastatic* has a disability weight of 0.451, while *Severe tooth loss* has a weight of 0.067. A total of 235 health states are specified and used in the calculation of YLD (Salomon et al. 2015).

Constructed in this way, the DALY is a summary measure of the overall population health for the year being reported (see Box 1.3 for an example). That is, 1 DALY represents 1 lost year of 'healthy life' and is equal to YLL plus YLD. The DALY measure enables comparison of specific diseases, population groups and points in time.

Box 1.3: Example of calculating disability-adjusted life years

Burden of disease analyses estimate health loss from living with or dying from disease and injury in a single year—measured as DALY.

Joe, aged 65, has angina. Joe suffers health loss from living with angina; in burden of disease analyses, this impact is measured using a 'disability weight'. Angina has a disability weight of 0.2 and, as it is a chronic condition, it would affect Joe for the entirety of that year (0.2 x 1 year = 0.2 YLD). However, if Joe then has a heart attack in the same year, he would also experience short-term health loss (for about a month) with a disability weight of 0.5 (0.5 x 1/12 = 0.04). This gives Joe a total of 0.24 YLD for his health loss due to coronary heart disease (that is, angina or heart attack).

If Joe then dies at the end of the year, he will lose a number of years by dying early. A man aged 65 would (according to the theoretical life tables maximum life span) live until he is 88. If Joe dies at 65, he will have lost 23 years due to dying prematurely (or 23 YLL).

Joe's total DALY will therefore be 0.24 YLD plus 23 YLL, making 23.24 DALY.

Measuring the contribution of risk factors

Information on the impact of various risk factors (such as smoking, physical inactivity, high blood pressure) on the health of the population can be used to measure the proportion of the burden of disease due to these risk factors. These estimates show how much of the disease burden could have been averted if the population's actual exposure to the risk had been modified to the lowest level (known as the theoretical minimum risk exposure distribution, or TMRED)—for example, if smoking were eliminated or if sodium intake were reduced to a minimum level.

The calculations use information on which diseases are linked to the various risk factors, the amount of extra risk of developing or dying from that disease caused by exposure to the risk factor (relative risks), and the number of people in the population exposed to the risk factor.

What is the history of burden of disease analysis?

The first global burden of disease study—for the year 1990—developed the DALY metric and quantified the global disease burden (and attribution to risk factors) reported for 8 regions of the world (Murray & Lopez 1996). Since then, more global and country studies have been undertaken and methods have been further developed. Before this study, in Australia, 3 major national burden of disease studies were conducted (AIHW 2016b; Begg et al. 2007; Mathers et al. 1999), as well as 2 studies for Indigenous Australians (AIHW 2016a; Vos et al. 2007). Some states and territories have also completed burden of disease work. Table 1.1 provides a summary of global and national Australian studies.

Table 1.1: Summary of global and Australian burden of disease studies

Study	Reference year	Reference
Global study: Harvard School of Public Health in collaboration with The World Bank and the World Health Organization (WHO)	1990	Murray & Lopez 1996
First Australian study: Australian Institute of Health and Welfare (AIHW)	1996	Mathers et al. 1999
Global study: The World Bank	2000–2002	Lopez et al. 2006
Second Australian study: AIHW and The University of Queensland	2003	Begg et al. 2007
First Indigenous Australian study: The University of Queensland	2003	Vos et al. 2007
Global study: WHO	2004 with projections to 2030	WHO 2009a
Global study: Institute for Health Metrics and Evaluation (IHME)	2010	Murray, Vos et al. 2012
Global study: WHO	2011	WHO 2014
Global study: IHME	2013	Murray et al. 2015
Third Australian study: AIHW	2011	AIHW 2016b

Study	Reference year	Reference
Second Indigenous Australian study: AIHW	2011	AIHW 2016a
Global studies: WHO	2015; 2016	WHO 2017; WHO 2018
Global study: IHME (annual updates from reference year of 2015 onwards)	2015; 2016; 2017	GBD 2015 DALYs and HALE Collaborators 2016; GBD 2016 DALYs and HALE Collaborators 2017; GBD 2017 DALYs and HALE Collaborators 2018

The Global Burden of Disease Study (GBD)—conducted by the Institute for Health Metrics and Evaluation (IHME) (located at the University of Washington) and other academic partners—was first published in December 2012 (Murray, Vos et al. 2012). It used substantially revised methods from those of earlier studies to generate DALY for 2010 and revised estimates for 1990 and 2005 (see AIHW 2014 for further detail on method changes). Following this GBD study, the World Health Organization (WHO) applied GBD methods (with some modifications) to produce global burden of disease estimates for 2000–2012 (WHO 2014), then for 2015 and 2016 (WHO 2017, 2018). The IHME has since updated its estimates for the reference years 2013, 2015, 2016 and 2017, along with revised estimates for 2010 and earlier years (respectively, Murray et al. 2015; GBD 2015 DALYs and HALE Collaborators 2016, GBD 2016 DALYs and HALE Collaborators 2017, GBD 2017 DALYs and HALE Collaborators 2018). The most recent Australian study included estimates for 2011 with revised estimates for 2003 (AIHW 2016b).

The ABDS uses Australian data sources and adapts the methods of global studies to quantify burden of disease. Further information and international comparisons are presented in Chapter 9.

What's new in the Australian Burden of Disease Study 2015 and this report?

The ABDS 2015 was undertaken to build on the AIHW's previous burden of disease studies and current disease monitoring work. It updates burden of disease estimates, using the infrastructure developed as part of the ABDS 2011, and includes several improvements since the previous Australian study. It provides burden of disease estimates best matched to the Australian context for the Australian population (including sub-national estimates) for 2015. It also provides estimates for 2011 and 2003, revised using the same methods as for 2015, to enable direct comparisons.

The chosen reference period (2015) reflects the data availability from key data sources (such as the National Health Survey, deaths data, hospital admissions data and various disease registers) at the time analyses began.

In particular, this detailed report contains a new chapter on HALE (Chapter 5) and presents key changes in estimates over the 3 Australian burden of disease studies (Chapter 7) (see Box 1.4 for a brief list of the main developments).

Box 1.4: Key developments since the 2011 Australian study

1. A more comprehensive list of diseases, including disaggregation of:
   - diabetes into type 1 and type 2 diabetes
   - leukaemia into 5 sub-types
   - mouth and pharyngeal cancer into lip and oral cavity cancer, nasopharyngeal cancer and other oral cavity and pharynx cancers
   - vision loss into 5 conditions—refractive errors, cataract and other lens disorders, glaucoma, age-related macular degeneration and other vision disorders
   - varicella-zoster into varicella and herpes-zoster
   - other land transport accidents into road traffic injury—pedestrians, road traffic injury—pedal cyclists, and other land transport accidents

   together with new diseases previously reported in residual groupings:
   - urinary tract infections
   - mumps
   - interstitial nephritis.
2. New conceptual models for some diseases in line with changes to the disease list or new evidence.
3. New data sources for many diseases, notably greater use of linked hospital/deaths data.
4. Reporting of sub-categories of risk factor estimates including:
   - overweight & obesity, reported separately, as well as combined
   - illicit drug use by type
   - tobacco use by exposure method (active or passive)
   - high blood plasma glucose by intermediate hyperglycaemia and diabetes.
5. Impaired kidney function as a new risk factor.
6. Child abuse risk factor, expanded from just sexual abuse to include physical, emotional abuse and neglect.
7. Intimate partner violence, expanded from physical and sexual abuse to include emotional abuse.
8. Revised risk factor calculations and an increased number of linked diseases for selected risk factors due to increased evidence.
9. Estimation of HALE (see Chapter 5).

Estimates for 2003 and 2011 have been recalculated, where methods were updated, to enable comparison with 2015 estimates (see Chapter 7). The published estimates from previous Australian studies are not directly comparable with those for the ABDS 2015 due to the method changes.

Further information on these developments can be found in Appendix A.

Data sources

The ABDS 2015 includes over 200 diseases and injuries, with a total of 644 sequelae. National estimates were produced for 3 reference years and sub-national estimates for 2 years. There were 38 risk factor components or exposures that combined into 18 individual risk factors. In total, 977,592 estimates were created.

Data to develop the ABDS 2015 estimates were obtained from many different sources. Deaths data for the fatal burden were sourced from the National Mortality Database. Data for the non-fatal burden came from a variety of sources: national data sets with complete coverage (such as the National Hospital Morbidity Database and the Australian Cancer Database), national surveys (such as the National Health Survey 2014–15 and the National Drug Strategy Household Survey 2016), linked hospitals and deaths data, and a number of epidemiological studies, to comprise 45 key data sources.

Where possible and appropriate, other inputs for the ABDS 2015 were obtained from the GBD studies. The standard life table for fatal burden, health states and disability weights for the non-fatal burden were obtained from the GBD 2013. Relative risks and the TMRED for the risk factor attribution were obtained from the GBD 2016 and the AIHW's review of the literature.

Population estimates underpinning all estimates were sourced from the Australian Demographic Statistics from the Australian Bureau of Statistics (ABS).

Details on the various data sources, including standard inputs, are in Appendix B and in Australian Burden of Disease Study 2015: methods and supplementary material (AIHW 2019a).

Additional tables/information to accompany this report, as well as data visualisations showing burden of disease estimates, are provided on the AIHW website <http://www.aihw.gov.au/burden-of-disease/>.

2 Total burden of disease

Key results

- In 2015, Australians lost 4.8 million years of healthy life due to living with and dying early from disease and injury.
- For the first time, Australians suffered more burden from living with illness (50.4% of total burden) than burden from premature death (49.6% of total burden).
- Overall, males experienced more health loss (53% of total burden) than females (47%). Dying from disease and injury accounted for more burden in males, while living with illness accounted for more burden in females.
- The rate of burden (number of DALY per 1,000 population) increased with age, with older Australians experiencing a substantial amount of the total burden despite having a smaller population.
- Chronic diseases and injuries dominated total burden in Australia. In 2015, the 5 conditions causing the most burden were coronary heart disease, back pain & problems, chronic obstructive pulmonary disease (COPD), dementia and lung cancer.
- The disease groups which caused main burden for children and young adults were injuries and mental & substance use disorders, while musculoskeletal conditions caused substantial burden for the working age groups.
- Cardiovascular diseases, cancer and neurological conditions were the major causes of total burden in older Australians.

Burden of disease measures the health impact of disease and injury on a population in a given year—both from dying prematurely and living with disease and injury. Total burden (DALY) is the sum of fatal burden (YLL) and non-fatal burden (YLD) (see Chapter 1 for more information).

What is the total burden of disease in Australia?

In 2015, Australians lost 4.8 million years of healthy life due to living with and dying from disease and injury. This is equivalent to 199 years of healthy life lost per 1,000 population.

Australians experienced lower rates of burden over time, decreasing by 11% between 2003 (208 DALY per 1,000 population) and 2015 (184), after accounting for population changes and age structure differences in those years.

Living with disease caused over half of the total burden

In 2015, Australians lost more healthy years of life from living with disease and injury (which accounted for 50.4% of the total health loss) than from dying prematurely (which accounted for the remainder, 49.6%). By comparison, dying prematurely caused more burden than living with illness in 2011 (51%) and 2003 (53%).

Males experienced more burden than females

For all 3 years analysed in this study (2003, 2011 and 2015), males accounted for more than half of the total burden (53%) compared with 47% for females. This means that, in 2015, males in total lost around 289,000 more years of healthy life than females.

Males experienced a higher proportion (55%) of their total burden (DALY) due to dying early from disease and injury while females experienced more of their burden from living with disease (56%).

How does total burden vary across the life course?

Health loss (DALY) in Australians varied across the different stages of life. Figure 2.1 compares the proportion of people in different age groups in 2015 with the proportion of health loss experienced by each age group.

Infants (aged under 1) accounted for a smaller proportion of the total population than young children (aged 1–4) but experienced greater health loss. This is mainly because infants had a much larger amount of fatal burden than young children.

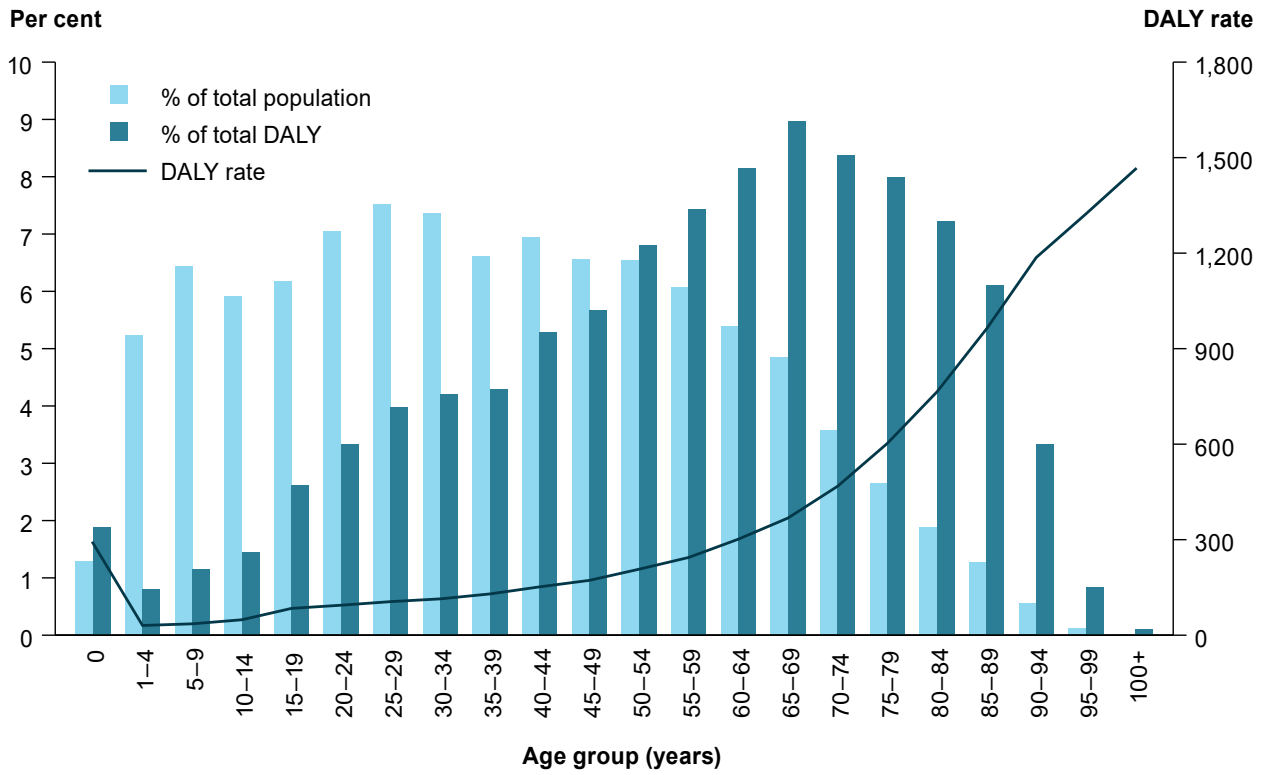
Australians aged under 40 (excluding infants) experienced less health loss than those aged 40 and over. The under 40 age group comprised 52% of the Australian population but only contributed to 22% of the total burden, mainly from the burden of living with illness.

With ageing, the amount of health loss rose substantially in the older age groups of the population. Australians aged 65–69 made up 5% of the population and experienced more health loss than any other 5-year age group, contributing to 9% of the total burden.

Older Australians aged 70 and over comprised a small proportion of the population (10%) but contributed to a substantial amount (34%) of the total burden. Dying from disease and injury (fatal burden) caused more burden than living with illness (non-fatal burden) for this group.

The rate of health loss (the number of DALY per 1,000 population, depicted as a line in Figure 2.1) was high in infants but much lower in the 1–4 age group. The rate began increasing from early childhood, continuing throughout life course, and was highest in the oldest Australians who are the most burdened by diseases and injuries.

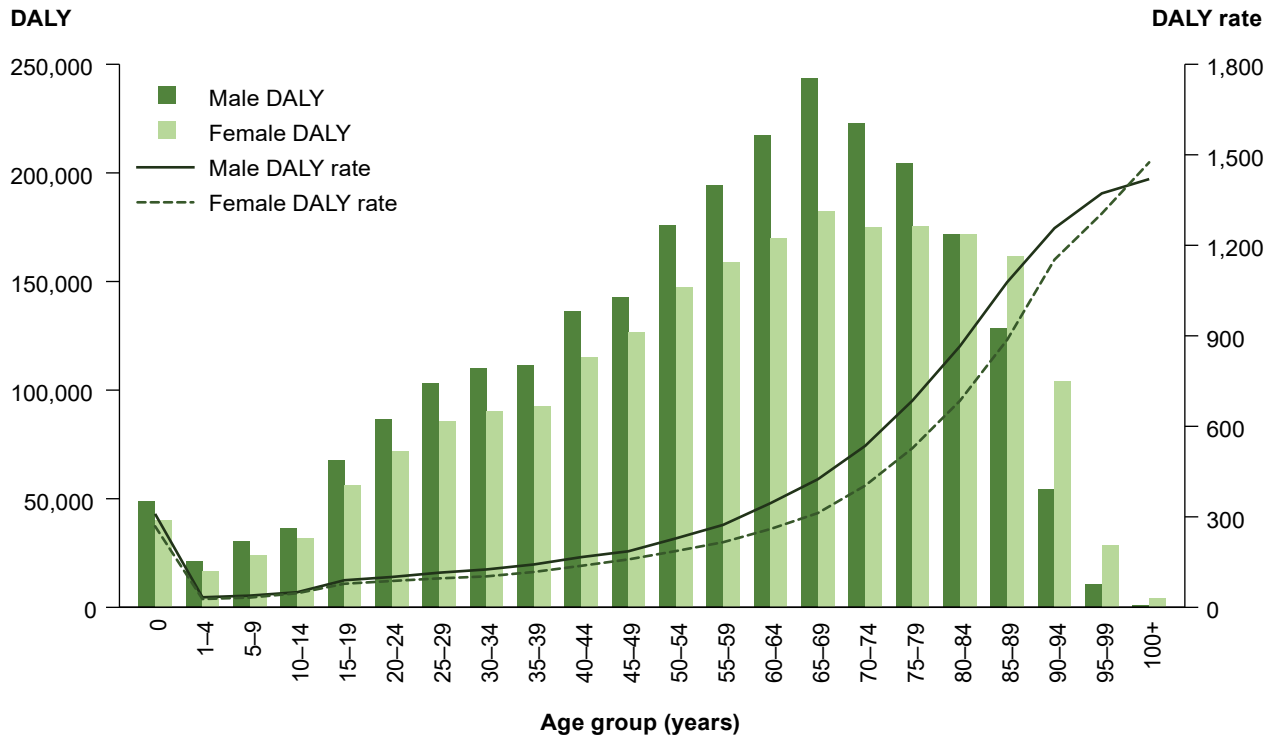
Figure 2.1: Age distribution (%) of the Australian population and contribution (%) to total burden (DALY), 2015



Note: DALY rate is expressed as DALY per 1,000 population.

Both males and females experienced similar patterns of health loss throughout the life course (as shown in Figure 2.2), although males suffered a higher amount (and rate) of health loss than females for most age groups. In older Australians aged 85 and over, men suffered a considerably lower amount of burden than women due to having a smaller population.

Figure 2.2: Number and rates of total burden (DALY, DALY per 1,000 population), by age group and sex, 2015



Which disease groups cause the most burden?

Australians experienced the majority of burden from chronic diseases and injuries rather than acute illness. The total burden (DALY) caused by specific disease groups is described in this section. For information relating to the reporting of disease groups and individual diseases in the ABDS 2015, refer to Box 2.1.

Box 2.1: How are diseases and disease groups assigned in the Australian Burden of Disease Study 2015?

The ABDS 2015 estimated the years of healthy life lost due to living with illness (YLD) and the years of life lost due to dying from illness (YLL) for 216 separate diseases and injuries, which were grouped into 17 disease groups (16 disease groups, 1 injury group reported by external cause and nature of injury).

Disease

Disease is a term that describes a health problem. The ABDS 2015 disease list was developed to reflect the needs of health reporting and monitoring in Australia; it listed mutually exclusive diseases and injuries (defined according to the International Statistical Classification of Diseases and Related Health Problems, 10th Revision, or ICD-10) that collectively reflected the total disease burden in Australia.

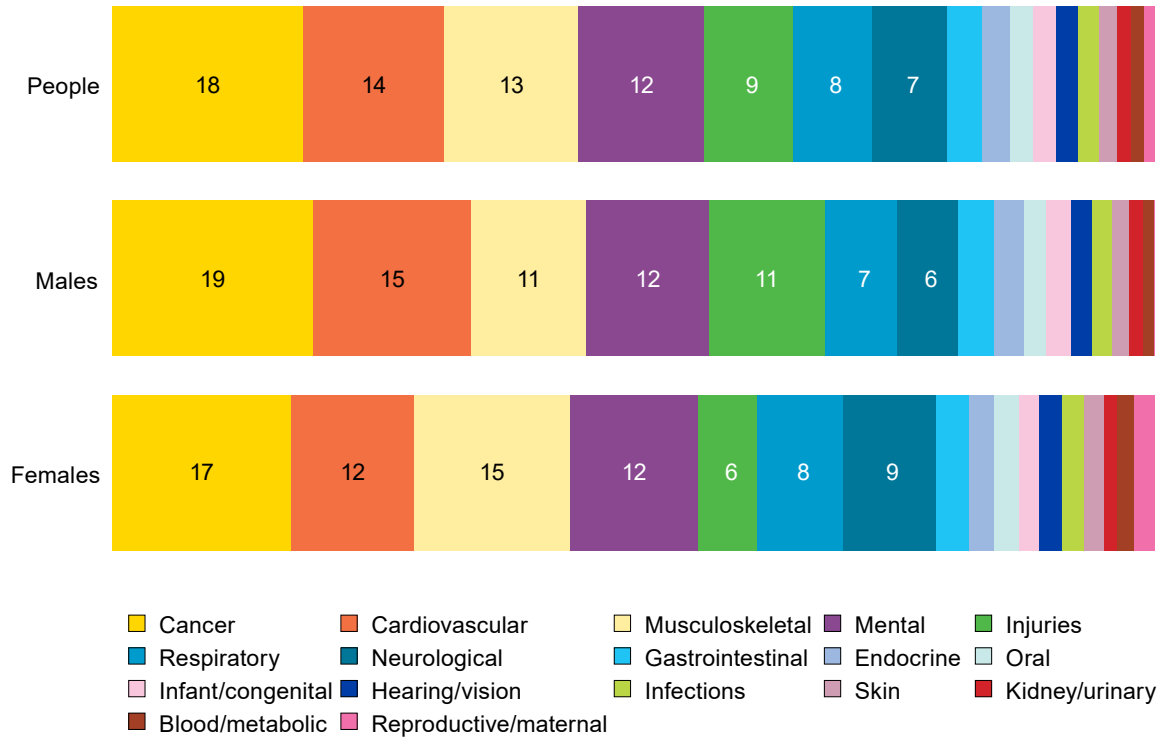
Disease group

A disease group consists of a number of related diseases/conditions. Each of the 216 diseases was assigned to a disease group, based on the chapter structure of ICD-10 codes (WHO 2016). For injuries, the conditions were grouped by both external cause (presented in this chapter) and nature of injury (see Appendix D). Conditions that could not be individually specified for analysis were grouped into the residual ('other') category of each disease group.

For example, musculoskeletal conditions is a disease group that includes back pain & problems, osteoarthritis, rheumatoid arthritis and gout. A number of conditions (such as fibromyalgia, tendonitis) were grouped into the residual category—'other musculoskeletal conditions'—and are collectively analysed and reported in the study.

The leading causes of total burden (DALY) in 2015 were cancer (18% of total burden), cardiovascular diseases (14%), musculoskeletal conditions (13%), mental & substance use disorders (12%) and injuries (8.5%) (see Figure 2.3). Together, these disease groups caused around two-thirds of the burden in Australia and have been consistently the main contributors since 2003.

Figure 2.3: Proportion (%) of total burden (DALY), by disease group and sex, 2015



Burden from 'living with disease' and 'dying from disease' is shared differently across disease groups

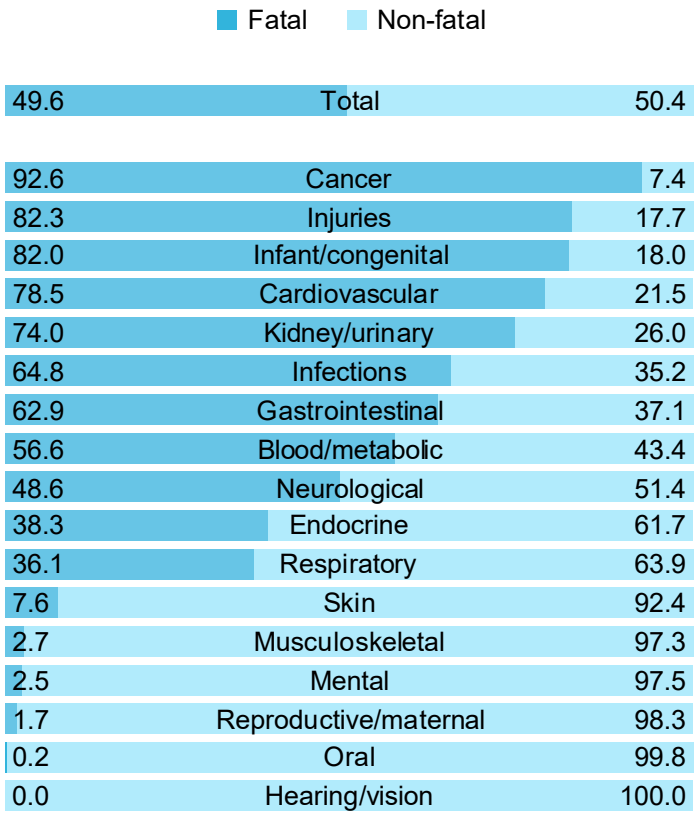
The contribution to total burden due to dying prematurely (fatal burden) and living with illness (non-fatal burden) differed greatly for each disease group (Figure 2.4).

Among the most burdensome disease groups, Australians lost many more years of life due to dying from cancer (93% of total cancer burden), injuries (82%) and cardiovascular diseases (79%) than healthy years lost from living with the impacts of these diseases.

For mental & substance use disorders and for musculoskeletal conditions, health loss was predominantly caused by living with the impacts of disease (98% and 97% of the total burden, respectively) rather than dying from the disease.

These results highlight that disease groups (and individual diseases) cause different types of health loss. It is important to consider the drivers of burden (fatal and non-fatal) when analysing the total burden for disease groups in Australia.

Figure 2.4: Proportion (%) of total burden (DALY) by fatal burden (YLL) versus non-fatal burden (YLD), by disease group, 2015



Disease groups had different impacts on males and females

Males and females experienced substantial health loss from the same leading disease groups (Table 2.1). Cancer (19% of total male burden), cardiovascular diseases (15%) and injuries (11%) contributed to greater proportions of the total burden (DALY) in males whereas musculoskeletal conditions (15% of total female burden) and neurological conditions (8.9%) contributed to higher proportions of the burden in females.

Males and females experienced different rates of burden (reported as age-standardised rates, or ASRs; see Box 2.2 for more information) for each disease group. In particular, males suffered much higher rates of burden (DALY per 1,000 population) due to injuries, cardiovascular diseases, cancer and kidney & urinary diseases than females. Females suffered higher rates of burden from blood & metabolic disorders and slightly more burden from musculoskeletal conditions and neurological conditions compared with males.

Box 2.2: Age-standardised rates

The ABDS 2015 compares the rate of disease burden between different population groups and different time periods using ASRs. ASRs seek to allow like-for-like comparisons.

Firstly, the ASR expresses the burden in terms of the number of years lost per 1,000 population (the 'rate' part) to remove differences in burden that are just due to the different sizes of the 2 populations.

Secondly, it adjusts for differences in the age structure between the 2 populations. The burden of both living with illness and dying from disease is influenced by age. Different population groups (for example, males versus females, 2003 versus 2015 population) have a different composition of age groups. For example, the 2015 Australian population had a higher proportion of older Australians aged 65 and over (15%) than the 2003 population (13%).

Using ASRs ensures the rate of each comparison group is based on a standard population with consistent age structure (to remove differences in burden due to differences in age composition) and allows for accurate comparison of disease burden between 2 groups.

Table 2.1: Comparison of total burden (DALY, DALY%, DALY ASR), by disease group and sex, 2015

	Males				Females			
Disease group	**Rank**	**DALY**	**Proportion (%)**	**ASR**	**Rank**	**DALY**	**Proportion (%)**	**ASR**
Cancer	1	484,537	19.2	37.8	1	383,616	17.2	27.8
Cardiovascular	2	384,161	15.2	30.6	4	262,223	11.7	16.8
Mental	3	297,101	11.8	25.6	3	275,674	12.4	23.4
Injuries	4	279,532	11.1	23.8	7	126,429	5.7	10.0
Musculoskeletal	5	277,754	11.0	22.3	2	333,533	14.9	25.3
Respiratory	6	175,397	7.0	14.1	6	182,239	8.2	13.7
Neurological	7	147,161	5.8	12.0	5	198,962	8.9	13.1
Gastrointestinal	8	87,773	3.5	7.0	8	71,835	3.2	5.3
Endocrine	9	70,722	2.8	5.5	9	53,429	2.4	3.8
Infant/congenital	10	58,914	2.3	4.9	13	44,930	2.0	3.9
Oral	11	54,827	2.2	4.5	10	52,481	2.4	4.0
Hearing/vision	12	51,137	2.0	4.1	12	47,582	2.1	3.2
Infections	13	48,965	1.9	4.0	11	48,196	2.2	3.4
Skin	14	40,160	1.6	3.4	15	41,682	1.9	3.4
Kidney/urinary	15	35,520	1.4	2.8	17	28,762	1.3	1.9
Blood/metabolic	16	24,799	1.0	2.0	16	35,547	1.6	2.7
Reproductive/maternal	17	2,193	0.1	0.2	14	44,641	2.0	3.6
Total		**2,520,652**	**100.0**	**204.8**		**2,231,762**	**100.0**	**165.3**

Notes

1. Rates were age-standardised to the 2001 Australian Standard Population and are expressed as DALY per 1,000 population (DALY ASR).
2. Numbers and percentages shown for disease groups may not add up to the total due to rounding.

Which diseases cause the most burden?

Of the 216 individual diseases analysed, the leading 20 diseases and injuries together caused 53% of the total burden (DALY). Rankings for diseases that caused the largest amount of burden in males and females are shown in Table 2.2. The majority of these belonged to the 5 leading disease groups of total burden, although COPD, dementia and type 2 diabetes were notable exceptions.

Coronary heart disease, back pain & problems and COPD were leading causes of total burden in both males and females. However, males suffered almost 3 times the amount of burden due to suicide (ranked second in males) and more burden from lung cancer than females, while females experienced substantially more healthy years lost from dementia (ranked second in females), anxiety disorders, depressive disorders and osteoarthritis.

Stroke was another high burden disease and caused a similar amount of health loss in both males and females. Despite this similar health loss, stroke was ranked much higher in males (seventh) than in females (11th). As rankings show only the relative position of individual disease burden compared with other diseases, it is important to look at the actual amount of burden caused by the disease to understand its impact on the population.

Table 2.2: Leading 20 causes of total burden (DALY), by sex, 2015

Rank	Males	DALY	% of total	Females	DALY	% of total	People	DALY	% of total
1	Coronary heart disease	216,774	8.6	Coronary heart disease	111,999	5.0	Coronary heart disease	328,773	6.9
2	Suicide	100,882	4.0	Dementia	110,615	5.0	Back pain & problems	196,218	4.1
3	Back pain & problems	97,862	3.9	Back pain & problems	98,356	4.4	COPD	184,038	3.9
4	COPD	92,367	3.7	COPD	91,670	4.1	Dementia	179,804	3.8
5	Lung cancer	91,850	3.6	Anxiety disorders	90,468	4.1	Lung cancer	157,486	3.3
6	Dementia	69,188	2.7	Depressive disorders	78,290	3.5	Anxiety disorders	149,914	3.2
7	Stroke	62,511	2.5	Osteoarthritis	74,902	3.4	Depressive disorders	136,033	2.9
8	Anxiety disorders	59,446	2.4	Breast cancer	69,690	3.1	Suicide	135,373	2.8
9	Type 2 diabetes	58,968	2.3	Asthma	66,796	3.0	Stroke	128,047	2.7
10	Depressive disorders	57,742	2.3	Lung cancer	65,635	2.9	Asthma	120,774	2.5
11	Bowel cancer	54,713	2.2	Stroke	65,536	2.9	Osteoarthritis	115,430	2.4
12	Asthma	53,978	2.1	Rheumatoid arthritis	54,093	2.4	Type 2 diabetes	102,714	2.2
13	Alcohol use disorders	51,586	2.0	Type 2 diabetes	43,746	2.0	Bowel cancer	96,936	2.0
14	Prostate cancer	50,471	2.0	Bowel cancer	42,223	1.9	Rheumatoid arthritis	94,654	2.0
15	Poisoning	43,964	1.7	Suicide	34,491	1.5	Hearing loss	71,138	1.5
16	Rheumatoid arthritis	40,561	1.6	Falls	34,038	1.5	Breast cancer	70,226	1.5
17	Osteoarthritis	40,528	1.6	Hearing loss	32,311	1.4	Alcohol use disorders	68,455	1.4
18	Chronic liver disease	39,341	1.6	Chronic kidney disease	27,209	1.2	Falls	66,521	1.4
19	Hearing loss	38,827	1.5	Severe tooth loss	22,642	1.0	Poisoning	62,681	1.3
20	Falls	32,483	1.3	Bipolar affective disorder	22,354	1.0	Chronic liver disease	58,029	1.2
	Leading 20 diseases	*1,354,042*	*53.7*	*Leading 20 diseases*	*1,237,066*	*55.4*	*Leading 20 diseases*	*2,523,241*	*53.1*
	All other diseases	*1,166,611*	*46.3*	*All other diseases*	*994,696*	*44.6*	*All other diseases*	*2,229,173*	*46.9*
	Total	**2,520,652**	**100.0**	**Total**	**2,231,762**	**100.0**	**Total**	**4,752,415**	**100.0**

Colour legend: % of total burden — >= 5% | 4–5% | 3–4% | 2–3% | 0–2%

Note: Disease rankings exclude 'other' residual conditions from each disease group; for example, 'other musculoskeletal conditions'.

How does disease burden change across the life course?

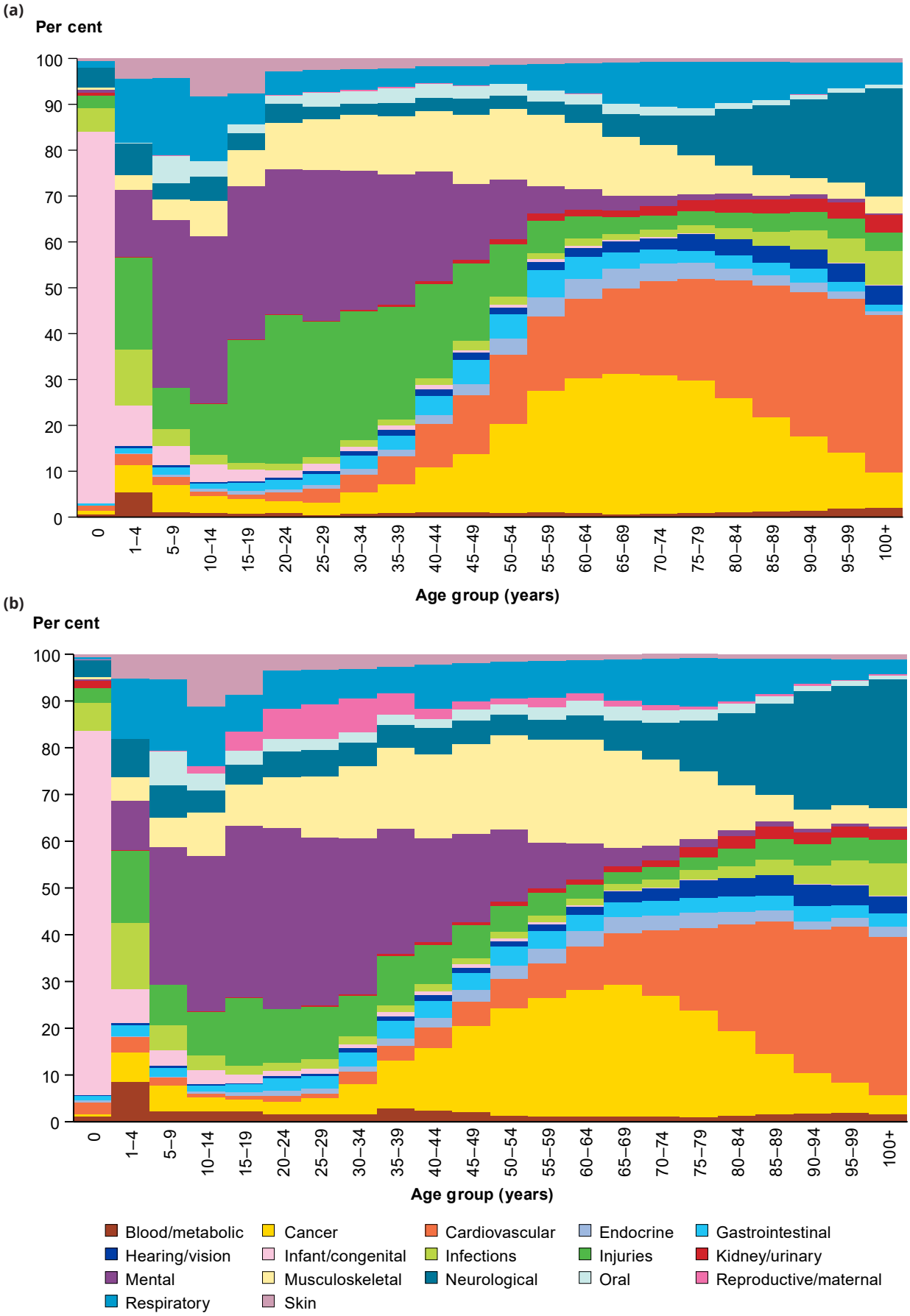
Australians experienced major health loss from different types of disease groups and specific diseases throughout the life course.

Trends in burden for main disease groups

Figure 2.5 shows the relative proportion of total burden (DALY) contributed by each disease group throughout the life course for (a) males and (b) females in 2015.

- Mental & substance use disorders caused predominant burden in Australians aged under 50 (except for infants and young children) and collectively contributed 28% and 29% of the total burden in males and females, respectively. However, this type of burden declined substantially from age 55.
- Injuries was highly burdensome for males aged under 50 (except infants) and caused 23% of their total burden. For females of the same age group, injuries contributed to a much lower proportion (9.8%) of the total burden.
- Respiratory diseases caused a notable amount of burden throughout the entire life course and was more burdensome for children. These diseases collectively contributed to 15% of the total burden in boys aged 1–14 and 14% in girls the same age.
- Musculoskeletal conditions contributed to substantial burden in Australians aged from 10 to 84, more so for females than males. In particular, women aged 35–74 experienced 20% of their total burden from these conditions, and for men of the same age group, 14%.
- Cancer and cardiovascular diseases were 2 dominant causes of total burden in older Australians aged 50 and over (together accounting for 47% of male burden, and 38% of female burden). Cancer contributed the largest proportion of burden in Australians aged 65–69 while cardiovascular diseases contributed to more of the burden with ageing.
- Neurological conditions caused substantial burden in Australians aged 75 and over (12% in men, 17% in women). The proportion of burden from neurological conditions increased with older age and was highest in the oldest population.

Figure 2.5: Relative proportion (%) of total burden (DALY) for males (a) and females (b), by disease group and age group, 2015



Leading diseases causing total burden at different stages of life

A ranking of the leading 10 diseases of total burden (DALY) in males and females of different age groups is shown in figures 2.6 and 2.7, respectively. As the amount of burden varies greatly by age, the same leading causes may have very large differences in burden across age groups (for example, asthma in infants versus in children). Conversely, causes that are not ranked among the leading 10 for some age groups may still be high-burden diseases.

Infants and young children (aged under 5)

- Infants and young children experienced total burden mainly from a range of infant & congenital conditions, including pre-term & low birthweight complications, birth trauma & asphyxia, cardiovascular defects and sudden infant death syndrome (SIDS).
- Other high-burden diseases for this group were asthma, lower respiratory infections and dermatitis & eczema.

Children (aged 5–14)

- Asthma was the leading cause of burden in all children aged 5–14 and contributed to 14% and 12% of the total burden in boys and girls, respectively.
- Boys and girls experienced substantial burden from a range of mental & substance use disorders including anxiety, depressive disorders, conduct disorder, autism (boys), attention deficit hyperactivity disorder (boys) and eating disorders (girls).
- Other leading causes of burden for children were dental caries, back pain & problems, epilepsy and acne.

Adolescents and adults (aged 15–44)

- Among adolescents and adults, suicide caused the most burden in males while anxiety disorders was the leading cause of burden in females. Asthma still contributed substantial burden for this group but was ranked much lower than in children.
- Mental & substance use disorders dominated the leading 10 causes of burden. Males, in particular, suffered from alcohol use, depressive and drug use disorders, while females experienced substantial burden from depressive and bipolar disorders.
- Other highly ranked diseases for both sexes were back pain & problems, motor vehicle accidents and poisoning. Females also suffered burden from polycystic ovarian syndrome and migraine.

Adults (aged 45–74)

- Among adults aged 45–74, many chronic conditions emerged as the leading causes of burden while there was lower burden from mental disorders and injuries.
- Men suffered more burden from coronary heart disease (ranked as the leading cause in men), back pain & problems, COPD, type 2 diabetes and chronic liver disease than women; women suffered more burden from osteoarthritis and rheumatoid arthritis.
- A range of cancers caused substantial burden for both sexes, in particular, lung, bowel, liver and prostate cancer for men and lung and breast cancer for women.

Older people (aged 75 and over)

- From age 75, coronary heart disease remained as the leading cause of burden in men while dementia was the leading cause of burden in women.
- Older Australians continued to experience substantial burden from COPD, a range of cancers and musculoskeletal conditions. Other high-burden diseases (including stroke, hearing loss, atrial fibrillation & flutter, chronic kidney disease and falls) also appeared in older Australians.

Figure 2.6: Leading causes of total burden (DALY '000; proportion %) for males, by age group, 2015

Rank	Age group (years)								
	Under 5	5–14	15–24	25–44	45–54	55–64	65–74	75–84	85+
1st	Pre-term/lbw complications (10.3; 14.6%)	Asthma (9.2; 13.7%)	Suicide/self-inflicted injuries (19.7; 12.8%)	Suicide/self-inflicted injuries (47.7; 10.3%)	Coronary heart disease (28.5; 8.9%)	Coronary heart disease (43.7; 10.6%)	Coronary heart disease (53.0; 11.4%)	Coronary heart disease (47.8; 12.7%)	Coronary heart disease (30.7; 15.8%)
2nd	Birth trauma/ asphyxia (6.3; 9.0%)	Anxiety disorders (7.0; 10.5%)	Alcohol use disorders (11.1; 7.2%)	Back pain and problems (29.2; 6.3%)	Back pain and problems (18.9; 5.9%)	Lung cancer (23.7; 5.8%)	COPD (32.8; 7.0%)	COPD (27.0; 7.2%)	Dementia (25.5; 13.1%)
3rd	SIDS (3.9; 5.5%)	Conduct disorder (4.6; 6.9%)	RTI/motor vehicle occupant (8.7; 5.7%)	Alcohol use disorders (27.8; 6.0%)	Suicide/self-inflicted injuries (18.4; 5.8%)	Back pain and problems (18.2; 4.4%)	Lung cancer (31.7; 6.8%)	Dementia (25.4; 6.8%)	Stroke (12.8; 6.6%)
4th	Cardiovascular defects (3.7; 5.2%)	Depressive disorders (4.1; 6.1%)	Depressive disorders (8.3; 5.4%)	Poisoning (27.2; 5.9%)	Anxiety disorders (11.7; 3.7%)	Type 2 diabetes (15.5; 3.8%)	Type 2 diabetes (17.2; 3.7%)	Lung cancer (19.3; 5.1%)	COPD (11.1; 5.7%)
5th	Asthma (2.6; 3.8%)	Autism spectrum disorders (3.6; 5.3%)	Back pain and problems (7.8; 5.1%)	Depressive disorders (25.9; 5.6%)	Depressive disorders (10.4; 3.3%)	COPD (15.5; 3.8%)	Prostate cancer (16.2; 3.5%)	Stroke (18.4; 4.9%)	Prostate cancer (8.9; 4.6%)
6th	Lower respiratory infections (1.6; 2.2%)	Dental caries (3.1; 4.6%)	Asthma (7.2; 4.7%)	Anxiety disorders (22.8; 4.9%)	Chronic liver disease (10.3; 3.2%)	Chronic liver disease (14.0; 3.4%)	Bowel cancer (15.3; 3.3%)	Prostate cancer (16.2; 4.3%)	Falls (6.1; 3.1%)
7th	Drowning (1.2; 1.8%)	Back pain and problems (2.0; 3.0%)	Anxiety disorders (7.1; 4.6%)	Drug use disorders (15.2; 3.3%)	Poisoning (9.5; 3.0%)	Bowel cancer (12.6; 3.1%)	Stroke (14.2; 3.0%)	Bowel cancer (11.3; 3.0%)	Chronic kidney disease (5.0; 2.6%)
8th	Epilepsy (1.1; 1.5%)	Epilepsy (2.0; 2.9%)	Drug use disorders (5.6; 3.7%)	Asthma (14.4; 3.1%)	Lung cancer (9.3; 2.9%)	Osteoarthritis (11.4; 2.8%)	Back pain and problems (13.6; 2.9%)	Type 2 diabetes (10.7; 2.8%)	Lung cancer (4.7; 2.4%)
9th	Urogenital malformations (1.0; 1.4%)	Attention deficit hyperactivity disorder (2.0; 2.9%)	Acne (4.5; 2.9%)	Coronary heart disease (12.7; 2.8%)	Alcohol use disorders (8.3; 2.6%)	Rheumatoid arthritis (10.6; 2.6%)	Dementia (13.3; 2.9%)	Hearing loss (10.3; 2.7%)	Atrial fibrillation (4.3; 2.2%)
10th	Dermatitis and eczema (1.0; 1.4%)	Acne (1.9; 2.8%)	Bipolar affective disorder (4.3; 2.8%)	Schizophrenia (12.4; 2.7%)	Type 2 diabetes (7.5; 2.4%)	Liver cancer (9.3; 2.3%)	Rheumatoid arthritis (11.0; 2.4%)	Chronic kidney disease (8.3; 2.2%)	Lower respiratory infections (4.2; 2.2%)

lbw = low birthweight; RTI = road traffic injuries.

Note: Disease rankings exclude 'other' residual conditions from each disease group; for example, 'other musculoskeletal conditions'.

Figure 2.7: Leading causes of total burden (DALY '000; proportion %) for females, by age group, 2015

Rank	Age group (years)								
	Under 5	5–14	15–24	25–44	45–54	55–64	65–74	75–84	85+
1st	Pre-term/lbw complications (7.0; 12.3%)	Asthma (7.0; 12.4%)	Anxiety disorders (14.5; 11.3%)	Anxiety disorders (36.3; 9.5%)	Back pain and problems (18.2; 6.7%)	Osteoarthritis (20.6; 6.3%)	COPD (23.0; 6.4%)	Dementia (33.6; 9.7%)	Dementia (59.7; 20.0%)
2nd	Birth trauma/ asphyxia (6.2; 10.9%)	Anxiety disorders (6.1; 10.8%)	Depressive disorders (11.4; 8.9%)	Back pain and problems (30.4; 7.9%)	Anxiety disorders (17.1; 6.2%)	Lung cancer (18.3; 5.6%)	Osteoarthritis (20.7; 5.8%)	Coronary heart disease (29.8; 8.6%)	Coronary heart disease (40.0; 13.4%)
3rd	Cardiovascular defects (2.5; 4.3%)	Depressive disorders (4.7; 8.3%)	Asthma (9.2; 7.1%)	Depressive disorders (30.1; 7.8%)	Breast cancer (15.5; 5.6%)	Breast cancer (18.2; 5.5%)	Lung cancer (20.6; 5.8%)	COPD (25.2; 7.3%)	Stroke (24.2; 8.1%)
4th	SIDS (2.3; 4.1%)	Dental caries (2.9; 5.2%)	Back pain and problems (7.7; 6.0%)	Asthma (19.1; 5.0%)	Depressive disorders (14.1; 5.1%)	Back pain and problems (17.8; 5.4%)	Coronary heart disease (20.3; 5.7%)	Stroke (19.1; 5.5%)	COPD (14.2; 4.8%)
5th	Asthma (2.0; 3.6%)	Conduct disorder (2.8; 4.9%)	Suicide/self-inflicted injuries (7.6; 6.0%)	Suicide/self-inflicted injuries (13.8; 3.6%)	Osteoarthritis (11.1; 4.0%)	COPD (13.3; 4.0%)	Breast cancer (15.1; 4.2%)	Lung cancer (12.2; 3.5%)	Falls (11.8; 4.0%)
6th	Lower respiratory infections (1.3; 2.3%)	Acne (2.5; 4.5%)	Bipolar affective disorder (5.9; 4.6%)	Bipolar affective disorder (11.1; 2.9%)	COPD (10.5; 3.8%)	Coronary heart disease (12.2; 3.7%)	Rheumatoid arthritis (14.9; 4.2%)	Osteoarthritis (11.6; 3.3%)	Atrial fibrillation (8.3; 2.8%)
7th	Neonatal infections (1.0; 1.8%)	Back pain and problems (2.2; 4.0%)	Polycystic ovarian syndrome (5.3; 4.1%)	Polycystic ovarian syndrome (10.2; 2.6%)	Asthma (9.4; 3.4%)	Rheumatoid arthritis (11.3; 3.4%)	Back pain and problems (13.3; 3.7%)	Hearing loss (10.0; 2.9%)	Hearing loss (7.4; 2.5%)
8th	Dermatitis and eczema (0.9; 1.7%)	Epilepsy (1.8; 3.3%)	Alcohol use disorders (5.0; 3.9%)	Poisoning (10.0; 2.6%)	Lung cancer (8.5; 3.1%)	Anxiety disorders (11.0; 3.3%)	Dementia (12.6; 3.5%)	Rheumatoid arthritis (9.9; 2.9%)	Chronic kidney disease (7.2; 2.4%)
9th	Brain malformations (0.9; 1.6%)	Dermatitis and eczema (1.8; 3.2%)	RTI/motor vehicle occupant (4.2; 3.3%)	Migraine (9.5; 2.5%)	Rheumatoid arthritis (6.9; 2.5%)	Depressive disorders (9.7; 2.9%)	Type 2 diabetes (11.0; 3.1%)	Bowel cancer (9.4; 2.7%)	Lower respiratory infections (6.8; 2.3%)
10th	Neural tube defects (0.9; 1.6%)	Eating disorders (1.1; 1.9%)	Acne (4.0; 3.1%)	Eating disorders (9.0; 2.4%)	Suicide/self-inflicted injuries (6.8; 2.5%)	Type 2 diabetes (9.4; 2.8%)	Stroke (9.9; 2.8%)	Type 2 diabetes (9.1; 2.6%)	Non-rheumatic valvular disease (5.3; 1.8%)

lbw = low birthweight; RTI = road traffic injuries.

Note: Disease rankings exclude 'other' residual conditions from each disease group; for example, 'other musculoskeletal conditions'.

3 Non-fatal burden of disease

Key results

- In 2015, Australians lost 2.4 million years of healthy life due to living with the impacts of disease and injury (non-fatal burden).
- The overall rate of non-fatal burden was 95 YLD per 1,000 population. This was 7.1% higher than the rate of fatal burden (89 YLL per 1,000 population) in 2015.
- Males and females experienced similar rates of non-fatal burden throughout the life course, which was lowest in infants and children and increased with age, peaking in the oldest age group.
- The main disease groups causing non-fatal burden in Australia were musculoskeletal conditions (25%), mental & substance use disorders (24%) and respiratory diseases (10%).
- Young Australians experienced substantial non-fatal burden from mental & substance use disorders (including anxiety and depressive disorders) and respiratory diseases (mostly asthma).
- Middle and older aged Australians experienced substantial non-fatal burden from musculoskeletal conditions (back pain & problems, osteoarthritis and rheumatoid arthritis), cardiovascular diseases (coronary heart disease and atrial fibrillation & flutter), hearing & vision disorders (hearing loss and macular degeneration) as well as COPD and dementia.

The population is ageing in Australia and people may be living longer with the effects of disease and injury. The burden of living with illness (discussed in detail in this chapter) has large impacts on the quality of life, with severe diseases having a greater impact on the life of an individual. As substantial resources are devoted to preventing and treating disease/injury, measuring this non-fatal burden has important implications for public health policy and planning.

In this report, the burden of living with illness is measured as the years lived with disability (YLD; see Box 3.1), also expressed as the non-fatal burden—where 1 YLD is 1 year of healthy life lost due to living with the impacts of disease or injury.

What is the overall non-fatal burden in Australia?

In 2015, Australians lost 2.4 million years of healthy life from living with the impacts of disease and injury. After adjusting for age, the rate of non-fatal burden was 95 YLD per 1,000 population, 7.1% higher than the rate of fatal burden (89 YLL per 1,000 population). Overall, Australia did not make substantial gains in reducing non-fatal burden over time as the rate remained similar to that in 2003 (97 YLD per 1,000 population).

Overall, males and females experienced a similar amount of non-fatal burden (contributing to 48% and 52% of the total non-fatal burden, respectively). In total, in 2015, females lost around 100,900 more years of healthy life from living with the impacts of disease and injury than males.

Box 3.1: How is years lived with disability calculated?

The years lived with disability (YLD) experienced by the entire population is calculated for each disease in the ABDS 2015. This is estimated by multiplying the point prevalence of the various sequelae (that is, consequences) of a disease by the disability weight (which reflects the severity; see Box 1.2) of the disease. Point prevalence is defined as the number of people with a condition at a particular point in time, for a reference year, and accounts for duration of the sequela experienced (expressed as a fraction of a year).

For example, stroke has 2 sequelae: acute stroke (initial consequence) and chronic stroke (long-term consequence). The YLD for each sequela is estimated as follows: number of people suffering from acute (or chronic) stroke in a reference year x duration (out of 1 year) x severity of the sequela (scale of 0–1). The total number of healthy years lost from living with stroke is obtained by adding the YLD for acute and chronic stroke.

For more detailed information on estimating YLD, see Appendix A.

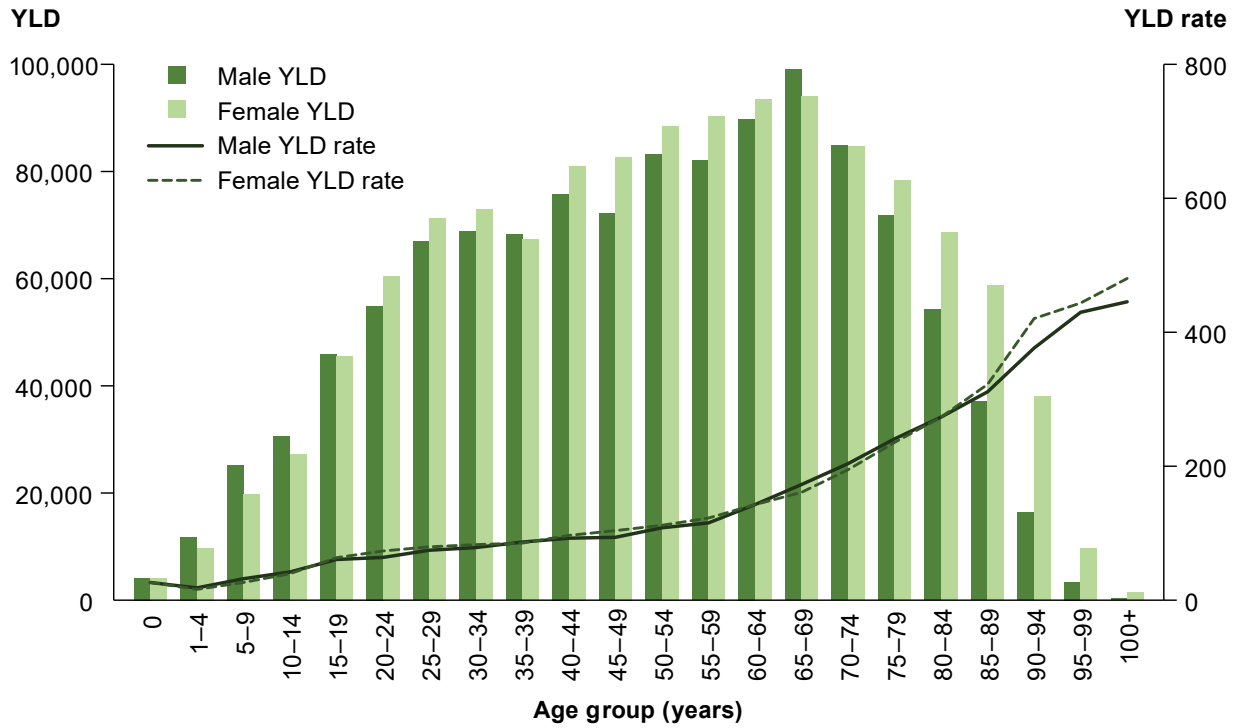
How does living with illness vary across the life course?

Australians experienced more burden from living with disease and injury as they aged. This section describes how the rate of non-fatal burden (expressed as YLD per 1,000 population) changed at various stages of life.

The rate of non-fatal burden was low in infants and young children aged 1–4 and increased steadily from childhood through to middle age (Figure 3.1). From age 60, the rate of non-fatal burden rose rapidly and peaked in the oldest Australians who are most burdened by diseases and injuries.

Males and females experienced similar rates of non-fatal burden across the life course (Figure 3.1). Compared with females, though, males lost more healthy years of life in young people aged 1–14 while females lost much more healthy years of life in those aged 80 and over.

Figure 3.1: Number and rates of non-fatal burden (YLD, YLD per 1,000 population), by age group and sex, 2015

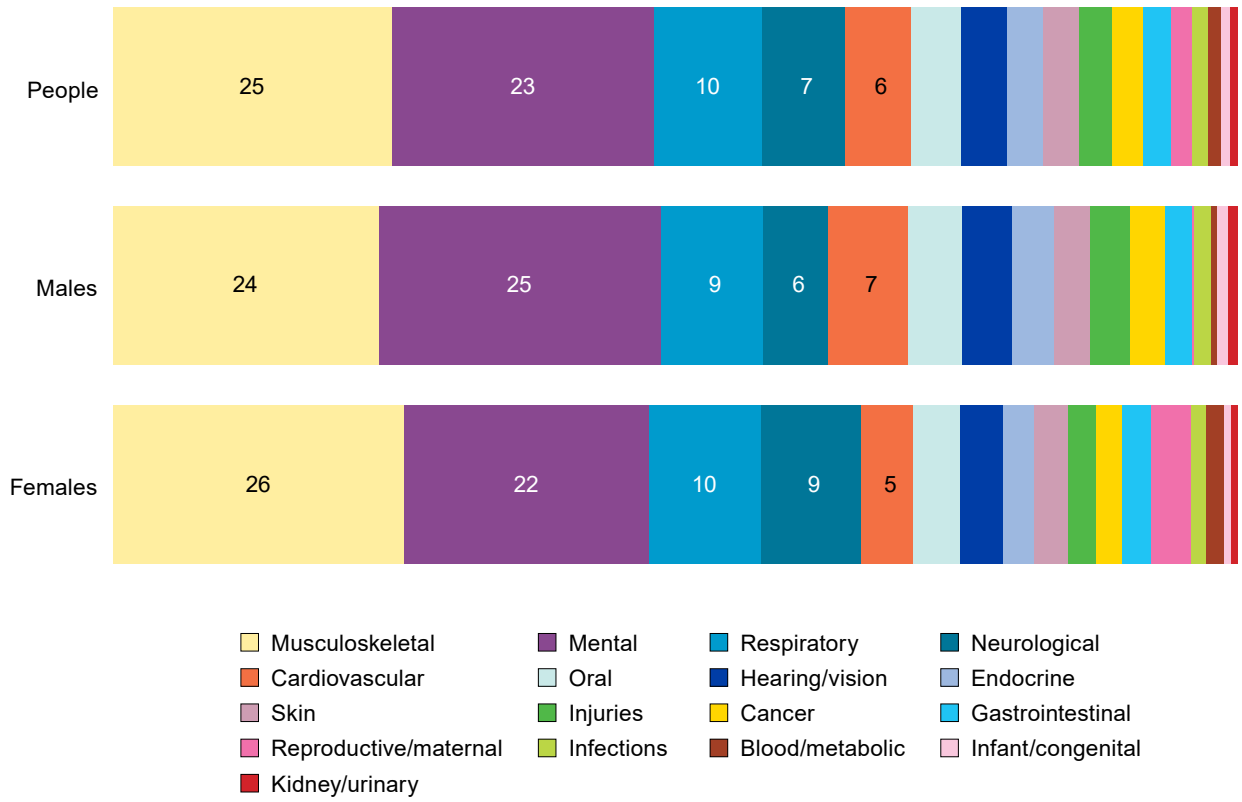


Which disease groups cause the most non-fatal burden?

This section describes non-fatal burden (YLD) for each of the 17 disease groups (comprising related diseases/conditions) in the ABDS 2015. The contribution to non-fatal burden by each disease group is shown in Figure 3.2 and Table 3.1.

Nearly half of the non-fatal burden in Australia was caused by musculoskeletal conditions (25%) and mental & substance use disorders (23%). Other important contributors were respiratory diseases (9.5%), neurological conditions (7.4%) and cardiovascular diseases (5.8%). These disease groups were the leading 5 causes of non-fatal burden since 2003.

Figure 3.2: Proportion (%) of non-fatal burden (YLD), by disease group and sex, 2015



Males and females are affected differently by disease groups

Both sexes are affected by the same leading disease groups for non-fatal burden as described earlier in this section. Mental & substance use disorders and cardiovascular diseases caused a larger proportion of non-fatal burden in males (25% and 7.1%, respectively) than in females (22% and 4.6%, respectively), as shown in Table 3.1. Musculoskeletal conditions and neurological conditions caused a larger proportion of the burden in females (26% and 9.0%, respectively) than in males (24% and 5.8%).

Males and females experienced different rates of non-fatal burden for individual disease groups, also shown in Table 3.1. Among the high-burden disease groups, males and females had similar rates of non-fatal burden from musculoskeletal conditions, mental & substance use disorders and respiratory diseases. However, males experienced much higher rates of non-fatal burden from cardiovascular diseases and injuries; females suffered higher rates of non-fatal burden from blood & metabolic disorders and neurological conditions.

Table 3.1: Comparison of non-fatal burden (YLD, YLD%, YLD ASR), by disease group and sex, 2015

	Males				Females			
Disease group	Rank	YLD	Proportion (%)	ASR	Rank	YLD	Proportion (%)	ASR
Mental	1	287,513	25.1	24.9	2	271,084	21.7	23.0
Musculoskeletal	2	271,045	23.6	21.8	1	323,521	25.9	24.6
Respiratory	3	104,660	9.1	8.5	3	123,920	9.9	9.7
Cardiovascular	4	81,807	7.1	6.4	5	57,069	4.6	3.8
Neurological	5	65,948	5.8	5.4	4	111,986	9.0	7.7
Oral	6	54,702	4.8	4.5	6	52,357	4.2	4.0
Hearing/vision	7	51,137	4.5	4.1	7	47,582	3.8	3.2
Endocrine	8	42,446	3.7	3.3	10	34,217	2.7	2.5
Injuries	9	40,475	3.5	3.4	12	31,267	2.5	2.3
Skin	10	37,427	3.3	3.2	9	38,186	3.1	3.2
Cancer	11	35,601	3.1	2.8	13	29,063	2.3	2.1
Gastrointestinal	12	27,939	2.4	2.3	11	31,283	2.5	2.4
Infections	13	16,864	1.5	1.4	15	17,325	1.4	1.4
Infant/congenital	14	11,218	1.0	1.0	16	7,504	0.6	0.6
Kidney/urinary	15	9,641	0.8	0.8	17	7,048	0.6	0.5
Blood/metabolic	16	6,097	0.5	0.5	14	20,076	1.6	1.6
Reproductive/maternal	17	2,044	0.2	0.2	8	43,981	3.5	3.6
Total		**1,146,562**	**100.0**	**94.4**		**1,247,469**	**100.0**	**96.2**

Notes

1. Rates were age-standardised to the 2001 Australian Standard Population and are expressed as YLD per 1,000 population (YLD ASR).
2. Numbers and percentages shown for disease groups may not add up to the total due to rounding.

Which diseases cause the most non-fatal burden?

In 2015, almost two-thirds of the non-fatal burden in Australia was due the impacts of living with 20 high-burden diseases and injuries. Rankings for these top 20 diseases/injuries are shown in Table 3.2.

For both males and females, the leading causes of non-fatal burden were back pain & problems, anxiety disorders and depressive disorders, followed by asthma (ranked fourth in males and fifth in females).

There were some differences in individual disease burden experienced by males and females. Compared with females, males experienced almost 3 times the burden from alcohol use disorders (ranked fifth in males, outside top 20 for females) and 1.7 times the burden from coronary heart disease (ranked seventh in males, 11th in females). Despite having the same rankings, females suffered around 31,000 more YLD for anxiety disorders than males and had higher burden from osteoarthritis (ranked fourth in females, eighth in males), rheumatoid arthritis, dementia and severe tooth loss.

Among the 20 most burdensome diseases, autism spectrum disorders, drug use disorders and schizophrenia were other important causes of non-fatal burden for males, while migraine, genital prolapse, eating disorders and polycystic ovarian syndrome were ranked as highly burdensome diseases for females.

Table 3.2: Leading 20 causes of non-fatal burden (YLD), by sex, 2015

Rank	Males	YLD	% of total	Females	YLD	% of total	People	YLD	% of total
1	Back pain & problems	97,385	8.5	Back pain & problems	97,677	7.8	Back pain & problems	195,062	8.1
2	Anxiety disorders	59,388	5.2	Anxiety disorders	90,440	7.2	Anxiety disorders	149,828	6.3
3	Depressive disorders	57,509	5.0	Depressive disorders	77,951	6.2	Depressive disorders	135,459	5.7
4	Asthma	50,681	4.4	Osteoarthritis	74,423	6.0	Osteoarthritis	114,551	4.8
5	Alcohol use disorders	45,889	4.0	Asthma	62,449	5.0	Asthma	113,129	4.7
6	COPD	43,404	3.8	Rheumatoid arthritis	52,331	4.2	COPD	94,146	3.9
7	Coronary heart disease	42,141	3.7	Dementia	51,987	4.2	Rheumatoid arthritis	92,177	3.9
8	Osteoarthritis	40,129	3.5	COPD	50,741	4.1	Dementia	80,140	3.3
9	Rheumatoid arthritis	39,846	3.5	Hearing loss	32,311	2.6	Hearing loss	71,138	3.0
10	Hearing loss	38,827	3.4	Type 2 diabetes	29,163	2.3	Coronary heart disease	66,816	2.8
11	Type 2 diabetes	36,068	3.1	Coronary heart disease	24,675	2.0	Type 2 diabetes	65,231	2.7
12	Dementia	28,153	2.5	Severe tooth loss	22,642	1.8	Alcohol use disorders	61,397	2.6
13	Autism spectrum disorders	25,279	2.2	Bipolar affective disorder	22,297	1.8	Bipolar affective disorder	40,422	1.7
14	Drug use disorders (excluding alcohol)	25,006	2.2	Migraine	21,469	1.7	Severe tooth loss	39,263	1.6
15	Schizophrenia	22,928	2.0	Genital prolapse	20,285	1.6	Dental caries	39,051	1.6
16	Dental caries	21,270	1.9	Falls	20,216	1.6	Drug use disorders (excluding alcohol)	37,372	1.6
17	Bipolar affective disorder	18,125	1.6	Dental caries	17,781	1.4	Falls	36,667	1.5
18	Dermatitis & eczema	16,909	1.5	Dermatitis & eczema	17,124	1.4	Schizophrenia	34,420	1.4
19	Severe tooth loss	16,621	1.4	Eating disorders	16,591	1.3	Dermatitis & eczema	34,033	1.4
20	Periodontal disease	16,572	1.4	Polycystic ovarian syndrome	16,066	1.3	Autism spectrum disorders	31,348	1.3
	Leading 20 diseases	*742,129*	*64.7*	*Leading 20 diseases*	*818,617*	*65.6*	*Leading 20 diseases*	*1,531,652*	*64.0*
	All other diseases	*404,433*	*35.3*	*All other diseases*	*428,852*	*34.4*	*All other diseases*	*862,379*	*36.0*
	Total	**1,146,562**	**100.0**	**Total**	**1,247,469**	**100.0**	**Total**	**2,394,031**	**100.0**

Colour legend: % of total burden — >= 5% | 4–5% | 3–4% | 2–3% | 0–2%

Note: Disease rankings exclude 'other' residual conditions from each disease group; for example, 'other musculoskeletal conditions'.

How does non-fatal disease burden change across the life course?

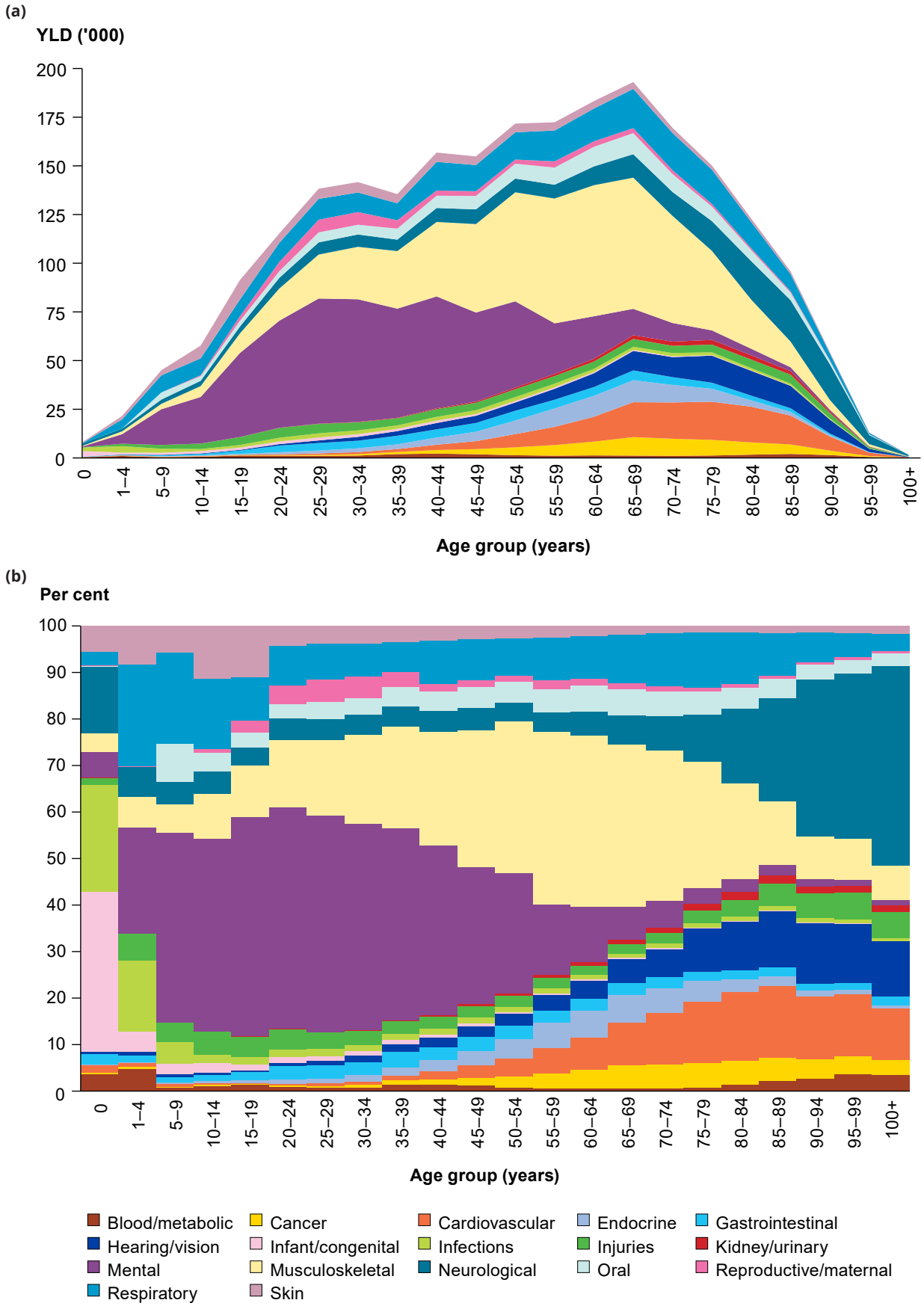
Australians at various stages of life experienced non-fatal burden from different diseases. This section outlines the important disease groups and individual diseases that caused the most non-fatal burden for Australians in different age groups.

Trends in burden for main disease groups

Figure 3.3 shows the amount (3.3a) and relative proportion (3.3b) of non-fatal burden (YLD) contributed by each disease group across the life course in 2015.

- Mental & substance use disorders caused the largest non-fatal burden for Australians aged under 50 (41% of the burden in this group), except for infants. This disease group contributed to much lower proportions of the non-fatal burden in age groups over 55.
- Respiratory diseases was burdensome for Australians at all ages. In particular, these diseases caused 18% of the total non-fatal burden in young Australians aged 1–14.
- Musculoskeletal conditions caused substantial non-fatal burden from age 10 through to the oldest Australians. In particular, this group was the predominant cause of non-fatal burden in Australians aged 50–84, contributing to one-third of the total non-fatal burden for this group.
- Cardiovascular diseases and hearing & vision disorders caused 12% and 8.4% of the non-fatal burden, respectively, among Australians aged 65 and over.
- Neurological conditions was the dominant cause of non-fatal burden for Australians aged 85 and over, contributing to 27% of their burden. As age increased, neurological conditions accounted for greater proportions of the non-fatal burden in older Australians.

Figure 3.3: Number (a) and relative proportion (b) of non-fatal burden (YLD), by disease group and age group, 2015



Leading diseases and injuries causing non-fatal burden at various stages of life

The leading 10 diseases causing non-fatal burden across the life course for males and females are shown in figures 3.4 and 3.5, respectively.

Infants and young children (aged under 5)

- Infants and young children suffered the most non-fatal burden from asthma and dermatitis & eczema, together contributing to around one-fifth of the burden for this group.
- Autism spectrum disorders (in boys), intellectual disability, anxiety disorders, epilepsy, protein energy deficiency and lower respiratory infections were also highly ranked diseases in this age group.

Children (aged 5–14)

- Among children aged 5–14, the leading causes of non-fatal burden were asthma (ranked number 1), and anxiety, depressive and conduct disorders.
- Both boys and girls experienced substantial non-fatal burden from dental caries, back pain & problems, acne and dermatitis & eczema. However, boys also had high burden from autism spectrum disorders and attention deficit hyperactivity disorder, while girls experienced substantial burden from epilepsy and eating disorders.

Adolescents and adults (aged 15–44)

- Mental & substance use disorders dominated the leading causes of non-fatal burden in adolescents and adults. Asthma still caused a substantial number of healthy years lost but was ranked progressively lower with increase in age.
- Alcohol use disorders and back pain & problems caused the largest non-fatal burden in males, while anxiety disorders caused the largest burden in females. Both sexes also suffered large burden from depressive, drug use and bipolar disorders and dental caries.
- In males, autism spectrum disorders and schizophrenia were other highly ranked diseases for this age group. In females, polycystic ovarian syndrome, eating disorders and migraine appeared as important causes of non-fatal burden.

Adults (aged 45–74)

- Among adults aged 45–74, musculoskeletal conditions, including back pain & problems, osteoarthritis and rheumatoid arthritis dominated the leading causes of non-fatal burden.
- Men and women experienced substantial burden from similar diseases. Anxiety disorders, depressive disorders and asthma were still among the leading diseases but contributed to a lower proportion of the non-fatal burden than in younger Australians.
- Other chronic conditions also appeared as high-burden diseases, in particular COPD. Men experienced more non-fatal burden from coronary heart disease, type 2 diabetes and hearing loss than women, while women experienced substantial burden from severe tooth loss and genital prolapse.

Older people (aged 75 and over)

- Older Australians experienced the majority of non-fatal burden from a range of chronic and age-related diseases. Both men and women suffered a large amount of burden from dementia, COPD, coronary heart disease, hearing loss and a few musculoskeletal conditions. Other lower ranked diseases in the top 10 were type 2 diabetes, falls, macular degeneration, atrial fibrillation & flutter, severe tooth loss and prostate cancer (men).

Figure 3.4: Leading causes of non-fatal burden (YLD '000; proportion %) for males, by age group, 2015

Rank	Age group (years)								
	Under 5	5–14	15–24	25–44	45–54	55–64	65–74	75–84	85+
1st	Asthma (2.6; 16.4%)	Asthma (8.9; 16.0%)	Alcohol use disorders (11.1; 11.1%)	Back pain and problems (29.2; 10.4%)	Back pain and problems (18.9; 12.2%)	Back pain and problems (18.2; 10.6%)	COPD (17.4; 9.4%)	COPD (11.6; 9.2%)	Dementia (10.3; 18.0%)
2nd	Dermatitis and eczema (1.0; 6.3%)	Anxiety disorders (7.0; 12.6%)	Depressive disorders (8.3; 8.2%)	Alcohol use disorders (26.7; 9.6%)	Anxiety disorders (11.7; 7.5%)	Osteoarthritis (11.3; 6.6%)	Back pain and problems (13.5; 7.3%)	Coronary heart disease (10.6; 8.4%)	Coronary heart disease (4.6; 8.0%)
3rd	Autism spectrum disorders (0.9; 5.5%)	Conduct disorder (4.6; 8.3%)	Back pain and problems (7.7; 7.6%)	Depressive disorders (25.9; 9.3%)	Depressive disorders (10.4; 6.7%)	Type 2 diabetes (11.0; 6.4%)	Coronary heart disease (13.1; 7.1%)	Hearing loss (10.3; 8.2%)	Hearing loss (4.0; 7.1%)
4th	Intellectual disability (0.8; 5.0%)	Depressive disorders (4.1; 7.3%)	Anxiety disorders (7.1; 7.0%)	Anxiety disorders (22.8; 8.1%)	Rheumatoid arthritis (7.1; 4.6%)	Rheumatoid arthritis (10.5; 6.1%)	Type 2 diabetes (11.0; 6.0%)	Dementia (9.3; 7.4%)	COPD (3.6; 6.3%)
5th	Anxiety disorders (0.8; 4.9%)	Autism spectrum disorders (3.6; 6.4%)	Asthma (6.9; 6.8%)	Drug use disorders (14.7; 5.2%)	Osteoarthritis (6.9; 4.4%)	Coronary heart disease (8.7; 5.1%)	Osteoarthritis (10.8; 5.9%)	Back pain and problems (6.2; 5.0%)	Falls (2.0; 3.6%)
6th	Protein-energy deficiency (0.5; 3.1%)	Dental caries (3.1; 5.5%)	Drug use disorders (5.6; 5.5%)	Asthma (13.7; 4.9%)	Alcohol use disorders (6.8; 4.4%)	COPD (8.3; 4.8%)	Rheumatoid arthritis (10.7; 5.8%)	Osteoarthritis (5.4; 4.3%)	Atrial fibrillation (2.0; 3.4%)
7th	Conduct disorder (0.5; 3.0%)	Attention deficit hyperactivity disorder (2.0; 3.5%)	Acne (4.5; 4.4%)	Schizophrenia (12.4; 4.4%)	Asthma (5.7; 3.6%)	Anxiety disorders (6.5; 3.8%)	Hearing loss (9.4; 5.1%)	Type 2 diabetes (4.9; 3.9%)	Macular degeneration (1.8; 3.1%)
8th	Epilepsy (0.5; 3.0%)	Back pain and problems (1.9; 3.4%)	Bipolar affective disorder (4.3; 4.3%)	Bipolar affective disorder (10.2; 3.7%)	Type 2 diabetes (5.3; 3.4%)	Hearing loss (6.2; 3.6%)	Dementia (6.0; 3.2%)	Rheumatoid arthritis (4.8; 3.8%)	Prostate cancer (1.7; 3.1%)
9th	Lower respiratory infections (0.4; 2.8%)	Acne (1.9; 3.4%)	Autism spectrum disorders (3.9; 3.9%)	Dental caries (8.2; 2.9%)	Coronary heart disease (3.9; 2.5%)	Asthma (6.1; 3.6%)	Severe tooth loss (5.6; 3.1%)	Atrial fibrillation (4.4; 3.5%)	Severe tooth loss (1.6; 2.8%)
10th	Falls (0.4; 2.5%)	Dermatitis and eczema (1.9; 3.4%)	Schizophrenia (3.1; 3.1%)	Autism spectrum disorders (7.3; 2.6%)	Hearing loss (3.8; 2.5%)	Depressive disorders (4.3; 2.5%)	Atrial fibrillation (4.8; 2.6%)	Severe tooth loss (4.1; 3.2%)	Back pain and problems (1.5; 2.7%)

Note: Disease rankings exclude 'other' residual conditions from each disease group; for example, 'other musculoskeletal conditions'.

Figure 3.5: Leading causes of non-fatal burden (YLD '000; proportion %) for females, by age group, 2015

Rank	Age group (years)								
	Under 5	5–14	15–24	25–44	45–54	55–64	65–74	75–84	85+
1st	Asthma (1.9; 13.8%)	Asthma (6.8; 14.4%)	Anxiety disorders (14.5; 13.7%)	Anxiety disorders (36.3; 12.4%)	Back pain and problems (18.1; 10.6%)	Osteoarthritis (20.6; 11.2%)	Osteoarthritis (20.7; 11.6%)	Dementia (14.1; 9.6%)	Dementia (28.7; 26.6%)
2nd	Dermatitis and eczema (0.9; 6.9%)	Anxiety disorders (6.1; 12.9%)	Depressive disorders (11.4; 10.8%)	Back pain and problems (30.2; 10.3%)	Anxiety disorders (17.1; 10.0%)	Back pain and problems (17.8; 9.7%)	Rheumatoid arthritis (14.3; 8.0%)	COPD (12.9; 8.8%)	Hearing loss (7.4; 6.9%)
3rd	Anxiety disorders (0.6; 4.3%)	Depressive disorders (4.7; 9.9%)	Asthma (8.8; 8.3%)	Depressive disorders (30.1; 10.3%)	Depressive disorders (14.1; 8.2%)	Rheumatoid arthritis (11.2; 6.1%)	Back pain and problems (13.2; 7.4%)	Osteoarthritis (11.5; 7.8%)	COPD (6.9; 6.4%)
4th	Protein-energy deficiency (0.5; 3.5%)	Dental caries (2.9; 6.2%)	Back pain and problems (7.7; 7.3%)	Asthma (18.4; 6.3%)	Osteoarthritis (11.1; 6.5%)	Anxiety disorders (11.0; 6.0%)	COPD (10.1; 5.7%)	Hearing loss (10.0; 6.8%)	Coronary heart disease (6.0; 5.5%)
5th	Epilepsy (0.5; 3.3%)	Conduct disorder (2.8; 5.9%)	Bipolar affective disorder (5.9; 5.6%)	Bipolar affective disorder (11.1; 3.8%)	Asthma (8.9; 5.2%)	Depressive disorders (9.7; 5.3%)	Type 2 diabetes (8.3; 4.7%)	Rheumatoid arthritis (9.3; 6.3%)	Falls (5.7; 5.3%)
6th	Intellectual disability (0.4; 3.0%)	Acne (2.5; 5.4%)	Polycystic ovarian syndrome (5.3; 5.0%)	Polycystic ovarian syndrome (10.2; 3.5%)	COPD (8.3; 4.9%)	Asthma (8.3; 4.5%)	Severe tooth loss (7.3; 4.1%)	Coronary heart disease (7.1; 4.8%)	Osteoarthritis (4.7; 4.4%)
7th	Rheumatoid arthritis (0.4; 2.8%)	Back pain and problems (2.2; 4.6%)	Alcohol use disorders (5.0; 4.7%)	Migraine (9.5; 3.2%)	Rheumatoid arthritis (6.8; 4.0%)	Type 2 diabetes (7.4; 4.0%)	Dementia (6.8; 3.8%)	Back pain and problems (6.3; 4.3%)	Macular degeneration (3.4; 3.2%)
8th	Lower respiratory infections (0.4; 2.7%)	Dermatitis and eczema (1.8; 3.8%)	Acne (4.0; 3.8%)	Eating disorders (8.9; 3.0%)	Migraine (4.4; 2.6%)	COPD (7.3; 4.0%)	Hearing loss (6.6; 3.7%)	Severe tooth loss (5.7; 3.9%)	Severe tooth loss (3.1; 2.9%)
9th	Falls (0.3; 2.2%)	Epilepsy (1.7; 3.6%)	Eating disorders (3.8; 3.6%)	Rheumatoid arthritis (7.1; 2.4%)	Type 2 diabetes (4.4; 2.5%)	Genital prolapse (5.5; 3.0%)	Coronary heart disease (6.0; 3.4%)	Type 2 diabetes (4.7; 3.2%)	Atrial fibrillation (3.0; 2.8%)
10th	Conduct disorder (0.3; 2.1%)	Eating disorders (1.1; 2.3%)	Dental caries (3.2; 3.0%)	Drug use disorders (7.0; 2.4%)	Genital prolapse (3.5; 2.0%)	Severe tooth loss (4.7; 2.6%)	Asthma (5.3; 3.0%)	Falls (4.4; 3.0%)	Protein-energy deficiency (2.3; 2.1%)

Note: Disease rankings exclude 'other' residual conditions from each disease group; for example, 'other musculoskeletal conditions'

4 Fatal burden of disease

Key results

- In 2015, Australians lost 2.4 million years of life due to dying from disease and injury (fatal burden).
- The overall rate of fatal burden was 89 YLL per 1,000 population in 2015 and had reduced substantially since 2003. Most disease groups had lower rates of fatal burden over time.
- Overall, males experienced a 60% higher rate of fatal burden (110 YLL per 1,000 population) than females (69).
- Throughout the life course, the rate of fatal burden was relatively high in infants and dropped in childhood before increasing steadily with age.
- Dying from injuries (mainly suicide, poisoning and road traffic injuries) was the predominant cause of fatal burden in young Australians (aged under 45) and caused more than half (53%) of their total years of life lost.
- Dying from cancer (mainly brain, lung, bowel, prostate and breast cancers) and cardiovascular diseases (mainly coronary heart disease and stroke) caused the majority of fatal burden in older Australians.

Australians are now dying at older ages, reflecting the benefits of better health, hygiene and safety practices as well as improved medical interventions and technology. Measuring mortality from disease and injury and its associated burden on the population (discussed in detail in this chapter) is fundamental to public health planning and interventions.

In this report, the burden of dying prematurely due to disease and injury is measured as the years of life lost (YLL; see Box 4.1), also expressed as the fatal burden––where 1 YLL is 1 year of life lost due to dying from disease and injury.

What is the overall fatal burden in Australia?

In 2015, Australians experienced 157,162 deaths from disease and injury, causing 2.4 million years of life lost. Over time, fatal burden declined substantially in Australia. There was a 20% reduction in the rate of fatal burden between 2003 and 2015 (from 111 YLL per 1,000 population to 89). This decline resulted from lower fatal burden in most of the disease groups. For detailed information on changes in fatal burden over time, see Chapter 7.

Box 4.1: How to interpret the years of life lost

Fatal burden is a measure of the years of life lost in the population due to dying from disease or injury, where 1 YLL is 1 year of life lost. The YLL associated with each death is based on 2 factors: the age at which death occurs and the life expectancy (according to an aspirational life table), which is the number of remaining years that a person would, on average, expect to live from that age.

At a population level, the total years of life lost for a disease is the sum of the number of deaths from the disease at each age multiplied by the life expectancy for each age of death. Diseases that usually cause deaths at younger ages (for example, birth trauma & asphyxia and cardiovascular defects) have a much higher average YLL per death than diseases that tend to cause deaths at older ages (for example, stroke and chronic kidney disease).

Therefore, a similar amount of fatal burden can result from a small number of deaths occurring at young ages or a large number of deaths occurring at older ages. See Appendix Figure D7 for a comparison of diseases with the highest and lowest average YLL per death.

Males suffered a higher rate of fatal burden

Males experienced substantially more years of life lost due to dying prematurely from disease and injury than females. In 2015, males lost around 389,800 more years of life than females and experienced 58% of the total fatal burden. When adjusted for differences in population size and age structures, males suffered a 60% higher rate of fatal burden (110 YLL per 1,000 population) than females (69).

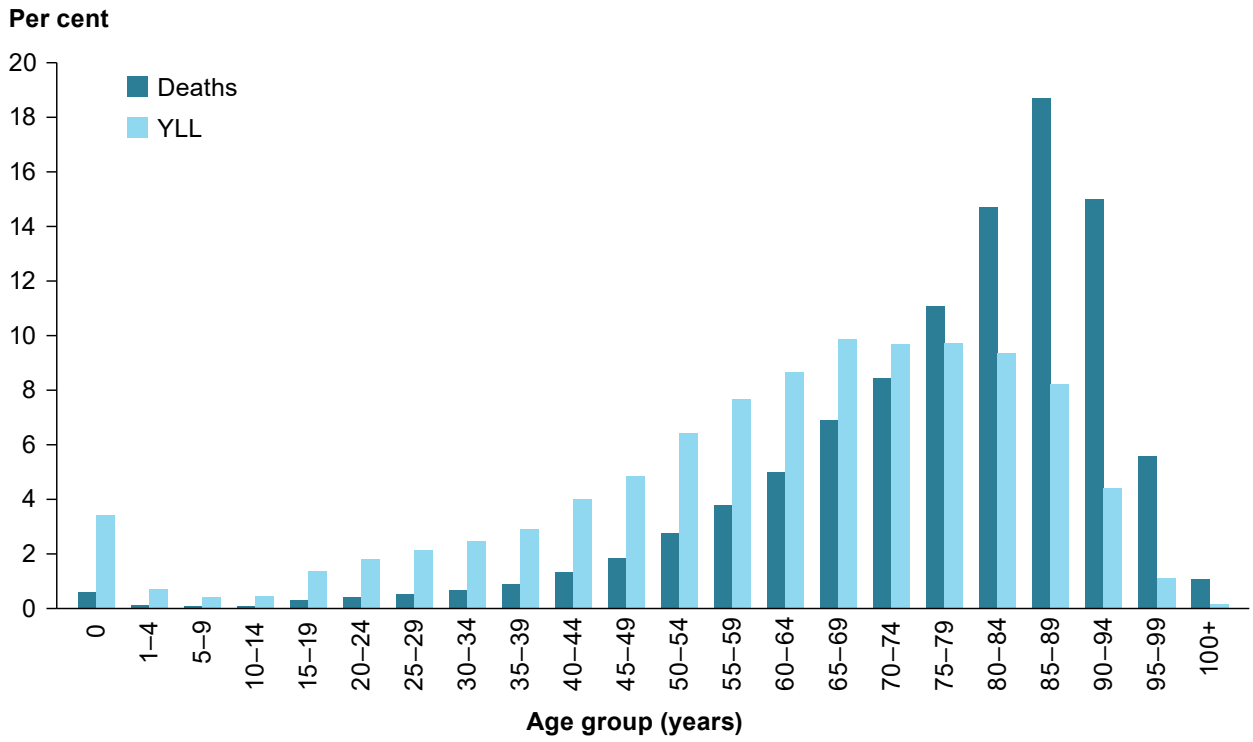
How does years of life lost vary at different ages?

Australians experienced varying numbers of deaths and amounts of fatal burden throughout the life course. Figure 4.1 shows the proportion of total deaths and fatal burden (YLL) contributed by different age groups in 2015.

Deaths among infants (those aged under 1) represented less than 1% of all deaths but contributed to 3% of the total fatal burden. As infants have the highest aspirational life expectancy, each death is associated with a large number of years of life lost. Young people (aged 1–14) had very few deaths; even with a high life expectancy for their age, they contributed the lowest amount of fatal burden compared to all other age groups under 100.

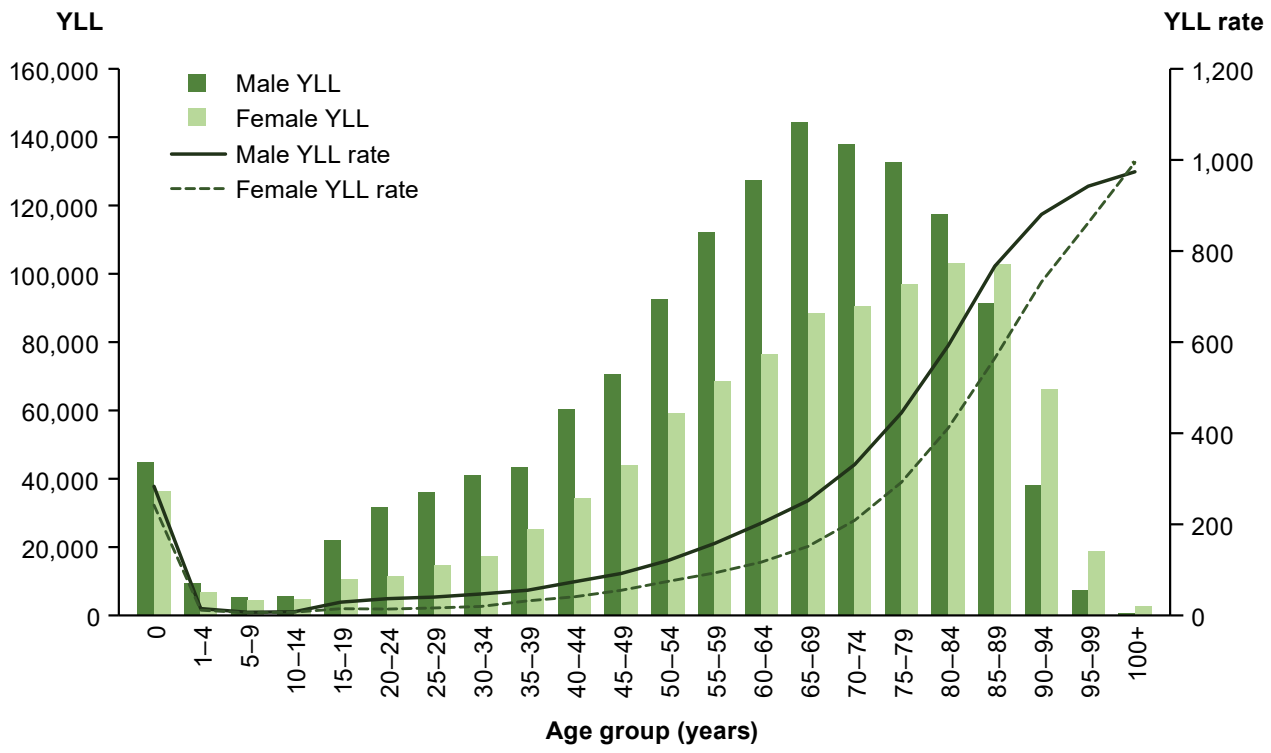
The number of deaths and fatal burden increased with increasing age, with 82% of the deaths and more than half the total fatal burden occurring in people aged 65 and over (see Appendix Table D1). A large number of deaths caused substantial fatal burden in Australians age 65–89, although each death resulted in fewer years of life lost as people approached the ideal life expectancy. The number of deaths reduced substantially in the oldest Australians (especially ages 95 and over) in line with a smaller population in this age group, resulting in lower fatal burden.

Figure 4.1: Proportion of fatal burden (YLL) and deaths, by age group, 2015



Males and females experienced similar patterns of fatal burden across the life course (Figure 4.2). Both sexes experienced high rates of fatal burden in infants and equally low rates of burden in children aged 1–14. As age increased, the rate of fatal burden also rose, especially from age 65 onwards, and was highest in the oldest Australians. Compared with females, males experienced a larger amount of fatal burden for those aged under 85 due to having more deaths, and higher rates of burden for most age groups across the life course.

Figure 4.2: Number and rates of fatal burden (YLL, YLL per 1,000 population), by age group and sex, 2015

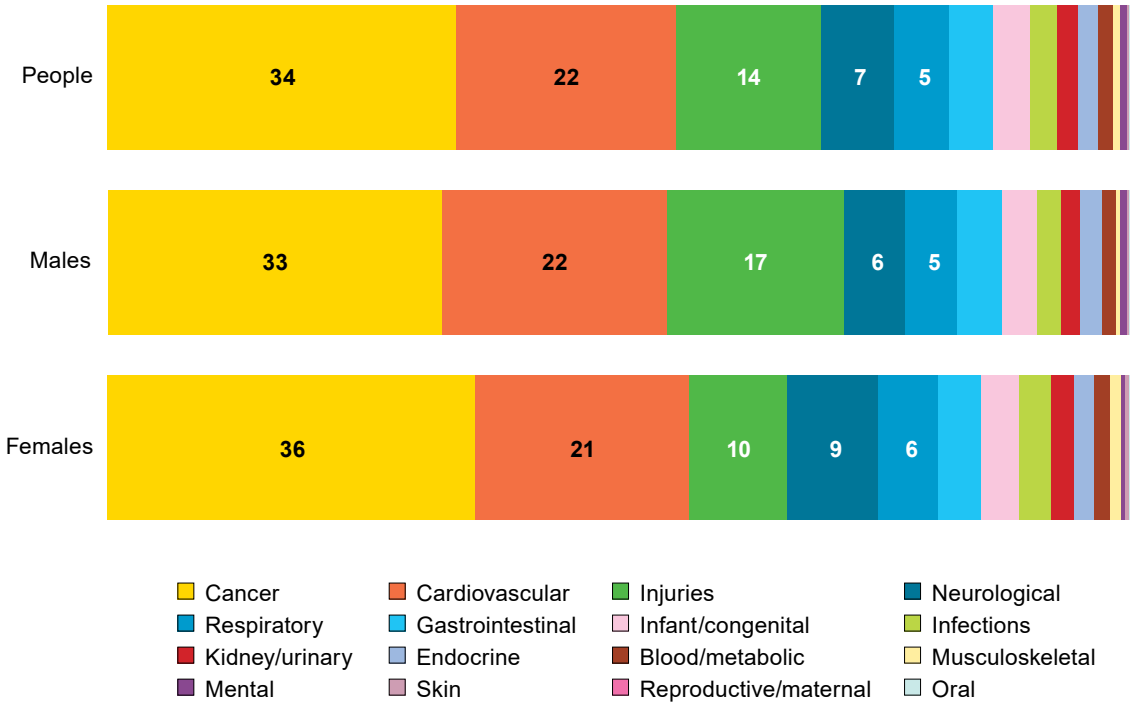


Which disease groups cause the most fatal burden?

The contribution of each of the 17 disease groups to fatal burden (YLL) in Australia is shown in Figure 4.3.

Dying from cancer (34% of total fatal burden) and cardiovascular diseases (22%) caused over half of the total fatal burden in Australia. Other major causes of fatal burden were injuries (14%), neurological conditions (7.1%) and respiratory diseases (5.5%).

Figure 4.3: Proportion (%) of fatal burden (YLL), by disease group and sex, 2015



Note: Hearing & vision disorders are excluded as they did not cause any fatal burden.

'Number of deaths' and 'age of death' influenced fatal burden within disease groups

As described previously, fatal burden is determined by both the number of deaths and the age at each death. Therefore, it is important to take account of both factors when interpreting the fatal burden of individual disease groups.

As an example, both injuries and cardiovascular diseases were leading causes of fatal burden but had substantially different numbers of deaths. For injuries, large fatal burden (17% in males and 9.7% in females) was the result of a small proportion of deaths (8.6% in males, 5.2% in females) occurring, on average, at a younger age. On the other hand, cardiovascular diseases caused large fatal burden (22% in males and 21% in females) resulting from a much higher proportion of deaths (28% in males and 31% in females), which occurred mostly in older age. This means that, on average, deaths from injuries resulted in more years of life lost than deaths from cardiovascular diseases.

Disease group burden differed by sex

Males and females suffered fatal burden from the same leading disease groups, as shown in Table 4.1. Males experienced a higher proportion of their fatal burden due to dying from injuries (17%) than females (9.7%); females experienced higher proportions of their fatal burden due to dying from cancer (36% compared with 33% for males) and neurological conditions (8.8% compared with 5.9% for males).

Males experienced higher rates of fatal burden for most disease groups than females. Notably, males had substantially higher rates from cancer, cardiovascular diseases, injuries and gastrointestinal disorders, while females experienced slightly higher rates from musculoskeletal conditions.

Table 4.1: Comparison of deaths and fatal burden (YLL, YLL%, YLL ASR), by disease group and sex, 2015

	Males						Females					
Disease group	**Rank (YLL)**	**Deaths (number)**	**Deaths (%)**	**YLL (number)**	**YLL (%)**	**YLL ASR**	**Rank (YLL)**	**Deaths (number)**	**Deaths (%)**	**YLL (number)**	**YLL (%)**	**YLL ASR**
Cancer	1	26,432	32.9	448,936	32.7	35.0	1	20,607	26.9	354,553	36.0	25.7
Cardiovascular	2	22,217	27.6	302,355	22.0	24.2	2	23,396	30.5	205,154	20.8	13.0
Injuries	3	6,902	8.6	239,057	17.4	20.4	3	4,025	5.2	95,163	9.7	7.7
Neurological	4	7,110	8.8	81,213	5.9	6.6	4	10,371	13.5	86,977	8.8	5.5
Respiratory	5	5,402	6.7	70,737	5.1	5.6	5	4,892	6.4	58,319	5.9	3.9
Gastrointestinal	6	3,153	3.9	59,834	4.4	4.7	6	3,091	4.0	40,552	4.1	2.9
Infant/congenital	7	685	0.9	47,696	3.5	3.9	7	554	0.7	37,425	3.8	3.2
Infections	8	2,418	3.0	32,101	2.3	2.6	8	3,273	4.3	30,871	3.1	2.0
Endocrine	9	1,874	2.3	28,276	2.1	2.2	10	1,744	2.3	19,212	2.0	1.3
Kidney/urinary	10	2,069	2.6	25,879	1.9	2.1	9	2,098	2.7	21,714	2.2	1.4
Blood/metabolic	11	920	1.1	18,702	1.4	1.5	11	998	1.3	15,471	1.6	1.1
Mental	12	496	0.6	9,588	0.7	0.8	13	349	0.5	4,590	0.5	0.3
Musculoskeletal	13	490	0.6	6,710	0.5	0.5	12	917	1.2	10,012	1.0	0.7
Skin	14	235	0.3	2,733	0.2	0.2	14	382	0.5	3,496	0.4	0.2
Reproductive/maternal	15	9	0.0	149	0.0	0.0	15	25	0.0	660	0.1	0.1
Oral	16	9	0.0	125	0.0	0.0	16	20	0.0	124	0.0	0.0
Total		**80,419**	**100.0**	**1,374,090**	**100.0**	**110.4**		**76,743**	**100.0**	**984,293**	**100.0**	**69.1**

Notes

1. Rates were age-standardised to the 2001 Australian Standard Population and are expressed as YLL per 1,000 population (YLL ASR).
2. Numbers and percentages shown for disease groups may not add up to the total due to rounding.
3. As a result of rounding, very small percentages and rates are expressed as 0.0.
4. Hearing & vision disorders are excluded as they did not cause any fatal burden.

Which diseases cause the most fatal burden?

The leading 20 causes of fatal burden are presented in Table 4.2. Together, dying from these diseases and injuries accounted for 63% of the total years of life lost in Australia in 2015.

Coronary heart disease was the leading cause of fatal burden in both males and females and contributed to 13% and 8.9% of their total fatal burden, respectively. Other leading causes of fatal burden were suicide (ranked second) among males, and breast cancer (ranked third) and dementia (ranked fourth) among females; lung cancer, stroke, bowel cancer and COPD featured among the top 10 for both sexes.

Although males and females shared similar leading causes, males experienced almost 3 times the burden from suicide as females and notably more burden from poisoning, chronic liver disease, road traffic injuries to motor vehicle occupants and liver cancer. Despite having lower rankings for lung cancer, chronic kidney disease and pancreatic cancer than females, males still had more years of life lost from these conditions. Among the shared leading 20 diseases, females only experienced more fatal burden from dementia and stroke than males.

Among the lower ranked diseases, males and females also suffered from different causes of fatal burden. Males experienced substantial burden from prostate cancer, oesophageal cancer, melanoma and cardiomyopathy while females suffered burden from ovarian cancer and falls.

Table 4.2: Leading 20 causes of fatal burden (YLL), by sex, 2015

Rank	Males	YLL	% of total	Females	YLL	% of total	People	YLL	% of total
1	Coronary heart disease	174,633	12.7	Coronary heart disease	87,323	8.9	Coronary heart disease	261,956	11.1
2	Suicide & self-inflicted injuries	100,329	7.3	Lung cancer	64,297	6.5	Lung cancer	154,364	6.5
3	Lung cancer	90,066	6.6	Breast cancer	60,338	6.1	Suicide & self-inflicted injuries	134,132	5.7
4	Stroke	52,356	3.8	Dementia	58,628	6.0	Stroke	109,612	4.6
5	Bowel cancer	51,232	3.7	Stroke	57,256	5.8	Dementia	99,663	4.2
6	COPD	48,963	3.6	COPD	40,929	4.2	Bowel cancer	90,638	3.8
7	Poisoning	43,626	3.2	Bowel cancer	39,405	4.0	COPD	89,892	3.8
8	Dementia	41,035	3.0	Suicide & self-inflicted injuries	33,804	3.4	Poisoning	62,102	2.6
9	Chronic liver disease	38,831	2.8	Pancreatic cancer	21,034	2.1	Breast cancer	60,783	2.6
10	Prostate cancer	37,883	2.8	Chronic kidney disease	20,423	2.1	Chronic liver disease	57,191	2.4
11	Pancreatic cancer	26,773	1.9	Poisoning	18,476	1.9	Pancreatic cancer	47,807	2.0
12	RTI – motor vehicle occupants	25,716	1.9	Chronic liver disease	18,360	1.9	Chronic kidney disease	44,466	1.9
13	Liver cancer	24,652	1.8	Ovarian cancer	17,221	1.7	Prostate cancer	37,883	1.6
14	Chronic kidney disease	24,043	1.7	Lower respiratory infections	15,826	1.6	RTI – motor vehicle occupants	37,648	1.6
15	Type 2 diabetes	22,900	1.7	Type 2 diabetes	14,583	1.5	Type 2 diabetes	37,483	1.6
16	Brain & CNS cancer	22,750	1.7	Brain & CNS cancer	13,940	1.4	Brain & CNS cancer	36,690	1.6
17	Melanoma of the skin	19,000	1.4	Falls	13,822	1.4	Liver cancer	35,306	1.5
18	Oesophageal cancer	18,291	1.3	Unknown primary neoplasm	12,468	1.3	Lower respiratory infections	32,797	1.4
19	Lower respiratory infections	16,971	1.2	RTI—motor vehicle occupants	11,932	1.2	Falls	29,853	1.3
20	Cardiomyopathy	16,539	1.2	Liver cancer	10,654	1.1	Melanoma of the skin	29,218	1.2
	Leading 20 diseases	*896,590*	*65.2*	*Leading 20 diseases*	*630,720*	*64.1*	*Leading 20 diseases*	*1,489,486*	*63.2*
	All other diseases	*477,501*	*34.8*	*All other diseases*	*353,573*	*35.9*	*All other diseases*	*868,898*	*36.8*
	Total	**1,374,090**	**100.0**	**Total**	**984,293**	**100.0**	**Total**	**2,358,384**	**100.0**

Colour legend: % of total burden — >= 5% | 4–5% | 3–4% | 2–3% | 0–2%

Note: Disease rankings exclude 'other' residual conditions from each disease group; for example, 'other musculoskeletal conditions'. CNS = central nervous system; RTI = road traffic injuries.

How does fatal disease burden change across the life course?

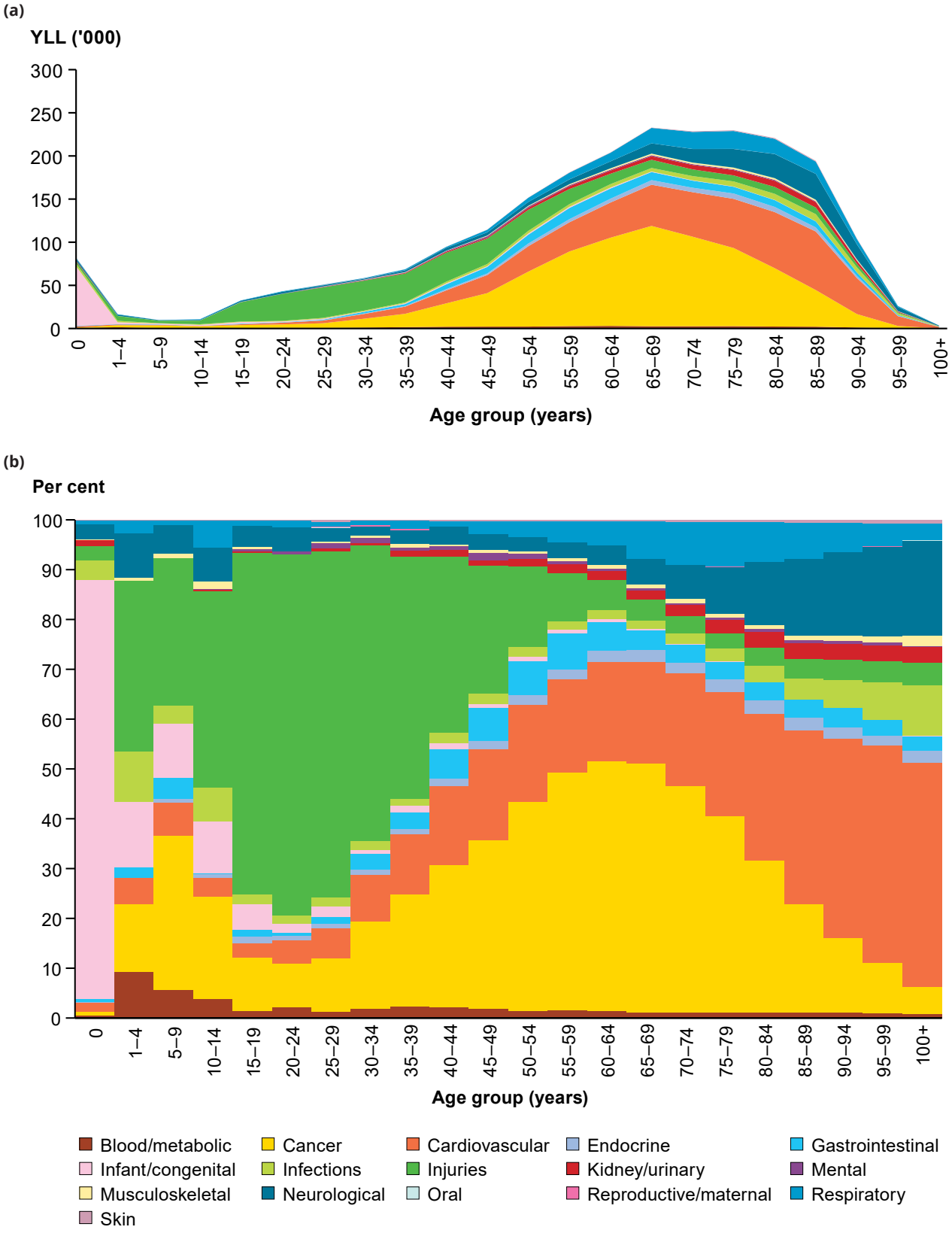
Australians at various stages of life died prematurely from different diseases and injuries. Hence, the patterns of fatal burden for leading disease groups and specific diseases changed throughout the life course.

Trends in burden for main disease groups

Figure 4.4 shows the amount (4.4a) and relative proportion (4.4b) of fatal burden contributed by each disease group across the life course in 2015.

- Injuries was the predominant cause of fatal burden in Australians aged under 45 (excluding infants). Dying from injuries contributed to more than half (53%) of the total fatal burden in this age group but accounted for a lower proportion of fatal burden in older aged adults.
- Cancer caused substantial fatal burden in Australians of all ages (except infants). Dying from cancer was the predominant cause (43%) of fatal burden for those aged 45–84, but burden declined sharply from age 85.
- Cardiovascular diseases was a major cause of fatal burden from age 35 and contributed to more of the fatal burden with ageing. In particular, dying from cardiovascular diseases contributed 37% of the total fatal burden in Australians aged 85 and over.
- Neurological conditions caused substantial fatal burden in older Australians aged 75 and over and accounted for 13% of the burden in this group.
- Other disease groups that caused a notable amount of fatal burden were gastrointestinal disorders, respiratory diseases and infections.

Figure 4.4: Number (a) and relative proportion (b) of fatal burden (YLL), by disease group and age group, 2015



Leading diseases and injuries causing fatal burden at various stages of life

The leading 10 diseases/injuries causing fatal burden for males and females at different stages of life are described in this section (see figures 4.5 and 4.6).

Infants and young children (aged under 5)

- Infants and young children had the majority of fatal burden from infant & congenital conditions, including pre-term & low birthweight complications, birth trauma & asphyxia, SIDS and cardiovascular defects. Baby boys also had high fatal burden from urogenital malformations and girls from neural tube defects.
- Other high fatal burden diseases for this group included drowning, lower respiratory infections and homicide & violence.

Children (aged 5–14)

- Among children aged 5–14, suicide, motor vehicle accidents, drowning, homicide & violence and brain cancer were leading causes of fatal burden in both boys and girls.
- For boys, acute lymphoblastic and myeloid leukaemia, cerebral palsy and epilepsy emerged among the leading 10 causes of fatal burden while girls experienced fatal burden from lower respiratory infections, brain malformations and influenza.

Adolescents and adults (aged 15–44)

- A range of injuries caused major fatal burden in adolescents and adults, with suicide ranked as the leading cause for this group. Other high-burden injuries included poisoning, road traffic injuries, homicide & violence, drowning and falls (males).
- Both sexes experienced substantial burden from a range of cancers, including brain and bowel cancer. Females also had high rankings for fatal burden from lung cancer, breast cancer and melanoma.
- Adolescents experienced some fatal burden from epilepsy and cerebral palsy while adults had substantial burden due to chronic liver disease and coronary heart disease.

Adults (aged 45–74)

- Among adults aged 45–74, coronary heart disease caused the most fatal burden in men while breast and lung cancer caused the most fatal burden in women.
- Both sexes had substantial fatal burden from bowel cancer, pancreatic cancer and chronic liver disease; however, men also experienced substantial burden from liver and prostate cancer and women had burden from ovarian cancer.
- Although suicide and poisoning were still ranked among the leading causes of fatal burden, stroke and COPD emerged as high-burden diseases in this group and contributed to an increasingly higher proportion of fatal burden with ageing.

Older people (aged 75 and over)

- Older Australians experienced the largest amount of fatal burden from coronary heart disease, followed by dementia, stroke and COPD for both men and women.
- Many cancers (lung, bowel, prostate, breast and pancreatic cancer) still caused substantial burden in this group. Men and women also experienced high fatal burden from chronic kidney disease, type 2 diabetes, falls, lower respiratory infections, Parkinson disease (men) and atrial fibrillation & flutter (women).

Figure 4.5: Leading causes of fatal burden (YLL '000; proportion %) for males, by age group, 2015

Rank	Age group (years)								
	Under 5	5–14	15–24	25–44	45–54	55–64	65–74	75–84	85+
1st	Pre-term/lbw complications (10.1; 18.5%)	Brain/CNS cancer (0.9; 7.8%)	Suicide/self-inflicted injuries (19.6; 36.6%)	Suicide/self-inflicted injuries (47.4; 26.2%)	Coronary heart disease (24.6; 15.1%)	Coronary heart disease (35.0; 14.6%)	Coronary heart disease (39.9; 14.1%)	Coronary heart disease (37.2; 14.9%)	Coronary heart disease (26.1; 18.9%)
2nd	Birth trauma/ asphyxia (6.2; 11.4%)	RTI/motor vehicle occupant (0.8; 6.8%)	RTI/motor vehicle occupant (8.3; 15.4%)	Poisoning (27.0; 14.9%)	Suicide/self-inflicted injuries (18.3; 11.2%)	Lung cancer (23.4; 9.8%)	Lung cancer (31.1; 11.0%)	Lung cancer (18.8; 7.5%)	Dementia (15.2; 11.0%)
3rd	SIDS (3.9; 7.1%)	Acute lymphoblastic leukaemia (0.6; 5.1%)	Poisoning (2.9; 5.4%)	Coronary heart disease (11.6; 6.4%)	Chronic liver disease (10.2; 6.2%)	Chronic liver disease (13.8; 5.8%)	COPD (15.4; 5.5%)	Dementia (16.2; 6.5%)	Stroke (11.3; 8.2%)
4th	Cardiovascular defects (3.4; 6.3%)	Suicide/self-inflicted injuries (0.5; 4.5%)	RTI/motor motorcyclist (2.1; 3.9%)	RTI/motor vehicle occupant (10.3; 5.7%)	Poisoning (9.5; 5.8%)	Bowel cancer (12.0; 5.0%)	Bowel cancer (14.3; 5.1%)	Stroke (15.4; 6.2%)	COPD (7.5; 5.5%)
5th	Drowning (1.2; 2.3%)	Drowning (0.5; 4.3%)	Homicide/ violence (1.5; 2.7%)	Chronic liver disease (4.8; 2.7%)	Lung cancer (9.2; 5.6%)	Liver cancer (9.2; 3.8%)	Prostate cancer (11.6; 4.1%)	COPD (15.4; 6.1%)	Prostate cancer (7.2; 5.2%)
6th	Lower respiratory infections (1.1; 2.1%)	Cerebal palsy (0.4; 3.6%)	Epilepsy (1.3; 2.3%)	Homicide/ violence (4.3; 2.4%)	Bowel cancer (7.1; 4.4%)	Suicide/self-inflicted injuries (8.4; 3.5%)	Stroke (11.4; 4.0%)	Prostate cancer (12.9; 5.2%)	Lung cancer (4.5; 3.3%)
7th	Urogenital malformations (1.0; 1.8%)	Cardiovascular defects (0.4; 3.5%)	Drowning (1.2; 2.3%)	RTI/motor motorcyclist (4.1; 2.2%)	Stroke (4.1; 2.5%)	Pancreatic cancer (7.5; 3.1%)	Pancreatic cancer (8.6; 3.0%)	Bowel cancer (10.3; 4.1%)	Chronic kidney disease (4.3; 3.1%)
8th	Brain malformations (0.9; 1.6%)	Homicide/ violence (0.2; 2.2%)	Falls (1.1; 2.1%)	Brain/CNS cancer (4.0; 2.2%)	Brain/CNS cancer (3.9; 2.4%)	Stroke (7.5; 3.1%)	Dementia (7.4; 2.6%)	Chronic kidney disease (6.5; 2.6%)	Falls (4.0; 2.9%)
9th	Neonatal infections (0.8; 1.5%)	Epilepsy (0.2; 2.2%)	Cardiomyopathy (0.9; 1.7%)	Bowel cancer (3.7; 2.1%)	Liver cancer (3.4; 2.1%)	COPD (7.1; 3.0%)	Chronic liver disease (6.7; 2.4%)	Type 2 diabetes (5.8; 2.3%)	Lower respiratory infections (4.0; 2.9%)
10th	Homicide/ violence (0.8; 1.5%)	Acute myeloid leukaemia (0.2; 2.1%)	Cerebal palsy (0.7; 1.3%)	Cardiomyopathy (3.3; 1.8%)	Pancreatic cancer (3.3; 2.0%)	Brain/CNS cancer (6.2; 2.6%)	Liver cancer (6.4; 2.3%)	Parkinson disease (5.1; 2.1%)	Bowel cancer (3.6; 2.6%)

lbw = low birthweight; CNS = central nervous system; RTI = road traffic injuries.

Note: Disease rankings exclude 'other' residual conditions from each disease group; for example, 'other musculoskeletal conditions'.

Figure 4.6: Leading causes of fatal burden (YLL '000; proportion %) for females, by age group, 2015

Rank	Age group (years)								
	Under 5	5–14	15–24	25–44	45–54	55–64	65–74	75–84	85+
1st	Pre-term/lbw complications (6.8; 15.8%)	Suicide/self-inflicted injuries (1.0; 10.3%)	Suicide/self-inflicted injuries (7.5; 33.8%)	Suicide/self-inflicted injuries (13.5; 14.8%)	Breast cancer (13.7; 13.3%)	Lung cancer (18.1; 12.4%)	Lung cancer (20.2; 11.3%)	Coronary heart disease (22.7; 11.3%)	Coronary heart disease (34.0; 17.9%)
2nd	Birth trauma/ asphyxia (6.2; 14.3%)	RTI/motor vehicle occupant (0.8; 8.4%)	RTI/motor vehicle occupant (3.8; 17.4%)	Poisoning (9.9; 10.8%)	Lung cancer (8.4; 8.2%)	Breast cancer (15.9; 11.0%)	Coronary heart disease (14.3; 8.0%)	Dementia (19.5; 9.7%)	Dementia (31.0; 16.3%)
3rd	SIDS (2.3; 5.4%)	Brain/CNS cancer (0.6; 6.8%)	Epilepsy (0.8; 3.4%)	Breast cancer (7.1; 7.8%)	Suicide/self-inflicted injuries (6.7; 6.5%)	Coronary heart disease (8.7; 6.0%)	COPD (12.9; 7.2%)	Stroke (16.6; 8.3%)	Stroke (22.1; 11.6%)
4th	Cardiovascular defects (2.2; 5.2%)	Homicide/ violence (0.4; 4.3%)	Homicide/ violence (0.7; 3.3%)	Bowel cancer (4.0; 4.4%)	Bowel cancer (5.9; 5.8%)	Bowel cancer (7.4; 5.1%)	Breast cancer (12.7; 7.1%)	COPD (12.3; 6.1%)	COPD (7.3; 3.8%)
5th	Neonatal infections (1.0; 2.2%)	Acute lymphoblastic leukaemia (0.4; 4.3%)	Poisoning (0.7; 3.2%)	RTI/motor vehicle occupant (3.6; 3.9%)	Coronary heart disease (5.1; 4.9%)	COPD (6.0; 4.1%)	Bowel cancer (9.0; 5.0%)	Lung cancer (11.9; 5.9%)	Lower respiratory infections (6.6; 3.4%)
6th	Lower respiratory infections (1.0; 2.2%)	Drowning (0.3; 3.4%)	Acute lymphoblastic leukaemia (0.4; 1.9%)	Chronic liver disease (3.2; 3.5%)	Chronic liver disease (4.5; 4.4%)	Stroke (5.4; 3.7%)	Stroke (8.3; 4.6%)	Bowel cancer (8.6; 4.3%)	Falls (6.1; 3.2%)
7th	Brain malformations (0.9; 2.0%)	Lower respiratory infections (0.2; 2.6%)	Cerebal palsy (0.3; 1.5%)	Brain/CNS cancer (3.0; 3.3%)	Poisoning (4.2; 4.1%)	Chronic liver disease (5.4; 3.7%)	Pancreatic cancer (6.1; 3.4%)	Breast cancer (7.5; 3.7%)	Chronic kidney disease (5.6; 3.0%)
8th	Neural tube defects (0.9; 2.0%)	Brain malformations (0.2; 2.6%)	Brain/CNS cancer (0.3; 1.5%)	Coronary heart disease (2.4; 2.7%)	Stroke (3.0; 2.9%)	Pancreatic cancer (4.4; 3.0%)	Dementia (5.8; 3.2%)	Chronic kidney disease (5.8; 2.9%)	Atrial fibrillation (5.3; 2.8%)
9th	Drowning (0.9; 2.0%)	Influenza (0.2; 2.6%)	Drowning (0.3; 1.5%)	Lung cancer (2.3; 2.5%)	Pancreatic cancer (2.6; 2.5%)	Ovarian cancer (4.3; 3.0%)	Ovarian cancer (5.3; 2.9%)	Pancreatic cancer (5.0; 2.5%)	Bowel cancer (4.4; 2.3%)
10th	Homicide/ violence (0.8; 1.9%)	Asthma (0.2; 2.1%)	Asthma (0.3; 1.5%)	Melanoma (2.0; 2.2%)	Ovarian cancer (2.5; 2.4%)	Brain/CNS cancer (3.2; 2.2%)	Chronic kidney disease (3.6; 2.0%)	Type 2 diabetes (4.4; 2.2%)	Non-rheumatic valvular disease (3.9; 2.0%)

lbw = low birthweight; CNS = central nervous system; RTI = road traffic injuries.

Note: Disease rankings exclude 'other' residual conditions from each disease group; for example, 'other musculoskeletal conditions'.

5 Health-adjusted life expectancy

Key results

- Health-adjusted life expectancy (HALE) for males and females born in 2015 was 71.5 and 74.4 years, respectively.
- On average, females born in 2015 expected to live 4.2 years longer and have 2.9 more years of healthy life than males.
- Like life expectancy, HALE increased between 2003 and 2015 and males experienced the greatest gains. Males born in 2015 expected 2.0 more years in full health than males born 12 years earlier in 2003, while females expected 1.3 more years in full health.
- Australians aged 65 in 2015 could expect, on average, around 76% of their remaining life to be lived in full health.
- HALE at birth in 2015 was longest for males in the Australian Capital Territory (72.6 years) and for females in Western Australia (75.3) and shortest for males and females in the Northern Territory (66.8 and 68.6, respectively).

HALE by remoteness area

- HALE at birth for males and females in 2015 in *Remote and very remote* areas was 5.2 and 5.8 years shorter, respectively, than for those in *Major cities.*

HALE by socioeconomic group

- In 2015, the highest (least disadvantaged) socioeconomic group expected, at birth, to live more healthy years (75.7 for males and 77.6 for females) than those in the lowest socioeconomic group (68.3 for males and 71.8 for females).
- People in the highest socioeconomic group expected more of their remaining years of life in full health (90% for males and females) than those in the lowest socioeconomic group (88% for males and 87% for females).
- Between 2011 and 2015, HALE at birth increased for the highest socioeconomic group (from 74.8 to 75.7 years for males and from 76.7 to 77.6 for females) but decreased for the lowest socioeconomic group (from 68.7 to 68.3 years for males and from 72.7 to 71.8 for females).

HALE extends the concept of life expectancy by considering the time spent living with ill health from disease and injury. It reflects the length of time an individual at a specific age could, on average, expect to live in full health. It can be measured at any age but is typically reported from birth (which represents the average life expectancy for a baby born that year) and at age 65, describing health in an ageing population. See Appendix A for an overview of methods used to estimate HALE.

HALE as a measure of population health

Measures of HALE show whether longer lives are accompanied by more or less years lived in full health. HALE is comparable across populations and over time; differences in age composition of the populations being compared are overcome as the age-specific health and mortality experiences are applied to a hypothetical population.

HALE is most meaningful when compared with life expectancy. The difference between HALE and life expectancy represents the average number of years that a person can expect to live in less than full health.

The ratio of HALE to life expectancy, expressed as a percentage, represents the proportion of life expectancy that is spent in full health. Comparing the ratio over time can highlight whether or not an increase in life expectancy is accompanied by an increase in ill health. When this ratio increases over time, there may be compression of morbidity (that is, increased life expectancy is accompanied by relatively fewer years in ill health) while decreases may suggest an expansion of morbidity (that is, a higher percentage of life expectancy being in ill health).

On average, almost 90% of years lived are in full health

HALE and life expectancy at birth

Life expectancy and HALE at birth represent the average number of years of life and equivalent years of healthy life, respectively, that a newborn in a particular year could expect if mortality and morbidity rates (of that particular year) remained throughout their lives

Life expectancy in Australia for males born in 2015 was 80.4 years and 84.6 years for females (Appendix Table D4). The average number of healthy years (HALE) for these babies was 71.5 years for males and 74.4 years for females. The difference between life expectancy and HALE in this cohort—that is, the time expected in less than full health—was 8.9 years for males and 10.2 years for females.

Looking at the percentage of life expectancy in full health, males and females could expect to spend 89% and 88% of their lives, respectively, in full heath.

While females born in 2015 expected, on average, to live 4.2 years longer than males, they also expected 2.9 more years of healthy life than males.

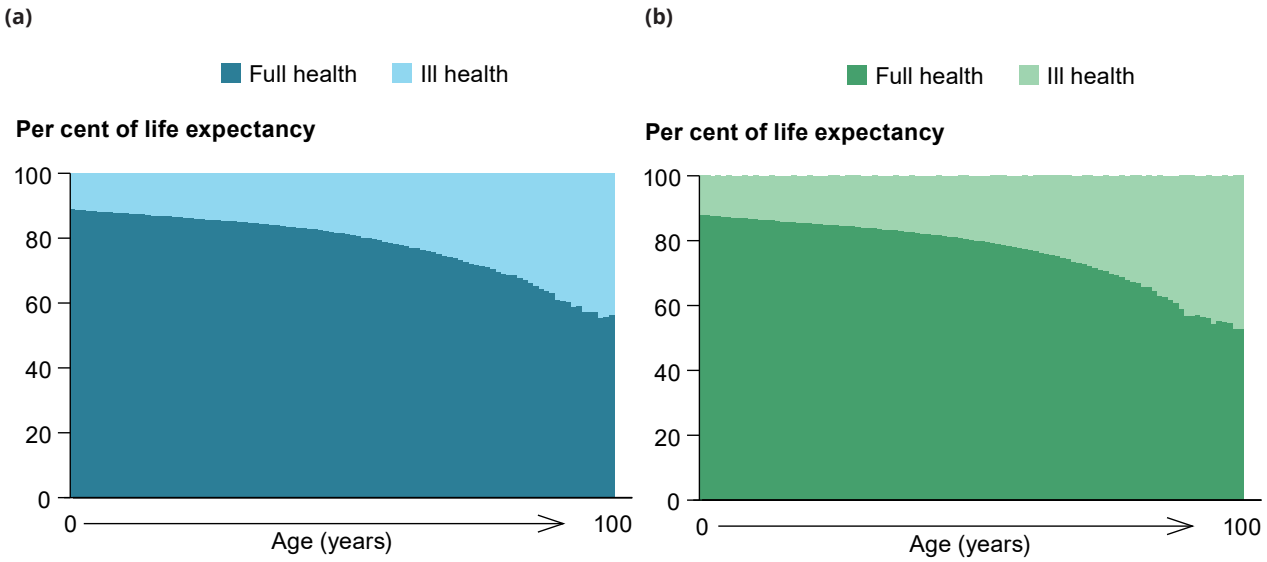
HALE and life expectancy at older ages

Estimates of life expectancy and HALE at older ages describe the extent to which people spend their final years of life in full health.

Life expectancy in 2015 for men and women aged 65 was 19.6 and 22.3 years, respectively (Appendix Table D4; Figure 5.1). At this age, men could expect 15.0 healthy years and women, 16.8. Accordingly, the average time per person expected to live in less than full health was 4.6 and 5.5 years for men and women, respectively.

At age 65, around three-quarters of life expectancy was healthy years: 76% for both men and women.

Figure 5.1: Percentage of remaining life expectancy in full health and ill health at each age, males (a) and females (b), 2015



Source: Appendix Table D6.

Years of life gained are healthy years

Monitoring changes over time in HALE alongside life expectancy provides more insight into the net benefit of longer life expectancy; that is, if the years of life gained are healthy years or lived in ill health (Box 5.1).

Box 5.1: Interpreting changes in HALE over time

While overall life expectancy increases, the number and proportion of years in ill health can decline or increase. The link between health expectancies and life expectancies can be described by way of broad health scenarios depicting the relative changes between life expectancy and HALE. In these scenarios, changes in the number and proportion of healthy years (that is, if these aspects become shorter or longer over time) are described alongside relative changes (that is, how the HALE:life expectancy ratio changes over time).

Compression of morbidity

- In this scenario, the age of onset of chronic illness is delayed such that most morbidity occurs at the end of life (that is, squeezing all illness into the later stages of life). This would shorten the period of living with ill health and slow the rate of increase in life expectancy.
- If the number of expected years of life in illness falls, there is an absolute compression of morbidity.
- If the proportion of expected years of life in ill health falls without the number of expected years of ill health decreasing (it may even rise), there is a relative compression of morbidity.

Expansion of morbidity

- In this scenario, increasing longevity is accompanied by more survivors who are frail and suffer from chronic conditions, resulting in a longer period living with ill heath before death.
- If the number of expected years of life in full health falls, there is an absolute expansion of morbidity.
- If the proportion of healthy years falls without the number of expected healthy years decreasing (it may even rise), there is a relative expansion of morbidity.

Dynamic equilibrium

- In this scenario, the overall level of ill health increases largely due to the increase of less severe ill health, while the prevalence of severe ill health falls or remains stable, due to a slowdown in the rate of progression of ill health.
- If the ratio of HALE to total life expectancy is constant, there is an equilibrium.

Sources: Howse 2006; Robine et al. 2000.

Changes in HALE and life expectancy at birth

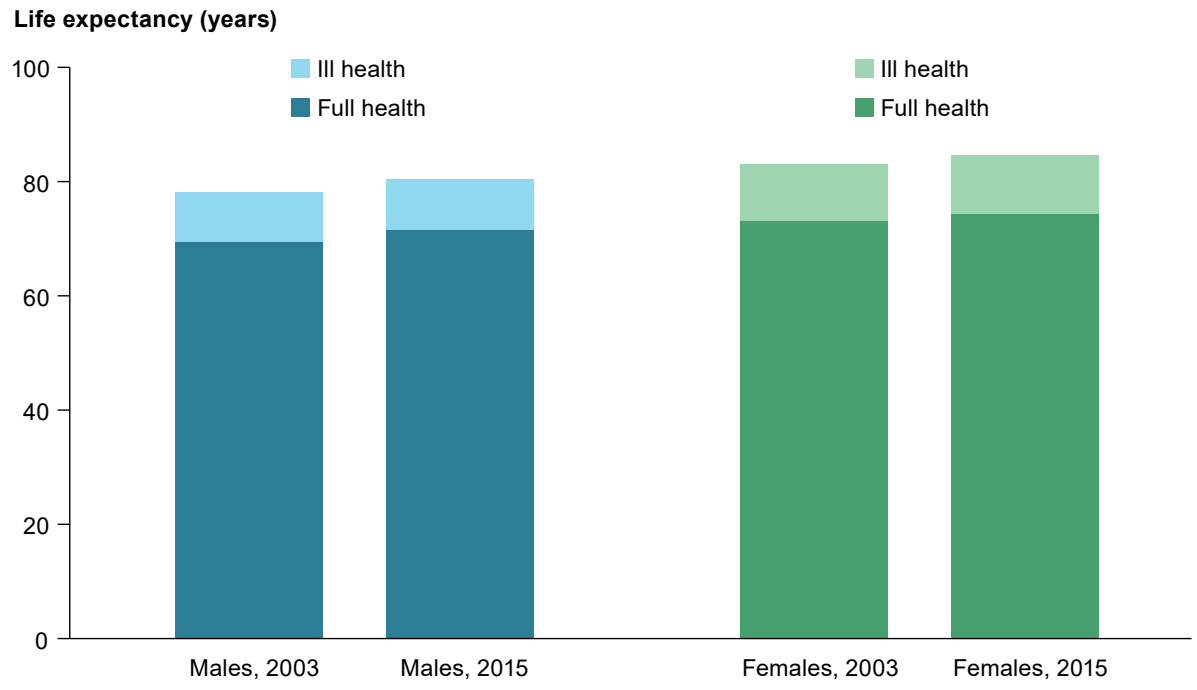
Between 2003 and 2015, life expectancy and HALE at birth increased for males and females. During this 12-year period, life expectancy rose faster than HALE and males experienced the greatest gains in both. Between these 2 years, males gained 2.3 years in life expectancy (from 78.1 years in 2003 to 80.4 in 2015) and 2.0 years in HALE (from 69.5 to 71.5) (Appendix Table D5). The corresponding gains for females were 1.6 years in life expectancy (from 83.0 in 2003 to 84.6 in 2015) and 1.3 years in HALE (from 73.1 to 74.4). The majority of the gains in life expectancy were healthy years; however, the:

- average time spent in ill health increased by 0.3 years for both males and females
- percentage of life expectancy at birth as healthy years remained largely the same between all the years: 89% for males and 88% for females (Appendix Table D5).

These changes are illustrated in Figure 5.2, showing the demarcation in life expectancy that is average number of healthy years (HALE) and average years in ill health.

These results suggest that, at a national level, gains in healthy years at birth are comparable with gains in life expectancy at birth; that is, there is neither compression nor expansion of morbidity. Rather, HALE is keeping pace with life expectancy: increases in life expectancy are not associated with a disproportionate amount of time expected in ill health reflecting, at a national level, a scenario of equilibrium.

Figure 5.2: Life expectancy at birth as years lived in full health (HALE) and years lived in ill health, by sex, 2003 and 2015

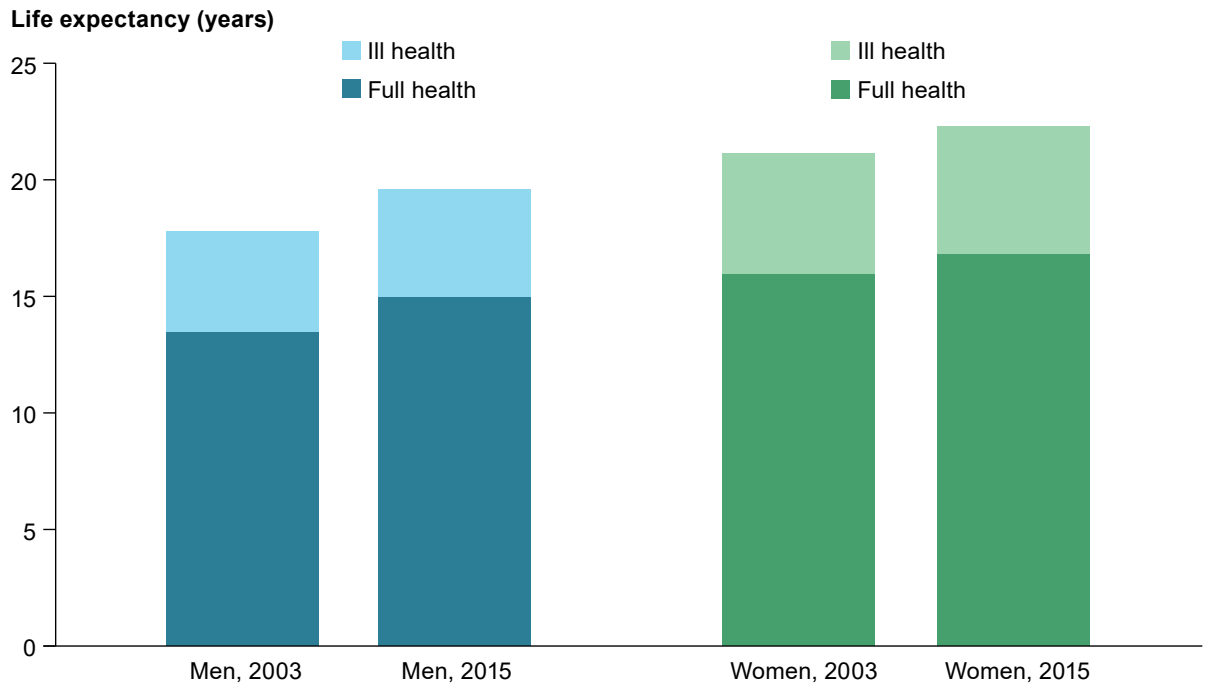


Source: Appendix Table D5.

Changes in HALE at age 65

For people aged 65, life expectancy and HALE increased between 2003 and 2015, by 1.8 and 1.5 years, respectively, for men and by 1.2 and 0.9 years, respectively, for women (Appendix Table D5; Figure 5.3). Despite women at age 65 having higher life expectancy and HALE than men, there was relative stability over time in the percentage of life expectancy as healthy years (around 76% in 2003, 2011 and 2015); as such, there is no suggestion that morbidity is compressing or expanding among the ageing population (Appendix Table D5).

Figure 5.3: Life expectancy at age 65 as years lived in full health (HALE) and years lived in ill health, by sex, 2003 and 2015



Source: Appendix Table D5.

HALE is unequal across states and territories

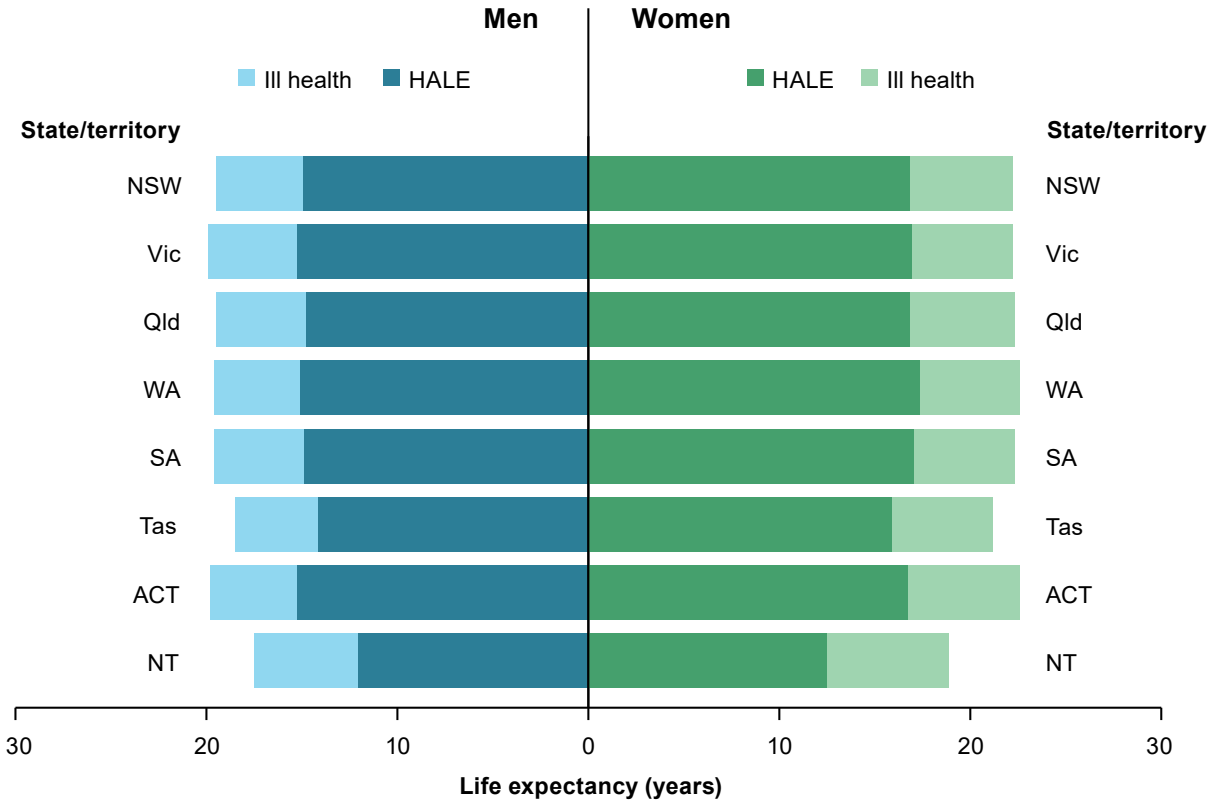
HALE at birth varied across states and territories. HALE at birth in 2015 for males was highest in the Australian Capital Territory (72.6 years) and lowest in the Northern Territory (66.8 years) (Appendix Table D4)—a gap of 5.8 healthy years between these jurisdictions. For females, the highest HALE was in Western Australia (75.3 years) and the lowest in the Northern Territory (68.6 years)—a gap of 6.7 health years (Appendix Table D4).

The variation in HALE between the jurisdictions reflects both geographical variation in life expectancy and variation in disease burden.

The percentage of healthy years of life expectancy at birth for males ranged from 89.4% in Western Australia to 88.4% in South Australia and the Northern Territory (Appendix Table D4). For females, this percentage ranged from 88.8% in Western Australia to 87.2% in the Northern Territory.

The results for people aged 65 are shown in Figure 5.4. The Northern Territory had the lowest HALE for people aged 65 (12.1 years for men and 12.5 years for women) and the lowest percentage of remaining life as healthy years (68.9% for men and 66.2% for women) compared with the other jurisdictions. Men and women aged 65 in the other jurisdictions could expect the equivalent of around three-quarters or more of their remaining life as healthy years (Appendix Table D4).

Figure 5.4: Life expectancy at age 65 in full health (HALE) and ill health, men and women, by state and territory, 2015



Source: Appendix Table D4.

HALE varies by remoteness of area lived

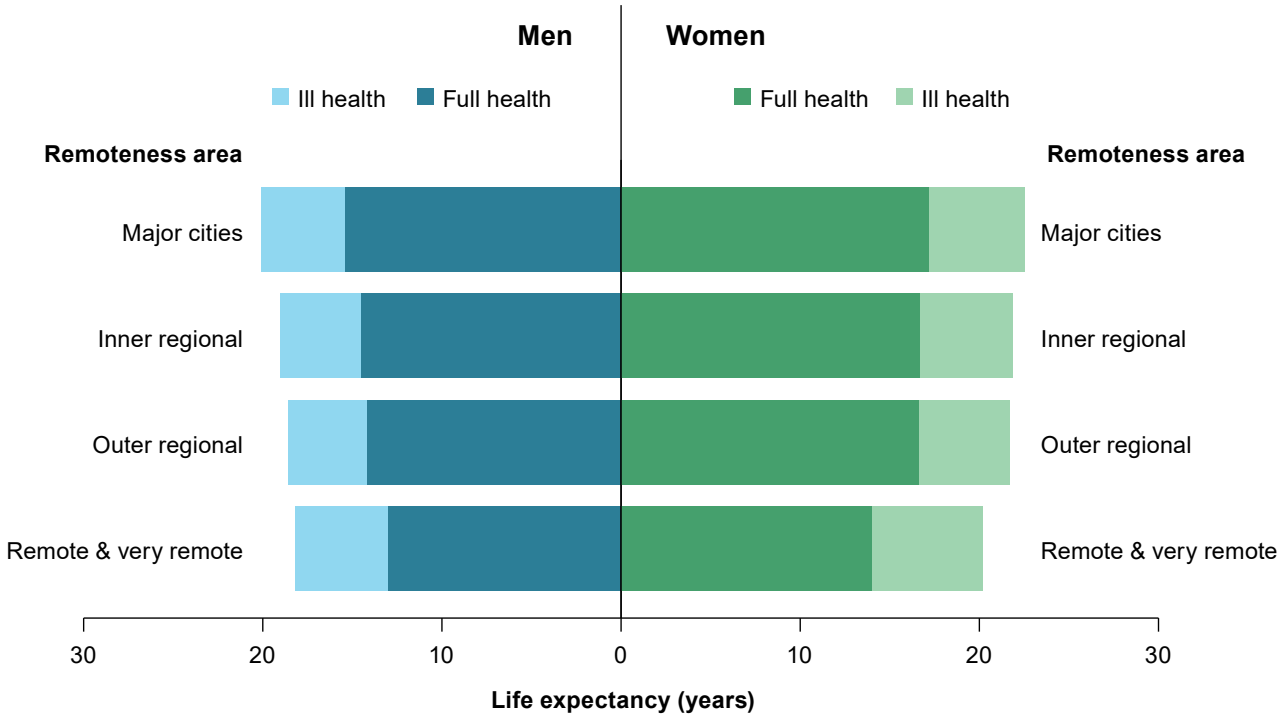
There is considerable variation in the burden of disease by remoteness area (see Chapter 8). Life expectancy and HALE also vary by region of remoteness, with greater differentials for HALE. Life expectancy and HALE at birth in 2015 were highest in *Major cities* and declined with increasing remoteness.

HALE and life expectancy were higher for males and females in *Major cities* than in *Remote and very remote* areas, both at birth and at age 65 (Appendix Table D7; Figure 5.5). In 2015, males and females in *Remote and very remote* areas expected 5.2 and 5.8 fewer years of full health (at birth), respectively, than their counterparts in *Major cities* (Appendix Table D7).

Notably, the percentage of life expectancy as healthy years at age 65 for people in *Major cities* was higher than for those in *Remote and very remote* areas: for men it was 77% and 72%, respectively, and for women, 76% and 70%, respectively.

At age 65, people in *Remote and very remote* areas had shorter life expectancy and at least 2 fewer years of full health (2.4 fewer for men and 3.1 fewer for women) than people in *Major cities*.

Figure 5.5: Life expectancy at age 65 in full health (HALE) and ill health, men and women, by remoteness area, 2015



Source: Appendix Table D4.

Gaps in life expectancy and HALE narrow between remoteness areas

The gap in life expectancy and HALE between *Major cities* and *Remote and very remote* areas is reflected by the difference between these 2 areas for each measure. It represents the inequality in the number of healthy years lived between the least remote and most remote areas. The HALE gap is equal to HALE in *Remote and very remote* areas minus HALE in *Major cities*. The life expectancy gap is calculated the same way.

It is important to see how the gap has changed over time; that is, if the disparity in HALE between the least remote and most remote areas has changed and if the changes are consistent with changes in the life expectancy gap.

For males and females, the life expectancy gaps at birth and at age 65 were slightly lower (or the same) in 2015 than in 2011; that is, there was less disparity in life expectancy between the areas in 2015 than in 2011.

The gap in HALE at birth and at age 65 remained the same between 2011 and 2015 for males (Appendix Table D7). For females, the changes were more noticeable and the HALE gap at birth and age 65 was smaller in 2015 compared with 2011. In 2011, HALE for females in *Remote and very remote* areas was 6.8 years less than their counterparts in *Major cities*, while in 2011 it was 5.8 years shorter. At age 65, the HALE gap also reduced between 2011 and 2015 for women in *Remote and very remote* areas, from 4.1 to 3.1 fewer healthy years than women in *Major cities*.

HALE is unequal between socioeconomic groups

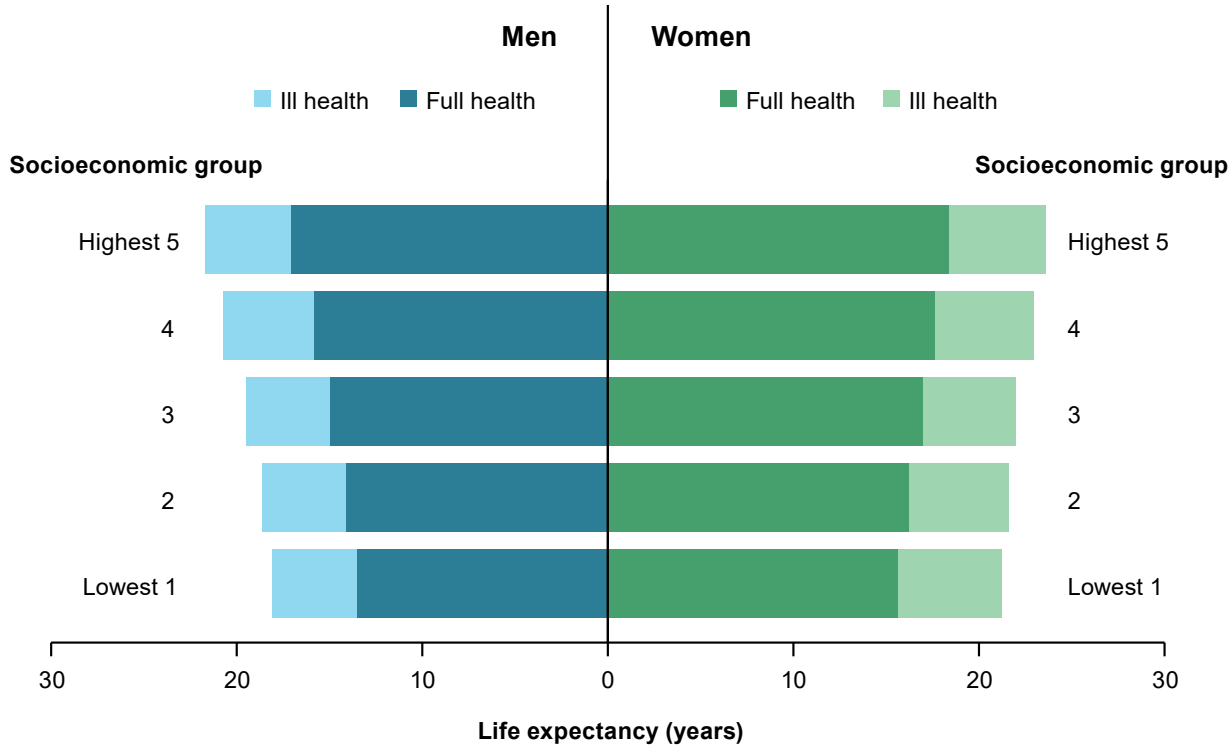
Socioeconomic groups are presented as approximate quintiles in this analysis. The lowest quintile (1) represents the approximate 20% of the population living in areas with the lowest socioeconomic characteristics; that is, it is the most disadvantaged. The level of socioeconomic position increases with each quintile, through to the approximate 20% of the population living in areas with the highest socioeconomic characteristics (5); that is, the least disadvantaged.

Life expectancy and aspects of health vary by socioeconomic group, with the highest group usually faring better than the lowest. HALE reflects this, with the lowest socioeconomic group expecting to live fewer healthy years and to have a smaller percentage of their remaining life as healthy years than the highest group.

Males and females in the highest group had the longest life expectancy and HALE, both at birth and at age 65 than their counterparts in the lowest group (Appendix Table D4; Figure 5.6).

The percentage of life expectancy at birth as healthy years was also greater in the highest socioeconomic group (90% for males and females) than in the lowest group (88% for males and 87% for females). As shown in Figure 5.6, at age 65, there was a greater disparity in the percentage of life expectancy as healthy years between the 2 groups: men in the lowest group expected 75% of LE as healthy years compared with 79% in the highest group, and women expected 74% and 78%, respectively.

Figure 5.6: Life expectancy at age 65 in full health (HALE) and ill health, men and women, by socioeconomic group, 2015



Source: Appendix Table D4.

Changes in life expectancy and HALE over time within socioeconomic group

Between 2011 and 2015, HALE at birth increased for the highest socioeconomic group (from 74.8 to 75.7 years for males and from 76.7 to 77.6 for females) but decreased for the lowest group (from 68.7 to 68.3 years for males and from 72.7 to 71.8 for females). During this period, life expectancy increased (or remained the same) for both groups.

Similar patterns were evident for people aged 65: HALE decreased over time for those in the lowest socioeconomic group while it increased in the highest group.

Socioeconomic HALE gap widens over time

The gap in life expectancy and HALE between the highest and lowest socioeconomic groups is calculated as the difference in years between the lowest and highest groups on each measure—that is, the HALE gap for socioeconomic groups is the HALE in the lowest group minus the HALE in the highest group. The gap represents the inequality in the number of healthy years lived between the highest and lowest groups. A negative value suggests that the lowest socioeconomic group experiences fewer years (for life expectancy) or fewer healthy years (for HALE) than the highest.

Both the life expectancy and HALE gaps, at birth and at age 65, were larger (wider) in 2015 than in 2011; that is, there was greater disparity between the socioeconomic groups in 2015 than in 2011.

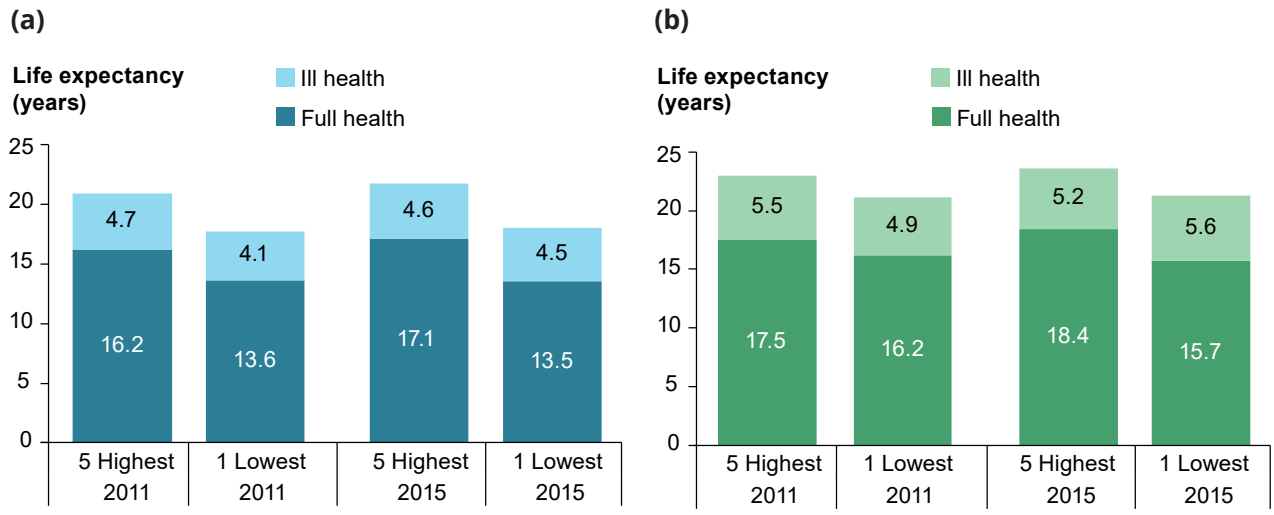
For HALE at birth, the gap widened by 1.3 years for males (from 6.1 years in 2011 to 7.4 years in 2015) and by 1.8 years for females (from 4.0 to 5.8 years) (Appendix Table D8).

Figure 5.7 presents life expectancy for men and women aged 65 in 2011 and 2015, disaggregated by years in full health (HALE) and years in ill health. It shows that:

- life expectancy at age 65 (the sum of years in full health and years in ill health) was consistently longer in the highest socioeconomic group than in the lowest group, at both time points and for men and women
- HALE was also consistently longer in the highest socioeconomic group than in the lowest group
- HALE in the highest socioeconomic group increased between 2011 and 2015 for men (from 16.2 to 17.1 years) and for women (from 17.5 to 18.4 years)
- in contrast, HALE in the lowest socioeconomic group was about the same in 2011 and 2015 for men but declined for women (from 16.2 to 15.7 years)
- the HALE gap (the difference in HALE between the highest and lowest socioeconomic groups) was greater in 2015 than in 2011. For men, this gap was 2.6 years in 2011 compared with 3.6 years in 2015. For women, the gap doubled: from 1.3 years in 2011 to 2.7 years in 2015.

The disparity in HALE between the highest and lowest socioeconomic groups is further emphasised by the percentage of life expectancy at age 65 that is expected as healthy years. While this percentage increased over time for men and women in the highest socioeconomic group, it declined for those in the lowest group: from 77% for both men and women in 2011 to 75% for men and 74% for women in 2015. That is, for men and women in the lowest socioeconomic group, the number of expected healthy years fell over time as did the percentage of healthy years—both signs of expansion of morbidity in the lowest socioeconomic group (Appendix Table D8).

Figure 5.7: Life expectancy by years in full health and ill health, for the highest and lowest socioeconomic groups, males (a) and females (b), 2011 and 2015



Source: Appendix Table D8.

6 Contribution of risk factors to burden

Key results

- Risk factors included in this study were responsible for 38% of the total burden of disease and injury in Australia in 2015.
- The risk factors contributing the most burden in 2015 were tobacco use (9.3%), overweight & obesity (8.4%), dietary risks (7.3%), high blood pressure (5.8%) and high blood plasma glucose (including diabetes) (4.7%).
- The joint effect of all the risk factors combined contributed substantially to the burden for endocrine disorders (98%), kidney & urinary diseases (89%), cardiovascular diseases (65%), cancer (44%) and injuries (43%).
- In males, child abuse & neglect was the leading contributor to burden in the 0–14 age group, alcohol use for ages 15–44, tobacco use for ages 45–84 and high blood pressure in the older ages.
- In females, child abuse & neglect was the leading contributor for ages 0–44, overweight & obesity for ages 45–64, tobacco use for ages 65–84 and high blood pressure in the older ages.

This chapter describes the contribution of selected risk factors to the burden of disease. Attributable burden reflects the direct link between a risk factor (for example, tobacco use) and a disease or injury outcome, referred to in this report as a linked disease (for example, lung cancer). See Box 6.1 for a description of how attributable burden is estimated.

Box 6.1: How is attributable burden measured?

The basic steps for estimating attributable burden are described as follows:

- Select linked diseases for which there is convincing or probable evidence in the literature that the risk factor has a causal association.
- Define the exposure to the risk factor that is not associated with increased risk of the linked disease (the TMRED).
- Estimate the population attributable fractions (PAFs) by either the comparative risk assessment method or the direct method:
  - Comparative risk assessment involves using the amount of increased risk (relative risk) of linked disease morbidity or mortality due to exposure to the risk factor and an estimate exposure to each risk factor in the population. For most risk factors, exposure to the risk factor was estimated using high-quality survey data. For information about the quality of data inputs, see Appendix B.
  - The direct method uses comprehensive data sources such as registries to estimate the amount of the linked disease due to the risk factor.
- Estimate the attributable burden by multiplying the PAFs by the burden for each linked disease.

How are risk factors selected?

There are 38 risk factor components or exposures included in this report (such as cannabis and cocaine use) that combine into 18 individual risk factors (such as illicit drug use) (Table 6.1). The risk factors are categorised as behavioural, metabolic, dietary and environmental risks. While this list is extensive, it does not cover all potential risk factors. The risk factors included needed to meet the following criteria:

- have strong evidence of causal association
- are modifiable
- can be measured in the Australian population
- are linked to diseases that occur in Australia, and are measured in the ABDS.

Some changes have been made to the list of selected risk factors compared with that for the ABDS 2011. In the list for the ABDS 2015, impaired kidney function was added, and child abuse & neglect and intimate partner violence were expanded to include extra exposures: child abuse & neglect now includes physical abuse, emotional abuse and neglect as well as sexual abuse; intimate partner violence now includes emotional abuse.

The risk factor suboptimal breastfeeding is included in the GBD 2016 study linked to intestinal infection diseases but was not included in the ABDS 2015 as the linked diseases are not common in Australia. Per- and poly-fluoroalkyl substances (PFAS) was excluded as a risk factor as there is insufficient evidence in the literature of disease outcomes (DoH 2018). Exposure to lead was also excluded as data were not available for the Australian population.

Risk factors that were social determinants (such as income, employment and education) could not be included. They have not been incorporated into burden of disease studies either here or internationally, and developing methods to do so was outside the scope of this study. However, their importance is clear, and it is hoped that they could be included as risk factors in future burden of disease studies. Chapter 8 contains an analysis of the burden of disease attributed to risk factors by socioeconomic groups.

Detailed estimates of attributable burden due to individual risk factors can be found in data visualisations on the AIHW website <http://www.aihw.gov.au/burden-of-disease/>.

What is the contribution of all risk factors combined?

Of the total burden of disease and injury in Australia for 2015, 38% was attributable to all the risk factors included in this study. This illustrates the potential for health gain in preventing disease and injury by reducing exposure to these risk factors. Although it may not be feasible or achievable to prevent all health loss, it quantifies what is theoretically possible.

Almost half of all deaths (48%) could be attributed to the risk factors included in this study (Appendix Table D2), as could a similar amount of fatal burden (47%). A smaller proportion of non-fatal burden (29%) was attributable to these risk factors (Appendix Table D2). This is due to a high proportion of leading causes of fatal burden, such as cancer and cardiovascular disease, being attributable to these risk factors (Table 6.2).

Which risk factors contribute the most burden?

The individual contribution of each risk factor was calculated as the number of attributable DALY for each relevant disease. Table 6.1 shows the proportion of the total burden of disease in Australia in 2015 attributed to each risk factor, as well as the contribution from each component of the risk factor (such as the burden from second-hand smoke as part of tobacco use).

The risk factors contributing the most disease burden were tobacco use (9.3%), overweight & obesity (8.4%), dietary risks (7.3%), high blood pressure (5.8%) and high blood plasma glucose (including diabetes) (4.7%). Among the dietary risk factors, a diet low in whole grains & high fibre cereals contributed the most to disease burden (1.6%).

The contribution of risk factors to deaths, fatal and non-fatal burden was also calculated as part of this study. The risk factors that contributed the most to deaths and fatal burden were tobacco use (13% of deaths, 14% of fatal burden), dietary risks (13% of deaths, 11% of fatal burden) and high blood pressure (12% of deaths, 9.1% of fatal burden) (Appendix Table D2). The risk factors that contributed the most to non-fatal burden were overweight & obesity (7.7%), tobacco use (5.0%) and high blood plasma glucose (4.0%). Note that these estimates are calculated independently and it is not appropriate to sum them due to the complex interactions between risk factors and disease development (Box 6.2).

Table 6.1: Proportion (%) of total burden attributable to each risk factor, 2015

Risk factor	%	Risk factor	%
Behavioural		*Diet low in polyunsaturated fat*	*0.6*
Tobacco use	9.3	*Diet high in red meat*	*0.3*
Tobacco use	*9.2*	*Diet low in milk*	*0.2*
Second-hand smoke	*0.1*	*Diet high in sugar-sweetened beverages*	*0.2*
Illicit drug use	2.7	*Diet low in fish & seafood*	*0.1*
Opioid use	*1.0*	**Environmental**	
Amphetamine use	*0.6*	Occupational exposures & hazards	2.0
Cocaine use	*0.3*	High sun exposure	0.8
Cannabis use	*0.2*	Air pollution	0.8
Other illicit drug use	*0.1*	**Metabolic**	
Unsafe injecting practices	*0.5*	Overweight & obesity	8.4
Alcohol use	4.5	*Overweight*	*3.7*
Physical inactivity	2.5	*Obesity*	*4.7*
Intimate partner violence	0.7	High blood pressure	5.8
Unsafe sex	0.3	High blood plasma glucose	4.7
Child abuse & neglect	2.2	*Intermediate hyperglycaemia*	*0.5*
Dietary risks	7.3	*Diabetes*	*4.2*
Diet low in whole grains & high fibre cereal	*1.6*	High cholesterol	3.0
Diet low in fruit	*1.4*	Impaired kidney function	2.1
Diet low in nuts & seeds	*1.3*	*Chronic kidney disease stage 1–3*	*0.9*
Diet high in processed meat	*1.2*	*Chronic kidney disease stage 4–5*	*1.1*
Diet high in sodium	*1.2*	Iron deficiency	0.4
Diet low in vegetables	*1.2*	Low bone mineral density	0.4
Diet low in legumes	*0.8*		
		Joint effect	**37.5**

Notes

1. The percentages for individual dietary risk factors do not add up to the overall dietary risk percentage as they were analysed independently.
2. The percentages for the individual risk factors in the table do not add up to the joint effect as the risk factors were analysed independently.

Linked diseases span a range of disease groups

The proportion of burden attributable to each risk factor within each disease group is presented in Table 6.2. Blank cells indicate that the risk factor was not linked to any diseases or injuries in the disease group in this study. When interpreting this table, note that the number of DALY for each disease group differs, so the percentages need to be considered with the size of the disease group. Also note that the numbers in the table cannot be added together, as the risk factors were analysed independently (Box 6.2).

The burden estimated for each linked disease also influences the amount of burden due to each risk factor in 2015. For example, risk factors linked to cardiovascular diseases have a high attributable burden, partly because there is high burden from these diseases in Australia. This contrasts with hepatitis C, which is around 80% attributable to illicit drug use but only contributes a small amount of burden.

Some risk factors had linked diseases across a large number of disease groups. Tobacco use contributed to the burden for 9 disease groups, including 41% of respiratory diseases, 22% of cancer, 12% of cardiovascular diseases, 6.8% of infections and 3.7% of endocrine disorders. Overweight & obesity also contributed to a range of disease groups, including 45% of the burden for endocrine disorders, 36% for kidney & urinary diseases, 19% for cardiovascular diseases and 7.8% for cancer (Table 6.2).

All the risk factors combined (the joint effect) contributed greatly to the burden for endocrine disorders (98%), kidney & urinary diseases (89%), cardiovascular diseases (65%), cancer (44%) and injuries (43%) (Table 6.2).

Box 6.2: Why risk factor estimates cannot be added together

For the majority of the analysis in this chapter, the risk factors are analysed independently. It is important to note that it is not possible to add or combine the separate estimates for different risk factors without further analysis, due to complex pathways and interactions between them. For example, if the burden of diabetes attributable to a diet high in sweetened beverages and to overweight & obesity was added, the amount of diabetes attributable would be an overestimate. This is because these risk factors can be found along the same causal pathway—for example, where high intake of sweetened beverages increases the risk of being overweight or obese, which, in turn, increases the risk of diabetes.

Further analysis is needed to combine risk factors. In this report, this has been done for all the included risk factors to produce an estimate for 'all risk factors combined'. This is referred to as the 'joint effect' of all risk factors in this study.

Table 6.2: Proportion (%) of total burden attributable to selected risk factors for each disease group, 2015

Risk factor	Cancer	Cardiovascular	Musculoskeletal	Mental	Injuries	Respiratory	Neurological	Gastrointestinal	Endocrine	Infections	Kidney
DALY (number)	**868,200**	**646,400**	**611,300**	**572,800**	**406,000**	**357,600**	**346,100**	**159,600**	**124,200**	**97,200**	**64,300**
Attributable burden (%)											
Tobacco use	22.1	11.5	2.1			41.0	1.5	0.4	3.7	6.8	
Overweight & obesity	7.8	19.3	10.9			8.0	9.0	1.4	44.6		35.6
Alcohol use	4.5	3.6		12.0	14.1		1.6	10.5		2.9	
High sun exposure	4.3										
Dietary risks	4.2	40.2	0.2			0.3	0.2	<0.1	34.2		7.7
Physical inactivity	2.9	8.0					7.0		15.9		
High blood plasma glucose	2.9	4.9					2.9		98.0		53.7
Occupational exposures & hazards	2.6		5.3		4.2	4.8					
Illicit drug use	1.0			7.3	15.5			8.9		0.7	
Unsafe sex	0.9							0.7		3.6	
Air pollution	0.2	4.6				1.6				0.8	
Intimate partner violence				4.3	2.2						
Child abuse & neglect				11.8	8.6						
High blood pressure		38.0					1.8				34.1
High cholesterol		21.8									
Impaired kidney function		3.9	0.1				4.4				88.4
Low bone mineral density					4.2						
Joint effect	**43.5**	**65.2**	**17.7**	**33.4**	**42.5**	**51.4**	**23.6**	**19.1**	**98.0**	**13.7**	**89.2**

Notes

1. Attributable burden is expressed as a percentage of total burden (DALY) for that disease group. Disease groups are ordered by number of total burden.
2. The percentages in the table cannot be added together by row or column and do not add up to the joint effect row as the risk factors were analysed independently.
3. Blank cells indicate that the risk factor has no associated diseases or injuries in the disease group.

How do risk factors change through the life course?

The health impacts due to risk factors varied by age and sex. Risk factors ranked by their contribution to total burden (DALY) in each age group are shown for males (Figure 6.1) and females (Figure 6.2). The number of attributable DALY and the proportion of attributable burden to the overall DALY by risk factor, age and sex are also shown. Rankings according to contribution to non-fatal and fatal burden for males and females are presented in Appendix D (figures D8, D9, D10, D11).

Exposure to risk factors in the past can influence the proportion of burden attributable in the reference year of the study or for a particular age group. This is because evidence of past exposure can be linked to current burden—for example, to take into account the lag time from exposure through to outcomes such as cancer. The risk factors where past exposure or any exposure during the life course contributes to the calculation of attributable burden are tobacco use, child abuse & neglect, intimate partner violence, high sun exposure, occupational exposures & hazards, alcohol use, illicit drug use and unsafe sex.

Overall, child abuse & neglect was the leading contributor to burden for ages under 15, alcohol use for ages 15–44, tobacco use for ages 45–84 and high blood pressure for ages over 85. Men experienced a higher amount of attributable burden due to the 3 highest ranking risk factors from ages 45–84. From age 85, women experienced a higher attributable burden.

Children and young people aged under 15

In children and young people aged under 15, child abuse & neglect was the leading risk factor of the total burden in both males (0.9%) and females (1.8%). In this age group, males and females experienced similar amounts of burden from overweight & obesity; however, females experienced nearly 54% more burden from child abuse & neglect than males. Note that many other risk factors were not measured in this age group due to low disease burden of linked diseases at this age.

Young people aged 15–24

Males

Alcohol use was the leading risk factor contributing to disease burden in males in this age group (13%). Illicit drug use (8.1%) and child abuse & neglect (5.1%) were also leading causes. Males experienced nearly 3 times the burden from alcohol use and from illicit drug use than females.

Females

Child abuse & neglect was the leading risk factor contributing to disease burden in females in this age group (8.0%), followed by alcohol (5.8%) and illicit drug use (3.4%). Intimate partner violence (2.3%) and occupational exposures & hazards (1.9%) were also in the 5 leading risk factors.

Adults aged 25–44

Men

The leading risk factor contributing to disease burden for men in this age group was alcohol use (12%). Illicit drug use (10%), child abuse & neglect (4.7%), occupational exposures & hazards (4.3%) and diet (4.0%) were also among the leading 5 causes of disease burden. Alcohol use contributed a much higher proportion of the burden in men than in women. Tobacco and metabolic risk factors (overweight & obesity, high blood pressure, high cholesterol and high blood plasma glucose) made up the 10 leading risk factors causing burden in men in this age group.

Women

Child abuse & neglect (6.5%) was the leading risk factor for women aged 25–44. Various behavioural risk factors were included in the leading 10 causes of burden in women in this age group—illicit drug use ranked second (4.4%), followed by intimate partner violence (4.1%) and alcohol use (3.4%). Overweight & obesity (3.3%) ranked fifth. Iron-deficiency was ranked 10th in women (1.5%).

Adults aged 45–64

For people aged 45–64, tobacco use, overweight & obesity and diet were the leading 3 risk factors contributing to disease burden in both men and women. This age group experienced increased burden from metabolic and dietary risk factors, especially high blood pressure; however, the amount differed by sex.

Men

In men, high blood pressure (7.0%) and alcohol use (6.1%) were among the 5 leading risk factors. High cholesterol accounted for 5.9% of the burden for men in this age group, and illicit drug use remained within the leading 10 causes (3.5%).

Women

Similar risk factors to those for men made up the leading 3 causes for women; however, the fourth and fifth ranking differed between sexes. High blood plasma glucose levels and alcohol use ranked fourth (4.3%) and fifth (3.4%), respectively, for women. The remaining risk factors within the leading 10 for women were similar to those for men, except for intimate partner violence instead of occupational exposures & hazards. Aside from child abuse & neglect and intimate partner violence, women in this age group experienced smaller proportions of burden from these risk factors than men.

Adults aged 65–84

Tobacco use, overweight & obesity and diet remained the leading 3 risk factors in adults aged 65–84, where men experienced higher proportions of burden attributable to these risk factors than women.

Men

High blood plasma glucose replaced alcohol use in the leading 5 causes of burden in men aged 65–84. Men experienced a higher proportion of burden from dietary risk factors than women.

Women

High blood pressure rose in rank and became one of the leading 5 causes in women aged 65–84 (5.7% aged 65–74; 9.1% aged 75–84). Low bone mineral density entered the list of the leading 10 risk factors for women in this age group while child abuse & neglect and intimate partner violence fell out of it.

Older Australians aged 85+

In older Australians, high blood pressure was the leading cause of disease burden in men and women. The contribution of high cholesterol to burden increased slightly in men with older age, from 5.3% in age group 85–94 to 6.2% in age group 95+; and in women, from 4.8% to 5.8%. The contribution of tobacco decreased from age group 85–94 to age group 95+ for both men and women.

Figure 6.1: Leading risk factor contribution to total burden (DALY '000; proportion %), for males, by age group, 2015

Rank	Age group (years)							
	0–14	15–24	25–44	45–64	65–74	75–84	85–94	95+
1st	Child abuse/neglect (1.3; 0.9%)	Alcohol (20.2; 13.1%)	Alcohol (55.0; 11.9%)	Tobacco (92.6; 12.7%)	Tobacco (75.8; 16.3%)	Tobacco (52.7; 14.0%)	Blood pressure (21.9; 11.9%)	Blood pressure (1.7; 14.0%)
2nd	Overweight/obesity (1.0; 0.7%)	Illicit drug use (12.5; 8.1%)	Illicit drug use (46.8; 10.1%)	Overweight/obesity (88.2; 12.1%)	Overweight/obesity (58.9; 12.6%)	Diet (40.6; 10.8%)	Diet (21.2; 11.6%)	Diet (1.5; 12.8%)
3rd	Blood glucose (0.5; 0.4%)	Child abuse/neglect (7.9; 5.1%)	Child abuse/neglect (21.6; 4.7%)	Diet (84.1; 11.5%)	Diet (54.5; 11.7%)	Overweight/obesity (38.2; 10.1%)	Tobacco (19.9; 10.8%)	Tobacco (0.9; 7.5%)
4th		Occupational (6.4; 4.1%)	Occupational (19.9; 4.3%)	Blood pressure (51.1; 7.0%)	Blood pressure (41.6; 8.9%)	Blood pressure (38.1; 10.1%)	Overweight/obesity (13.1; 7.1%)	Kidney function (0.8; 6.4%)
5th		Overweight/obesity (1.1; 0.7%)	Diet (18.5; 4.0%)	Alcohol (44.3; 6.1%)	Blood glucose (35.1; 7.5%)	Blood glucose (26.8; 7.1%)	Blood glucose (11.6; 6.3%)	Cholesterol (0.7; 6.2%)
6th		Blood glucose (1.1; 0.7%)	Overweight/obesity (18.0; 3.9%)	Cholesterol (42.9; 5.9%)	Cholesterol (16.5; 3.5%)	Kidney function (15.6; 4.1%)	Cholesterol (9.8; 5.3%)	Overweight/obesity (0.7; 6.0%)
7th			Tobacco (15.6; 3.4%)	Blood glucose (42.0; 5.8%)	Alcohol (15.9; 3.4%)	Cholesterol (14.8; 3.9%)	Kidney function (9.7; 5.3%)	Blood glucose (0.7; 5.7%)
8th			Blood pressure (10.0; 2.2%)	Occupational (27.8; 3.8%)	Physical inactivity (15.3; 3.3%)	Physical inactivity (14.7; 3.9%)	Physical inactivity (7.9; 4.3%)	Physical inactivity (0.5; 4.4%)
9th			Cholesterol (9.5; 2.1%)	Illicit drug use (25.3; 3.5%)	Kidney function (11.4; 2.5%)	Alcohol (10.2; 2.7%)	Alcohol (4.5; 2.5%)	Alcohol (0.3; 2.8%)
10th			Blood glucose (8.4; 1.8%)	Physical inactivity (19.1; 2.6%)	Occupational (10.0; 2.1%)	Occupational (5.7; 1.5%)	Bone density (3.5; 1.9%)	Bone density (0.3; 2.3%)

Figure 6.2: Leading risk factor contribution to total burden (DALY '000; proportion %), for females, by age group, 2015

Rank	Age group (years)							
	0–14	15–24	25–44	45–64	65–74	75–84	85–94	95+
1st	Child abuse/neglect (2.0; 1.8%)	Child abuse/neglect (10.3; 8.0%)	Child abuse/neglect (24.9; 6.5%)	Overweight/obesity (63.8; 10.6%)	Tobacco (48.5; 13.6%)	Tobacco (40.9; 11.8%)	Blood pressure (33.3; 12.5%)	Blood pressure (4.8; 14.7%)
2nd	Iron deficiency (0.9; 0.8%)	Alcohol (7.4; 5.8%)	Illicit drug use (16.9; 4.4%)	Tobacco (62.8; 10.4%)	Overweight/obesity (43.2; 12.1%)	Overweight/obesity (34.8; 10.0%)	Diet (26.5; 10.0%)	Diet (3.8; 11.6%)
3rd	Overweight/obesity (0.8; 0.7%)	Illicit drug use (4.3; 3.4%)	Partner violence (15.9; 4.1%)	Diet (33.8; 5.6%)	Diet (26.0; 7.3%)	Blood pressure (31.6; 9.1%)	Overweight/obesity (21.1; 8.0%)	Kidney function (2.3; 7.1%)
4th	Blood glucose (0.7; 0.6%)	Partner violence (2.9; 2.3%)	Alcohol (13.2; 3.4%)	Blood glucose (25.8; 4.3%)	Blood glucose (21.7; 6.1%)	Diet (28.1; 8.1%)	Tobacco (20.8; 7.8%)	Overweight/obesity (2.2; 6.8%)
5th		Occupational (2.5; 1.9%)	Overweight/obesity (12.8; 3.3%)	Alcohol (20.4; 3.4%)	Blood pressure (20.4; 5.7%)	Blood glucose (22.7; 6.5%)	Kidney function (17.3; 6.5%)	Cholesterol (1.9; 5.8%)
6th		Iron deficiency (2.1; 1.6%)	Tobacco (10.9; 2.8%)	Child abuse/neglect (18.0; 3.0%)	Physical inactivity (11.4; 3.2%)	Kidney function (15.5; 4.4%)	Blood glucose (16.0; 6.0%)	Blood glucose (1.8; 5.4%)
7th		Overweight/obesity (1.4; 1.1%)	Occupational (8.5; 2.2%)	Blood pressure (17.1; 2.8%)	Alcohol (7.6; 2.1%)	Physical inactivity (15.3; 4.4%)	Physical inactivity (14.3; 5.4%)	Physical inactivity (1.8; 5.4%)
8th		Blood glucose (1.1; 0.9%)	Diet (7.9; 2.0%)	Partner violence (13.9; 2.3%)	Cholesterol (6.7; 1.9%)	Cholesterol (10.1; 2.9%)	Cholesterol (12.7; 4.8%)	Tobacco (1.7; 5.2%)
9th			Blood glucose (6.8; 1.8%)	Physical inactivity (13.8; 2.3%)	Kidney function (6.5; 1.8%)	Alcohol (7.8; 2.2%)	Bone density (8.0; 3.0%)	Bone density (1.1; 3.4%)
10th			Iron deficiency (5.6; 1.5%)	Cholesterol (12.8; 2.1%)	Bone density (3.6; 1.0%)	Bone density (6.4; 1.8%)	Alcohol (5.7; 2.1%)	Alcohol (0.8; 2.4%)

7 Changes over time

Key results

- Between 2003 and 2015, the total burden of disease rose 14% (from 4.2 million to 4.8 million DALY). Non-fatal and fatal burden increased 24% (from 1.9 to 2.4 million YLD) and 6.3% (from 2.2 to 2.4 million YLL), respectively.
- When the impact of increasing age and size of the population was considered, the rate of burden fell 11% during this period, from 208 to 184 DALY per 1,000 population. Non-fatal burden decreased 2.0% from 97 to 95 YLD per 1,000 population and fatal burden decreased 20% from 111 to 89 YLL per 1,000 population.
- Before 2015, dying prematurely caused more burden than the burden caused by living with illness in Australia. There was a shift toward more non-fatal burden between 2003 and 2015.
- ASRs of total burden for most disease groups decreased or stayed the same between 2003 and 2015, although there was a notable increase for neurological conditions.
- There was a large fall in the rate of fatal burden for cardiovascular diseases, but rates rose for neurological conditions and kidney & urinary diseases.
- Between 2003 and 2015, there was a small overall decrease in the proportion of burden attributable to the risk factors measured at both time points (from 37% in 2003 to 36% in 2015). This reflects reductions in exposure to the risk factor, or reductions in burden from the linked diseases and injuries, or both.
- There was a substantial drop in total DALY attributable to high cholesterol (down 32%), high blood pressure (down 19%), dietary risks (down 11%) and unsafe sex (down 5.8%) between 2003 and 2015.
- The ASRs decreased for high cholesterol by 49%, for high blood pressure by 41%, for dietary risks by 34% and for tobacco use by 24%.
- There were also increases in total attributable DALY for some risk factors, including illicit drug use (up 43%) and overweight & obesity (up 27%). The ASR increased for illicit drug use by 18% and remained steady for overweight & obesity.

This chapter compares the disease burden at 2 points in time: 2003 and 2015. As noted earlier, comparisons can be made within a study only where the same methods have been used to produce the non-fatal, fatal and total burden, and the burden attributed to risk factors.

To ensure comparability, estimates for the years 2003 and 2011 were calculated using the ABDS 2015 methods. Data for all reference years are available on the AIHW website.

> The estimates for 2003 in this report cannot be compared with those for 2003 from previous Australian studies—including the ABDS 2011 (AIHW 2016b; Begg et al. 2007)—as they are developed using different methods. See Appendix A for further information on the methods used to develop the estimates presented here.

How should changes between time points be interpreted?

When comparing estimates for the same disease between time points, it is important to note that:

- YLD and YLL may change by differing proportions, depending on prevalence and risk factor exposure, thus making different contributions to the change in DALY
- individual diseases within disease groups may have different trends: countering results for specific diseases may mask changes at the disease group level
- unless adjusted for, the impact of population changes (for example, ageing and an increase in population size) may mask changes in underlying disease prevalence and/or severity.

Where possible, adjustments were made for definitional changes between time points.

To help interpret the change in disease burden, this section presents changes in DALY, YLD, YLL and attributable burden in multiple ways:

- **Numbers:** show the total *impact* of the disease burden on the population at each time point. Changes are expressed as the absolute change for 2015 compared with 2003 and the relative change expressed as a *percentage*. A negative absolute or relative change indicates a decline between 2003 and 2015 and a positive value indicates an increase.
- **ASRs:** account for changes in population composition over time, such as increasing size and ageing. *Rate ratios* show how many times the rate of burden is in 2015 relative to that in 2003—values greater than 1 indicate an increase in underlying burden (once changes to the population are taken into account), while values less than 1 indicate a decrease in underlying burden. Values close to 1 indicate that there has been minimal change. *Rate differences* show the absolute difference between the ASR of burden from 2003 to 2015. The differences between ASRs are also expressed as a *percentage*.
- **Changes in ranking:** disease rankings are used in burden of disease reporting to describe which diseases contribute the most burden. While they are used in some places in this section, the AIHW cautions against placing too great an emphasis on changes in rankings as the story can be misleading. Rankings do not provide the reader with context of the size of each estimate, nor of the magnitude of difference between estimates that are adjacent in rank.

How has total burden changed over time?

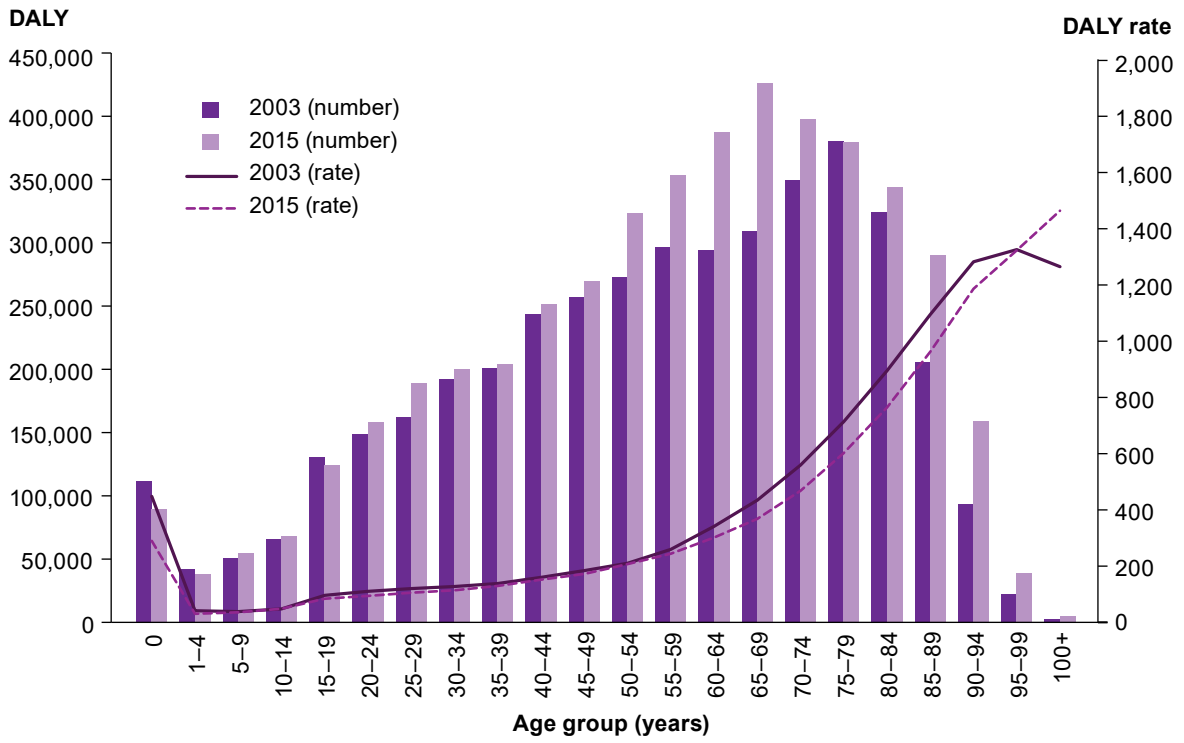
Total burden has increased over time, but rates have decreased

Total DALY increased by 14% between 2003 and 2015, from 4.2 million to 4.8 million DALY, reflecting rises in the size of the population in the main (the Australian population increased by 21% between 2003 and 2015).

Age-specific DALY *rates* were lower in 2015 than in 2003 for every age group, except for age 95 and over; however, there was little change in total burden between 2003 and 2015 for ages 1 to 49 (Figure 7.1). The increase in the *number* of DALY experienced in most of those aged 50–94 is due to the increase in population for this age group. Information on the Australian population by age group for each of the reference years is provided in Appendix D (Figure D12 and Table D3).

After taking account of the impact of the increasing age of the population (by using age-standardisation), there was a more pronounced decrease by 24 DALY per 1,000 population (11%) in overall burden, from 208 to 184 (Table 7.1).

Figure 7.1: Number and rates of total burden (DALY per 1,000 population), by age, 2003 and 2015



What are the drivers of changes observed between 2003 and 2015?

Changes in non-fatal burden and fatal burden

The contributions of fatal burden (YLL) and non-fatal burden (YLD) were closer to one another in 2015 than in 2003 (the YLL to YLD ratio was 53.4:46.6 in 2003 compared with 49.6:50.4 in 2015). This shows that there has been a shift toward a greater contribution of non-fatal burden to overall burden in 2015.

The higher DALY that occurred in those aged 60–69 (in 2015 compared with 2003) was driven primarily by an increase in YLD in these age groups, along with minor increases in YLL. The increase in DALY for those aged 80 and over was driven by increases in both YLD and YLL (figures 7.4 and 7.6). The changes in YLD and YLL are described in more detail in the following sections.

Disease-specific drivers of change

For most disease groups, rates for 2015 were similar to, or slightly lower than, those for 2003. The exceptions were cardiovascular disease and infant & congenital, which had much lower rates. This trend, together with an overall lower rate in 2015 than in 2003 (a rate ratio of 0.9), indicates that there has generally been an improvement in underlying disease epidemiology (Table 7.1).

The most notable increase in age-standardised burden rates was in neurological conditions (18%; an increase of 1.9 DALY per 1,000 population). While the rate for kidney & urinary diseases rose by 21%, the rate difference was small (0.4). The most notable decreases were for cardiovascular diseases and infant & congenital conditions (36% and 30%, respectively). Disease-specific changes are described more fully in the following sections.

Table 7.1: Change in total burden (DALY) between 2003 and 2015, by disease group

Disease group	2003 DALY (number)	2015 DALY (number)	Change in DALY (number)	Change in DALY (%)	2003 DALY ASR	2015 DALY ASR	Change in ASR	ASR rate ratio 2015:2003
Cancer	772,986	868,153	95,167	12.3	38.4	32.4	–6.0	0.8
Cardiovascular	738,982	646,384	–92,597	–12.5	36.5	23.4	–13.1	0.6
Musculoskeletal	531,161	611,288	80,127	15.1	26.6	23.9	–2.7	0.9
Mental	472,655	572,775	100,120	21.2	24.0	24.5	0.5	1.0
Injuries	356,938	405,961	49,023	13.7	18.1	16.9	–1.2	0.9
Respiratory	285,051	357,636	72,586	25.5	14.3	13.8	–0.4	1.0
Neurological	215,765	346,124	130,359	60.4	10.7	12.6	1.9	1.2
Gastrointestinal	128,160	159,608	31,448	24.5	6.4	6.2	–0.2	1.0
Endocrine	96,224	124,151	27,927	29.0	4.8	4.7	–0.1	1.0
Oral	84,782	107,307	22,525	26.6	4.3	4.2	–0.0	1.0
Infant/congenital	121,730	103,844	–17,886	–14.7	6.3	4.4	–1.9	0.7
Hearing/vision	74,648	98,719	24,071	32.2	3.7	3.6	–0.1	1.0
Infections	92,720	97,161	4,441	4.8	4.6	3.7	–0.9	0.8
Skin	65,867	81,842	15,975	24.3	3.3	3.4	0.1	1.0
Kidney/urinary	38,600	64,282	25,682	66.5	1.9	2.3	0.4	1.2
Blood/metabolic	44,073	60,346	16,272	36.9	2.2	2.4	0.2	1.1
Reproductive/maternal	36,508	46,834	10,326	28.3	1.8	1.9	0.1	1.0
Total	**4,156,850**	**4,752,415**	**595,565**	**14.3**	**208.0**	**184.3**	**–23.7**	**0.9**

Notes

1. Rates were age-standardised to the 2001 Australian Standard Population and expressed per 1,000 population.
2. Change in DALY is 2015 DALY minus 2003 DALY, expressed as a percentage of 2003 DALY.
3. Change in ASR is 2015 ASR minus 2003 ASR.
4. Rate ratios divide 2015 ASRs by corresponding 2003 ASRs.

Changes in burden of specific diseases over time

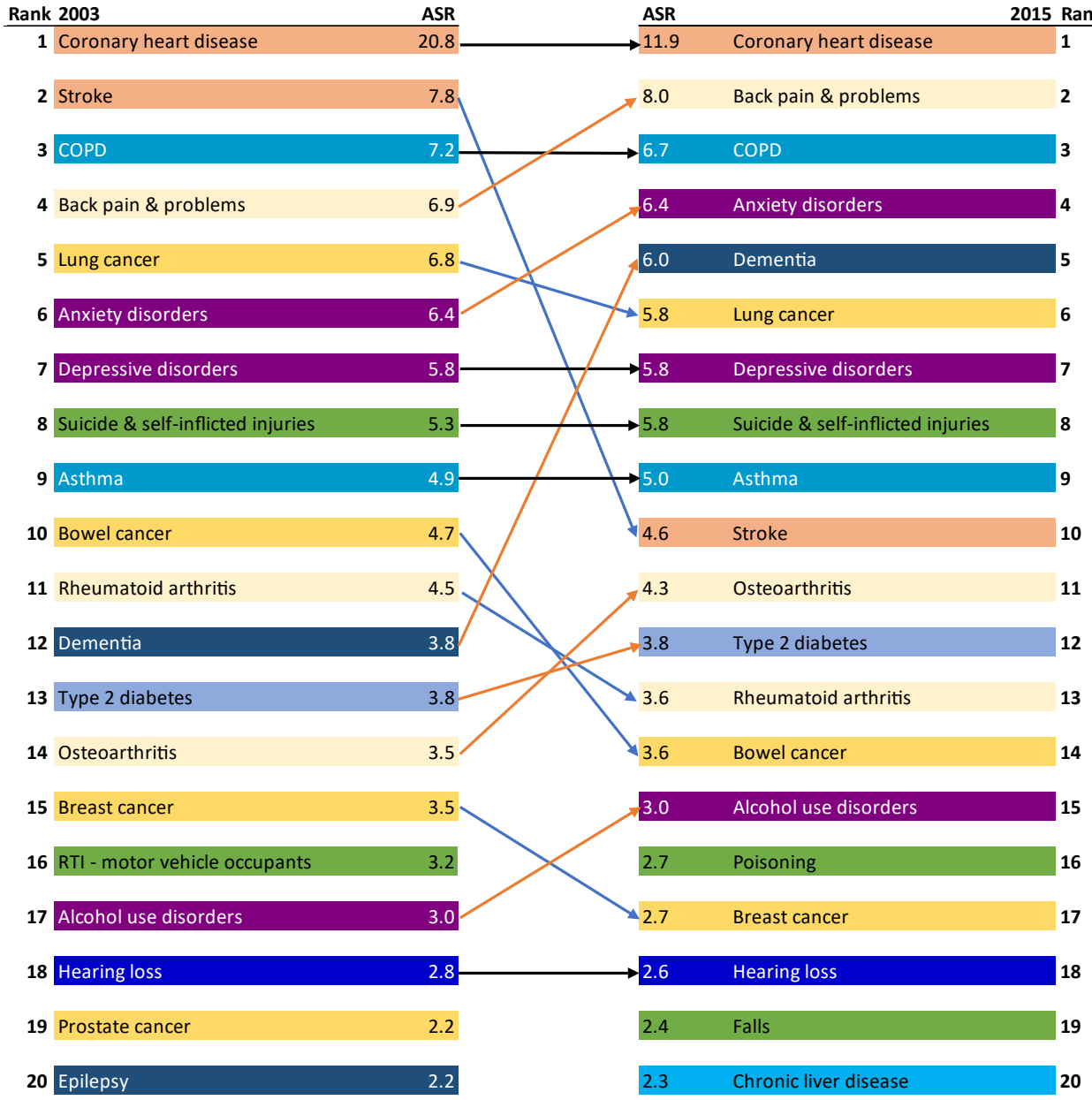
The leading causes of total burden (based on rates) in 2003 and 2015 remained largely the same (Figure 7.2). Although coronary heart disease remained the most burdensome disease in Australia in 2015, the total burden rate fell by 43% between 2003 and 2015 (from 21 DALY per 1,000 population to 12).

Total burden rates also decreased for stroke, lung cancer, bowel cancer, breast cancer and rheumatoid arthritis, resulting in a drop in the rankings for each disease. While total burden also reduced for hearing loss, its ranking remained the same between 2003 and 2015.

Australians suffered increased rates of disease burden from back pain & problems, suicide, dementia and osteoarthritis. In particular, burden from dementia rose by 57%, from 3.8 DALY per 1,000 population to 6.0. This may be due to an increase in the number of deaths coded to dementia since 2006, which was partly a result of changes to coding practices (see Box 7.2 for more information). This was associated with a rise in ranking from 12th in 2003 to fifth in 2015 for dementia.

Notably, motor vehicle accidents and prostate cancer caused high rates of burden in 2003, but were no longer ranked among the leading 20 diseases/injuries in 2015. Instead, poisoning and falls were more burdensome for the population in 2015, ranked 16th and 19th, respectively.

Figure 7.2: Rankings for the leading 20 causes of disease burden in Australia, by age-standardised DALY rate (per 1,000 population), persons, 2003 and 2015



RTI = road traffic injuries.

Notes

1. 'Other musculoskeletal conditions' are excluded from the rankings.
2. There were changes in practices of codig deaths due to dementia; therefore, caution is recommended when interpreting changes over time for dementia burden.

Cardiovascular diseases, neurological conditions and injuries: disease-specific changes

Disease burden from cardiovascular diseases has dramatically decreased since 2003

Cardiovascular diseases was the second largest disease group causing burden in Australia, accounting for 14% of the total burden in 2015. Since 2003, Australians suffered 36% lower rates of disease burden from cardiovascular diseases, from 37 years lost per 1,000 population to 23 years in 2015. This is equivalent to 92,600 less healthy years of life lost in 2015 than in 2003. This lower burden was a result of reductions in the rate of burden from both dying prematurely (38%; by 11 YLL per 1,000 population) and living with the impacts of cardiovascular disease (28%; 2 YLD per 1,000 population).

Most diseases in this group had lower rates of burden since 2003. Coronary heart disease and stroke, the major contributors to cardiovascular disease burden (51% and 20%, respectively), were also the main drivers in reducing this burden as their DALY rates decreased by over 40% from 2003 to 2015. Despite this reduction, coronary heart disease was still ranked as the disease with the highest burden for Australians, while the ranking for stroke changed from second to 10th.

Disease burden from neurological conditions has increased, mainly due to dementia

Neurological conditions accounted for 7.3% of total burden in 2015. Burden rates increased by 18% since 2003 (from 11 DALY per 1,000 population to 13 in 2015) reflecting 130,400 more DALY in 2015. The increase over time was higher among males than females (20% and 16%, respectively).

Dementia, the largest contributor to neurological disease burden (52%) was the main driver of this rise in burden. Dementia burden rates were 57% higher in 2015 than in 2003, largely driven by an 80% increase in the rate of fatal burden due to dementia. These changes over time led to a climb in rank for dementia from 12th position in 2003 to fifth in 2015. It is important to note that this rise may be partly due to changes in ICD (International Statistical Classification of Diseases and Related Health Problems) coding practices for dementia, implemented in 2006. See Box 7.2 for further information on this issue.

Disease burden from injuries decreased, especially for road traffic injuries

Overall, injuries accounted for 8.5% of the total disease burden in Australia. The rate of burden for injuries reduced by 6.6% since 2003, an effect seen across a wide range of injury types. Most importantly, burden from road traffic injuries involving motor vehicle occupants reduced by 45% (from 3.2 DALY per 1,000 population to 1.8). Injuries to motor vehicle occupants were ranked 16th in 2003 but were no longer among the leading 20 causes of disease burden in 2015.

However, the overall reduction in injury burden masked increases in burden from falls, poisoning and suicide, which were high-burden injuries for Australians in 2015. Together, they accounted for 65% of the injury burden and 5.6% of the total burden in Australia. Compared with the situation in 2003, Australians had a higher burden rate from falls (up by 25%), poisoning (46%) and suicide (9%) in 2015. Changes in burden increased rankings for falls and poisoning and maintained suicide as the eighth most burdensome disease/injury for Australians in 2015.

Are changes in burden due to population changes?

ASRs, rate ratios (which show how many times the rate of burden is at one time point relative to another) and rate differences (which show the difference in rate of burden from one time point to another) used earlier are helpful to tease out the changes in disease burden, as distinct from the changes in population size and structure.

To help distinguish the impact of population increase compared with population ageing—as well as impacts of epidemiological changes—this study estimated:

(a) a hypothetical DALY/YLD/YLL for 2015, reflecting just the population size increase (that is, with the same age–sex structure as for 2003 and with the same 2003 age–sex specific rates), and

(b) a hypothetical DALY/YLD/YLL for 2015, using the 2015 population size and age–sex structure, but with 2003 age–sex specific rates.

Looking at the differences between the actual and hypothetical scenarios provides a measure of the change due to:

- population increase only: measured as the difference between the 2003 estimate and scenario (a)
- population ageing: measured as the difference between the estimates in scenarios (a) and (b)
- epidemiological change: measured as the difference between the 2015 estimates and scenario (b).

Changes in total burden due to population and disease factors

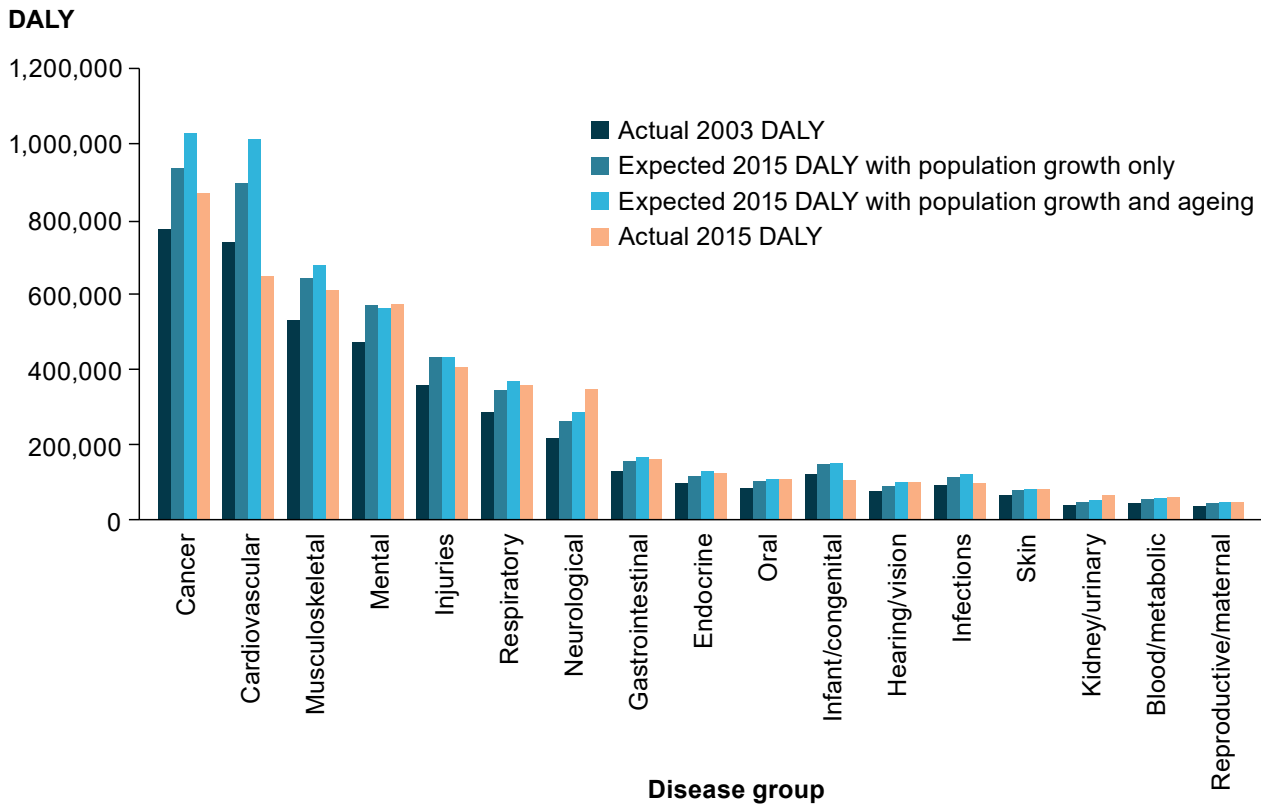
Figure 7.3 compares the actual estimates for 2015 for each disease group with those that would have been expected, based on population increase and ageing. The percentage differences are provided in Appendix Table D9.

Generally, the actual 2015 DALY for most disease groups was lower than would have been expected if the rates in 2003 had also applied in 2015. This indicates an improvement in the underlying disease burden of these groups. Proportionally large gains were evident in cardiovascular diseases, infant & congenital conditions, cancer and infections.

While overall burden for cancer, musculoskeletal conditions and injuries was higher in 2015 than in 2003, these increases were lower than would have been expected based on population changes.

Conversely, 2015 DALY were considerably higher than expected for neurological conditions and kidney & urinary diseases, and slightly higher for blood & metabolic disorders and reproductive & maternal conditions.

Figure 7.3: Expected and actual DALY, by disease group, 2003 and 2015



How have the non-fatal and fatal burden changed over time?

The following sections describe the contribution of changes in non-fatal (YLD) and fatal (YLL) burden between 2003 and 2015.

Changes in non-fatal burden

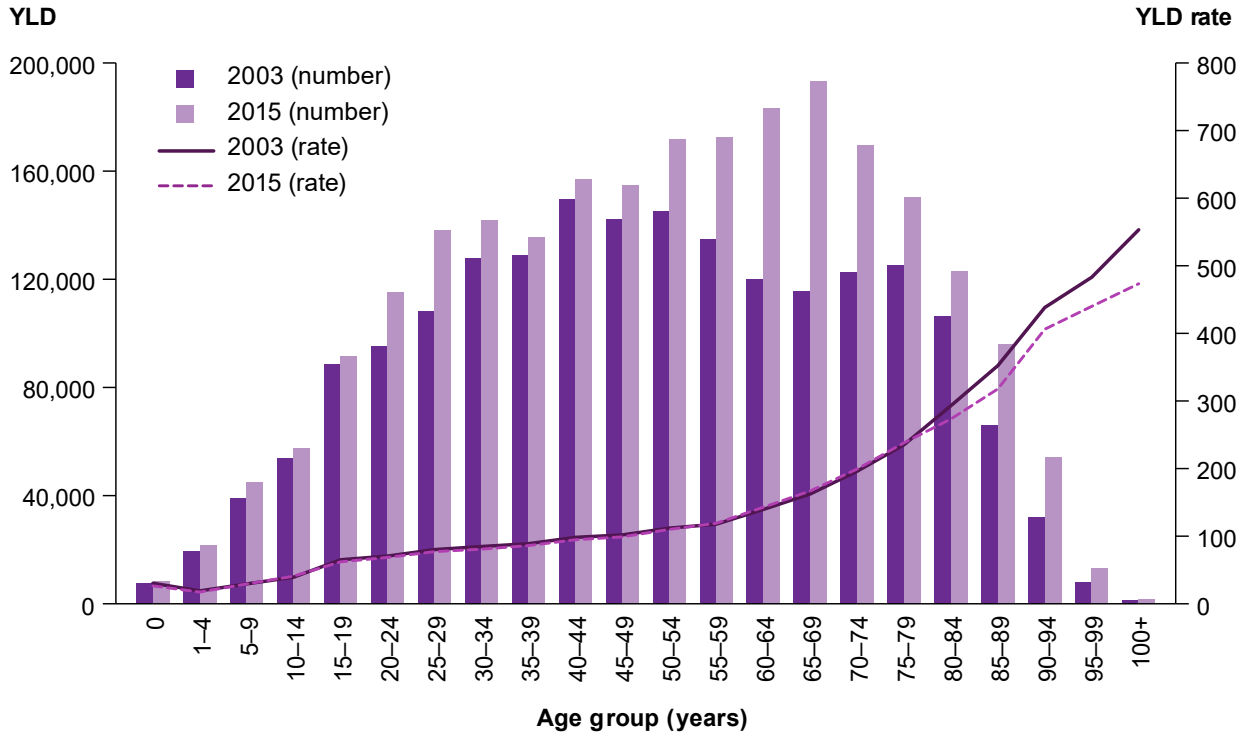
Changes in non-fatal burden (YLD) rates are influenced by changes in the prevalence and/or the severity of the disease.

Overall change in non-fatal burden

There was a 24% increase in the total YLD between 2003 and 2015, from 1.9 million to 2.4 million YLD. The rise in YLD occurred in almost all age groups but was largest in the older age groups. However, there was little difference in age-specific YLD *rates* for all age groups up to age 80 (Figure 7.4). Beyond age 80, the 2015 rate was slightly lower than that for 2003; factors contributing to this are explored further in this section.

After adjusting for ageing of the population, age-standardised YLD rates fell by 2.0% between 2003 and 2015, from 97 to 95 YLD per 1,000 population (rate ratio 0.98) (Table 7.2).

Figure 7.4: Number and rates of non-fatal burden (YLD per 1,000 population), by age, 2003 and 2015



Changes in non-fatal burden by disease group

All disease groups except cardiovascular diseases contributed to the overall rise in the number of YLD, but in differing amounts (Table 7.2). Comparing ASRs, most disease groups showed very little underlying change (as indicated by rate ratios around 1.0).

Increases in non-fatal burden rates were observed for endocrine disorders (30%) and blood & metabolic disorders (20%); however, the rate difference was small for these disease groups (0.7 and 0.2 YLD per 1,000 population, respectively). Rates were lower in 2015 for cardiovascular diseases (30%), and there was a minor decrease for musculoskeletal conditions (10%).

Table 7.2: Change in non-fatal burden (YLD) between 2003 and 2015, by disease group

Disease group	2003 YLD (number)	2015 YLD (number)	Change in YLD (number)	Change in YLD (%)	2003 YLD ASR	2015 YLD ASR	Change in ASR	ASR rate ratio 2015:2003
Musculoskeletal	516,760	594,566	77,806	15.1	25.8	23.3	–2.6	0.9
Mental	456,138	558,596	102,458	22.5	23.2	24.0	0.8	1.0
Respiratory	179,639	228,580	48,941	27.2	9.0	9.1	0.1	1.0
Neurological	124,819	177,933	53,115	42.6	6.2	6.6	0.4	1.1
Cardiovascular	139,982	138,876	–1,106	–0.8	6.9	5.1	–1.9	0.7
Oral	84,626	107,058	22,433	26.5	4.2	4.2	–0.0	1.0
Hearing/vision	74,648	98,719	24,071	32.2	3.7	3.6	–0.1	1.0
Endocrine	43,971	76,663	32,692	74.3	2.2	2.9	0.7	1.3
Skin	62,018	75,613	13,595	21.9	3.1	3.2	0.1	1.0
Injuries	54,435	71,742	17,307	31.8	2.7	2.9	0.1	1.0
Cancer	45,287	64,663	19,376	42.8	2.2	2.4	0.1	1.1
Gastrointestinal	47,386	59,222	11,836	25.0	2.4	2.4	–<0.1	1.0
Reproductive/maternal	35,625	46,025	10,400	29.2	1.8	1.9	0.1	1.0
Infections	26,282	34,189	7,907	30.1	1.3	1.4	0.1	1.1
Blood/metabolic	16,954	26,172	9,218	54.4	0.8	1.0	0.2	1.2
Infant/congenital	17,607	18,723	1,116	6.3	0.9	0.8	–0.1	0.9
Kidney/urinary	11,137	16,689	5,552	49.9	0.6	0.6	0.1	1.1
Total	**1,937,315**	**2,394,031**	**456,716**	**23.6**	**97.3**	**95.3**	**–2.0**	**1.0**

Notes

1. Rates were age-standardised to the 2001 Australian Standard Population and expressed per 1,000 population.
2. Change in YLD is 2015 YLD minus 2003 YLD, expressed as a percentage of 2003 YLD.
3. Change in ASR is 2015 ASR minus 2003 ASR.
4. Rate ratios divide 2015 ASRs by corresponding 2003 ASRs.

Disease-specific changes in non-fatal burden

There were some differences between 2003 and 2015 for many of the leading ranked causes of non-fatal burden (Table 7.3). Of particular note, YLD rates in 2015 were:

- higher for type 2 diabetes and autism spectrum disorders (40% each), dementia (30%), osteoarthritis, back pain & problems and falls (20% each), and drug use disorders (10%)—notably due to increases in amphetamine dependence
- lower for coronary heart disease (30%) and rheumatoid arthritis (20%), compared with 2003.

While it is not completely clear why the burden of autism is increasing, both higher levels of diagnosis and heightened awareness of the condition may have contributed to an increase in the reporting of autism-related disorders (AIHW 2017a).

It is important to note that for some diseases the absolute change in ASR between the reference years was small. There was little or no change in the non-fatal burden of the remaining leading 20 ranked diseases; however, prevalence data for these conditions in Australia are not readily available over time (see Box 7.1). Further information on the data quality for these diseases can be found in Appendix B.

Table 7.3: Change in leading causes of non-fatal burden (YLD) between 2003 and 2015

Disease	Rank 2003	Change in YLD (number)	Change in YLD (%)	ASR difference	ASR rate ratio 2015:2003	Rank 2015
Back pain & problems	1	58,754	43.1	1.1	1.2	1
Anxiety disorders	2	24,041	19.1	<0.1	1.0	2
Depressive disorders	3	21,904	19.3	<0.1	1.0	3
Osteoarthritis	8	44,373	63.2	0.8	1.2	4
Asthma	4	23,684	26.5	0.2	1.0	5
COPD	7	22,859	32.1	–<0.1	1.0	6
Rheumatoid arthritis	5	4,622	5.3	–0.8	0.8	7
Dementia	11	39,912	99.2	0.7	1.3	8
Hearing loss	9	15,645	28.2	–0.1	1.0	9
Coronary heart disease	6	–6,149	–8.4	–1.2	0.7	10
Type 2 diabetes	12	29,090	80.5	0.6	1.4	11
Alcohol use disorders	10	8,997	17.2	<0.1	1.0	12
Bipolar affective disorder	13	6,308	18.5	<0.1	1.0	13
Severe tooth loss	17	10,554	36.8	–<0.1	1.0	14
Dental caries	14	5,905	17.8	–<0.1	1.0	15
Drug use disorders (excluding alcohol)	19	9,930	36.2	0.2	1.1	16
Falls	21	13,281	56.8	0.2	1.2	17
Schizophrenia	16	5,685	19.8	–<0.1	1.0	18
Dermatitis & eczema	18	5,990	21.4	<0.1	1.0	19
Autism spectrum disorders	26	12,777	68.8	0.4	1.4	20

Notes

1. 'Other musculoskeletal conditions' excluded from rankings.
2. Rates were age-standardised to the 2001 Australian Standard Population and expressed per 1,000 population.
3. Change in YLD is 2015 YLD minus 2003 YLD, expressed as a percentage of 2003 YLD.
4. Change in ASR is 2015 ASR minus 2003 ASR.
5. Rate ratios divide 2015 ASRs by corresponding 2003 ASRs.
6. Ranked by number of YLD.

Box 7.1: Data gaps in non-fatal health loss over time

Unlike mortality data, there is no single reliable source of data on the incidence, prevalence, severity and duration of non-fatal health loss for all conditions. Instead, morbidity data were drawn from a wide variety of sources; however, the availability and quality of data over time varied by disease.

Conditions that require hospitalisation or where a high-quality national disease registry exists provide more reliable data on disease outcomes over time, compared with diseases where data were obtained from a one-off epidemiological study or health survey.

Prevalence or incidence of conditions with limited data over time were assumed to have remained unchanged; therefore, any change to YLD for these conditions reflects population growth and ageing only. Of the leading ranked YLD diseases, this included:

- mental health conditions—depressive disorders, anxiety disorders, schizophrenia and bi-polar affective disorders
- oral disorders—dental caries and severe tooth loss
- COPD
- hearing loss in older Australians
- dermatitis & eczema.

Therefore, these diseases will not show changes in rates over time. This highlights the need for more data on these conditions to determine if there are underlying changes in disease epidemiology in Australia.

Endocrine disorders and musculoskeletal conditions: disease-specific changes

Burden from living with type 2 and gestational diabetes increased

Endocrine disorders (comprising type 1, type 2 and other diabetes; and other endocrine disorders) accounted for over 3% of the non-fatal burden in Australia. Type 2 diabetes typically causes burden in Australians aged over 50 and is the biggest contributor to the endocrine disease group. In 2015, Australians suffered 36% higher non-fatal burden rates from type 2 diabetes than in 2003 (increasing from 1.8 YLD per 1,000 population to 2.4). However, the fatal burden rate for type 2 diabetes fell by 31% between 2003 and 2015 (from 2.0 YLL per 1,000 population to 1.4). This results in no change in the total burden rate for type 2 diabetes over time.

The burden rate also increased for gestational diabetes (a condition classified under maternal conditions) with women having almost 3 times the burden in 2015 than in 2003. This is a substantial increase in burden and shows the importance of monitoring the disease in Australia given that it can affect the immediate and longer term health of both mothers and children (Kampmann et al. 2015). Changes to gestational diabetes testing practices, diagnostic criteria and treatment practices may influence the number of women with gestational diabetes reported in a given year. Due to these factors, comparing the number of women with gestational diabetes over time should be done with caution.

The burden of living with back pain and osteoarthritis has increased

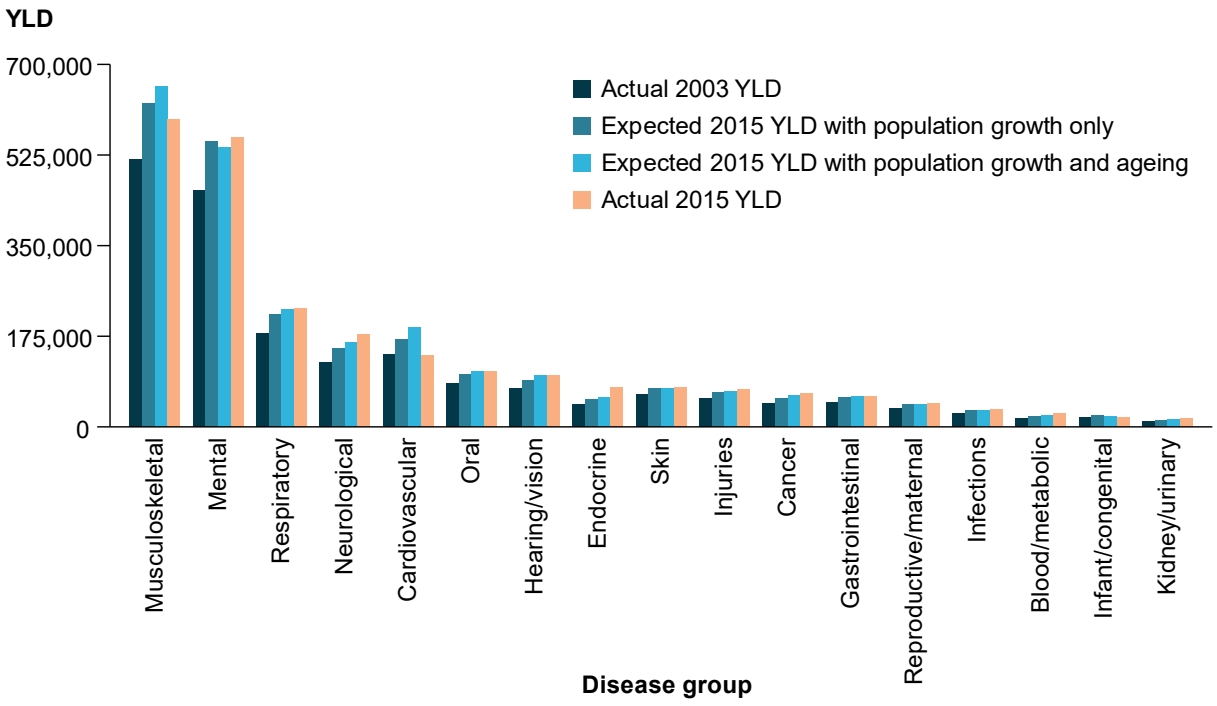
Musculoskeletal conditions was the largest contributor of non-fatal burden in Australia, causing around one-quarter of the total burden. Overall, the non-fatal burden rate from musculoskeletal conditions fell by 10% between 2003 and 2015 (from 26 YLD per 1,000 population to 23). Although overall non-fatal musculoskeletal burden rates reduced, some conditions in this group experienced increases. Australians suffered much more burden in 2015 than in 2003 from back pain & problems (15% rise) and osteoarthritis (22% rise), which together contributed to 51% of the total musculoskeletal burden. The increase in burden of osteoarthritis resulted in an increase in ranking from eighth to fourth, while back pain & problems remained as the leading cause of non-fatal burden in Australia in 2015. On the other hand, burden reduced for rheumatoid arthritis from 4.4 YLD per 1,000 population to 3.5 (19% decrease).

Changes in non-fatal burden due to population and disease factors

The slight reduction in ASRs between 2003 (97 YLD per 1,000 population) and 2015 (95 YLD per 1,000 population) shows that the 24% increase in YLD is predominantly due to demographic factors. Figure 7.5 compares the actual estimates for 2015 for each disease group with those that would have been expected based on population increase and ageing. The percentage differences are provided in Appendix Table D10.

While there has been some reduction of non-fatal burden due to underlying disease (in particular, in musculoskeletal conditions, cardiovascular diseases and infant & congenital conditions), increases in underlying disease for a number of disease groups, coupled with population growth and ageing, is increasing the overall YLD in the Australian population.

Figure 7.5: Expected and actual YLD, by disease group, 2003 and 2015



Non-fatal burden (YLD) for 2015 was higher than in 2003 in all disease groups except cardiovascular diseases. However, many were lower than would have been expected, given the population changes over this time period, including musculoskeletal conditions and infant & congenital conditions.

Conversely, there were larger than expected increases in non-fatal burden for neurological conditions, kidney & urinary diseases (mostly chronic kidney disease), endocrine disorders (mostly diabetes) and blood & metabolic disorders.

Changes in fatal burden

Changes in fatal burden (YLL) are influenced by both the number of deaths and the ages at which those deaths occur.

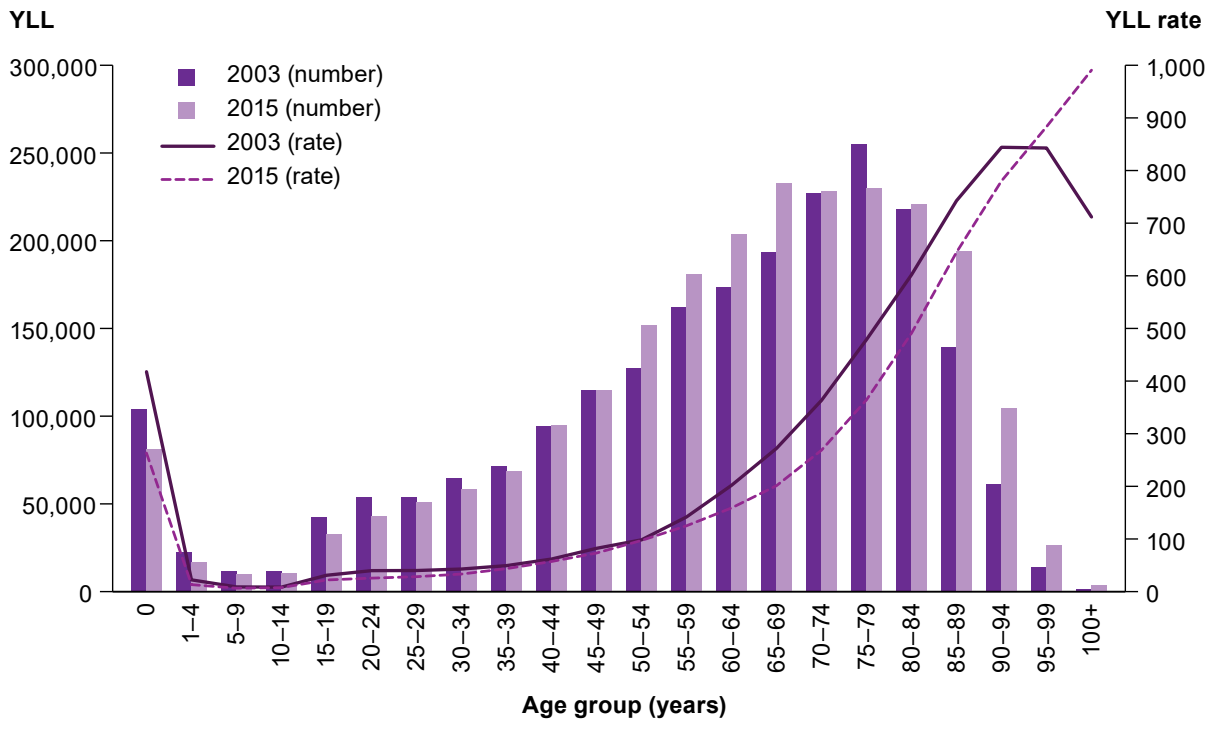
Overall change in fatal burden

The overall YLL was 6.3% higher in 2015 (2.4 million compared with 2.2 million in 2003). The higher number of YLL in 2015 can in part be attributed to the natural rise in the number of deaths associated with population increases.

In the age groups 0–39 and 75–79, there were more YLL in 2003 than in 2015 (Figure 7.6). The YLL rate was similar for both years up to age 55, beyond which it remains consistently lower in 2015 than in 2003 until age 95. This reflects a trend in rising age at death.

After adjusting for the ageing population, age-standardised YLL rates decreased by 20% between 2003 and 2015. The rate fell from 111 to 89 YLL per 1,000 population (rate ratio 0.8) (Table 7.4).

Figure 7.6: Number and rates of fatal burden (YLL per 1,000 population), by age, 2003 and 2015



Changes in YLL by disease group

Fatal burden rates (YLL per 1,000 population) were lower or the same in 2015 for all major causes of death except neurological conditions and kidney & urinary diseases, which both rose by 30% (Table 7.4). Lower fatal burden rates were observed in 2015 for cardiovascular diseases (40% decrease), infant & congenital conditions, infections, endocrine disorders and mental & substance use disorders (30% decrease each), compared with 2003.

Table 7.4: Change in fatal burden (YLL) between 2003 and 2015, by disease group

Disease group	2003 YLL (number)	2015 YLL (number)	Change in YLL (number)	Change in YLL (%)	2003 YLL ASR	2015 YLL ASR	Change in ASR	ASR rate ratio 2015:2003
Cancer	727,698	803,489	75,791	10.4	36.1	30.0	–6.1	0.8
Cardiovascular	599,000	507,509	–91,491	–15.3	29.6	18.4	–11.3	0.6
Injuries	302,504	334,219	31,716	10.5	15.4	14.0	–1.3	0.9
Neurological	90,946	168,190	77,244	84.9	4.5	6.0	1.5	1.3
Respiratory	105,412	129,056	23,644	22.4	5.2	4.7	–0.5	0.9
Gastrointestinal	80,774	100,386	19,611	24.3	4.0	3.8	–0.2	0.9
Infant/congenital	104,123	85,121	–19,002	–18.2	5.4	3.6	–1.8	0.7
Infections	66,438	62,972	–3,466	–5.2	3.3	2.3	–1.0	0.7
Kidney/urinary	27,463	47,593	20,130	73.3	1.4	1.7	0.4	1.3
Endocrine	52,253	47,488	–4,765	–9.1	2.6	1.8	–0.8	0.7
Blood/ metabolic	27,119	34,173	7,054	26.0	1.4	1.3	–<0.1	1.0
Musculoskeletal	14,401	16,722	2,321	16.1	0.7	0.6	–0.1	0.9
Mental	16,516	14,178	–2,338	–14.2	0.8	0.5	–0.3	0.7
Skin	3,849	6,229	2,380	61.8	0.2	0.2	<0.1	1.2
Reproductive/maternal	883	809	–74	–8.4	0.0	0.0	–<0.1	0.8
Oral	156	249	93	59.4	0.0	0.0	<0.1	1.1
Total	**2,219,535**	**2,358,384**	**138,849**	**6.3**	**110.7**	**89.0**	**–21.7**	**0.8**

Notes

1. Rates were age-standardised to the 2001 Australian Standard Population and expressed per 1,000 population.
2. Change in YLL is 2015 YLL minus 2003 YLL, expressed as a percentage of 2003 YLL.
3. Change in ASR is 2015 ASR minus 2003 ASR.
4. Rate ratios divide 2015 ASRs by corresponding 2003 ASRs.
5. Hearing & vision disorders are not included as this disease group did not incur any YLL.

Disease-specific changes in fatal burden

Table 7.5 shows the leading ranked causes of fatal burden in 2015 compared with 2003, including the absolute and relative change in the number of deaths for each cause. There were substantial changes between 2003 and 2015, contributing to the overall decrease in YLL. Changes of particular note are described as follows:

- Coronary heart disease, stroke, injuries to motor vehicle occupants and lower respiratory infections had fewer deaths and fewer YLL in 2015 than in 2003.
- Breast cancer had more deaths, but fewer YLL, in 2015 than in 2003—due to deaths, on average, occurring at older ages.
- Lung, prostate and brain cancers and COPD had more deaths and higher YLL but a slightly lower age-standardised YLL rate in 2015 than in 2003. These results reflect the impact of population ageing combined with delayed mortality from these causes.
- Dementia had substantially higher deaths and YLL in 2015 than in 2003, resulting in a substantial increase in fatal burden rate (an 80% increase from 1.9 YLL per 1,000 population to 3.4). This increase is most likely due to a large increase in deaths being coded to dementia as a result of changes in certification practices from 2006 onwards. The ABS has described this coding change (see Box 7.2). The difference in the age-standardised YLL rate between 2011 and 2015 was not as large, with only a 10% increase between these years.
- Poisoning showed a substantial increase in fatal burden rates (a 50% increase from 1.8 YLL per 1,000 population to 2.7). This large difference can in part be explained by changes in coding (see Box 7.2). Like dementia, the difference was not as large between 2011 and 2015 (10% increase).
- Liver cancer had substantially higher deaths and YLL in 2015, which resulted in an increase in fatal burden rate (a 40% increase from 0.9 YLL per 1,000 population to 1.3). This may be due to hepatitis B infection in older age groups (Kirby Institute 2016), which is one of the most common risk factors for liver cancer.

Table 7.5: Change in leading causes of fatal burden between 2003 and 2015

Disease	Rank 2003	Change in deaths (number)	Change in YLL (number)	Change in YLL (%)	ASR rate ratio 2015:2003	Rank 2015
Coronary heart disease	1	–5,088	–85,639	–24.6	0.6	1
Lung cancer	3	1,463	19,292	14.3	0.8	2
Suicide & self-inflicted injuries	4	866	31,186	30.3	1.1	3
Stroke	2	–1,425	–26,742	–19.6	0.6	4
Dementia	11	8,775	61,229	159.3	1.8	5
Bowel cancer	5	368	56	0.1	0.8	6
COPD	6	1,729	16,554	22.6	0.9	7
Poisoning	14	678	26,116	72.6	1.5	8
Breast cancer	7	215	–2,611	–4.1	0.7	9
Chronic liver disease	9	704	16,788	41.6	1.1	10
Pancreatic cancer	15	886	12,820	36.6	1.0	11
Chronic kidney disease	20	1,832	19,886	80.9	1.3	12
Prostate cancer	13	346	104	0.3	0.7	13
RTI - motor vehicle occupants	8	–361	–21,160	–36.0	0.5	14
Type 2 diabetes	10	90	–2,441	–6.1	0.7	15
Brain and CNS cancer	16	246	3,933	12.0	0.9	16
Liver cancer	25	905	16,591	88.6	1.4	17
Lower respiratory infections	12	–364	–5,022	–13.3	0.6	18
Falls	32	2,049	13,989	88.2	1.3	19
Melanoma of the skin	19	362	3,223	12.4	0.9	20

CNS = central nervous system; RTI = road traffic injuries.

Notes

1. 'Other cardiovascular diseases' and 'Other blood and metabolic disorders' excluded from the rankings.
2. Rates were age-standardised to the 2001 Australian Standard Population and expressed per 1,000 population.
3. Change in deaths is 2015 deaths minus 2003 deaths.
4. Change in YLL is 2015 YLL minus 2003 YLL, expressed as a percentage of 2003 YLL.
5. Rate ratios divide 2015 ASRs by corresponding 2003 ASRs.
6. Ranked by number of YLL.

Box 7.2: Death data coding changes impacting on trends

Dementia

There has been a substantial rise in the number of deaths coded to dementia since 2006. According to the ABS (ABS 2014), there are 2 issues that may be partly responsible for this increase:

- Updates to the ICD-10 coding instructions resulted in deaths that may have previously been coded as cerebrovascular diseases (which includes stroke) being coded as vascular dementia.
- Changes to the *Veterans' Entitlements Act 1986* and the *Military Rehabilitation and Compensation Act 2004*, and a subsequent promotional campaign aimed at health professionals, allowed for death from vascular dementia of veterans or members of the Defence forces to be related to relevant service.

YLL estimates are based on the cause of death data, which are coded by the ABS without any adjustment for this variation. Hence, no adjustments have been made in the ABDS.

These changes will have an impact on comparisons made between 2003 and 2015 but not on those made between 2011 and 2015.

Poisoning

Since newer software for coding cause of death was implemented by the ABS in 2013, there have been some notable changes to causes of death data and, specifically, for some injuries. Previously, where a death was due to an accidental overdose with a known addiction to the drug, it would have been coded to a mental and behavioural disorder. Under the new coding system, the drug overdose is captured as the underlying cause (accidental poisoning) while the addiction is maintained as an associated cause. As a result, since 2013 some of the increase in deaths (and YLL) due to poisoning may be influenced by these coding changes.

These changes will have an impact on comparisons made between 2003 and 2015 but not on those made between 2003 and 2011.

Infant & congenital conditions and respiratory diseases: disease-specific changes

Fatal burden from infant & congenital conditions decreased

Although infant and congenital conditions were not ranked highly in Australia's most burdensome diseases, they are the predominant causes of fatal burden (80%) in infants. In 2015, there were good gains in reducing burden of dying prematurely for Australian infants, as they suffered a reduced fatal burden rate (34%) since 2003. Boys had a slightly larger reduction in burden (35%) than girls (32%).

All diseases in this group had lower fatal burden since 2003. Birth trauma & asphyxia and pre-term birth/low birthweight complications were the main causes of infant and congenital burden and, together, accounted for one-third of the total years of life lost in this group. Since 2003, the rate of years of life lost for these diseases reduced by 50% and 17%, respectively. As well, infants suffered 42% less fatal burden due to dying from cardiovascular defects and SIDS.

Fatal burden due to respiratory diseases decreased

Respiratory diseases together contributed to 5.5% of the fatal burden in 2015. Since 2003, overall fatal burden from respiratory diseases reduced by 10% in Australia. Males experienced a substantial reduction in fatal burden rate (by 18%) while females experienced minimal change (decrease by 2.5%) in the rate of years of life lost from respiratory diseases.

The major causes of fatal burden from respiratory diseases were COPD (70%), interstitial lung disease (13%) and asthma (5.9%). Both males and females suffered much lower rates of burden from asthma and upper respiratory conditions in 2015 than in 2003, but had increased burden due to interstitial lung disease. For COPD, males experienced lower burden (22% decrease), while females experienced little change in the burden rate.

Changes in fatal burden due to population and disease factors

The substantial reduction in age-standardised fatal burden rates in 2003 (111 YLL per 1,000 population) compared with 2015 (89 YLL per 1,000 population) corresponds to a small (6.3%) increase in YLL, due primarily to the increasing and ageing population.

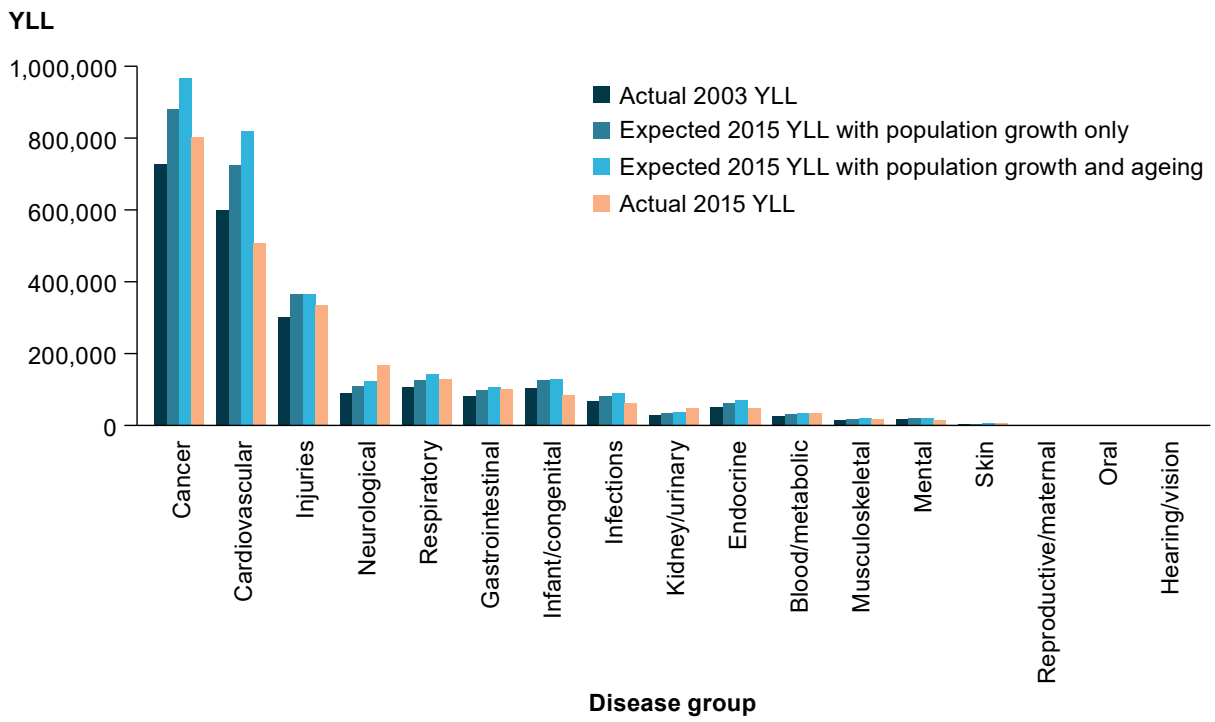
Figure 7.7 shows actual and expected YLL estimates by disease group for 2015 and 2003, while percentage differences between the actual and expected estimates are provided in Appendix Table D11.

There was less fatal burden in 2015 than in 2003 for infant & congenital conditions (overall reduction of 18%), cardiovascular diseases (15%) and mental & substance use disorders (14%).

Increases in YLL were apparent for all other disease groups but, for many, these increases were less than would have been expected based on population changes. The most notable exception is neurological conditions, which was 85% higher in 2015 than in 2003. This is much higher than would be expected due to population changes and is largely due to an increase in dementia deaths as outlined in Box 7.2.

Note that differences between 2003 and 2015 for reproductive & maternal conditions, skin disorders and oral disorders are based on a small number of deaths, and the results are subject to volatility.

Figure 7.7: Expected and actual YLL, by disease group, 2003 and 2015



How have risk factors changed over time?

Analyses of the effects of changes in risk factors are provided only for those risk factors that were included in both the 2003 and 2015 estimates. The risk factors that could not be measured for 2003 were air pollution and high blood plasma glucose.

Results are expressed as changes in the total burden (DALY) attributable to each risk factor, as well as changes in the fraction of burden (population attributable fraction, or PAF) that is attributable to each risk factor.

Changes in attributable burden

In this analysis, changes in attributable burden may be due to changes in:

- exposure to the risk factors
- the age at which exposure occurs, or
- the overall burden for those diseases or injuries that are linked to these risk factors.

Overall change in attributable burden

The risk factors able to be measured in 2003 contributed 37% of the total burden in 2003. These same risk factors contributed to 36% of the total burden in 2015, indicating that there was a small drop in the proportion of burden attributable to these risk factors over the 12 years.

Changes in attributable burden by risk factor

There was a fall in total DALY attributable to high cholesterol (32% decrease), high blood pressure (19%), dietary risks (11%) and unsafe sex (5.8%) between 2003 and 2015 (Table 7.6). The ASR (attributable burden rate), which adjusts for changes in the structure and size of the population, decreased for high cholesterol by 49%, for high blood pressure by 41%, for dietary risks by 34%, and for tobacco use by 24%.

Between 2003 and 2015, there was an increase in total DALY attributable to illicit drug use (43%), overweight & obesity (27%), child abuse & neglect (23%), intimate partner violence (20%), high sun exposure (20%), alcohol use (9.2%) and physical inactivity (5.1%). However, considering differences between the 2015 and 2003 population size and structure, the attributable burden rates for most of these risk factors either decreased or stayed the same. This indicates that population changes are driving the increase in DALY attributable to these risk factors. The exception is illicit drug use, where the ASR of burden attributable rose by 18%.

There was an increase in total DALY attributable to low bone mineral density (98% increase) and iron deficiency (57% increase) as well as a rise in the ASR for these risk factors. This is due to changes in the burden from the linked disease (falls and iron deficiency anaemia, respectively) and not due to changes in exposure to the risk factors, as the same PAF was applied in both years.

It is important to note that these results are summary measures that are influenced by the changes in the fatal or non-fatal burden of the linked diseases. The period from 2003 to 2015 may be too short a time span to reflect the changes in overall burden. Possible reasons are too complex to unpack within the scope of this report; however, a focus on tobacco use and overweight & obesity is provided in the section that follows, and further information on specific disease burden attributable to each risk factor can be found on the AIHW website.

Table 7.6: Change in total attributable burden between 2003 and 2015, by risk factor

Risk factor	2003 attributable DALY (no.)	2015 attributable DALY (no.)	Change in attributable DALY (no.)	Change in attributable DALY (%)	2003 attributable DALY ASR	2015 attributable DALY ASR	Change in ASR	Rate ratio 2015:2003
Tobacco use	434,504	443,235	8,731	2.0	21.6	16.4	–5.1	0.8
Overweight & obesity	313,434	399,419	85,984	27.4	15.6	14.9	–0.7	1.0
Dietary risks	388,292	346,742	–41,550	–10.7	19.2	12.8	–6.5	0.7
High blood pressure	338,032	273,894	–64,137	–19.0	16.7	9.8	–6.8	0.6
Alcohol use	195,622	213,705	18,083	9.2	9.9	8.6	–1.2	0.9
High cholesterol	208,712	141,050	–67,662	–32.4	10.3	5.2	–5.1	0.5
Illicit drug use	89,799	128,087	38,288	42.6	4.6	5.4	0.8	1.2
Physical inactivity	115,334	121,158	5,825	5.1	5.7	4.4	–1.3	0.8
Child abuse & neglect[(a)]	83,754	102,751	18,997	22.7	4.3	4.4	0.1	1.0
Impaired kidney function	72,013	97,700	25,687	35.7	3.5	3.5	–0.1	1.0
Occupational exposures & hazards	86,955	94,311	7,356	8.5	4.4	3.8	–0.6	0.9
High sun exposure[(a)]	31,028	37,185	6,157	19.8	1.5	1.4	–0.1	0.9
Intimate partner violence	29,232	35,078	5,846	20.0	1.5	1.5	–0.0	1.0
Iron deficiency[(a)]	11,015	17,274	6,259	56.8	0.6	0.7	0.2	1.3
Low bone mineral density[(a)]	8,700	17,204	8,504	97.7	0.4	0.6	0.2	1.4
Unsafe sex	12,834	12,090	–744	–5.8	0.6	0.5	–0.2	0.8
All risk factors combined[(b)]	**1,540,124**	**1,712,809**	**172,685**	**11.2**	**76.7**	**65.3**	**–11.4**	**0.9**

(a) The same PAFs have been used in 2003 and 2015 and any change in attributable burden is due to changes in the ASRs of the linked disease.

(b) All risk factors combined estimate excludes high blood plasma glucose and air pollution, which were not estimated in 2003.

Notes

1. Rates were age-standardised to the 2001 Australian Standard Population and expressed per 1,000 population.
2. Rate ratios divide 2015 ASRs by corresponding 2003 ASRs.
3. Rate differences subtract 2015 ASRs from the corresponding 2003 ASRs.

Changes in attributable burden: a focus on tobacco use and overweight & obesity

Tobacco use

The total burden attributable to tobacco use was slightly higher in 2015 than in 2003 (2.0% increase) (Table 7.6). The largest impact from tobacco use is on cancer, respiratory diseases and cardiovascular diseases. However, while the burden of cancer and respiratory diseases due to tobacco use rose (approximately 14,000 and 27,000 DALY, respectively), this was outweighed by a large drop in the burden of cardiovascular diseases (around 32,000 DALY).

The ASR of burden attributable to tobacco use dropped 24% (rate ratio 0.8) in 2015 compared with 2003 (Table 7.6). This change varied between diseases linked to tobacco use. The rate ratios for cancer and respiratory diseases were 0.8 and 0.9, respectively, compared with 0.5 for cardiovascular diseases. This is likely to be due to health improvements from reductions in tobacco use taking longer to become apparent in cancer and chronic respiratory diseases than in cardiovascular diseases (CDC 2015).

The burden attributable to second-hand smoke was 57% lower in 2015 than in 2003. The attributable burden rate was 75% lower (rate ratio 0.3) (Appendix Table D12).

Overweight & obesity

The total burden attributable to overweight & obesity was 27% higher in 2015 than in 2003. The change over time was larger for the burden attributable to obesity (42% higher in 2015 than in 2003) than to overweight (13% higher in 2015 than in 2003) (Appendix Table D12).

The ASR of total burden attributable to overweight & obesity was 4% lower in 2015 than in 2003 (rate ratio 1.0) (Table 7.6). This includes a higher rate of burden attributable to obesity (6% higher in 2015 than in 2003, rate ratio 1.1) and a lower rate of burden attributable to overweight (16% lower in 2015 than in 2003, rate ratio 0.8).

Overweight & obesity is linked to a number of different diseases, the most prevalent being cardiovascular diseases, followed by cancer, musculoskeletal conditions, and endocrine disorders. There was a fall in the rate of attributable burden (rate ratio 0.7) for cardiovascular diseases due to overweight & obesity, but this was balanced by an rise in the attributable burden rate of kidney & urinary diseases (rate ratio of 1.4), musculoskeletal conditions (rate ratio of 1.3) and respiratory diseases (rate ratio of 1.1).

Changes in population attributable fraction

The PAF is the proportion of a disease or injury that can be attributed to a risk factor.

Changes in PAF are estimated by the percentage change in *total PAF*. The total PAF is the sum of all the PAFs for the risk factor and will vary between risk factors by the number of linked diseases (Table 7.7).

Any changes over time in the total PAF are risk weighted so that changes in exposures associated with the most increased risk of the linked disease have the highest influence on the estimate. More information on how the total PAF is calculated is in Appendix A.

Changes in population attributable fraction by risk factor

The rankings for most risk factors changed between 2003 and 2015.

Tobacco use remained the top-ranking risk factor in 2003 and 2015, despite a 12% drop in its total PAF due to a reduction in exposure to tobacco use. High blood pressure, which was ranked third in 2003, also had a drop (11%) in the total PAF, and the ranking fell to fourth in 2015. The total PAF also fell for alcohol use (7.6%), high cholesterol (7.6%) and illicit drug use (5.4%) between 2003 and 2015 (Table 7.7).

The percentage change in total PAF for overweight & obesity increased by 3.1% between 2003 and 2015 and it moved from fourth to second in ranking. Other risk factors where the total PAF rose were all dietary risks (3.5%), intimate partner violence (3.5%), impaired kidney function (1.6%) and occupational exposures & hazards (1.5%). Exposure to these risk factors increased between 2003 and 2015 (Table 7.7).

Table 7.7: Risk factor ranking, total PAF, number of linked diseases and percentage change in total PAF between 2003 and 2015

Risk factor	Rank 2003	Rank 2015	Total PAF 2003	Total PAF 2015	Linked diseases (no.)	% change in total PAF
Tobacco use	1	1	9.1	8.2	41	–11.5
Overweight & obesity	4	2	8.6	8.9	30	3.1
All dietary risks	2	3	4.2	4.3	41	3.5
High blood pressure	3	4	4.7	4.3	12	–10.7
Alcohol use	6	5	9.9	9.2	29	–7.6
High cholesterol	5	6	1.2	1.2	2	–7.6
Illicit drug use	8	7	5.9	5.6	13	–5.4
Physical inactivity	7	8	1.3	1.3	7	–0.3
Impaired kidney function	11	10	1.9	1.9	6	1.6
Occupational exposures & hazards	9	11	4.9	5.0	24	1.5
Intimate partner violence	13	13	1.0	1.0	6	3.5

Note: Ranking does not include risk factors not measured in 2003.

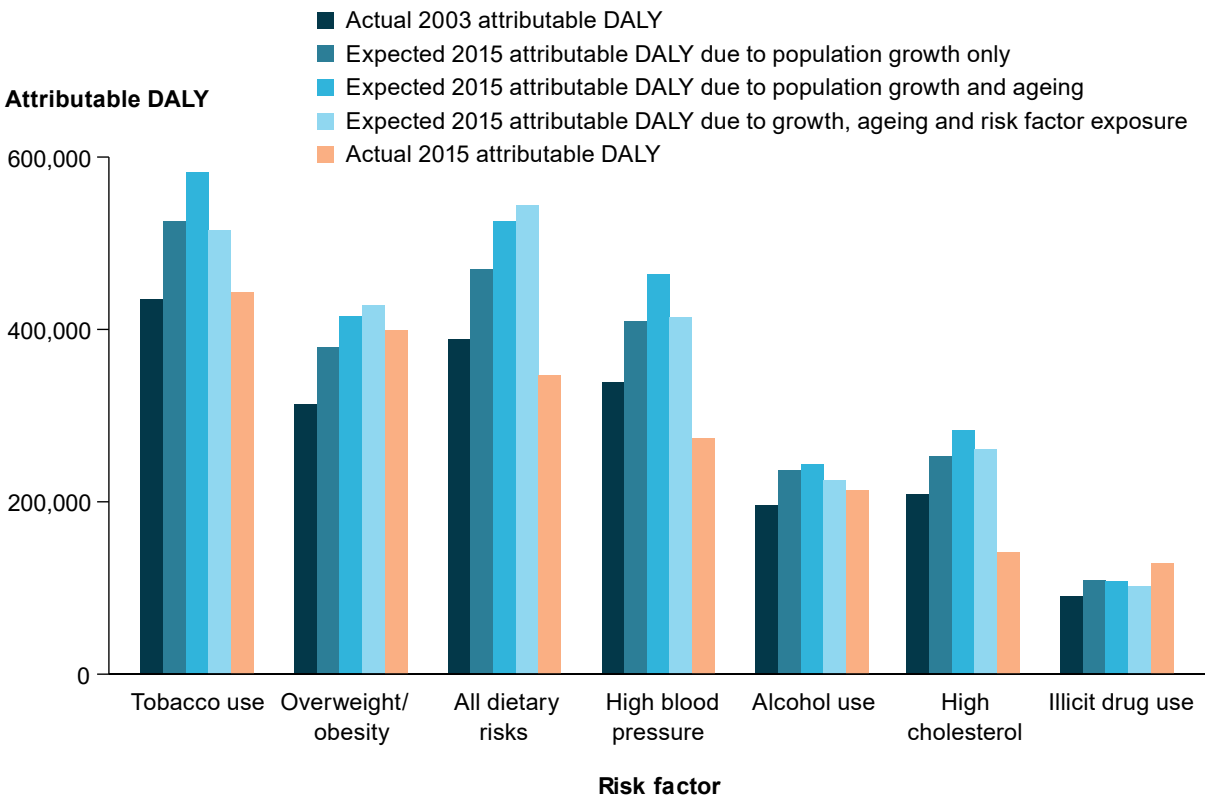
Changes in attributable burden due to demographic and epidemiological factors

Figure 7.8 compares the actual estimates for 2015 for each risk factor with those that would have been expected, based on population increase, ageing and changes to risk factor exposure. Changes to risk factor exposure were calculated by applying the percentage change in total PAF to the expected 2015 DALY due to population growth and ageing. The percentage differences are provided in Appendix Table D13.

Generally, the actual 2015 DALY for most risk factors was lower than would have been expected if the DALY rates in 2003 also applied to 2015, while also taking into account changes in risk factor exposure (Figure 7.8; Appendix Table D13). This indicates an improvement in the disease burden linked to these risk factors, potentially due to improved prevention or treatment of the diseases. The exception was

illicit drug use, where the actual 2015 DALY was as high as expected.

Figure 7.8: Expected and actual attributable DALY for selected risk factors, 2003 and 2015



8 Variation across geographic areas and population groups

Key results

- The total burden rates (DALY per 1,000 population) were similar for all states and territories except the Northern Territory, where the rate was around 1.4 times as high as the national average. Total burden rates were exceptionally high in the Northern Territory for kidney & urinary diseases (more than 4 times the national rate); injuries were more than 2 times the national rate, and cardiovascular diseases, 2 times the national rate.
- The burden rate in *Remote and very remote* areas was 1.4 times as high as *Major cities.* There were noticeably higher burden rates in *Remote and very remote* areas for kidney & urinary diseases, injuries, infectious diseases, endocrine disorders and cardiovascular diseases.
- Total burden would have been 4.3% lower if all areas had the same rates of burden as *Major cities*.
- Burden rates rose with decreasing socioeconomic group, and non-fatal and fatal rates were 1.4 and 1.7 times as high, respectively, in the lowest group as in the highest.
- The greatest relative differences between the highest and lowest socioeconomic groups were for endocrine disorders (2.3 times), kidney & urinary diseases (2.1 times) and injuries (1.8 times as high in the lowest socioeconomic group as in the highest).
- Total burden would have been 20.4% lower if all areas had the same rates of burden as the highest socioeconomic group.
- For every risk factor, the lowest socioeconomic group experienced greater burden than the highest group.

Burden of disease by state and territory

Variations in patterns of disease burden across states and territories reflect a complex interaction of a number of factors, such as demographic (including the age structure of the population and the proportion of the population that is Indigenous), socioeconomic and environmental differences (Table 8.1). For example, the Northern Territory is quite different from other states and territories. It not only has the smallest population, but also a younger population and people more likely to identify as Aboriginal or Torres Strait Islander Australians than other states and territories.

Table 8.1: Demographic characteristics of population, by state and territory, 2015

Jurisdiction	Total population (million)	Proportion living in greater capital city (%)	Median age (years)	Proportion of population aged <15 (%)	Proportion aged 65+ years (%)
NSW	7.62	65	37.9	19	16
Vic	5.94	76	37.3	18	15
Qld	4.78	48	36.9	20	14
WA	2.59	79	36.1	19	13
SA	1.70	78	39.9	18	17
Tas	0.52	43	41.9	18	18
ACT	0.39	100	35.1	19	12
NT	0.24	58	32.2	22	7

Source: ABS 2016b.

This chapter focuses on the variability of burden across states and territories, rather than on the detailed estimates for each jurisdiction. Results are presented as rates (the number of DALY, YLD or YLL for every 1,000 people in the population) that have been adjusted to remove the influence of differences in age structure between each state and territory, but not other demographic, socioeconomic or environmental factors.

Data quality for these estimates is described at the end of the chapter.

Total burden

Burden of disease rates were similar across states and territories, except for the Northern Territory where total burden (DALY) rates were 1.4 times as high as the national rate (Table 8.2).

The fatal burden rates varied considerably, from 76 YLL per 1,000 population in the Australian Capital Territory to 159 in the Northern Territory. By comparison, non-fatal burden rates showed less variation across jurisdictions, ranging from 90 YLD per 1,000 population in Western Australia to 101 in the Northern Territory (Table 8.2).

Accordingly, the proportion of total burden that was fatal burden ranged from 43% in the Australian Capital Territory to 62% in the Northern Territory. The proportion of fatal burden was greater than that of non-fatal burden in the Northern Territory and Tasmania; it was around the same in New South Wales, Queensland, Western Australia and South Australia.

Table 8.2: Total (DALY), non-fatal (YLD) and fatal (YLL) burden, burden rates and rate ratios, by state and territory, 2015

	Total burden			Non-fatal burden			Fatal burden		
Jurisdiction	DALY ('000s)	Rate	Rate ratio	YLD ('000s)	Rate	Rate ratio	YLL ('000s)	Rate	Rate ratio
NSW	1,534	182.3	1.0	765	94.0	1.0	769	88.2	1.0
Vic	1,163	178.0	1.0	610	96.0	1.0	553	81.9	0.9
Qld	950	188.8	1.0	470	94.9	1.0	480	93.9	1.1
WA	469	179.7	1.0	232	89.5	0.9	237	90.2	1.0
SA	374	190.0	1.0	186	99.4	1.0	189	90.6	1.0
Tas	125	205.3	1.1	57	98.6	1.0	69	106.8	1.2
ACT	67	170.5	0.9	37	94.5	1.0	29	76.0	0.9
NT	52	259.6	1.4	20	100.5	1.1	32	159.0	1.8
Australia	**4,752**	**184.3**	**—**	**2,394**	**95.3**	**—**	**2,358**	**89.0**	**—**

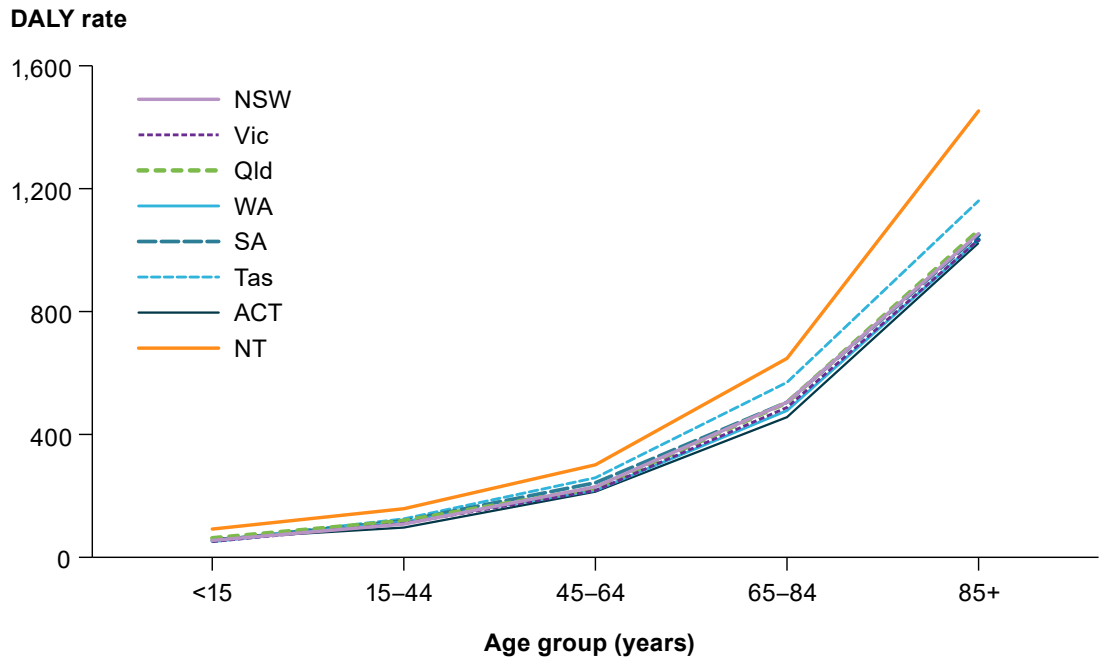
Notes

1. Rates were age-standardised to the 2001 Australian Standard Population and expressed per 1,000 population.
2. Rate ratios compare the state/territory rate of burden with the Australian rate of burden.
3. Non-fatal burden by state/territory may not add up to the Australian total due to modelling and rounding.

Age

States and territories had a similar trend: rate of burden increased with increasing age. Rates were higher in the Northern Territory than in other jurisdictions across all age groups. The gap between rates for the Northern Territory and other jurisdictions increased with increasing age but was most pronounced from age 65 (Figure 8.1).

Figure 8.1: Age-specific total burden (DALY) rates, by life stage and state and territory, 2015



Note: DALY rate is expressed as DALY per 1,000 population.

Disease groups

Total burden per population varied across states and territories for all disease groups. The higher rates for total burden described earlier for the Northern Territory are largely attributable to higher rates in almost all disease groups, except for mental & substance use disorders, musculoskeletal conditions, reproductive & maternal conditions, skin disorders and neurological conditions (Table 8.3). In particular, in the Northern Territory, kidney & urinary diseases were 4.5 times as high as the national rate; blood & metabolic disorders were 2.4 times as high, injuries 2.1 times as high, and cardiovascular diseases 2.0 times as high.

Table 8.3: Total burden (DALY) rates, by disease group and state and territory, 2015

Disease group	NSW	Vic	Qld	WA	SA	Tas	ACT	NT	Australia
Blood/metabolic	2.4	2.1	2.3	2.4	2.5	2.9	2.9	5.7	2.4
Cancer	33.0	30.2	33.6	31.4	33.2	37.5	29.4	42.8	32.4
Cardiovascular	23.6	21.8	24.2	22.6	24.1	26.8	19.8	45.9	23.4
Endocrine	4.7	4.4	4.5	4.9	4.8	5.3	4.2	8.0	4.7
Gastrointestinal	6.3	5.9	6.1	6.0	6.5	6.0	5.1	8.8	6.2
Hearing/vision	3.4	3.7	4.0	3.4	3.4	4.1	3.9	4.8	3.6
Infant/congenital	4.4	3.5	5.7	3.6	4.2	5.3	4.6	7.4	4.4
Infections	3.5	3.6	4.2	3.5	4.1	3.6	3.0	7.1	3.7
Injuries	15.1	15.0	19.4	20.4	16.1	18.4	13.6	34.7	16.9
Kidney/urinary	2.3	2.1	2.4	2.4	2.2	2.5	1.5	10.4	2.3
Mental	23.7	26.5	23.0	25.0	26.1	19.8	25.0	21.5	24.5
Musculoskeletal	24.4	23.7	22.9	22.6	25.4	31.5	24.5	18.8	23.9
Neurological	12.8	12.3	12.7	11.6	14.0	15.2	12.3	14.7	12.6
Oral	4.2	4.5	4.4	3.3	4.1	5.0	3.0	5.3	4.2
Reproductive/maternal	1.2	1.1	2.0	0.7	1.5	1.2	0.8	1.4	1.9
Respiratory	13.8	13.8	13.9	12.7	14.3	16.2	13.5	19.0	13.8
Skin	3.4	3.6	3.3	3.1	3.6	4.1	3.4	3.3	3.4
All diseases	**182.3**	**178.0**	**188.8**	**179.7**	**190.0**	**205.3**	**170.5**	**259.6**	**184.3**

Note: Rates were age-standardised to the 2001 Australian Standard Population and expressed per 1,000 population.

There was some variation in rates of non-fatal burden across states and territories (Appendix Table D14). For example, the non-fatal burden rate was lowest in the Northern Territory for musculoskeletal conditions (17 YLD per 1,000 population) and highest in Tasmania (30). For mental & substance use disorders, the non-fatal burden rate was lowest in Tasmania (19 YLD per 1,000 population) and highest in Victoria (26).

Fatal burden also differed considerably across states and territories (Appendix Table D15). For the 3 leading causes of fatal burden nationally—cancer, cardiovascular diseases and injuries—rates were lowest in the Australian Capital Territory (27, 15 and 11 YLL per 1,000 population, respectively) and highest in the Northern Territory (41, 34 and 29, respectively).

Variation by disease

Figure 8.2 describes the 10 leading causes of total burden in 2015, ranked by proportion of total DALY for each state and territory. In all jurisdictions, coronary heart disease was the leading cause of burden with back pain & problems, COPD and lung cancer also featuring as leading causes. Suicide & self-inflicted injuries was a leading cause in all jurisdictions except New South Wales and Victoria. Notably, stroke was a leading cause in all jurisdictions except Western Australia, the Northern Territory and the Australian Capital Territory. Dementia and anxiety disorders were a leading cause in all jurisdictions except the Northern Territory. Asthma was a leading cause of burden in all jurisdictions except for South Australia and the Northern Territory. Depressive disorders and anxiety disorders were leading causes in all jurisdictions except Tasmania.

Several other causes ranked in the leading causes for a state or territory but not nationally: osteoarthritis (all jurisdictions except Queensland and the Northern Territory); rheumatoid arthritis (Tasmania); and chronic kidney disease, road traffic injuries to motor vehicle occupants, type 2 diabetes, and alcohol use disorders (all in the Northern Territory).

These variations reflect a complex interaction between factors described at the start of this section. Analyses of burden by remoteness area and socioeconomic group provide further information on how these factors influence the distribution of the burden in Australia.

Figure 8.2: Leading causes of total burden (proportion %; age-standardised DALY rate), by state and territory, 2015

Rank	State/territory								
	NSW	Vic	Qld	WA	SA	Tas	ACT	NT	Australia
1st	Coronary heart disease (7.2%; 12.0)	Coronary heart disease (6.5%; 10.7)	Coronary heart disease (6.9%; 12.5)	Coronary heart disease (6.8%; 11.9)	Coronary heart disease (7.3%; 12.2)	Coronary heart disease (7.2%; 12.9)	Coronary heart disease (5.2%; 9.0)	Coronary heart disease (9.4%; 26.7)	Coronary heart disease (6.9%; 11.9)
2nd	Back pain and problems (4.1%; 7.8)	Back pain and problems (4.2%; 7.9)	Back pain and problems (4.1%; 8.0)	Back pain and problems (4.4%; 8.0)	Dementia (4.8%; 7.1)	Lung cancer (4.7%; 8.4)	Anxiety disorders (5.1%; 8.4)	Suicide and self-inflicted injuries (4.7%; 9.4)	Back pain and problems (4.1%; 8.0)
3rd	Dementia (4.0%; 6.2)	Dementia (3.9%; 5.9)	COPD (3.9%; 7.0)	Suicide and self-inflicted injuries (3.9%; 7.2)	Back pain and problems (4.2%; 8.7)	COPD (4.5%; 8.0)	Back pain and problems (4.7%; 7.9)	COPD (4.1%; 13.5)	COPD (3.9%; 6.7)
4th	COPD (4.0%; 6.8)	COPD (3.8%; 6.4)	Suicide and self-inflicted injuries (3.6%; 7.3)	COPD (3.5%; 6.3)	COPD (4.0%; 6.8)	Dementia (4.0%; 6.7)	COPD (3.4%; 6.0)	Chronic kidney disease (3.5%; 9.8)	Dementia (3.8%; 6.0)
5th	Lung cancer (3.4%; 5.9)	Anxiety disorders (3.7%; 7.2)	Lung cancer (3.5%; 6.2)	Depressive disorders (3.5%; 6.4)	Lung cancer (3.1%; 5.3)	Back pain and problems (3.8%; 8.7)	Asthma (3.2%; 5.4)	RTI - motor vehicle occupants (3.2%; 6.2)	Lung cancer (3.3%; 5.8)
6th	Anxiety disorders (3.1%; 6.4)	Depressive disorders (3.6%; 7.1)	Dementia (3.4%; 6.0)	Lung cancer (3.3%; 5.8)	Stroke (2.9%; 4.8)	Osteoarthritis (3.4%; 6.4)	Dementia (3.2%; 5.6)	Back pain and problems (2.7%; 6.0)	Anxiety disorders (3.2%; 6.4)
7th	Stroke (3.0%; 4.8)	Lung cancer (3.1%; 5.2)	Anxiety disorders (2.9%; 5.9)	Anxiety disorders (3.2%; 5.8)	Anxiety disorders (2.9%; 6.5)	Stroke (3.2%; 5.8)	Suicide and self-inflicted injuries (3.0%; 5.0)	Lung cancer (2.6%; 7.8)	Depressive disorders (2.9%; 5.8)
8th	Osteoarthritis (2.6%; 4.7)	Asthma (2.9%; 5.5)	Stroke (2.6%; 4.7)	Dementia (3.1%; 5.5)	Depressive disorders (2.8%; 6.4)	Rheumatoid arthritis (3.0%; 6.1)	Osteoarthritis (2.8%; 4.9)	Type 2 diabetes (2.3%; 7.0)	Suicide and self-inflicted injuries (2.8%; 5.8)
9th	Depressive disorders (2.5%; 5.0)	Stroke (2.6%; 4.2)	Depressive disorders (2.5%; 5.2)	Osteoarthritis (2.5%; 4.3)	Osteoarthritis (2.6%; 4.7)	Suicide and self-inflicted injuries (2.7%; 7.1)	Depressive disorders (2.7%; 4.4)	Alcohol use disorders (2.2%; 4.4)	Stroke (2.7%; 4.6)
10th	Asthma (2.5%; 4.9)	Osteoarthritis (2.5%; 4.3)	Asthma (2.5%; 5.0)	Asthma (2.4%; 4.4)	Suicide and self-inflicted injuries (2.6%; 5.8)	Asthma (2.5%; 6.1)	Lung cancer (2.6%; 4.5)	Depressive disorders (1.9%; 4.0)	Asthma (2.5%; 5.0)

RTI = road traffic injuries.

Note: Rates were age-standardised to the 2001 Australian Standard Population and expressed per 1,000 population.

Burden of disease by remoteness areas

In this report, level of remoteness is classified as *Major cities, Inner regional, Outer regional, Remote* and *Very remote* areas. These categories are defined by an area's relative distance to services (ABS 2013a). In 2015, most (89%) of Australia's population lived in *Major cities* and *Inner regional* areas. For this analysis, results for *Remote* and *Very remote* areas are combined and presented as *Remote and very remote*.

The key aim of the analysis in this chapter is to assess the variation in disease burden across remoteness areas, rather than to provide detailed estimates (or analysis) for a particular remoteness category. There are some important demographic, socioeconomic and environmental factors that differ by remoteness and influence health status:

- As well as different population sizes, each remoteness area has a different population age structure. Children generally make up a greater proportion of the population in more remote areas than in less remote areas, whereas elderly Australians make up a smaller proportion. Age-standardisation removes the influence of different age structures to allow regions to be compared on a like-with-like basis, rather than just reflecting their different age profiles.
- People living in more remote areas are often disadvantaged with regard to educational and employment opportunities, income, and access to goods and services. Health behaviours and risks may also differ by remoteness. For example, the proportion of people who go to hospital for conditions that are considered potentially preventable with timely and adequate non-hospital care is higher outside *Major cities*. There are also higher proportions of Aboriginal and Torres Strait Islander people in more remote areas (AIHW 2018a). These factors have not been adjusted for in these comparisons.
- Geographical dispersion of the population in *Remote* and *Very remote* areas provides an added challenge due to a higher cost of providing health services in more remote areas and the more limited availability of both infrastructure and the workforce required to provide these services.

The following analysis highlights the overarching health inequalities across remoteness areas. While this cannot fully explain *why* such inequalities exist, it does contribute to a more informed and specialised approach to health-care planning, program development and service delivery models outside *Major cities*.

Data quality for estimating total, non-fatal and fatal burden by remoteness area is described at the end of the chapter.

Burden of diseases varies by remoteness

Total burden rates increased with increasing remoteness. *Major cities* experienced the least burden per population (175 DALY per 1,000 population) while *Remote and very remote* areas experienced the most (249). The total burden rate in *Remote and very remote* areas was 1.4 times as high as that for *Major cities* (Table 8.4). This pattern was mostly driven by fatal burden: in *Remote and very remote* areas, the rate was 1.7 times as high as in *Major cities* while non-fatal burden was 1.2 times as high.

Table 8.4: Total (DALY), non-fatal (YLD) and fatal (YLL) burden, burden rates and rate ratios, by remoteness area, 2015

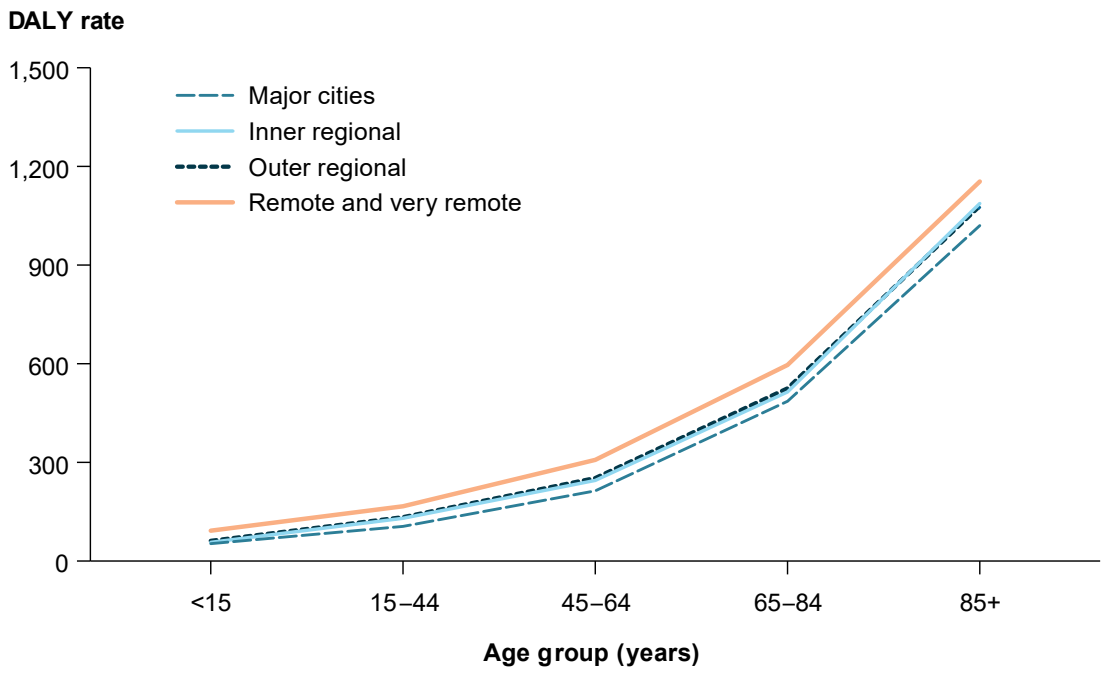
Remoteness area	Total burden			Non-fatal burden			Fatal burden		
	DALY ('000s)	Rate	Rate ratio	YLD ('000s)	Rate	Rate ratio	YLL ('000s)	Rate	Rate ratio
Major cities	3,115	174.8	1.0	1,631	93.2	1.0	1,484	81.7	1.0
Inner regional	1,000	198.0	1.1	471	98.7	1.1	529	99.3	1.2
Outer regional	479	203.0	1.2	216	95.1	1.0	263	107.9	1.3
Remote and very remote	121	248.6	1.4	53	108.9	1.2	67	139.6	1.7
Australia	**4,752**	**184.3**	—	**2,394**	**95.3**	—	**2,358**	**89.0**	—

Notes

1. Rates were age-standardised to the 2001 Australian Standard Population and expressed per 1,000 population.
2. Rate ratios compare the remoteness area rate of burden with the *Major cities* rate of burden.
3. Prevalence estimates and deaths with insufficient geographic detail to align to a remoteness area are excluded from the analysis.

Each remoteness area showed a similar pattern of increasing rates of burden in older age groups with *Remote and very remote* areas having the highest rates across all age groups (Figure 8.3). *Inner regional* and *Outer regional* areas experienced similar burden rates for all age groups.

Figure 8.3: Age-specific total burden (DALY) rates, by life stage and remoteness area, 2015



Note: DALY rate is expressed as DALY per 1,000 population.

Excess burden

Based on remoteness areas, 201,200 DALY were considered 'excess' due to remoteness. 'Excess' DALY is the burden that would have been avoided if the burden rate had been the same as the area with the lowest rate (in this case, *Major cities*). As a percentage of the total DALY for Australia, 4.3% was excess. This excess burden was mostly from fatal burden: 170,000 YLL compared with 31,200 YLD (Table 8.5).

Dividing the excess burden into remoteness areas, *Remote and very remote* areas had the highest excess: 36,600 (or 30%) of the area's DALY was excess compared with *Major cities*. This excess comprised 7,400 YLD and 29,200 YLL; that is, 14% and 43%, respectively, of the areas' non-fatal and fatal burden would have been avoided if *Remote and very remote* areas experienced the same burden rates as *Major cities* (Table 8.5).

Table 8.5: Distribution of burden and excess burden[(a)] for non-fatal (YLD), fatal (YLL) and total (DALY) burden, by remoteness area, 2015

	Remoteness area				
	Major cities	Inner regional	Outer regional	Remote and very remote	Australia
			Non-fatal burden (YLD)		
YLD ('000s)	1,631	471	216	53	2,371
YLD (% of total)	68.8	19.9	9.1	2.2	100
Excess YLD ('000s)[(b)]	0	20	3	7	31
Excess YLD (% of total)[(c)]	0	4.3	1.6	14.0	1.3
			Fatal burden (YLL)		
YLL ('000s)	1,484	529	263	67	2,343
YLL (% of total)	63.3	22.6	11.2	2.9	100
Excess YLL ('000s)[(b)]	0	83	58	29	170
Excess YLL (% of total)[(c)]	0	15.6	22.1	43.3	7.3
			Total burden (DALY)		
DALY ('000s)	3,115	1,000	479	121	4,714
DALY (% of total)	66.1	21.2	10.2	2.6	100
Excess DALY ('000s)[(b)]	0	103	62	37	201
Excess DALY (% of total)[(c)]	0	10.3	12.9	30.4	4.3

(a) Excess burden in Australia represents all excess burden attributed to remoteness areas outside *Major cities*.

(b) Observed burden for each area compared with the expected burden if age-specific burden rates were the same as for *Major cities*.

(c) The proportion (%) of excess burden is expressed as a percentage of the total observed burden for the remoteness area.

Note: Prevalence estimates and deaths with insufficient geographic detail to align to a remoteness area are excluded from the analysis.

Disease groups

For most disease groups, total burden rates increased with increasing remoteness. Table 8.6 compares rates in the least remote areas (*Major cities*) with the most remote areas (*Remote and very remote*) to show the impact of remoteness for each disease group. For most disease groups, the burden rate was greater in *Remote and very remote* areas than in *Major cities* (represented as rate ratios greater than 1).

The greatest relative differences in total burden rates were for kidney & urinary diseases (*Remote and very remote* areas rate was 3.6 times as high as for *Major cities*), followed by injuries (2.5 times as high) and infections (1.9 times as high). For diseases with high-burden rates, injuries and cardiovascular diseases had the greatest absolute difference in rates between *Major cities* and *Remote and very remote* areas (22 and 17 DALY per 1,000 population, respectively).

Remote and very remote areas had slightly lower rates than *Major cities* for mental & substance use disorders and neurological conditions.

Table 8.6: Age-standardised DALY rates, by disease group and remoteness area, 2015

	Remoteness area						
Disease group	**Major cities**	**Inner regional**	**Outer regional**	**Remote and very remote**	**Australia**	**Rate ratio**	**Rate difference**
Blood/metabolic	2.2	2.6	2.4	3.3	2.4	1.5	1.1
Cancer	30.6	35.5	36.6	36.4	32.4	1.2	5.8
Cardiovascular	21.8	24.9	27.1	38.7	23.4	1.8	16.9
Endocrine	4.4	4.9	5.5	8.0	4.7	1.8	3.6
Gastrointestinal	5.8	6.6	7.0	8.2	6.2	1.4	2.4
Hearing/vision	3.4	4.1	4.5	3.6	3.6	1.1	0.2
Infant/congenital	4.1	4.7	5.4	7.1	4.4	1.8	3.0
Infections	3.6	3.7	4.3	6.8	3.7	1.9	3.2
Injuries	14.4	20.3	24.7	36.2	16.9	2.5	21.8
Kidney/urinary	2.0	2.1	2.6	7.3	2.3	3.6	5.3
Mental	25.1	23.4	21.4	23.4	24.5	0.9	–1.7
Musculoskeletal	23.1	26.7	23.8	28.8	23.9	1.2	5.7
Neurological	12.6	13.5	12.0	11.8	12.6	0.9	–0.8
Oral	3.9	4.9	5.3	5.5	4.2	1.4	1.6
Reproductive/maternal	1.3	1.6	1.5	1.5	1.9	1.2	0.2
Respiratory	13.2	14.9	15.3	18.6	13.8	1.4	5.4
Skin	3.4	3.6	3.5	3.5	3.4	1.0	0.2
All diseases	**174.8**	**198.0**	**203.0**	**248.6**	**184.3**	**1.4**	**73.7**

Notes

1. Rates were age-standardised to the 2001 Australian Standard Population and represent DALY per 1,000 population.
2. Rate ratios calculated as Remote and very remote ASR divided by *Major cities* ASR.
3. Rate differences calculated as Remote and very remote ASR minus *Major cities* ASR.
4. Prevalence estimates and deaths with insufficient geographic detail to align to a remoteness area are excluded from the analysis.

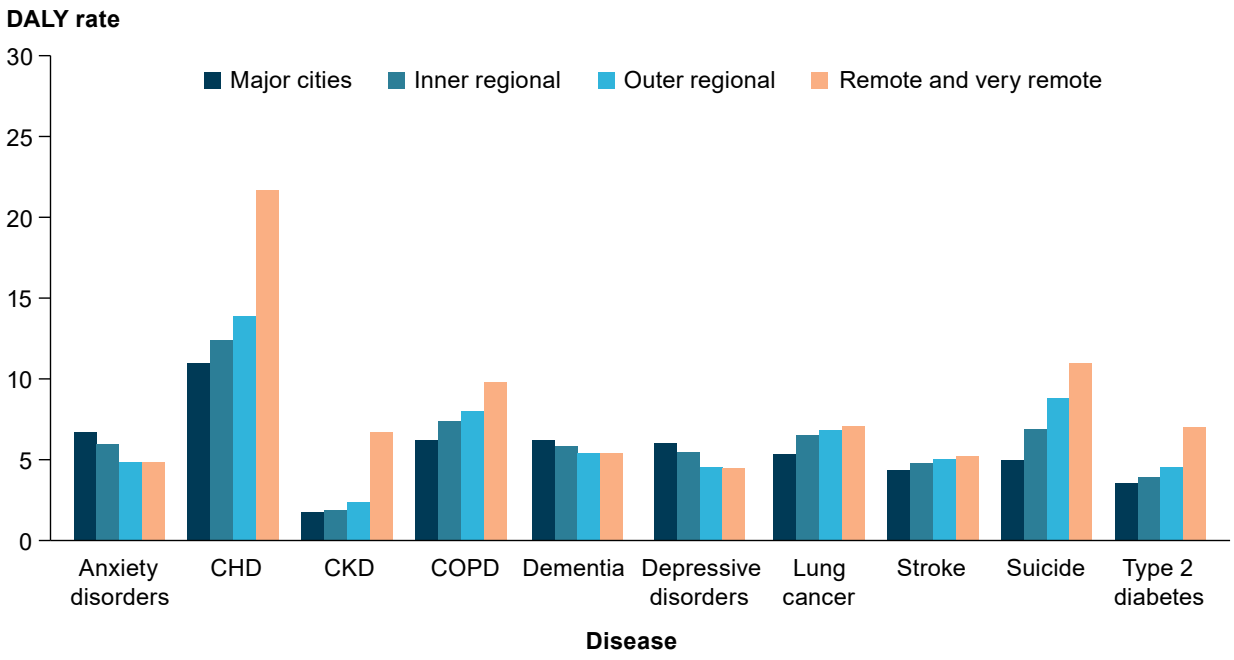
Non-fatal burden rates varied somewhat between remoteness areas (Appendix Table D16). Rates were lower in *Remote and very remote* areas than in *Major cities* for mental & substance use disorders (22 and 25 YLD per 1,000 population, respectively). For musculoskeletal conditions, rates were higher in *Remote and very remote* areas than in *Major cities* (28 and 23, respectively).

Fatal burden also differed by remoteness areas (Appendix Table D17). For the 3 leading causes of fatal burden nationally—cancer, cardiovascular diseases and injuries—rates were, respectively, 1.2, 1.8 and 2.6 times as high in *Remote and very remote* areas as in *Major cities*.

Variation by disease

Patterns of age-standardised DALY rates across remoteness areas depend on the disease (Figure 8.4). There is a clear trend of greater burden rates with increasing remoteness for coronary heart disease, chronic kidney disease, COPD, lung cancer, stroke, suicide & selfinflicted injuries and type 2 diabetes. In contrast, anxiety disorders, dementia and depressive disorders showed lower rates of burden in more remote areas.

Figure 8.4: Age-standardised total burden (DALY) rates, for selected diseases, by remoteness area, 2015



CHD = coronary heart disease; CKD = chronic kidney disease; Suicide = suicide & self-inflicted injuries.

Notes

1. DALY rates were age-standardised to the 2001 Australian Standard Population and expressed per 1,000 population.
2. Prevalence estimates and deaths with insufficient geographic detail to align to a remoteness area are excluded from the analysis.

In all remoteness areas, coronary heart disease was the leading cause of burden, with back pain & problems, COPD and lung cancer also in the 10 leading causes (Figure 8.5). Suicide & self-inflicted injuries was a leading cause in all areas and its ranking increased with increasing remoteness.

Notably, dementia and stroke were leading causes of burden in all but the *Remote and very remote* areas. Anxiety disorders and depressive disorders were leading causes in all areas except *Outer regional* and *Remote and very remote* areas while asthma was a leading cause only in *Major cities* and *Remote and very remote* areas.

Several other diseases/injuries were leading causes by remoteness area but not nationally. These were type 2 diabetes (*Outer regional* and *Remote and very remote*); chronic kidney disease, road traffic injuries to motor vehicle occupants and alcohol use disorders (*Remote and very remote)*; osteoarthritis (*Inner regional* and *Outer regional*); and bowel cancer (*Outer regional*).

These variations reflect a complex interaction between demographic, socioeconomic and environmental factors.

Figure 8.5: Leading causes of total burden (proportion %; age-standardised DALY rate), by remoteness area, 2015

	Remoteness area				
Rank	Major cities	Inner regional	Outer regional	Remote and very remote	Australia
1st	Coronary heart disease (6.6%; 11.0)	Coronary heart disease (7.3%; 12.4)	Coronary heart disease (7.7%; 13.9)	Coronary heart disease (8.6%; 21.7)	Coronary heart disease (6.9%; 11.9)
2nd	Back pain and problems (4.4%; 7.9)	COPD (4.4%; 7.4)	COPD (4.5%; 8.0)	Suicide and self-inflicted injuries (4.5%; 11.0)	Back pain and problems (4.1%; 8.0)
3rd	Dementia (4.0%; 6.2)	Back pain and problems (3.9%; 8.5)	Lung cancer (3.9%; 6.8)	COPD (3.6%; 9.8)	COPD (3.9%; 6.7)
4th	COPD (3.7%; 6.2)	Lung cancer (3.8%; 6.6)	Suicide and self-inflicted injuries (3.5%; 8.8)	Back pain and problems (3.4%; 8.2)	Dementia (3.8%; 6.0)
5th	Anxiety disorders (3.6%; 6.7)	Dementia (3.7%; 5.8)	Back pain and problems (3.4%; 7.4)	Lung cancer (2.9%; 7.1)	Lung cancer (3.3%; 5.8)
6th	Depressive disorders (3.3%; 6.0)	Stroke (2.9%; 4.8)	Dementia (3.1%; 5.4)	Type 2 diabetes (2.8%; 7.0)	Anxiety disorders (3.2%; 6.4)
7th	Lung cancer (3.1%; 5.3)	Suicide and self-inflicted injuries (2.7%; 6.9)	Stroke (2.8%; 5.0)	Asthma (2.7%; 6.6)	Depressive disorders (2.9%; 5.8)
8th	Suicide and self-inflicted injuries (2.7%; 5.0)	Osteoarthritis (2.6%; 4.8)	Osteoarthritis (2.5%; 4.7)	Chronic kidney disease (2.7%; 6.7)	Suicide and self-inflicted injuries (2.8%; 5.8)
9th	Asthma (2.7%; 5.0)	Anxiety disorders (2.4%; 6.0)	Type 2 diabetes (2.5%; 4.6)	RTI - motor vehicle occupants (2.7%; 6.4)	Stroke (2.7%; 4.6)
10th	Stroke (2.7%; 4.4)	Depressive disorders (2.2%; 5.5)	Bowel cancer (2.3%; 4.3)	Alcohol use disorders (2.6%; 6.3)	Asthma (2.5%; 5.0)

RTI = road traffic injuries.

Note: Rates were age-standardised to the 2001 Australian Standard Population and represent DALY per 1,000 population.

Burden of disease by socioeconomic group

This section provides information on the burden of disease across socioeconomic groups by disaggregating the burden estimates for the whole population by socioeconomic group. An alternative method for examining the impact of socioeconomic group on the burden of disease would be to treat social determinants as a risk factor. That approach was not in scope for this current study but could be a worthwhile future project. See Chapter 10 for further information.

In this report, socioeconomic groups are based on an index of relative socioeconomic disadvantage defined by the area in which a person lives. This index is determined by factors such as household income, employment and education level, and is developed as part of the Socio-Economic Indexes for Areas by the ABS (ABS 2013c).

Data quality for estimating total, non-fatal and fatal burden by socioeconomic group is described at the end of the chapter.

Socioeconomic groups are presented as approximate quintiles in this analysis. The lowest quintile (1) represents the approximate 20% of the population living in areas with the lowest socioeconomic characteristics; that is, it is the most disadvantaged. The level of socioeconomic position increases with each quintile, through to the approximate 20% of the population living in areas with the highest socioeconomic characteristics (5); that is, the least disadvantaged.

Poorer health outcomes are generally observed as greater rates of burden in lower socioeconomic groups. This disparity is influenced by a complex and interrelated set of social and economic factors, including reduced access to health services, lower resource availability and the influence of uptake of risky behaviours (AIHW 2018a).

The aim of this section is to assess variation of disease burden across socioeconomic groups and to highlight health disparities. This can help inform targeted approaches to the prevention of diseases and health-care planning, program development and service delivery models.

Variation in burden of disease by socioeconomic group

Taking into account the different age structures in the socioeconomic groups, total, fatal and non-fatal burden decreased with increasing socioeconomic group: total burden rates were 1.5 times as high in the lowest socioeconomic group (220 DALY per 1,000 population) as in the highest group (145) (Table 8.7). There were clear socioeconomic gradients for rates of non-fatal and fatal burden: rates in the lowest group were 1.4 and 1.7 times as high, respectively, as in the highest group.

The contribution of fatal and non-fatal burden to total burden also differed across socioeconomic groups. Fatal burden contributed slightly more to the total burden than non-fatal burden in the lowest groups (1 and 2), (53% and 51%, respectively), while total burden comprised less than 50% of fatal burden for the remaining groups.

Table 8.7: DALY, YLD and YLL counts, age-standardised rates and rate ratios, by socioeconomic group, 2015

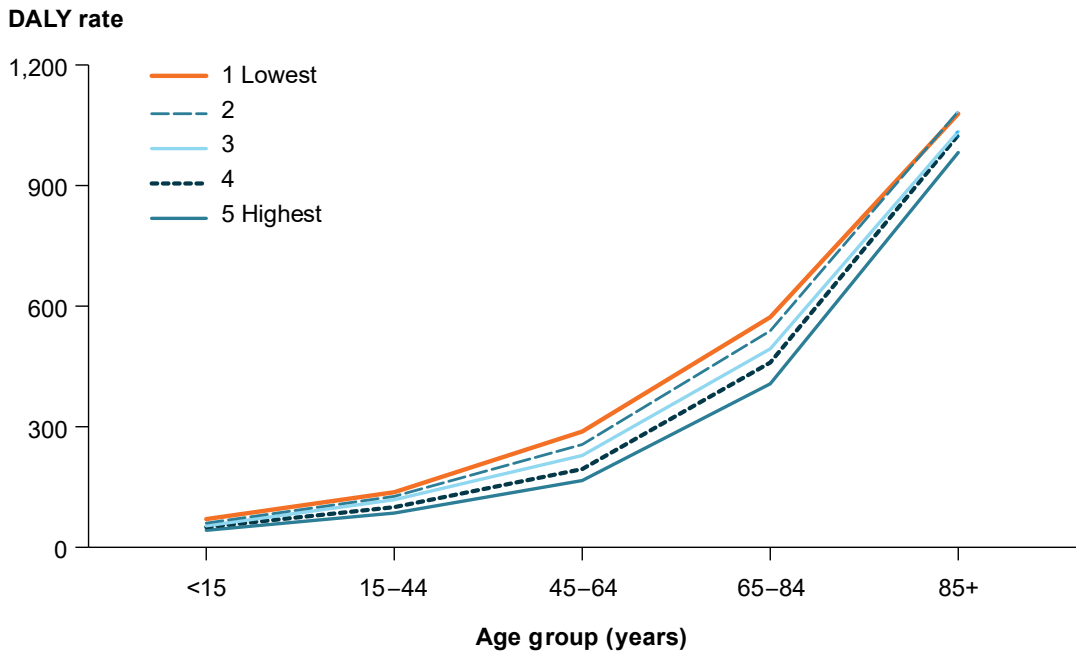
Socioeconomic group	Total burden			Non-fatal burden			Fatal burden		
	Number ('000s)	Rate	Rate ratio	Number ('000s)	Rate	Rate ratio	Number ('000s)	Rate	Rate ratio
1 Lowest	1,129	219.7	1.5	534	107.7	1.4	595	111.9	1.7
2	1,068	201.9	1.4	522	102.8	1.3	546	99.2	1.5
3	960	185.3	1.3	486	96.6	1.2	474	88.7	1.4
4	827	165.1	1.1	437	87.9	1.1	391	77.1	1.2
5 Highest	732	144.7	1.0	395	79.0	1.0	338	65.7	1.0
Australia	**4,752**	**184.3**	—	**2,394**	**95.3**	—	**2,358**	**89.0**	—

Notes

1. Rates were age-standardised to the 2001 Australian Standard Population and expressed per 1,000 population.
2. Rate ratios compare the socioeconomic group rate of burden with the rate of burden in the highest socioeconomic group (5).
3. Prevalence estimates and deaths with insufficient geographic detail to align to a socioeconomic group are excluded from the analysis.

Figure 8.6 shows the total burden rate by socioeconomic group and age group. The age pattern of burden rate is similar for all groups, with the rate of burden increasing with older age, coinciding with the onset of many chronic and age-related conditions. The rate of burden decreased as socioeconomic group increased; however, the gap between groups varied across the life course, with the smallest gaps being in the youngest age groups.

Figure 8.6: Age-specific total burden (DALY) rates, by life stage and socioeconomic group, 2015



Note: DALY rate is expressed as DALY per 1,000 population.

Excess burden

'Excess' burden is the burden that would have been avoided if the rate of burden had been the same as the area with the lowest rate of burden, in this case, the highest socioeconomic group (5).

By socioeconomic group, across Australia, 963,200 DALY were considered 'excess' due to socioeconomic position; this represents 20% of the total DALY for Australia. The excess burden was mostly from fatal burden: 581,900 YLL compared with 381,200 YLD (Table 8.8).

Apportioning the excess burden into socioeconomic groups, the lowest group (1) had the highest excess for total burden: 367,500 (or 33%) of the group's DALY was excess compared with the highest group (5). This excess comprised 137,000 YLD and 230,500 YLL; that is, 26% and 39%, respectively, of the group's non-fatal and fatal burden would have been avoided if the lowest group experienced the same burden rates as the highest group (Table 8.8).

Table 8.8: Distribution of burden and excess burden[(a)] as total (DALY), non-fatal (YLD) and fatal (YLL) burden, by socioeconomic group, 2015

	Socioeconomic group					
	1 Lowest	2	3	4	5 Highest	Australia
			Non-fatal burden (YLD)			
YLD ('000s)	534	522	486	437	395	2,374
Per cent of total YLL	22.5	22	20.5	18.4	16.6	100
Excess YLD ('000s)[(b)]	137	115	85	44	0	381
Excess YLD (% of total)[(c)]	25.7	22.1	17.4	10.1	0	16.1
			Fatal burden (YLL)			
YLL ('000s)	595	546	474	391	338	2,343
Per cent of total YLL	25.4	23.3	20.2	16.7	14.4	100
Excess YLL ('000s)[(b)]	231	175	118	57	0	582
Excess YLL (% of total)[(c)]	38.7	32.2	25	14.7	0	24.8
			Total burden (DALY)			
DALY ('000s)	1,129	1,068	960	827	732	4,717
Per cent of total DALY	23.9	22.6	20.4	17.5	15.5	100
Excess DALY ('000s)[(b)]	367	291	203	102	0	963
Excess DALY (% of total)[(c)]	32.5	27.2	21.2	12.3	0	20.4

(a) Excess burden in Australia represents all excess burden attributed to socioeconomic groups outside of the highest group (5).

(b) Observed burden for each group compared with expected burden if burden rates were the same as the highest group (5).

(c) The proportion (%) of excess burden is expressed as a percentage of the total observed burden for the socioeconomic group.

Note: Prevalence estimates and deaths with insufficient geographic detail to align to a socioeconomic group are excluded from the analysis.

Disease groups

Table 8.9 shows relative and absolute differences in rates of disease burden, comparing the lowest and highest socioeconomic groups by disease group.

The lowest socioeconomic group experienced greater burden than the highest in every disease group except skin disorders, indicated by a rate ratio higher than 1.0. The absolute differences between these 2 groups also varied by disease group.

The greatest relative difference in burden rate was for endocrine disorders (the lowest socioeconomic group had 2.3 times the rate of the highest group), followed by kidney & urinary diseases (2.1 times) and injuries (1.8 times). Other notable differences were for cardiovascular diseases (the lowest group had 1.7 times the rate of the highest group), mental & substance use disorders and respiratory diseases (each 1.6 times) and cancer (1.4 times).

For disease groups with high national rates, there were some large absolute differences in rates between the lowest and highest socioeconomic groups. The greatest difference was for cardiovascular diseases (a difference of 12 DALY per 1,000 population) followed by mental & substance use disorders, cancer and injuries (each having a difference of 10 DALY per 1,000 population between the lowest and highest socioeconomic groups).

Table 8.9: Age-standardised DALY rates, by disease group and socioeconomic group, 2015

	Socioeconomic group							
Disease group	**1 Lowest**	**2**	**3**	**4**	**5 Highest**	**Australia**	**Rate ratio**	**Rate difference**
Blood/metabolic	3.1	2.6	2.3	1.9	1.8	2.4	1.8	1.4
Cancer	36.4	35.1	33.1	30.2	26.6	32.4	1.4	9.8
Cardiovascular	29.4	26.1	22.9	20.2	17.8	23.4	1.7	11.6
Endocrine	6.8	4.9	4.9	3.7	3.0	4.7	2.3	3.8
Gastrointestinal	8.0	6.7	6.1	5.3	4.7	6.2	1.7	3.4
Hearing/vision	4.4	3.8	3.3	3.5	3.2	3.6	1.4	1.2
Infant/congenital	5.4	5.0	3.8	3.9	3.5	4.4	1.5	1.9
Infections	5.0	4.0	3.5	3.3	2.8	3.7	1.7	2.1
Injuries	21.9	18.3	17.3	14.4	12.2	16.9	1.8	9.7
Kidney/urinary	3.2	2.7	2.3	1.9	1.5	2.3	2.1	1.7
Mental	27.7	28.3	26.9	22.7	17.4	24.5	1.6	10.3
Musculoskeletal	28.0	25.5	23.6	21.5	20.7	23.9	1.4	7.3
Neurological	13.7	14.0	12.9	11.5	11.2	12.6	1.2	2.5
Oral	4.8	5.1	4.1	3.9	3.2	4.2	1.5	1.6
Reproductive/maternal	1.4	1.4	1.4	1.3	1.2	1.9	1.1	0.1
Respiratory	17.3	14.9	13.7	12.5	10.6	13.8	1.6	6.7
Skin	3.4	3.7	3.2	3.4	3.4	3.4	1.0	−0.1
All diseases	219.7	201.9	185.3	165.1	144.7	184.3	1.5	75.0

Notes

1. Rates were age-standardised to the 2001 Australian Standard Population and represent DALY per 1,000 population.
2. Rate ratios calculated as the lowest group (1) rate divided by the highest group (5) rate.
3. Rate differences calculated as the lowest group (1) rate minus by the highest group (5) rate.
4. Prevalence estimates and deaths with insufficient geographic detail to align to a socioeconomic group are excluded from the analysis.

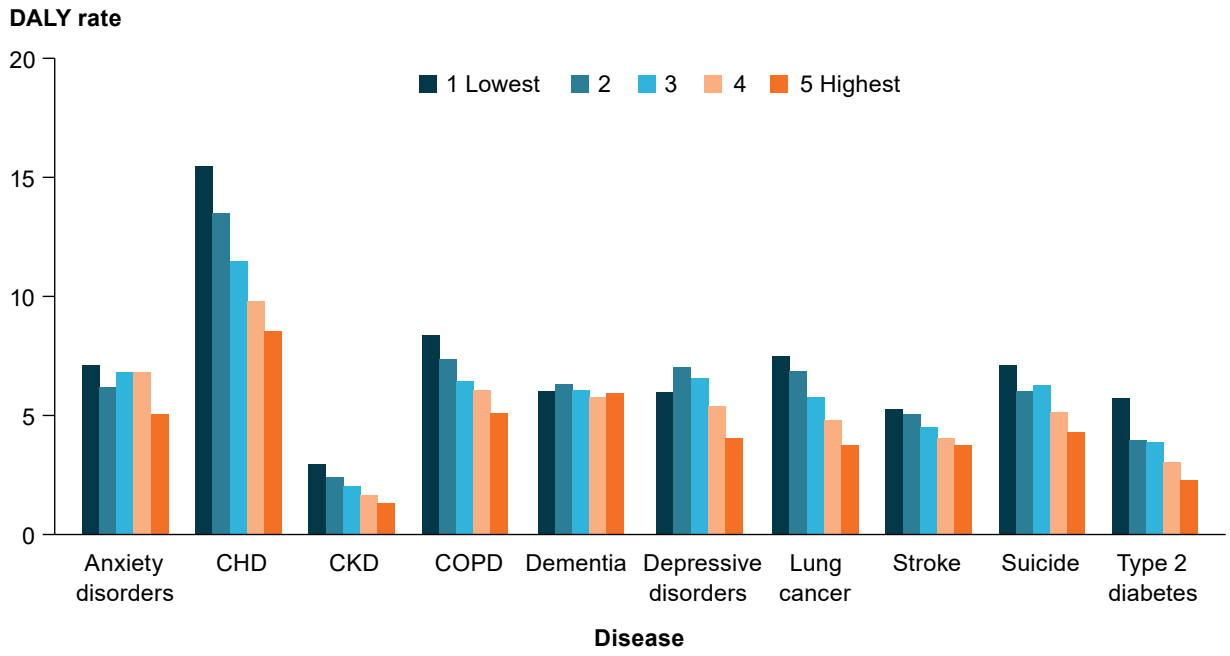
Non-fatal burden rates varied between socioeconomic groups (Appendix Table D18). Rates were greater in the lowest group when compared with the highest group for musculoskeletal conditions (27 and 20 YLD per 1,000 population, respectively), mental & substance use disorders (27 and 17) and endocrine disorders (4 and 2).

Fatal burden also differed by socioeconomic group (Appendix Table D19). For the 3 leading causes of fatal burden nationally—cancer, cardiovascular diseases and injuries—rates were, respectively, 1.4, 1.8 and 1.9 times as high in the lowest socioeconomic group as in the highest.

Variation by disease

Generally, a strong gradient in burden rates is apparent across socioeconomic groups, with higher rates of burden in the lowest group (Figure 8.7). There was a clear pattern of decreasing rate of burden from coronary heart disease, chronic kidney disease, COPD, lung cancer, stroke, suicide, and type 2 diabetes with increasing socioeconomic group.

Figure 8.7: Age-standardised total burden (DALY) rates, for selected diseases, by socioeconomic group, 2015



CHD = coronary heart disease; CKD = chronic kidney disease; Suicide = suicide & self-inflicted injuries.

Notes

1. Rates were age-standardised to the 2001 Australian Standard Population and expressed per 1,000 population.
2. Prevalence estimates and deaths with insufficient geographic detail to align to a socioeconomic group are excluded from the analysis.

Despite the variation by socioeconomic group, these diseases (excluding chronic kidney disease and type 2 diabetes) were major contributors to total burden in each of the socioeconomic groups (Figure 8.8). The total burden rates and the ranking, however, varied within each group.

In all socioeconomic groups, coronary heart disease was the leading cause of burden. Lung cancer ranked higher with decreasing socioeconomic group. Diseases that ranked in the leading causes for a group but not nationally were type 2 diabetes (in the lowest group) and osteoarthritis (in the highest group). Depressive disorders ranked as a leading cause in all groups except for the lowest, and asthma in all groups except for the highest.

Figure 8.8: Leading causes of total burden (proportion %; age-standardised DALY rate), by socioeconomic group, 2015

	Socioeconomic group					
Rank	1 Lowest	2	3	4	5 Highest	Australia
1st	Coronary heart disease (7.7%; 15.5)	Coronary heart disease (7.4%; 13.5)	Coronary heart disease (6.7%; 11.5)	Coronary heart disease (6.1%; 9.8)	Coronary heart disease (6.2%; 8.5)	Coronary heart disease (6.9%; 11.9)
2nd	COPD (4.3%; 8.4)	COPD (4.0%; 7.4)	Back pain and problems (4.0%; 7.8)	Back pain and problems (4.2%; 7.0)	Back pain and problems (5.3%; 7.9)	Back pain and problems (4.1%; 8.0)
3rd	Back pain and problems (3.9%; 9.0)	Dementia (3.8%; 6.3)	Dementia (3.8%; 6.1)	Anxiety disorders (4.0%; 6.8)	Dementia (4.4%; 6.0)	COPD (3.9%; 6.7)
4th	Lung cancer (3.7%; 7.5)	Back pain and problems (3.8%; 8.2)	COPD (3.7%; 6.5)	Dementia (3.7%; 5.8)	COPD (3.6%; 5.1)	Dementia (3.8%; 6.0)
5th	Dementia (3.4%; 6.0)	Lung cancer (3.7%; 6.9)	Anxiety disorders (3.3%; 6.8)	COPD (3.7%; 6.1)	Anxiety disorders (3.3%; 5.1)	Lung cancer (3.3%; 5.8)
6th	Type 2 diabetes (2.8%; 5.7)	Depressive disorders (3.0%; 7.0)	Lung cancer (3.3%; 5.8)	Depressive disorders (3.2%; 5.4)	Suicide and self-inflicted injuries (2.8%; 4.3)	Anxiety disorders (3.2%; 6.4)
7th	Anxiety disorders (2.8%; 7.1)	Stroke (2.8%; 5.1)	Depressive disorders (3.2%; 6.6)	Suicide and self-inflicted injuries (3.1%; 5.1)	Stroke (2.7%; 3.8)	Depressive disorders (2.9%; 5.8)
8th	Suicide and self-inflicted injuries (2.8%; 7.1)	Anxiety disorders (2.7%; 6.2)	Suicide and self-inflicted injuries (3.1%; 6.3)	Lung cancer (3.0%; 4.8)	Lung cancer (2.7%; 3.8)	Suicide and self-inflicted injuries (2.8%; 5.8)
9th	Stroke (2.7%; 5.3)	Suicide and self-inflicted injuries (2.6%; 6.0)	Stroke (2.6%; 4.5)	Asthma (2.6%; 4.5)	Depressive disorders (2.7%; 4.0)	Stroke (2.7%; 4.6)
10th	Asthma (2.7%; 6.6)	Asthma (2.4%; 5.5)	Asthma (2.6%; 5.1)	Stroke (2.5%; 4.1)	Osteoarthritis (2.6%; 3.6)	Asthma (2.5%; 5.0)

Note: Rates were age-standardised to the 2001 Australian Standard Population and represent DALY per 1,000 population.

Risk factors in socioeconomic groups

Table 8.10 shows relative and absolute differences in rates of burden attributable to selected risk factors, comparing the lowest (1) and highest (5) socioeconomic groups by risk factor.

The lowest socioeconomic group experienced greater burden than the highest group in every risk factor, indicated by a rate ratio higher than 1.0. The absolute differences between these 2 groups also varied by risk factor.

The greatest relative difference in burden rate was for tobacco use (the lowest socioeconomic group had 2.6 times the rate of the highest group), followed by intimate partner violence and high blood plasma glucose (both 2.4 times). Other notable risk factors having higher rates in the lowest socioeconomic group compared with the highest were illicit drug use (2.3 times), impaired kidney function (2.2 times), dietary risks and overweight & obesity (both 2.0 times), and high cholesterol and physical inactivity (1.9 times).

Corresponding to high national rates, tobacco use and overweight & obesity had high absolute differences in rates between the lowest and highest socioeconomic groups (differences of 15 and 10 DALY per 1,000 population, respectively).

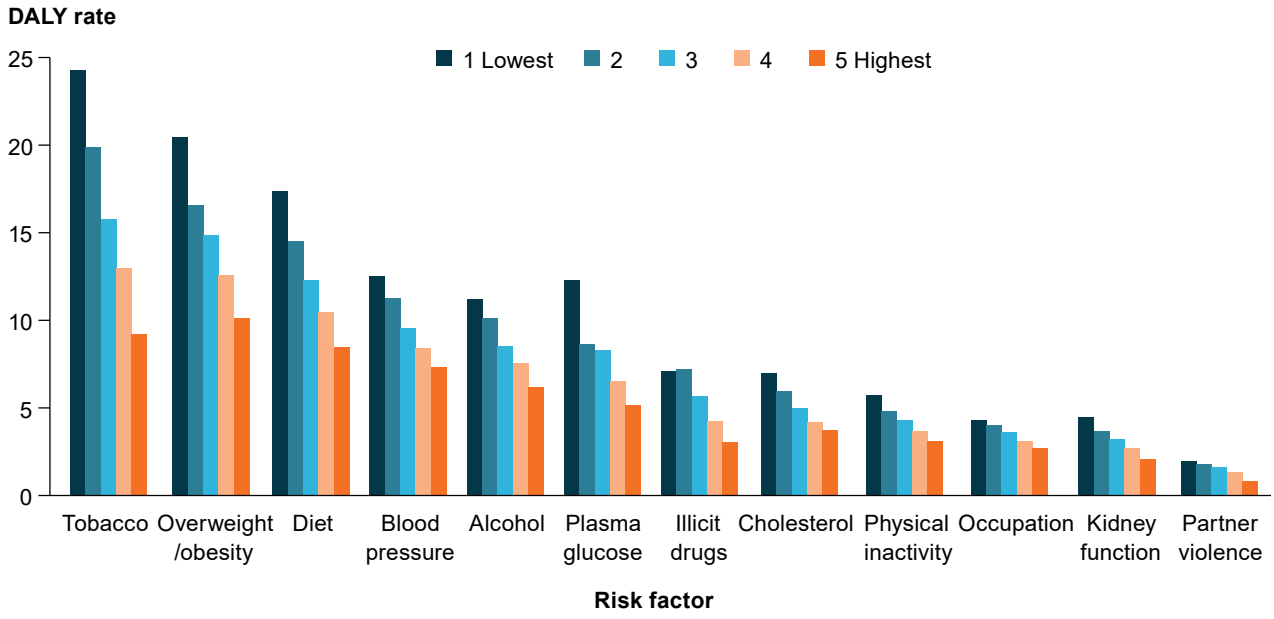
Table 8.10: Age-standardised DALY rates for risk factors, by socioeconomic group, 2015

Risk factor	1 Lowest	2	3	4	5 Highest	Australia	Rate ratio	Rate difference
Tobacco use	24.3	19.9	15.8	13.0	9.2	16.4	2.6	15.1
Overweight & obesity	20.4	16.6	14.9	12.6	10.1	14.9	2.0	10.3
Dietary risks	17.4	14.5	12.3	10.5	8.5	12.8	2.0	8.9
High blood pressure	12.5	11.3	9.6	8.4	7.3	9.8	1.7	5.2
Alcohol use	11.2	10.1	8.5	7.6	6.2	8.6	1.8	5.0
High blood plasma glucose	12.3	8.6	8.3	6.5	5.1	8.2	2.4	7.2
Illicit drug use	7.1	7.2	5.7	4.3	3.1	5.4	2.3	4.0
High cholesterol	7.0	6.0	5.0	4.2	3.7	5.2	1.9	3.2
Physical inactivity	5.7	4.8	4.3	3.7	3.1	4.4	1.9	2.7
Occupational exposures & hazards	4.3	4.0	3.6	3.1	2.7	3.8	1.6	1.6
Impaired kidney function	4.5	3.7	3.2	2.7	2.1	3.5	2.2	2.4
Intimate partner violence	2.0	1.8	1.6	1.4	0.8	1.5	2.4	1.2
All risk factors above combined	**79.9**	**70.1**	**60.5**	**51.6**	**41.3**	**61.0**	**1.9**	**38.7**

Variation by risk factor

Generally, a strong gradient in burden rates is apparent across socioeconomic groups, with higher rates of burden in the lowest group (Figure 8.9). There was a clear pattern of decreasing rate of burden from all risk factors with increasing socioeconomic group.

Figure 8.9: DALY age-standardised rate (DALY per 1,000 population) for selected risk factors, by socioeconomic group, 2015



Note: Rates were age-standardised to the 2001 Australian Standard Population and represent DALY per 1,000 population.

Data quality

Aside from the challenges of estimating burden of disease at a national level, sub-national estimates create new challenges—in particular, with regard to finding data for disease prevalence and for risk factor exposure that can be disaggregated by the sub-national groupings of interest.

States and territories

Data quality for fatal burden was high for all states and territories.

For estimating non-fatal burden, data quality varied across diseases at the jurisdictional level. For some diseases, there were reliable data for all states and territories; for others, there were reliable data for only some jurisdictions. Even when data were available by state and territory, estimates may not have been reliable in jurisdictions with smaller populations (for example, the Northern Territory, Tasmania and the Australian Capital Territory). When appropriate data were not available, adjustments were made to national prevalence rates to produce jurisdiction-specific rates.

Rates for the oldest age groups in the Australian Capital Territory and the Northern Territory may be unreliable due to the small population sizes in the older age groups.

Remoteness areas

Fatal burden estimates by remoteness area were based on geographical alignment of the area of usual residence to a remoteness area. A valid remoteness area is available for more than 99% of deaths in 2015.

Data quality varied substantially across diseases for remoteness estimates. For some diseases, reliable data were available; for others, only some remoteness categories were available, or some remoteness categories were grouped together. Data availability was particularly limited for *Very remote* areas as few large national surveys sampled from these areas. When appropriate data were not available, adjustments were made to national prevalence rates to produce rates by remoteness.

Socioeconomic groups

Fatal burden estimates by socioeconomic groups are based on geographical alignment of the area of usual residence to areas ranked according to an index of relative disadvantage. A valid area alignment is available for more than 99% of deaths in 2015.

Data quality by socioeconomic group varied for non-fatal burden. Where possible, data by socioeconomic group were obtained directly. When appropriate data were not available, adjustments were made to national prevalence rates to produce rates by socioeconomic group, using secondary data sources such as hospitalisations or national survey data.

Similar to estimating burden by remoteness, data availability was particularly limited for *Very remote* areas, which have a high proportion of the population in quintile 1 compared with other remoteness areas.

Data for risk factor exposure by socioeconomic group were based on data for national estimates. Modelling was used to estimate exposure for each socioeconomic group for dietary and biomedical risk factors. Data for physical activity were available for leisure-based activity but not for other domains (transport, household chores, occupational). It was also not possible to estimate occupational injuries by socioeconomic status.

Where any component of exposure by socioeconomic group was not available, attributable burden was not calculated and the risk factor was omitted from estimates for all risk factors combined.

9 International context and comparisons

While the ABDS is an Australian-specific study, it was developed in a context of several global burden of disease studies whose methods were studied and applied where and as appropriate. The international context of burden of disease and the comparisons that can be made are important and provide a useful perspective of global disease burden.

What is the international context of burden of disease studies?

As outlined in Chapter 1, there have been various global burden of disease studies since the first one, published in the 1990s, which developed the DALY metric (Murray & Lopez 1996). There have been a number of global studies since then:

- The first global study was updated for the period 2000–2002, with a more detailed analysis and a more comprehensive risk factor comparison (Lopez et al. 2006).
- The WHO updated the DALY results for 2004 with projections to 2030 (WHO 2009a), and the attribution to risk factors (WHO 2009b).
- The GBD 2010, coordinated by the IHME, was published in 2012 (Murray, Vos et al. 2012). This was the first GBD officially conducted by the IHME. It included a number of revisions to methods, which were then used to calculate DALY for 1990, 2005 and 2010.
- The WHO estimated its own global health estimates for 2012, 2015 and 2016 (WHO 2014, 2017, 2018).
- The IHME produced estimates for 2013 and, since the GBD 2015, has produced annual updates for its estimates (Murray et al. 2015; GBD 2015 DALYs and HALE Collaborators 2016; GBD 2016 DALYs and HALE Collaborators 2017; GBD 2017 DALYs and HALE Collaborators 2018).

ABDS and GBD

A key role of the GBD study is to provide global estimates, and then disaggregate to global region and country level to support international comparisons and benchmarking. The ABDS starts with Australian-specific data and estimates and then breaks down the estimates of disease burden within the country. Hence, the priority for the Australian study is for the best quality country-level data suited for use in health policy and planning for Australia. The GBD study provides the best basis for international comparisons, as it uses methods applicable to all countries; the ABDS provides the best basis for understanding Australia's burden of disease, and that of sub-national populations within Australia.

Following the GBD 2010 study, the AIHW assessed the methods used to determine how they could be applied to the Australian context (AIHW 2014). There were areas where it was appropriate to use the GBD approach and areas where the GBD method was adapted. Hence, the ABDS is largely based on the GBD framework but with modifications to make it best suited to the Australian context.

Why have an Australian-specific study?

Recent global studies have estimated disease burden in Australia; however, they do not fully capture the range and breadth of diseases and risk factors of importance in the Australian context. As well as this, the GBD studies do not reflect the high-quality, detailed and up-to-date health data available in Australia. Estimates are also not available for subnational population groups. The primary use of global studies is for international comparison, with methods and assumptions designed to match international data and context.

The ABDS is valuable as it considers data sources, methods and sub-populations that are more relevant to Australia than the global studies. It provides the most up-to-date picture of the disease burden faced by Australia to inform Australian health policy and planning.

Can the ABDS 2015 be compared with international studies?

International comparisons are important and can provide a useful perspective of global disease burden. The GBD studies and the WHO's Global Health Estimates help to inform comparisons that show how health challenges differ globally and regionally. Comparisons are best made with data that are based on consistent definitions and that have similar collection methods and population coverage. In practice, this means that results are comparable within a study but not between studies. Hence, the GBD and WHO results for Australia cannot be compared with results produced in this study. Table 9.1 outlines some of the differences between these studies.

Table 9.1: Comparison of key method choices in the ABDS 2015, GBD 2017 and the WHO 2015 burden of disease estimates

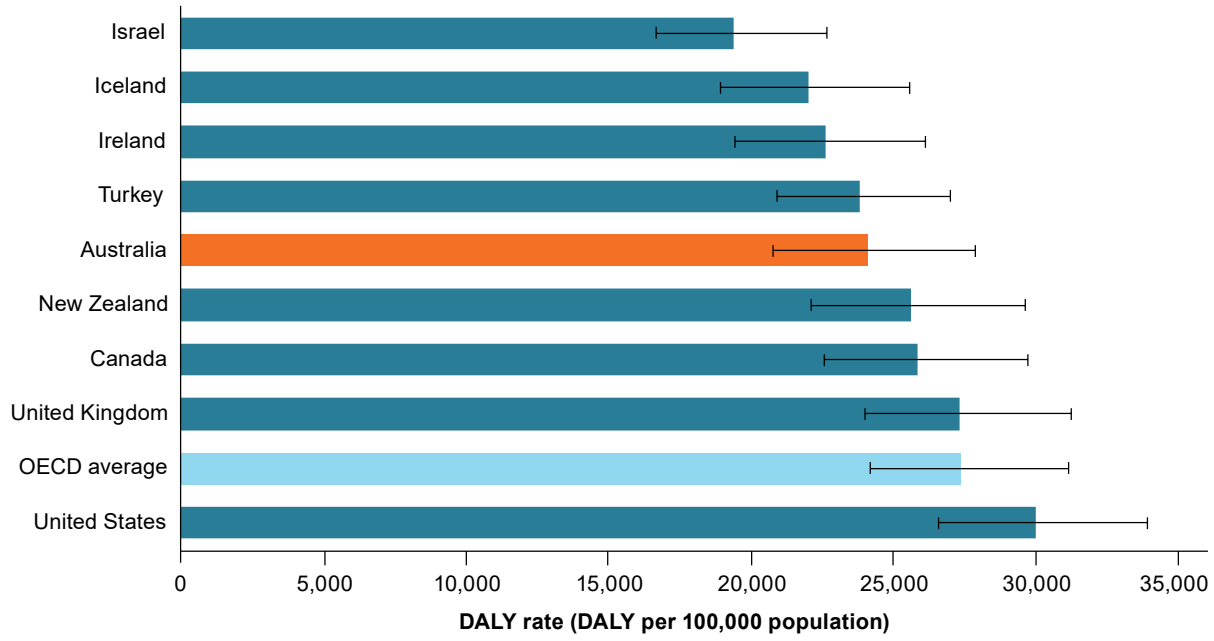
	ABDS 2015	GBD 2017	WHO 2015
Impacts on disease-specific results			
Disease (condition) list and ICD code allocation	Australia-specific (grouped for policy relevance)	GBD specific	WHO specific
Impacts on total deaths and YLL results			
Data sources	AIHW National Mortality Database	Modelled from various sources	WHO mortality database
Redistribution	Australia-specific	GBD specific	WHO specific
Standard life table	GBD 2010	GBD 2017	WHO specific
Impacts on YLD results			
Data sources	Australia-specific prevalence estimates derived directly where possible	Modelled from various sources	Modelled from various sources
Conceptual models	Australia-specific	GBD specific	GBD/WHO specific
Disability/health state weights	GBD 2013	GBD 2013	GBD 2015 with some modifications
Impacts on risk factor-specific results			
Risk factor list	Australia-specific	GBD 2017	—
Linked disease list	GBD 2016	GBD 2017	—
Data sources	Australia-specific exposure prevalence estimates	Modelled from various sources	—

How does Australian burden compare internationally?

Australian estimates can be compared with those for countries and regions as estimated in the GBD 2017. This section compares disease burden estimates for Australia with those for member countries of the Organisation for Economic Co-operation and Development (OECD) in 2015, using the GBD 2017 results (GBD Collaborative Network 2018). Comparisons have been made with member countries in the OECD, as these developed countries are considered most comparable to Australia. Global estimates have also been included.

In 2015, Australia had the fifth lowest rate of disease burden of all OECD countries, behind Israel, Iceland, Ireland and Turkey, and the average DALY rate was significantly lower than that of all OECD countries (Figure 9.1).

Figure 9.1: Total burden rate (DALY per 100,000 population) in Australia compared with that for selected OECD countries and OECD average, 2015



Note: The lines indicate 95% confidence intervals.

Source: AIHW analysis of the GBD 2017 (GBD Collaborative Network 2018).

Australia's lower rates of total burden were driven by significantly lower rates of fatal burden in Australia, ranking fourth lowest of all OECD countries. By comparison, Australia was ranked 10th of all OECD countries for rate of non-fatal burden and this was similar to the OECD average.

Figure 9.2 shows the leading causes of burden by GBD disease groupings for Australia, selected countries and globally for the year 2015. Note that these disease groups differ from those reported in the ABDS.

Neoplasms (cancer), cardiovascular diseases, musculoskeletal disorders, mental disorders and neurological disorders were the leading 5 disease groupings contributing to burden in Australia and overall for OECD countries. Similarly, enteric infections, human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS) & sexually transmitted infections, neglected tropical diseases & malaria and other infectious diseases were the disease groupings contributing to the least disease burden in these countries.

The types of health issues that affect the higher income countries in the OECD differ from those that afflict many other parts of the world. Globally, the leading 5 disease groupings that contributed to disease burden were cardiovascular disease, neoplasms, maternal & neonatal disorders, respiratory infections & tuberculosis and musculoskeletal disorders. Enteric infections, HIV/AIDS & sexually transmitted infections and neglected tropical diseases & malaria also ranked notably higher globally compared with Australia and other OECD countries. This shows that health challenges differ globally. Variations between countries are driven by multiple and complex factors such as country development, health spending, life expectancy, geography, and the quantity and effectiveness of public health intervention.

Figure 9.2: GBD 2017 ranking of the leading causes of total burden, by rate (DALY per 100,000 population) in 2015 for Australia, selected OECD countries and globally

GBD 2017 disease group	Australia	Israel	Iceland	Ireland	Turkey	New Zealand	Canada	United Kingdom	United States	OECD Countries	Global
Neoplasms	1	1	1	1	2	1	1	1	2	1	2
Cardiovascular diseases	2	3	2	2	1	2	2	2	1	2	1
Musculoskeletal disorders	3	2	3	3	3	3	3	3	3	3	5
Mental disorders	4	5	5	4	4	4	5	5	4	5	7
Neurological disorders	5	4	4	5	6	6	4	4	5	4	9
Unintentional injuries	6	9	7	8	10	5	7	8	10	8	10
Chronic respiratory diseases	7	10	6	6	8	7	8	6	7	7	8
Other non-communicable diseases	8	7	8	7	5	8	9	7	9	9	6
Diabetes and kidney diseases	9	6	9	9	7	9	6	10	8	6	11
Substance use disorders	10	17	14	12	12	16	10	11	6	11	22
Sense organ diseases	11	8	11	13	14	12	13	12	15	12	18
Self-harm and interpersonal violence	12	14	12	14	17	13	14	16	12	13	16
Skin and subcutaneous diseases	13	11	10	10	15	11	11	13	13	14	21
Digestive diseases	14	13	13	11	11	14	12	9	11	10	13
Transport injuries	15	16	15	17	13	10	15	17	14	15	14
Maternal and neonatal disorders	16	12	17	15	9	15	16	15	16	16	3
Respiratory infections and tuberculosis	17	15	16	16	16	17	17	14	17	17	4
Other infectious diseases	18	20	19	19	20	18	20	20	21	21	19
Nutritional deficiencies	19	18	18	18	18	19	19	18	20	18	20
Enteric infections	20	19	20	20	19	20	18	19	18	19	12
HIV/AIDS and sexually transmitted infections	21	21	21	21	21	21	21	21	19	20	15
Neglected tropical diseases and malaria	22	22	22	22	22	22	22	22	22	22	17

Source: AIHW analysis of the GBD 2017 (GBD Collaborative Network 2018).

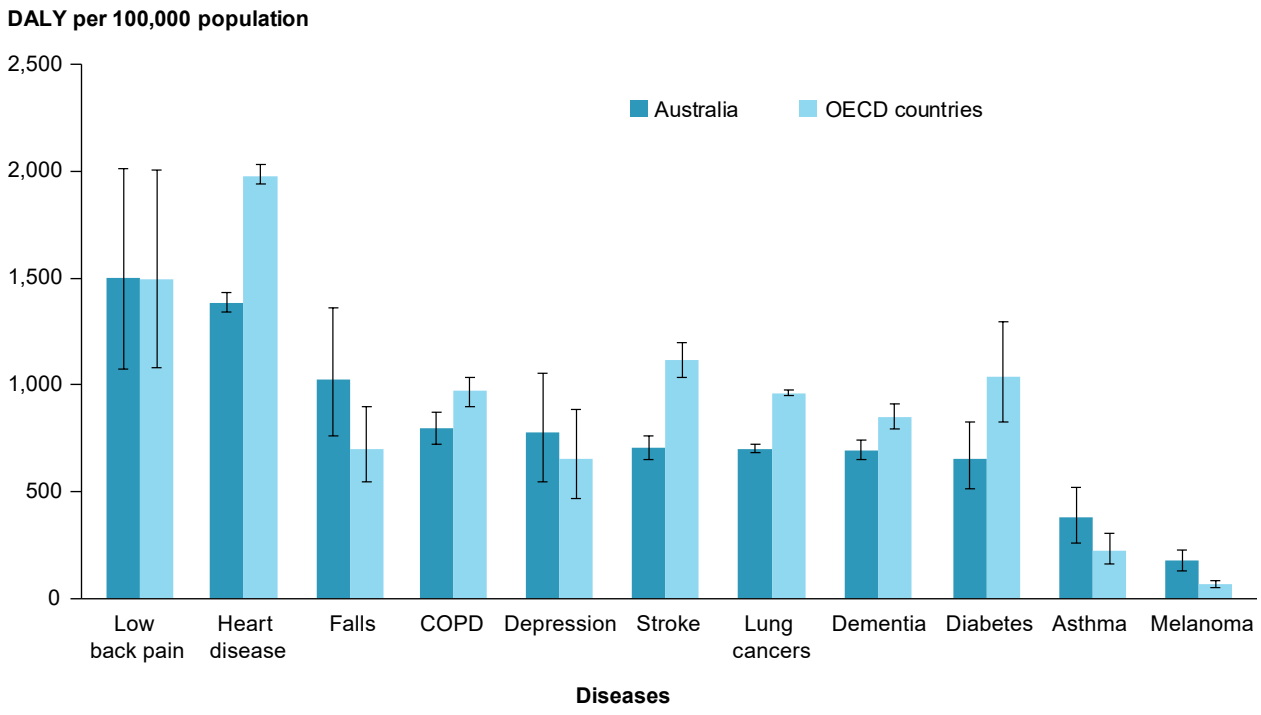
When examining the leading specific diseases contributing to DALY in Australia in 2015 (using the GBD 2017 results), most rates of burden for Australia were slightly lower than the average rates for OECD countries (Figure 9.3).

Compared with other OECD countries, Australia experienced significantly lower rates of burden from:

- ischemic heart disease
- stroke
- lung cancers
- COPD
- dementia
- diabetes.

By comparison, rates of burden for low back pain, falls, depression, asthma and melanoma were higher in Australia. This difference was statistically significant for melanoma only.

Figure 9.3: Total burden rate (DALY per 100,000 population) of selected high-burden diseases in Australia compared with OECD countries, 2015



Dementia = Alzheimer disease and other dementias; Diabetes = diabetes mellitus; Depression = major depressive disorders; Heart disease = ischaemic heart disease; Lung cancers = tracheal, bronchus and lung cancer; Melanoma = malignant skin melanoma.

Note: The lines indicate 95% confidence intervals.

Source: AIHW analysis of the GBD 2017 (GBD Collaborative Network 2018).

Further information on comparable estimates for global and country-specific disease burden can be found online at www.healthdata.org/gbd/data.

10 Study developments and limitations

It is important that the ABDS evolves and incorporates methodological changes and data improvements. The ABDS 2015 analyses, undertaken between 2017 and 2019, are an update of burden of disease estimates for Australia to add the reference year 2015. The study uses the infrastructure developed as part of the ABDS 2011 but includes developments to reflect improvements in both data and methods since that study.

What are the underlying principles of the ABDS?

The principles and requirements developed to guide the ABDS 2011 were adopted for the 2015 update. These were specified in 2014 (AIHW 2014) and included the following principles relevant to this study:

- provide national estimates of fatal, non-fatal and total burden, as well as the attribution to specific risk factors that are up to date, of high quality and meet Australia's needs
- provide sub-national estimates (such as for state/territory, regional, socioeconomic groups) where valid
- maintain comparability with GBD methods as much as possible, with full clarity around any differences
- provide transparency in the data sources, assumptions and methods used, with the ability to replicate the results
- complete the work in an efficient and flexible manner, build national capacity, and set up the relevant infrastructure to enable efficient and timely ongoing updates
- ensure collaboration with the various stakeholders, including other burden of disease experts both nationally and internationally in order to contribute to global burden of disease work.

What stayed the same between Australian studies?

The ABDS 2011 study was published in 2016 (AIHW 2016b). The overarching methods adopted in the ABDS 2011 were used in the ABDS 2015. These include the ABDS disease list structure and groupings, methods for redistributing deaths for fatal burden, prevalence estimates for non-fatal burden and the use of the comparative risk assessment method for attributable burden estimates.

As was done for the ABDS 2011, the majority of the estimates for the ABDS 2015 were based on the best available Australian data, using detailed unit record or linked data in many cases. In some instances, a single, high quality data source was identified as being appropriate for the Australian context (such as the mortality data for the fatal burden estimates); in other cases, multiple data sources were used (such as using a primary data source to obtain a total sex-specific prevalence estimate and a secondary data source to obtain age distributions). Use of detailed local data sources has resulted in less reliance on modelling than in the GBD studies.

The same disability weights were used as for the ABDS 2011. These were sourced from the GBD 2013 (Salomon et al. 2015) and continue to be used in the most recent GBD studies.

What changes were made in the ABDS 2015?

Methodological changes

The key methodological changes between the 2011 ABDS and the current study are outlined in Chapter 1 (Box 1.4).

The main method developments in the ABDS 2015 are the addition of new diseases (Box 10.1), revised conceptual models for some diseases—notably cardiovascular disease, cancer and injuries, greater use of linked data, more detailed risk factor reporting, revised risk factor models, attributable burden estimates by socioeconomic group and calculation of HALE.

Overall, 48% of the disease and injury non-fatal burden estimates were revised due to improvements in data and methods. Disease conceptual models (the concepts used to estimate health loss from the disease or injury based on knowledge of disease pathways) used in the ABDS 2011 were reviewed and revised where there had been changes in international methods or where new data sources were used that were previously unavailable. The revised conceptual models include the addition of specific sequelae (consequences of the disease), changes to chosen disability weights compared with the previous study, or changes in assumptions on durations of health loss. As well, recent Australian-specific epidemiological studies were used to inform age, sex or severity distributions for some disease estimates.

The ABDS 2015 also made more extensive use of state-level linked hospital and deaths data, which were unavailable when conducting the ABDS 2011. Linked data were available for New South Wales and Victoria in the ABDS 2015, whereas linked data from Western Australia only were used in the ABDS 2011.

To ensure transparency in terms of the data sources, assumptions and methods, detailed methods information is provided in the accompanying report *Australian Burden of Disease Study 2015: methods and supplementary material* (AIHW 2019a). Detailed data visualisations are also available on the AIHW website.

Box 10.1: New diseases in the ABDS 2015

The ABDS 2015 includes diseases not estimated in previous Australian studies; that is, they were previously grouped with other diseases within the disease group. This includes estimates of burden due to:

- acute and chronic lymphoblastic leukaemia
- acute and chronic myeloid leukaemia
- interstitial nephritis
- lip and oral cavity cancer
- mumps
- nasopharyngeal cancer
- road traffic injury—pedestrians and pedal cyclists
- type 1 and type 2 diabetes
- urinary tract infections.

Risk factors

In the ABDS 2015, new risk factors were included for impaired kidney function and child abuse & neglect. The dietary risk factors included in the study were revised, based on the latest evidence from a range of relevant reviews.

The methods for 14 of the 18 risk factors were revised, with the latest evidence including changes to linked diseases, the TMRED (that is, exposure not associated with health loss) and relative risks. For selected risk factors—overweight & obesity, physical inactivity, illicit drug use and alcohol use—assessment of relative risks and linked diseases were performed as part of extension projects from the ABDS 2011. The revised methods and inputs developed as part of these extension projects and any changes from the GBD 2016 have also been incorporated into the ABDS 2015. The model for high blood plasma glucose was revised to include exposure to diabetes as well as intermediate hyperglycaemia.

What are the data gaps?

The ABDS 2015 is based on the best current knowledge, methods and available data, as suited to the Australian context. Yet, undertaking this study highlighted a number of data gaps—particularly in the prevalence of diseases (for example, diseases treated in primary health care), data for some risk factors and Australian specific severity distributions.

Fatal burden

While Australia has very good quality deaths data, the method for estimating the fatal burden uses information on the underlying cause of death only—extra information contained in the associated causes of death is not currently used to assign the fatal burden. The current method assigns the entire burden to one cause of death, and therefore cannot take into account the more complex situation where multiple causes contribute to the death. It also relies on accurate allocation of the underlying cause of death.

Non-fatal burden

For the non-fatal component, as already mentioned, the ABDS 2015 was able to use detailed Australian data for many diseases and injuries, including unit record data and linked data combining separate data sets. The quality of prevalence data varies across diseases, however, and while the best available data were used, overseas data or older Australian data had to be relied on in some instances. For example, the dementia estimates are based on a published international meta-analysis, and thus the assumption was made that these rates apply in Australia. Further, while linked data have been used in the ABDS 2015, the majority were from linked data from 2 states. It would be a notable improvement if linked data were accessible at the national level.

Risk factors

For many of the risk factors it was possible to use high-quality measured or self-reported data on exposure. However, the quality for dietary risks, physical inactivity and those using blood measurements was limited by the data available to inform trends. In particular, for high blood plasma glucose, no data on trends were available and for low bone mineral density there were no national data. For many of the dietary risk factors, in particular risks for a diet high in a particular dietary component (e.g. diet high in processed meat), it was not possible to adjust the self-reported exposure estimate to account for under-reporting.

What are the methodological limitations?

The method used to derive the disability weights remains the subject of international discussion and debate (Haagsma et al. 2015; King et al. 2018; Nord 2013; Voigt & King 2014). The set of disability weights used in this study comes from the GBD 2013; the weights are based on surveys of populations in a number of countries as well as on an internet survey (Salomon et al. 2015) and are still being used in the most recent GBD studies. Analysis of the results suggested that there was little variation between countries in these valuations. However, to date, no specific validation in the Australian context has been undertaken.

Another general area where improvements could be made relates to the 'severity distributions', which represent the proportion of people with a given disease by levels of severity. The ABDS was able to use Australian data for some severity distributions, but relied on the GBD distributions for others. For many of these, the GBD had used data from the United States and Australian surveys, meaning that the distributions were likely to be suitable for Australia. While the global distribution would be appropriate in some cases, others may be improved with Australian-specific data.

While the ABDS 2015 used the best available data for prevalence, severity, risk relationships and other factors, these are constantly evolving and there is potential for improvement in future studies. As well, there are a number of opportunities to further explore the vast quantity of estimates presented in this report. This is discussed further in the section 'What opportunities are there for further analysis?' later in this chapter.

Quality of ABDS 2015 estimates

Uncertainty bounds have not been included in this study. Such estimation of uncertainty would need to take into account the complex analysis and manipulation needed to align the input data to the preferred epidemiological variables, disease definitions, population and time period. This would require a combination of assumptions, models and judgments. Thus, measures of uncertainty would need to take into account uncertainties in both the data (such as standard errors from surveys and misalignment with our preferred case definition) and the models and transformations (such as estimating prevalence from incidence and estimating sub-national estimates). It was not practical to incorporate all imperfections and uncertainties into a single measure, such as an uncertainty interval. Instead, the quality framework developed as part of the ABDS 2011 was used in the study.

A summary of the quality framework and quality information for all disease and risk factor estimates is provided (Appendix B), so that users of the ABDS 2015 can judge the appropriateness (or otherwise) of the estimates for particular purposes. Quality information specific to diseases and risk factors is provided in the accompanying report *Australian Burden of Disease Study 2015: methods and supplementary material* (AIHW 2019a).

What opportunities are there for further analysis?

During consultation with stakeholders, the AIHW identified a range of potential deeper analyses that could be undertaken of particular diseases and disease groups (for example, injuries), of particular risk factors (for example, nutrition) and of particular population groups. With appropriate data, further work could be undertaken to disaggregate sub-national estimates (for example, state by remoteness) or to explore the burden at local levels (for example, by primary health networks). Further work could also provide alternative groupings of diseases within and across disease groups (for example, vascular diseases, septicaemia).

There is further opportunity to explore the estimates for population health monitoring, including more in-depth expansion of morbidity estimates (for example, analysis in relation to chronic conditions using sequela level information that distinguishes acute and chronic effects, or detail across age/sex and sub-national groups) or to answer specific research questions (for example, burden in the last year of life for cancer, health of the working-age population).

The ABDS now has consistent, comparable estimates for 2003, 2011 and 2015 for analysis. Further studies to extend this time period will increase the value of the study by giving an even stronger and more reliable sense of the changes taking place in the health of the Australian population. Now that the necessary infrastructure to develop Australian specific estimates is in place, regular updates would enable future iterations to produce estimates closer to the current date, improving currency and relevance.

Another option would be to produce projections from the data. This could include short projections to the current year, which would allow the results to be presented in relation to the year the study is actually published. Longer term projections may also be useful.

There are opportunities to improve the estimates from the ABDS 2015. There are also various areas where refining our current methods would be beneficial; for example:

- validating comorbidity adjustment and introducing uncertainty estimation would provide more information about the reliability of the study's burden estimates
- incorporating multiple causes of death into YLL calculations would allow for further use of the available data to potentially improve YLL estimates.

There is also potential for work to explore Australia-specific disability weights (rather than using those from the GBD studies), based on more extensive data collections within Australia.

It is likely that further risk factors could be included in future analyses, including socioeconomic factors. The ABDS 2015 used an attenuation factor to derive joint effects from the risk factors (see Appendix A for more information). Further developments in this area may also be possible in the future.

Social factors (such as income/poverty, education and employment) play an important role in determining the health of a population, and they often have a strong association with health outcomes and health behaviours. The ABDS 2015 disaggregated the fatal, non-fatal and total burden estimates by a measure of socioeconomic position as a way to quantify disparities in fatal and non-fatal burden across different social and economic groups. Risk factors were estimated by socioeconomic group for the first time in this study.

As outlined in Chapter 9, the AIHW continues to monitor the methods used in other burden of disease studies. It will also incorporate developments into future iterations of the ABDS, as appropriate in the Australian context, and contribute to the body of knowledge and international expertise in this area.

Appendix A: Methods summary

This appendix summarises the methodological approach of the ABDS 2015. A more detailed methodological description is provided in a separate technical report (AIHW 2019a).

Burden of disease analysis aims to quantify health loss for all health outcomes, both fatal and non-fatal, and attribute it to a disease or injury category. This is achieved by separately estimating the fatal (YLL) and non-fatal (YLD) burden, according to a defined list of diseases, and summing them. The methods for estimating each are described below. This burden can then be attributed to risk factors selected for inclusion in that part of the analysis.

1 Disease and injury (condition) list

The disease and injury list details the specific diseases and causes of injury for which estimates were made. It is a classification which, in principle, is a set of mutually exclusive and collectively exhaustive categories of disease and causes of injury. Accordingly, it covers all fatal and non-fatal health outcomes (for which health loss is measured), with each outcome aligned to an item on the list.

An Australian disease and injury list was developed specifically for this study to reflect the Australian context; that is, the disease and cause groups are tailored to meet the needs of health reporting and monitoring for Australia. The list used in this study was developed with the following considerations:

- Australian policy interests are covered.
- The mortality and prevalence for each cause can be feasibly measured.

The resulting disease and injury list is hierarchical and comprises 2 levels. The highest level contains 17 disease groups under which 216 diseases and injuries are classified. This includes dual reporting of injury by either nature or external cause.

Residual causes are included for each disease group. These account for the health loss from diseases not specifically identified in the disease list and ensure that health loss is captured for all conditions. For example, 'other musculoskeletal conditions' are musculoskeletal conditions not included in arthritis, gout, rheumatoid arthritis and back pain & problems. Other musculoskeletal conditions will include conditions like systemic lupus erythematosus, fibromyalgia and tendonitis.

The disease list is included in Table A1 (see end of this appendix). Definitions of each disease by ICD-10 for mortality or ICD-10-AM (where relevant) for morbidity are in AIHW 2019a.

2 Fatal burden

A complete set of mortality data (by age, sex and geography) and a reference life table are the key requirements for producing estimates of YLL for each disease and injury included in the condition list.

2.1 Reference life table

The reference life table is a key component of the fatal burden analysis. Estimates of life expectancy at each age are used to indicate the number of years of life that are lost by dying at a specific age.

The ABDS 2015 uses the standard life table developed in the GBD 2010 study (Murray, Ezzati et al. 2012). This life table (see Table A2) was derived using the lowest age-specific mortality rates experienced around the world. The result is a hypothetical life table, rather than one experienced in any single country. The reference life table estimates life expectancy at birth to be 86.0 years for both males and females—28 years for a person aged 60 and 3 years for a person aged 95. See Table A2 for the reference life table used in this study.

2.2 Mortality data source

Analysis of burden of disease takes into account all deaths that occur in a population during a specified time period. The total number of deaths from all causes comes from the AIHW's National Mortality Database.

Australian deaths data are collected through the vital registration system—a system for collecting and maintaining records of life events, such as births, deaths and marriages, by a government authority. Cause of Death Unit Record File data are provided to the AIHW by the registries of births, deaths and marriages and the National Coronial Information System (managed by the Victorian Department of Justice) and include cause of death coded by the ABS. The data are maintained by the AIHW in the National Mortality Database.

The AIHW website <https://www.aihw.gov.au/reports-data/health-conditions-disability-deaths/life-expectancy-deaths/overview> provides detailed information on the registration of deaths and coding of causes of death to the ICD in Australia (AIHW 2018c). The completeness, accuracy and coding of these data are also described elsewhere (ABS 2016a). The deaths data are collated into an administrative data set for analysis. Given the high quality of these data, no modelling had to be undertaken to adjust for coverage or completeness for national estimates. Some transformation of the data has been undertaken to reassign some deaths to better fit the purposes of burden of disease analysis (see Section 2.3 in this appendix).

> Although derived from the same source, estimates of deaths by disease or disease group in this study should not be compared with estimates from other sources. This is because grouping of diseases may be different from that used in other studies, and deaths that do not fit within specific disease definitions for the ABDS 2015 have been 'redistributed' to other diseases (see Section 2.3 in this appendix).

Versions of mortality data

The analyses for this report include all deaths occurring during the reference periods (calendar years 2003, 2011 and 2015) that were registered up to and including 2016. Data were sourced from unit record files in the National Mortality Database and, by including the registrations for 2016, ensured that late registrations of deaths occurring in 2015 were included.

The analysis data set for this study comprised mostly cause of death information based on a final version of data. Specifically, 99% of deaths for the 2003 and 2011 reference years used a final version of cause of death data, while 95% for 2015 used a revised version of cause of death (that is, the cause is subject to change). Since 2006, deaths certified by a coroner are revised and causes are updated,

pending the status of coroner investigation. As such, some cause of death information is subject to change. The ABS revisions process is described in detail elsewhere (ABS 2016a).

2.3 Redistribution methods

There are a number of ICD codes that are not considered appropriate or valid causes of death for a burden of disease study. Some examples are:

- causes that should not be considered as the underlying cause or that are implausible as a cause of death, such as hypertension and paraplegia
- intermediate causes: causes such as septicaemia and pneumonitis that likely had some other precipitating cause
- immediate causes: causes that are generally observed as modes of dying, such as cardiac arrest, heart failure and respiratory failure
- causes that are ill defined or unspecified within a larger cause group; for example, ill-defined digestive cancer and ill-defined digestive diseases.

Despite its overall high quality, the Australian deaths data set includes some records with these codes. A list of the ICD-10 codes used to identify deaths for redistribution in the ABDS is shown in Appendix Table A3. For the 3 reference years combined, 9.0% of deaths were identified for redistribution.

The AIHW undertook a series of analyses in investigating methods for redistributing records with codes identified for redistribution. The methods ultimately adopted were, in order of priority, those described here:

- *Direct evidence*: this approach uses direct evidence about the particular deaths identified for redistribution. Information about the more likely cause of death is modelled on results of data linkage studies or sources other than the National Mortality Database. Direct evidence was used where available.
- *Indirect multiple causes of death (MCOD) method*: this method uses the pattern of the underlying causes of death (UCOD) where the cause identified for redistribution was mentioned as an associated cause of death. The corresponding UCODs and their proportional distribution provide the redistribution algorithm. For example, to inform the redistribution algorithm for deaths with an underlying cause of pneumonitis, all deaths that mentioned pneumonitis as an associated cause of death were identified. The UCODs of these records reflect a pattern of underlying causes of death for deaths that involved pneumonitis. This pattern was used to inform the algorithm for redistributing deaths where the underlying cause was coded as pneumonitis. The indirect MCOD method was applied where the redistribution was one of the most commonly occurring causes of death, and no direct evidence was available.
- *Proportional redistribution to specified target causes(s)*: this method reassigns deaths across a range of target causes selected according to the existing distribution of underlying cause of death within that disease group, or expert advice or the GBD redistribution algorithms. This method has the advantage of being a conceptually simple approach but may not be well customised to a particular redistribution code. Because of this, it was considered appropriate only for low-volume redistribution causes, and for those that were proportionately allocated by the GBD 2010 study where direct evidence was not available or where the indirect MCOD method was not suitable.

The expert panels for the disease groups assisted in identifying the direct evidence for redistribution causes and reviewed the application of the indirect MCOD and other redistribution approaches.

Applying the redistribution algorithms developed for the ABDS (using the methods described in this section) resulted in 85% of deaths identified for redistribution being reassigned to other causes using empirical evidence (direct evidence, indirect MCOD or a mix of both) (see Appendix Table A4).

2.4 Calculating YLL

YLL is calculated by summing the number of deaths at each single year of age, multiplied by the remaining life expectancy at this age according to the reference life table.

Age at death was missing in 14 records; in these instances, the age at death was set to the median age for the underlying cause of death for that sex.

2.5 Converting injury YLL from external cause to nature of injury

Two reporting perspectives are used for injury burden: external cause and nature of injury. Information pertaining to both perspectives is available in the National Mortality Database: external cause is reported as the UCOD, while information about the nature of injuries contributing to the death may be recorded as associated causes of death (ACOD). As each death record comprises a single UCOD and potentially multiple ACODs, a hierarchical list of injuries was developed to map the burden by external cause (the UCOD) to a single nature of injury category (the ACOD). The injury hierarchy was modified from the New Zealand Ministry of Health (unpublished), where injuries were ordered according to the likelihood of causing death, based on the nature of the injury, prognosis and clinical knowledge of injury conditions.

In this study, the links between the external cause and the nature of injury were produced as age- and sex-specific matrixes and used to convert YLL by external cause to YLL by nature of injury. The mapping process maintains internal consistency.

3 Non-fatal burden

The key inputs for estimating YLD are a complete set of point prevalence estimates for each defined outcome of a disease and injury included in the disease and injury list and a set of disability weights indicating the health loss.

3.1 Morbidity data sources

Unlike mortality data, there is no single comprehensive and reliable source of data on the incidence, prevalence, severity and duration of all non-fatal health conditions. Instead, morbidity estimates were drawn from a wide variety of sources, and generally based on the best single source.

Potential sources for disease-specific morbidity data had to have case definitions appropriate to the disease being analysed; had to be relevant to the Australian population; and had to be timely, accurate, reliable and credible. Where possible, national data sources, rather than sources relating to particular regions or sub-populations, were used.

Administrative data sources (for example, disease registers, hospitalisations) were evaluated for their level of ascertainment and coverage. Surveys were evaluated for their representativeness, potential selection bias and measurement bias (validity and reliability of measurement). Epidemiological studies were evaluated for the quality of their study design, their timeliness, credibility, representativeness and sources of bias or error.

All potential data sources (whether published or unpublished) were assessed for their comparability, relevance and representativeness, currency, accuracy, validation, credibility and accessibility/timeliness. These criteria were incorporated into a quality indicator for each estimate. Appendix B provides a summary of the quality for non-fatal estimates.

3.2 Disease conceptual models, disability weights and severity distributions

For each disease, a conceptual model of health loss was developed, based on models of the natural history of the disease. The conceptual models were developed in conjunction with disease experts. In many cases, a conceptual model was based on similar ones used in previous burden of disease studies. Each model depicts the major sources of health loss (sequelae) caused by different severity levels and stages of a disease, and then maps these to disability weights via corresponding 'health states'.

A health state reflects a combination of signs and symptoms that result in a certain amount of health loss and is not necessarily specific to one particular disease. Each health state is associated with a disability weight reflecting the health loss experienced by a person while in that state. The health states and disability weights used in the ABDS 2015 were drawn from the GBD 2013 (Vos et al. 2015).

Each sequela may be mapped to one or more health states—multiple states often constitute a severity distribution for the sequela (for example, mild, moderate, severe) or disease progression (such as progression through the various cancer phases). Within each sequela, a person can be in only one health state at any given point in time.

The disability weight for the sequela is the weighted average of the constituent disability weights.

Where prevalence measures were not available (such as long-term sequelae for injuries and congenital abnormalities), DISMOD II was used to produce estimates from incidence, mortality, case fatality and duration.

DISMOD II is a freely available statistical software tool that is commonly used in burden of disease studies to calculate missing epidemiological estimates or to refine them. It requires epidemiological estimates (such as measures of incidence, prevalence, remission and mortality) as inputs to calculate related epidemiological measures. For example, to estimate the prevalence of the long-term sequelae of injury, estimates were available for the incidence, remission of the injury sequelae and mortality (in this case, the mortality rate ratio). Using these measures as inputs, DISMOD II produces an estimate of prevalence that is consistent with the input parameters.

3.3 Comorbidity bias adjustment

Comorbidity (the existence of more than one disease or injury in an individual at the same time) introduces a potential challenge for burden of disease analysis. As the available prevalence data and disability weights represent the situation without regard to comorbidity, summing YLD estimates without adjustment would lead to an overestimation of the overall non-fatal burden. The unadjusted health loss from some combinations of comorbid causes might even be greater than 1 (that is, worse than death). A method is therefore required to correct for the comorbidity bias.

The ABDS 2015 did not attempt to compile data on the pattern of actual comorbidity within the population. Instead, it accounted for the comorbidity bias in the calculated YLD by adopting the 2 key assumptions used in burden of disease studies: the multiplicative independence model for prevalences of comorbidity, and the multiplicative model for health loss /disability weights associated with comorbidity. It then applied a modified deterministic approach, where all possible combinations of 4 or fewer conditions are taken from the disease sequelae list.

With this approach, the prevalence rate for a particular condition is a proxy for the probability of an individual having that particular condition. The probability of having just 1 condition is calculated by multiplying the probability of having the condition by the probabilities of not having any other condition(s). Similarly, the probability of having a particular combination is calculated by multiplying the probabilities of having each condition by the probabilities of not having any others.

Because of the multiplicative approach, the probabilities associated with each combination shrink rapidly toward zero (0) as the number of co-present sequelae rises. Capping the number of sequelae at 4 accounts for nearly all change in the associated disability weights. The impact of any change on the calculated YLD of the fifth co-present sequelae is minimal as the comorbidity bias adjusted disability weight is stable to the fifth decimal point. Any change in the fifth decimal place will only impact the YLD calculated for prevalence estimates greater than 100,000 in a particular age–sex cohort.

The model calculates an adjusted disability weight using all possible combinations of 1 to 4 simultaneous conditions drawn from the 700 conditions. Box A1 shows the calculation of the adjusted disability weight for a condition using all combinations of 2 of 4 conditions as an example.

Box A1: Calculation of an adjusted disability weight

Consider the calculation of the adjusted disability weight for a condition using all combinations of 2 of 4 conditions. Each of the 4 conditions (A–D) has a prevalence rate and an associated disability weight, specified by the following parameters:

4 conditions:	*A*	*B*	*C*	*D*
4 disability weights:	$DW_{(A)}$	$DW_{(B)}$	$DW_{(C)}$	$DW_{(D)}$
4 prevalence rates:	Pr(*A*)	Pr(*B*)	Pr(*C*)	Pr(*D*)

Calculate the probability that a person will have a combination of 2 or fewer conditions, including condition *A*.

The probability of a person in the population having condition *A* is approximated by the prevalence rate of condition *A* denoted as Pr(*A*).

The probability of a person in the population having ***only*** condition *A* is the probability of having condition *A* multiplied by the probability of ***not*** having condition *B*, *C* or *D* and is shown by:

$$Prob(A) = Pr(A)*(1-Pr(B))*(1-Pr(C))*(1-(Pr(D)).$$

It follows that the probability of having *A* and *B* only is given by:

$$Prob(AB) = Pr(A)*Pr(B)*(1-Pr(C))*(1-(Pr(D))$$

and, similarly, the probability of having *A* and *C* only is given by:

$$Prob(AC) = Pr(A)*Pr(C)*(1-Pr(B))*(1-(Pr(D))$$

and the probability of having *A* and *D* only is given by:

$$Prob(AD) = Pr(A)*Pr(D)*(1-Pr(B))*(1-(Pr(C)).$$

Combine disability weights:

The disability weight associated with having condition *A* only is shown as $DW_{(A)}$. Using the multiplicative method of combining disability weights, the DW for *A* and *B* combined is:

$$DW_{(AB)} = 1-[(1-DW_{(A)})(1-DW_{(B)})].$$

The proportion of this combined disability weight that can be attributed to condition *A* is:

$$Prob(A)/(Prob(A)+Prob(B)).$$

Therefore, the disability weight associated with condition *A* from the population with both conditions (*A* and *B*) is given by:

$$DW_{(AB\_A)} = Prob(A)/(Prob(A)+Prob(B))* DW_{(AB)}$$

and the disability weight associated with condition *B* from the population with both conditions (*A* and *B*) is given by:

$$DW_{(AB\_B)} = Prob(B)/(Prob(A)+Prob(B))* DW_{(AB)}.$$

Adjust disability weight for condition *A*:

The comorbidity adjusted disability weight for condition *A* is a combination of the 4 adjusted disability weights derived from all the possible combinations (that is, $DW_{(A)}$, $DW_{(AB\_A)}$, $DW_{(AC\_A)}$, $DW_{(AD\_A)}$). The contribution of each disability weight is proportional, derived from the probability of each combination. The comorbidity adjusted disability weight for condition A ($adjDW_{(A)}$) is calculated using the following formula:

$$adjDW_{(A)}=[(Prob(A)* DW_{(A)}) + (Prob(AB)* DW_{(AB\_A)}) + (Prob(AC)* DW_{(AC\_A)}) + (Prob(AD)* DW_{(AD\_A)})] / [Prob(A) + Prob(AB) + Prob(AC) + Prob(AD)]$$

3.4 Calculating YLD

YLD is calculated at the disease-sequela level (by age and sex) by multiplying the point prevalence of the disease-sequela by its comorbidity adjusted disability weight.

Residual causes

Where the prevalence of the residual cause within a disease group cannot be ascertained from data or modelled directly, the YLD for the residual cause is calculated using the ratio of YLDs to YLLs estimated for other conditions in that disease group. This method was used to generate estimates for other cardiovascular, endocrine, gastrointestinal, infectious, congenital, respiratory, kidney and neurological diseases.

4 Total burden of disease

4.1 Calculating burden of disease measures

The DALY for each condition is calculated by summing the YLL and YLD for that condition. The total burden of disease is calculated by summing DALY across all conditions.

5 Health-adjusted life expectancy

5.1 Overview of HALE methods

In this study, HALE is estimated using Sullivan's method (described by Jagger et al. 2014). This method requires age-specific proportions of time spent in different states of health (in this report, full heath and ill health) and age-specific mortality information from a life table.

To estimate HALE, Australian life table data were adjusted in proportion to the average health of the population in each age group.

YLD is a measure of the years of what could have been healthy life that were instead spent in states of ill health. They represent durations of time spent living with illness, weighted for the severity of the illness, reflecting an equivalent severity weighted duration of health loss. These amounts, summed for all causes of illness, adjusted for comorbidity and averaged for the population, represent the average YLD per person (that is, the average time, per person, lived with disability). Accordingly, the complement of the average time spent in ill health is the average time spent in full health.

Applying the average level of full health per person to the total person-years lived (from a life table) results in the total person-years lived in full health. Subsequent application of life table methods results in a corresponding adjusted life expectancy—the health-adjusted life expectancy, or HALE.

Sullivan's method is used by many countries for estimating HALE. More detail on HALE calculations are described in the methods report (AIHW 2019a).

HALE is used elsewhere as a standard measure of population health. The WHO estimates HALE for member countries with Sullivan's method using the Global Burden of Disease estimates of YLD rates for each country. The European Union also computes and monitors HALE for European Union countries on an annual basis. HALE has been used elsewhere in policy application: in the United Kingdom for monitoring the quality of life and social exclusion of older people and in Canada to compare health status across provinces (Steifel et al. 2010).

5.2 Example of a HALE calculation

HALE calculation using Sullivan's method requires life tables and a measure of the average health of the population. Life expectancy quantifies the mortality experience and the YLD rates quantify the average health. Average health is measured on a scale of 0 to 1 and is represented by the YLD rate per person, or average health per person.

Consider an age-specific YLD rate of 150 YLD per 1,000 population. Out of 1,000 potential person-years, the equivalent of 150 years (weighted for severity of the impact of the health conditions) were spent in less than full health. That is, on average, each person spent 0.150 years or 15% of the year in ill health. Conversely, on average, each person spent the equivalent of 85% of the year in full health. That is, the average health of the population in this age group is 0.85.

The life table for this population describes that, after accounting for mortality, this age group lives a total of 350,000 person-years that year. We know from the YLD rate for this age group there is, on average, full health for 85% of the time lived by the population in this age group.

Therefore 85% of these 350,000 person-years, or 297,500 person-years are lived in full health.

These calculations are applied to each sex and age group, and then life table methods are used to calculate an adjusted person-years lived in full health and the corresponding adjusted life expectancy. The adjusted life expectancy is that which is lived in full health, or HALE. Where life expectancy represents the (average) total years lived regardless of the health state, HALE is the equivalent (average) years of healthy life lived.

6 Risk factors

Quantification of the impact of risk factors assists in making evidence-based decisions about where to direct efforts to improve population health and prevent disease and injury. The comparative risk assessment method has become standard global practice in burden of disease risk factor analysis (Ezzati et al 2004).

The basic steps to estimate risk factor attributable burden are:

1. select risk factors
2. select linked diseases for which there is convincing or probable evidence in the literature that the risk factor has a causal association with increased prevalence or mortality
3. define the exposure to the risk factor that is not associated with increased risk of disease (the TMRED or the counterfactual)
4. estimate the PAFs by either the direct method or the comparative risk assessment method
   (a) if PAFs appropriate to the disease and population in question are available from a comprehensive data source (such as a disease register), they are estimated directly from this data source (named a 'direct PAF' in this report) and do not require the following steps
   (b) if not, PAFs are created using the comparative risk assessment method, which involves steps 5, 6 and 7
5. define the amount of increased risk (relative risk) of linked disease morbidity or mortality due to exposure to the risk factor

6. estimate exposure to each risk factor in the population
7. use these inputs to calculate the PAF.

This section describes the method used to quantify the impact of risk factors in the ABDS 2015.

6.1 Linked diseases

A linked disease is a condition in the disease list with a known risk factor for that condition. For example, high fasting blood plasma glucose is a risk factor for type 2 diabetes, ischaemic heart disease, stroke and chronic kidney disease. In this report, such associations are described as diseases or injuries being 'linked to' that risk factor. Thus, these diseases are linked to the risk factor high blood plasma glucose.

Convincing or probable evidence is used to identify linked diseases as defined according to criteria set by the World Cancer Research Fund (WCRF & AICR 2007). The criterion is broken down into 'convincing', 'probable', 'possible' and 'insufficient' evidence. Linked diseases are categorised as convincing or probable based on the robustness and volume of studies showing a relationship. The lists of risk factors, linked diseases and the size of the association (relative risk) changes between successive burden of disease studies as more research evidence becomes available. The risk factors selected for inclusion in the study are shown in Table 6.1.

For those risk factors selected for inclusion in this study, the ABDS 2015 adopted the available relevant linked diseases used in the GBD 2016 (GBD 2016 Risk Factors Collaborators 2017) and those identified by the AIHW from literature reviews undertaken for selected risk factors as part of extension projects (AIHW 2017b, 2017c, 2018b).

The linked diseases were spread across 15 disease groups. Some risk factors were linked to a single disease only, while others had many outcomes within these disease groups.

6.2 Theoretical minimum risk exposure distribution

The estimated contribution of a risk factor to disease burden is calculated by comparing the observed risk factor distribution with an alternative, hypothetical distribution (the counterfactual scenario). This scenario could be an increase or decrease in levels of exposure or changes in behaviour compared with what is currently observed in the population. In the ABDS 2015, as in previous burden of disease studies, a TMRED scenario was adopted. This involved determining the hypothetical exposure distribution that would lead to the lowest conceivable disease burden.

For some risk factors, the choice of the TMRED is obvious, as it involves no exposure to risk—for example, all people are lifelong non-smokers, or all people are highly active. However, for many risk factors, no exposure is not appropriate, either because it is physiologically impossible (for example, blood pressure or body mass index), or because there are lower limits beyond which exposure cannot feasibly be reduced (for example, air pollution). In these cases, epidemiological evidence is used to determine the optimal level of exposure, which reflects either the lowest level at which a dose–response relationship can be observed within a meta-analysis of cohort studies, or the lowest risk factor exposure distribution observed globally (GBD 2016 Risk Factors Collaborators 2017).

The counterfactual then becomes a narrow distribution around the optimal level. For example, based on a meta-analysis of global studies, the counterfactual distribution for high body mass index is based on a population mean of a body mass index of 20–25 kg/m^2 with a standard deviation of 1.

The TMRED may not be achievable, feasible or economically viable in the Australian population; for example, no unsafe sex.

Where the TMRED is a range, exposure to risk is not dichotomous (that is, at risk or not at risk). In this situation, the measure of attributable burden cannot be estimated by simply comparing each level of exposure in the population with the endpoints. Instead, to determine how much burden each exposure level contributes compared with the TMRED, the relative position in the range of the level of exposure is compared with its relative position in the range of the TMRED. The appropriate TMRED value for each category of exposure depends on the placement of their category within the risk factor exposure distribution of the population, starting at the lowest TMRED possible.

6.3 Direct population attributable fractions

For some risk–outcome pairs, direct evidence is used to calculate the PAFs. This is used:

- for linked diseases where there is evidence from high-quality data sources to attribute a disease outcome to a risk factor in Australia. It is important that the estimate captures all cases of the disease outcome in Australia. An example is the HIV register which collects data on the risk factor exposures that cause HIV (unsafe sex and/or drug use). The direct PAF is calculated as the proportion of the outcome caused by the risk factor
- when exposure to the risk factor is necessary to have the outcome—for example, all of the disease outcome 'alcohol use disorders' is attributable to the risk factor 'alcohol use'. In this case, the PAF is 1, where all of the disease outcome is attributed to the risk factor.

6.4 Population distribution of exposure

To estimate the PAF using comparative risk assessment, the population distribution of exposure needs to be estimated.

A clear and consistent definition of risk factor exposure is a key requirement for estimating the proportion of the population 'at risk.' For the ABDS 2015, the definitions of risk factor exposures have been adopted where possible from the GBD 2016 (GBD 2016 Risk Factors Collaborators 2017) and the AIHW's review of the literature (AIHW 2017b, 2017c, 2018b).

Estimates of distributions of risk factor exposure for the Australian population by age and sex have been based on a variety of data sources:

- Australian Health Survey 2011–12
- ABS data on apparent consumption of alcohol
- Census of Population and Housing
- Kirby Institute annual surveillance reports
- Labour Force Survey
- National Drug Strategy Household Survey 2016

- National Health Survey 2014–15
- National HIV Register
- National Homicide Monitoring Program
- National Hospital Morbidity Database
- National Mortality Database
- Personal Safety Survey 2016
- Safe Work Australia
- state-based air monitoring stations.

For the ABDS 2015 study, empirical survey data were used where possible to determine the exposure to risk factors. The proportion of the population exposed to each risk factor was estimated according to the finest exposure increments supported by the data source.

Where data were extracted directly from a survey (for example, the Australian Health Survey 2011–12), they were extracted so that the relative standard error for the majority of cells was 25% or less. Sex, age groups or exposure categories were aggregated into larger cells to conform to this principle as necessary; however, for a small number of age and sex categories, it was necessary to accept estimates with relative standard errors between 25% and 50%.

6.5 Estimates of effect size (relative risks)

Comparative risk assessment estimates use relative risks to measure the strength of causal association between risk factors and the linked disease outcomes. The ABDS 2015 has adopted relative risks released by the GBD 2016 or the AIHW's review of the literature (AIHW 2017b, 2017c, 2018b; GBD 2016 Risk Factors Collaborators 2017). The GBD relative risks used were deemed appropriate to be used globally, in different countries and for different ethnicities.

Effect sizes used were adjusted for confounders ('parallel' risk factors) but not for factors that occur successively along the causal pathway. For example, relative risk of coronary heart disease due to physical inactivity was not adjusted for high blood plasma glucose as these risk factors occur along the same causal pathway. This means that their effects cannot be added together, as discussed in Chapter 6.

The relevant relative risk to apply to each exposure category was determined as the relative risk for the median survey response of that category. For example, for the proportion of the population who ate 80–120 g of fruit, the relative risk for the median, which was 111 g in this example, was applied. When the exposure category included an open-ended range, the median in this range was also used.

6.6 Calculation of population attributable fractions

PAFs determine the proportion of a particular disease that could have potentially been avoided if the population had never been exposed to a risk factor (or, rather, had been exposed to TMRED levels). PAFs were calculated for each linked disease by sex and age group.

The calculation of PAFs using the comparative risk assessment method requires the input of the relative risk (*RR*) and prevalence of exposure in the population (*P*):

$$PAF = \frac{P(RR - 1)}{P(RR - 1) + 1} \times 100$$

When the risk factor has multiple categories of relative risks and exposure levels, the following formula is used:

$$PAF = \frac{\sum_c P_c\,(RR_c - 1)}{\sum_c P_c\,(RR_c - 1) + 1} \times 100$$

where:

$\sum_c$ is the sum over all categories

c is an index for category

P is prevalence

RR is relative risk.

6.7 Combined risk factor analysis

To combine risk factors, the following formula was used:

$$PAF_i = 1 - \prod_r (1 - PAF_{ir})$$

where:

PAF_i is the population attributable fraction of burden attributable to a particular disease from those risk factors being combined, such as all risk factors or all dietary risk factors

i is the linked disease

r is the individual risk factor for a linked disease being combined

PAF_{ir} is the population attributable fraction for risk factor *r* for linked disease *i*

Π is the product over all risk factors *r*.

This formula, which has been used in several other studies, has the desirable property of placing a cap on the estimated combined attributable burden and therefore avoids the possibility of exceeding 100% of the total burden of disease.

However, the formula assumes that risk factors are 'independent'; that is, it does not take into account risk factors that are on the same causal pathway. To account for risk factors on the same causal pathway, attenuation factors were used to attenuate the PAF of the risk factor second to the other factor in the same causal pathway. The attenuation factors were sourced from GBD 2016 (GBD 2016 Risk Factors Collaborators 2017).

7 Overarching methods/choices

7.1 Reference year

The reference year for the estimates is 2015. This was the latest year of data available at the time of analysis for the majority of data sources used to produce burden of disease estimates.

Estimates for the reference years 2011 and 2003 were also calculated, to supersede burden of disease estimates from previous burden of disease studies, and to allow for comparisons over time.

Where data were not available for the reference year from a particular data source, techniques were used to adjust the counts or rates to the reference year. The first step was to examine historical data over a number of years (if available) to determine if prevalence rates had changed over time. If so, regression techniques were used to model the data point to the reference year. Where this was not possible, or where an examination of historical data suggested that prevalence rates had been stable over the intervening period, prevalence rates from earlier studies were applied to the population in that reference year to derive estimates. The newly derived estimtes thus account for population growth and ageing only.

7.2 Age groups

Analysis of age groups

Preparation of input data was undertaken using as fine a disaggregation as the data supported. Analysis of YLL estimates was undertaken using single-year age groups, while YLD analysis was undertaken using 5-year age groups to 100+. DALY estimates were prepared using 5-year age groups to 100+ years.

Where data could not be obtained directly by single year or by the 5-year age groups as required for analysis, modelling was used to derive the required age groups.

Due to small populations in some jurisdictions and remoteness areas, sub-national estimates were prepared using 5-year age groups to age 85+.

Reporting of age groups

Age groups suitable for reporting are different for different aspects of the study. Generally, national estimates for each year have been reported using the analysis age groups, or grouped for issues of practicality (such as describing burden by life stage). While numbers and rates are reported for older age groups (that is, age groups over 85), it should be noted that these are based on much smaller populations and hence are subject to greater variability.

7.3 Sub-national analyses

Analysis for state and territory, remoteness and socioeconomic group was carried out by geographical areas. Where the data source included the geographical information based on the Australian Statistical Geography Standard 2011 (ABS 2013a), estimates were derived using ABS correspondence based on geographic location. Where geographical information was not available, ratios based on associated data sources for that reference year were used to disaggregate national data.

7.4 Reference populations

All Australian population-based rates are calculated using populations rebased to the 2016 Census (27 June 2017) (ABS 2017a). The Australian 2001 Standard Population (published 15 December 2016) is used for all age-standardisation as per AIHW and ABS standards (ABS 2016b).

Table A1: Disease and injury list

Infectious diseases	Infectious diseases (continued)	Cancer & other neoplasms (continued)
Barmah Forest virus	Urinary tract infections	Lip & oral cavity cancer
Campylobacteriosis	Varicella	Liver cancer
Chlamydia	**Infant & congenital conditions**	Lung cancer
Dengue	Birth trauma & asphyxia	Melanoma of the skin
Diphtheria	Brain malformations	Mesothelioma
Gonorrhoea	Cardiovascular defects	Myeloma
HIV/AIDS	Cerebral palsy	Nasopharyngeal cancer
Haemophilus influenzae type-b	Cleft lip and/or palate	Non-Hodgkin lymphoma
Hepatitis A	Down syndrome	Non-melanoma skin cancer
Hepatitis B (acute)	Gastrointestinal malformations	Oesophageal cancer
Hepatitis C (acute)	Neonatal infections	Other benign, in situ & uncertain neoplasms
Herpes-zoster	Neural tube defects	Other leukaemias
Influenza	Other chromosomal abnormalities	Other lymphohaematopoietic (blood) cancers
Lower respiratory infections	Other congenital conditions	Other malignant neoplasms (cancers)
Malaria	Other disorders of infancy	Other oral cavity & pharynx cancers
Measles	Pre-term birth & low birthweight complications	Ovarian cancer
Meningococcal disease	Sudden infant death syndrome	Pancreatic cancer
Mumps	Urogenital malformations	Prostate cancer
Other gastrointestinal infections	**Cancer & other neoplasms**	Stomach cancer
Other infections	Acute lymphoblastic leukaemia (ALL)	Testicular cancer
Other meningitis & encephalitis	Acute myeloid leukaemia (AML)	Thyroid cancer
Other sexually transmitted infections	Benign & uncertain brain tumours	Unknown primary
Otitis media	Bladder cancer	Uterine cancer
Pertussis	Bowel cancer	**Cardiovascular diseases**
Pneumococcal disease	Brain & central nervous system cancer	Aortic aneurysm
Ross River virus	Breast cancer	Atrial fibrillation & flutter
Rotavirus	Cervical cancer	Cardiomyopathy
Rubella	Chronic lymphocytic leukaemia (CLL)	Coronary heart disease
Salmonellosis	Chronic myeloid leukaemia (CML)	Hypertensive heart disease
Syphilis	Ductal carcinoma in situ (breast)	Inflammatory heart disease
Tetanus	Gallbladder cancer	Non-rheumatic valvular disease
Trachoma	Hodgkin lymphoma	Other cardiovascular diseases
Tuberculosis	Kidney cancer	Peripheral vascular disease
Upper respiratory infections	Laryngeal cancer	Rheumatic heart disease (including acute rheumatic fever)

(continued)

Table A1 (continued): Disease and injury list

Cardiovascular diseases (continued)	Mental & substance use disorders (continued)	Musculoskeletal conditions
Stroke	Attention deficit hyperactivity disorder	Back pain & problems
Respiratory diseases	Autism spectrum disorders	Gout
Asthma	Bipolar affective disorder	Osteoarthritis
COPD	Conduct disorder	Other musculoskeletal
Interstitial lung disease	Depressive disorders	Rheumatoid arthritis
Other pneumoconiosis	Drug use disorders (excluding alcohol)	**Hearing & vision disorders**
Other respiratory diseases	Eating disorders	Age-related macular degeneration
Sarcoidosis	Intellectual disability	Cataract & other lens disorders
Upper respiratory conditions	Other mental & substance use disorders	Glaucoma
Gastrointestinal disorders	Schizophrenia	Hearing loss
Abdominal wall hernia	**Endocrine disorders**	Other hearing & vestibular disorders
Appendicitis	Gestational diabetes	Other vision disorders
Chronic liver disease	Other diabetes mellitus	Refractive errors
Diverticulitis	Other endocrine disorders	**Skin disorders**
Functional gastrointestinal disorders (FGID)	Type 1 diabetes mellitus	Acne
Gallbladder & bile duct disease	Type 2 diabetes mellitus	Dermatitis & eczema
Gastro oesophageal reflux disease (GORD)	**Kidney & urinary diseases**	Other skin disorders
Gastroduodenal disorders	Chronic kidney disease	Psoriasis
Inflammatory bowel disease (IBD)	Enlarged prostate	Skin infections (including cellulitis)
Intestinal obstruction (without hernia)	Institial nephritis	Ulcers
Other gastrointestinal diseases	Kidney stones	**Oral disorders**
Pancreatitis	Other kidney & urinary diseases	Dental caries
Vascular disorders of intestine	**Reproductive & maternal conditions**	Other oral disorders
Neurological conditions	Early pregnancy loss	Periodontal disease
Dementia	Endometriosis	Severe tooth loss
Epilepsy	Genital prolapse	**Blood & metabolic disorders**
Guillain-Barré syndrome	Hypertensive disorders of pregnancy	Cystic fibrosis
Migraine	Infertility	Haemolytic anaemias
Motor neurone disease	Maternal haemorrhage	Haemophilia
Multiple sclerosis	Maternal infections	Iron-deficiency anaemia
Other neurological conditions	Obstructed labour	Other blood & metabolic disorders
Parkinson disease	Other maternal conditions	Protein-energy deficiency
Mental & substance use disorders	Other reproductive conditions	
Alcohol use disorders	Polycystic ovarian syndrome	
Anxiety disorders	Uterine fibroids	

(continued)

Table A1 (continued): Disease and injury list

External causes of Injury	Nature of injury
All other external causes of injury	Burn injuries
Drowning	Dislocations
Falls	Drowning & submersion injuries
Fire, burns & scalds	Hip fracture
Homicide & violence	Humerus fracture
Other land transport injuries	Internal & crush injury
Other unintentional injuries	Other fractures
Poisoning	Other injuries
Road traffic injuries—motor vehicle occupants	Poisoning
Road traffic injuries—motorcyclists	Soft tissue injuries
Road traffic injuries—pedal cyclists	Spinal cord injury
Road traffic injuries—pedestrians	Tibia & ankle fracture
Suicide & self-inflicted injuries	Traumatic brain injury

Table A2: Standard life table: remaining ideal life expectancy (years), by age for all people

Age	Life expectancy	Age	Life expectancy	Age	Life expectancy	Age	Life expectancy
0	86.02	27	59.43	54	33.32	81	10.32
1	85.21	28	58.44	55	32.38	82	9.65
2	84.22	29	57.45	56	31.47	83	8.98
3	83.23	30	56.46	57	30.55	84	8.31
4	82.24	31	55.48	58	29.64	85	7.64
5	81.25	32	54.49	59	28.73	86	7.12
6	80.25	33	53.50	60	27.81	87	6.61
7	79.26	34	52.52	61	26.91	88	6.09
8	78.26	35	51.53	62	26.00	89	5.57
9	77.27	36	50.56	63	25.10	90	5.05
10	76.27	37	49.58	64	24.20	91	4.70
11	75.28	38	48.60	65	23.29	92	4.35
12	74.28	39	47.62	66	22.42	93	4.00
13	73.29	40	46.64	67	21.55	94	3.66
14	72.29	41	45.67	68	20.68	95	3.31
15	71.29	42	44.71	69	19.80	96	3.09
16	70.30	43	43.74	70	18.93	97	2.88
17	69.32	44	42.77	71	18.10	98	2.66
18	68.33	45	41.80	72	17.28	99	2.44
19	67.34	46	40.85	73	16.45	100	2.23
20	66.35	47	39.90	74	15.62	101	2.11
21	65.36	48	38.95	75	14.80	102	1.99
22	64.37	49	38.00	76	14.04	103	1.87
23	63.38	50	37.05	77	13.27	104	1.75
24	62.39	51	36.12	78	12.51	105	1.63
25	61.40	52	35.19	79	11.75		
26	60.41	53	34.25	80	10.99		

Source: Murray, Ezzati et al. 2012.

Table A3: ICD-10 codes used to identify deaths for redistribution

	ICD-10 code
Redistribution	A40 (excluding A483), A41, A480, A483, B19, B942, C26, C76–C80, E853–E859, E86–E87, F99, G81–G83, H001, H01–H59, H602–H610, H62, H67, H71–H95, I10, I13, I15, I46, I490, I50, I709, J69, J96, K65–K66, K712, K92, L04, L21–L25, L27–L30, L41–L45, L52–L53, L55–L60, L63–L68, L70–L75, L80–L85, L87, L90–L92, L94, L980–L981, L988–L989, N17, N19, N51, N60–N61, N70–N73, N748, N84–N90, 094, Q10–Q18, Q381, Q54, Q65–Q74, Q82–Q84, Q899, Q999, R00–R94, R96–R99, X59, Y10–Y34, Y872, Y899, Y90–Y98

Table A4: Redistribution method for 2015 redistribution causes

Redistribution method	%
Direct evidence	31.0
Mix of direct evidence and indirect MCOD	30.7
Indirect MCOD	22.9
Proportional	15.4
Total	**100.0**

Appendix B: How reliable are the estimates?

All estimates within the ABDS 2015 were produced using the best possible data that were available within the scope and time frame of the study.

A number of actions were undertaken to ensure the accuracy and relevance of the estimates in the ABDS:

- All standard inputs (such as the standard life table, disability weights and relative risks) were reviewed and assessed as appropriate by the study's Expert Advisory Group for relevance and applicability in the Australian context.
- All data used in the ABDS had to meet strict inclusion criteria via protocols endorsed by the study's Expert Advisory Group.
- All models and inputs used in YLL and YLD estimates were reviewed by disease-specific experts and other experts to ensure their appropriateness for Australia. For YLD estimates, models reviewed as part of the ABDS 2011 were used, and where new diseases or models were developed in the ABDS 2015 these were reviewed by disease-specific experts. Methods for particular risk factors were also reviewed by experts.
- The quality index used in ABDS 2015 was used to interpret the reliability of estimates within this framework.

ABDS 2015 quality index

Uncertainty (or confidence) intervals—used to describe the reliability of estimates in some burden of disease studies—have not been produced for this study, largely due to the variety of sources of error: in data sources, in conceptual models and in assumptions underpinning the estimates. Confidence intervals are not straightforward to quantify and this was not within the scope of this project.

Instead of uncertainty intervals, guidance is provided to help users understand the quality and limitations of the estimates, especially which patterns and differences are most plausible and those which may reflect errors or uncertainties in the data or methods. This guidance is provided using a 2-dimensional *quality index* based on:

1. the relevance and quality of the source data, and
2. the methods used to transform that data into a form required for this analysis.

The quality index operates at the disease or risk factor level, and is applied to the YLD, YLL, DALY and attributable burden for the 2015 national estimates. The index is built from the lowest level of estimate using these 2 dimensions, weighted for the contribution to the overall disease level estimate or risk factor level estimate.

Generally, the higher the index, the more relevant and accurate the estimate. The ratings are interpreted as follows:

- A–B: highly relevant/accurate—estimate is derived from comprehensive and highly relevant data/ little data transformation was required. The estimates can be considered to be highly indicative of the health loss incurred from these diseases or risk factors.

- C–D: moderately relevant/accurate—estimate is derived from reasonably comprehensive and relevant data/moderate transformations required, taking into account known trends in the underlying data (such as over time or age-distributions). These estimates can be considered to be moderately indicative of the health loss experienced in Australia in 2015 due to these conditions or risk factors.
- E: questionable relevance/accuracy—estimate is derived from less comprehensive or relevant data/moderate transformations required with trends unknown or unaccounted for. These estimates are to be considered as possibly indicative of the health loss in Australia in 2015 and should be used with some caution.

More detailed information on the ABDS Quality Index, and the criteria and methods used, are provided in the *Australian Burden of Disease Study 2015: methods and supplementary material* (AIHW 2019a).

Fatal burden estimates

Using the ABDS Quality Index, all mortality data, and hence all YLL estimates, are considered relevant and accurate and highly indicative of the years of life lost due to these diseases. One exception to this is fatal injury burden by nature of injury, as injury-related deaths are classified by the external cause; subsequent mapping is required to estimate fatal burden by nature.

Fatal estimates account for around 50% of total DALY.

Non-fatal burden estimates

YLD estimates, which also account for around 50% of total DALY, vary in quality as there is no single comprehensive and reliable source of data on the incidence, prevalence, severity and duration of all non-fatal health conditions. The currency, generalisability and specificity of the data also varied, depending on the source.

YLD estimates for most of the major specific causes are considered relevant and accurate.

Relevance and quality of data sources

Nearly two-thirds (61%) of diseases (accounting for 68% of YLD) predominantly derived YLD from diagnostically confirmed disease registers, administrative data or national surveys that were either fully enumerated (or with known gaps in coverage), current and specific to both the disease (or sequela) in question and the population. This includes most cancer, cardiovascular, musculoskeletal, injuries, gastrointestinal, kidney & urinary and blood & metabolic estimates, as well as estimates for a large number of infections, mental & substance use and reproductive & maternal conditions.

A further 23% of diseases (accounting for 15% of YLD) predominantly derived YLD either from:

- diagnostically confirmed disease registers, administrative data or national surveys of medium currency/coverage and/or specificity to both the disease (or sequela) in question and the population, or
- systematic and generalisable meta-analyses of Australian data, or
- small-area Australian (or generalisable international) studies with good sampling.

The diseases that predominantly derived YLD by these means include type 2 diabetes and dementia, and most of the remaining infectious and infant & congenital diseases.

Only 1.0% of diseases (<1% total YLD) were predominantly derived from data that were of questionable quality. This included small Australian studies more than 5 years old, or international studies of questionable generalisability to the Australian context; or indirectly from secondary data sources. These diseases were Parkinson disease and benign & uncertain brain tumours.

Methods of transformation to overcome data shortcomings

Around half (49%) of the diseases estimated (accounting for 33% of YLD) could be derived with no transformation required or using known trends (for example, over time). A further 31% (accounting for 60% of YLD) needed to be derived from data where trends were unknown. A small proportion (18% of diseases, accounting for 7.3% of YLD) relied on deriving prevalence based on other epidemiological measures, or indirect methods from other (related) data sources. Only 2.1% of diseases (<0.5% of YLD) relied on indirect modelling methods or inferences of distributions from other (unrelated) data sources or expert advice (Table B1).

Table B1: Rating of data relevance, quality and transformation methods for YLD estimates

	Data relevance and quality		Method of transformation	
Rating	**% of diseases**	**% of YLD**	**% of diseases**	**% of YLD**
A	37.6	4.6	28.9	1.7
B	23.2	63.6	19.6	31.0
C	23.2	15.2	31.4	59.8
D	14.9	16.0	18.0	7.3
E	1.0	0.7	2.1	0.3

Note: The proportions may not add up to 100% due to rounding.

Risk factor estimates

It is possible to assess only the quality of data used to estimate exposure to the risk factors in Australia. The other inputs for this work, such as the relative risk data and the TMREDs, were adopted from the GBD 2016 and the AIHW's review of the literature, which independently and systematically reviewed and calculated appropriate relative risks and TMREDs.

Where the linked diseases were 100% attributable (such as alcohol use disorders attributable to alcohol use) or the exposure to the risk factor was estimated by the prevalence of a cause in the ABDS 2015 study, the quality of the causes was used to estimate the quality of exposure to the risk factor. Quality was assessed for each data source for exposure and weighted by the amount of attributable burden to give a score for each risk factor.

Risk factor exposure is estimated using robust national measured survey data for 72% of risk factors—this accounts for 85% of the attributable DALY. This is lower than in the ABDS 2011 because it was assessed at the data source level, and more consideration has been given to the specificity of self-report data to report the actual exposure to the risk factor.

For 50% of risk factors (accounting for 77% of attributable DALY), exposure was able to be derived with no transformation required or using known trends (Table B2). It was not possible to estimate a quality score for the method for high sun exposure and child abuse & neglect where the PAF were applied to this study directly from the source.

It is important to note that the quality of the attributable DALY for each risk factor depends on the quality of the estimate of the linked diseases, and the proportion attributable to YLL or YLD.

Table B2: Rating of data relevance, quality and transformation methods for risk factor estimates

	Data relevance and quality		Method of transformation	
Rating	**% of risk factors**	**% of DALY**	**% of risk factors**	**% of DALY**
A	16.6	27.7	11.1	23.5
B	55.6	57.8	38.9	53.2
C	16.7	12.6	33.3	17.1
D	5.6	1.3	5.6	1.3
E	5.6	0.6	0.0	0.0
. . [(a)]	0.0	0.0	11.1	4.9

(a) It was not applicable to estimate the quality of the method for the risk factors high sun exposure and child abuse & neglect as they were sourced directly from published studies.

Note: The proportions may not add up to 100% due to rounding.

Older age groups

Care should also be taken when comparing disease level information in age groups over 85 years. Data for this population is often limited, leading to greater variability.

Key data gaps

A key data source for the non-fatal burden was national hospitalisation data, particularly for admitted patient care. While this is a highly accurate and reliable source, the inability to link the separate admissions for individuals has been a barrier when calculating the best estimates for chronic conditions (for example, cardiovascular diseases, chronic liver disease, injuries). This data gap has been overcome by using linked New South Wales and Victorian hospital data applied to the national hospital data; however, estimates could be greatly improved if similarly linked national hospital data were available.

Similarly, for conditions with long-term effects post-hospitalisation, such as epilepsy, prevalence estimates were often obtained from Western Australian hospitals data linked with deaths data, and rates applied to national populations. Linked national hospitals and deaths data would greatly improve the accuracy of such estimates.

The data for injuries prevalence are fragmented. For non-fatal burden, admitted cases were sourced from the national hospital admissions. A national data source was used for assessing non-admitted (emergency care) cases of injury; however, only a portion of the data were usable due to the use of different classifications to describe the injury diagnoses.

There are also a small number of conditions for which little or no Australian data were available (for example, peripheral vascular disease, inflammatory bowel disease, dementia and Parkinson disease). In these situations, estimates rely on small-area Australian studies, or studies from similar countries. Further investigation into these areas to provide broader, Australian-specific results would increase the reliability of these estimates.

Appendix C: Understanding and using burden of disease estimates

This appendix provides guidance on using and interpreting estimates published in this report.

Different types of estimates presented in this report

There are a number of different estimates produced by a burden of disease study, which are useful for different purposes.

- DALY, YLD and YLL estimates provide a measure of the health impact from disease and injury and describe the overall disease burden in the population being analysed. They are useful for summarising the health of that population at a point in time, and for assessing health-care needs and planning health services.
- Crude rates of DALY, YLL and YLD provide a measure of disease burden against the size of the population, but without taking any other features of the population into account. These are useful for measuring the *relative* impact in one age group compared with another by describing the amount of disease burden relative to the size of the age group. They are also useful for assessing health-care needs and planning health services.
- The ASR of DALY, YLL and YLD also provide a measure of the disease burden against the size of the population but take into account the age structure of the population. ASRs have little use in service provision planning but are useful for comparing the impact of various diseases between 2 populations with different age structures (for example, males and females) or between 2 different time points (for example, 2003 and 2015).

As with many other statistics, it is comparisons (between diseases, across population groups, across time), rather than single estimates, that are the most useful. Comparisons are often done using rate ratios and rate differences. A rate ratio shows how many times the rate of burden is relative to another, while a rate difference shows the difference between one rate and another. For example, when analysing age-standardised DALY rates of males compared with females, a rate ratio of 1.0 indicates that the burden in males and females is the same; a rate higher than 1.0, that the burden is higher among males; and a rate lower than 1.0, that the burden is lower among males. For example, a rate ratio of 1.6 means that the age-standardised DALY rate for males is 1.6 times or 60% higher than that for females.

Both rate ratios and rate differences are useful and have complementary value.

Levels of reporting and alternative reporting categories

Estimates in this study are calculated for individual conditions (for example, lung cancer, anxiety, chronic kidney disease, epilepsy, hip fracture). For some aspects of reporting, conditions that have a similar aetiology, outcomes or treatment are grouped together—generally according to ICD-10 classifications—into 17 *disease groups*. For ease of recognition in this publication, each disease group has been allocated a colour—these are used consistently throughout each overview chapter to identify a disease grouping.

Diseases are grouped in this study to reflect the Australian health context (that is, to meet health reporting and monitoring needs) while also informing policy setting, health planning and research. These groupings may not suit all users. Alternative groupings of individual diseases are possible—these are not included in this report but can be the subject of future analyses.

It is important to be aware that some disease groups—such as injuries, infections and cancer & other neoplasms—are made up of a large number of separate diseases or injuries, while others—such as endocrine and oral disorders—include only a few specific conditions. Ranking by disease group and ranking by individual conditions may present different stories. For example, cancer is the disease group causing the most burden, but coronary heart disease (within the cardiovascular disease group) is the specific disease causing the most burden. This reflects the level of reporting and the choice as to how the disease group level is constructed. It is important to use the level of reporting that is most suited to a specific purpose.

In this report, YLL, YLD and DALY estimates are presented at 3 levels, each having a different purpose and audience:

1. **Overall burden:** for presenting a picture of the overall health of the population at a given point in time, including age and sex differences, regardless of the disease.
2. **Disease group level:** for understanding the broad patterns in the types of diseases causing health loss in the population. The collective impact of diseases of broadly similar cause assists in identifying large interrelated areas of health loss that might otherwise go unquantified (especially for the rarer and less prevalent diseases—such as blood & metabolic disorders). This is important for broad policy and research setting as well as for advocacy. There are 17 disease groups in the ABDS 2015.
3. **Disease level:** for a more detailed picture of the diseases and injuries that give rise to burden. These represent individual diseases (such as appendicitis, Parkinson disease), or finer aggregations of related diseases (such as gastrointestinal infections—which include salmonella and campylobacter—or dementia—which includes Alzheimer disease, as well as other dementias). Diseases at this level have been chosen to be as policy-relevant as possible, subject to the constraints of data availability. Disease-level estimates are useful for detailed policy setting and research. Burden was estimated for 216 diseases.

Comparing life lost in burden of disease studies with other measures of premature mortality

Different measures are used to highlight the impact of dying prematurely; however, the notion of 'premature' in relation to mortality can be arbitrary. Two of the most commonly used summary measures to describe premature mortality are YLL (as used in burden of disease studies) and potential YLL.

YLL in burden of disease studies assume a potential number of remaining years according to a *life table* (see Appendix Table A2). A life table specifies, for each age, a number of years that, on average, a person could potentially live—the life expectancy. For example, the standard life table from the Global Burden of Disease 2010 and 2013 studies (as used in this study) specifies that a person aged under 1 could potentially live 86.0 more years; a person aged 65, 23.3 more years; and a person aged 100, 2.2 more years. YLL is calculated by summing the number of deaths at each age multiplied by the remaining life expectancy for that age. In this measure, all deaths in a population are counted and accrue some lost years of life.

Potential years of life lost (PYLL), a simpler measure, specifies an *arbitrary age cut-off* to identify early deaths; that is, deaths occurring before the specified age are considered premature. For example, a recent AIHW report describes PYLL for deaths occurring before age 75 (AIHW 2015). Using this parameter, death of an infant (aged under 1) loses 75 years of life; death of a person aged 65, 10 years. The death of a person aged over 75 would not be counted in this measure.

Both summary measures provide a means of assessing premature death. YLL, based on all deaths in a population, describes early death according to the life expectancy at each age of death. It uses the same metric as the YLD—a count of the number of years lost. In burden of disease studies, this enables combining measures of fatal and non-fatal effects into a summary measure of health, the DALY. PYLL, on the other hand, considers deaths only within a population younger than the specified age cut-off. In contrast to YLL, it tends to more strongly reflect the magnitude and causes of death that typically affect the younger population.

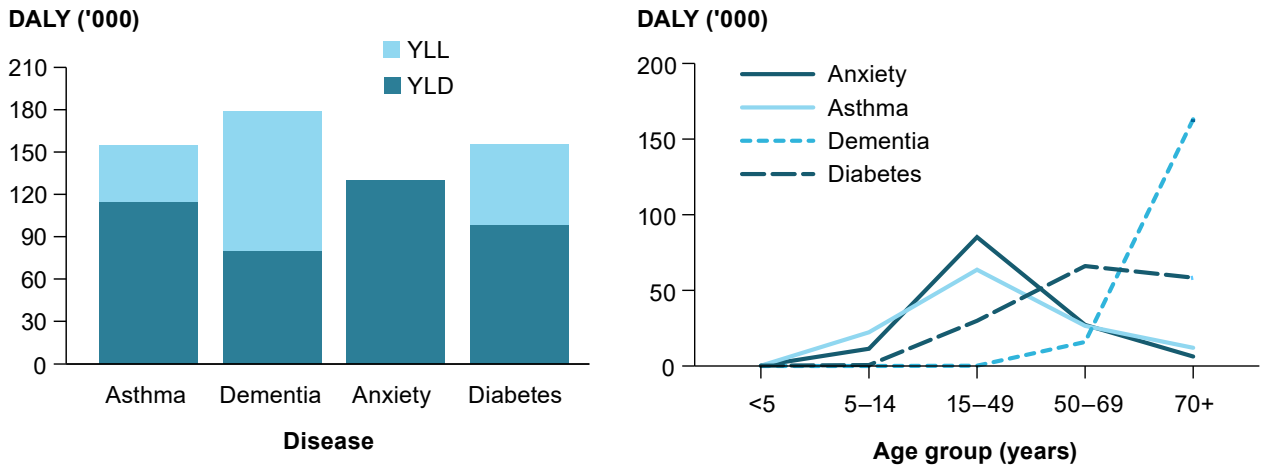
Interpreting estimates

There are many factors that should be taken into account when interpreting or comparing burden of disease estimates. Box C1 lists some general rules.

Interpreting and comparing DALY estimates

When interpreting DALY estimates, it is often useful to look at the relative contribution of each condition to the overall health loss, or the relative contributions of fatal and non-fatal health loss for a given condition, to gain a picture of a population's health. As a DALY is made up of YLL and YLD, diseases can have very similar DALY estimates, but tell very different stories about the relative contribution of YLL and YLD. For example, asthma, dementia, anxiety disorders and diabetes all have a similar number of DALY—but the contribution of fatal and non-fatal burden is quite different, as are the ages at which these diseases affect people (see Figure C1).

Figure C1: Example of different DALY stories



Source: AIHW 2016a.

Interpreting and comparing risk factor estimates

Risk factor analysis allows us to estimate how much the disease burden could be reduced if exposure to the risk factor were at or below the theoretical minimum level. Exposure to harmful levels of a risk factor can contribute to deaths and/or ill health resulting from one or more diseases. The estimates are presented in the following forms:

- the number of DALY that can be attributed to exposure to each risk factor. This 'attributable burden' is useful for gauging the contribution of each risk factor
- the proportion of disease DALY, disease group DALY or total DALY that can be attributed to the risk factor. This is a useful way of relating the contribution of each risk factor to the burden of the linked diseases, disease groups or to the total burden
- the age-specific rate of DALY attributable to a risk factor. Such a rate is used to compare the relative contribution of the risk in one age group with that of another, by depicting the amount of health loss relative to the size of each age group
- the ASR attributable to a risk factor. Such a rate also provides a relative measure of the health loss against the size of the population but takes into account the age structure of the population. This allows comparison of estimates between 2003, 2011 and 2015.

Exposure to some risk factors is known to cause both ill health *and* death while exposure to other risk factors may be associated only with ill health *or* death. This affects the patterns of attributable YLL and YLD across the risk factors and linked diseases.

DALY attributable to a risk factor may also vary by age and sex. These variations may be caused by age and sex differences in:

- amounts of exposure to the risk factor
- the degree of increased risk of the linked disease due to exposure to the risk factor (relative risk)
- patterns of DALY, YLL and YLD for the linked diseases.

Estimates of attributable burden for the different risk factors cannot be simply added together without further analysis, due to complex pathways and interactions between them. This analysis has been undertaken for all risk factors included in this report combined, and it underpins, for example, estimates of combined burden attributable to disease groups.

Interpreting rankings

Rankings are often used to tell the story of which disease or injury causes the biggest burden. However, rankings do not provide the reader with context of the size of each estimate, nor of the difference between adjacent estimates.

Further, the rankings in this report are specific to the level of reporting, as reporting rankings at different levels can be misperceived. For example, as a group, cancer ranks ahead of cardiovascular conditions for both men and women. This is because the cancer group is made up of many different cancer types, some of which have a very high burden. At the individual disease level, however, both coronary heart disease and stroke (part of the cardiovascular disease group) rank ahead of breast cancer and lung cancer in women, and coronary heart disease ranks ahead of lung cancer in men. Therefore, rankings should be interpreted with care.

Comparing with estimates from other studies

As a general rule, due to the large variety of data sources, possible disease models, assumptions and concepts of 'ideal health', the DALY, YLL and YLD estimates from different studies should not be compared.

For comparing the Australian burden with the burden of other countries, the AIHW recommends using the Australian estimates reported in either the most recent GBD—for example, GBD 2017 Disease and Injury Incidence and Prevalence Collaborators 2018, or the Global Health Estimates produced by the WHO (for example, WHO 2018).

Which estimate is 'right'?—interpreting multiple results

There are a number of current burden of disease estimates for Australia. As DALY are the final output of a complex set of models and assumptions, there is no 'right' answer. Global studies are designed to enable comparisons across countries and need to account for a large variation in the data availability and quality across countries. Country-based studies (such as the ABDS) are more likely to be designed to meet local needs and use detailed local data. When faced with more than one set of estimates, it is important to understand the data sources and assumptions behind the estimates and use the set that most closely matches its purpose and user needs.

Box C1: Dos and don'ts of using burden of disease estimates in this study

Do

- Use estimates to compare health loss between different diseases, groups of diseases, risk factors or population groups in this study.
- Look beyond the ranking to understand the level of impact of a disease.
- Look beyond the DALY estimate to YLL and YLD to understand the estimate better.
- Be careful comparing groups of diseases with individual diseases.
- Make sure you understand what is being measured and the assumptions that have been used.

Don't

- Compare YLL, YLD, DALY estimates from different burden of disease studies.
- Add together the unadjusted attributable YLL, YLD and DALY estimates across risk factors.
- Compare measures of *mortality* in this study with measures reported elsewhere, as burden of disease methods and grouping of causes are different from those used in other studies.

What can estimates from 2015 tell us about 2019?

The estimates in this report are for 2015, the common year that best reflects data availability from the main data sources—mortality, hospitals, disease registers and the latest Australian Health Survey—that were available to be analysed for this study.

Many factors influence health so it is difficult to project what might happen between 2015 and 2019. Some diseases, particularly chronic diseases such as cancer and musculoskeletal conditions, are relatively stable over short periods of time, and are influenced primarily by changes in the population, while episodic diseases such as infections can vary considerably from year to year. As the majority of the burden in Australia is from chronic diseases, it is likely that most of the patterns described here for the 2015 year are fairly generalisable to 2019.

Appendix D: Additional tables and figures

Figure D1: Leading causes of total burden (DALY '000; proportion %), by age group: males, 2015—nature of injury, including other causes

Rank	Age group (years)								
	Under 5	5–14	15–24	25–44	45–54	55–64	65–74	75–84	85+
1st	Pre-term/lbw complications (10.3; 14.6%)	Asthma (9.2; 13.7%)	Other injuries (30.4; 19.7%)	Other injuries (59.5; 12.9%)	Coronary heart disease (28.5; 8.9%)	Coronary heart disease (43.7; 10.6%)	Coronary heart disease (53.0; 11.4%)	Coronary heart disease (47.8; 12.7%)	Coronary heart disease (30.7; 15.8%)
2nd	Other disorders of infancy (8.4; 11.9%)	Anxiety disorders (7.0; 10.5%)	Alcohol use disorders (11.1; 7.2%)	Poisoning (37.7; 8.2%)	Other injuries (22.2; 6.9%)	Lung cancer (23.7; 5.8%)	COPD (32.8; 7.0%)	COPD (27.0; 7.2%)	Dementia (25.5; 13.1%)
3rd	Birth trauma/ asphyxia (6.3; 9.0%)	Conduct disorder (4.6; 6.9%)	Depressive disorders (8.3; 5.4%)	Back pain and problems (29.2; 6.3%)	Back pain and problems (18.9; 5.9%)	Other musculoskeletal (20.0; 4.9%)	Lung cancer (31.7; 6.8%)	Dementia (25.4; 6.8%)	Stroke (12.8; 6.6%)
4th	SIDS (3.9; 5.5%)	Depressive disorders (4.1; 6.1%)	Back pain and problems (7.8; 5.1%)	Alcohol use disorders (27.8; 6.0%)	Other musculoskeletal (15.4; 4.8%)	Back pain and problems (18.2; 4.4%)	Other musculoskeletal (18.9; 4.1%)	Lung cancer (19.3; 5.1%)	COPD (11.1; 5.7%)
5th	Cardiovascular defects (3.7; 5.2%)	Autism spectrum disorders (3.6; 5.3%)	Asthma (7.2; 4.7%)	Depressive disorders (25.9; 5.6%)	Poisoning (13.4; 4.2%)	Type 2 diabetes (15.5; 3.8%)	Type 2 diabetes (17.2; 3.7%)	Stroke (18.4; 4.9%)	Prostate cancer (8.9; 4.6%)
6th	Other injuries (2.8; 4.0%)	Other injuries (3.3; 4.9%)	Anxiety disorders (7.1; 4.6%)	Anxiety disorders (22.8; 4.9%)	Anxiety disorders (11.7; 3.7%)	COPD (15.5; 3.8%)	Prostate cancer (16.2; 3.5%)	Prostate cancer (16.2; 4.3%)	Chronic kidney disease (5.0; 2.6%)
7th	Other congenital conditions (2.8; 4.0%)	Dental caries (3.1; 4.6%)	Drug use disorders (5.6; 3.7%)	Other musculoskeletal (18.9; 4.1%)	Depressive disorders (10.4; 3.3%)	Chronic liver disease (14.0; 3.4%)	Bowel cancer (15.3; 3.3%)	Bowel cancer (11.3; 3.0%)	Lung cancer (4.7; 2.4%)
8th	Asthma (2.6; 3.8%)	Back pain and problems (2.0; 3.0%)	Other musculoskeletal (5.1; 3.3%)	Drug use disorders (15.2; 3.3%)	Chronic liver disease (10.3; 3.2%)	Bowel cancer (12.6; 3.1%)	Stroke (14.2; 3.0%)	Type 2 diabetes (10.7; 2.8%)	Atrial fibrillation (4.3; 2.2%)
9th	Other neurological conditions (2.3; 3.3%)	Epilepsy (2.0; 2.9%)	Poisoning (4.8; 3.1%)	Asthma (14.4; 3.1%)	Lung cancer (9.3; 2.9%)	Other injuries (12.5; 3.0%)	Back pain and problems (13.6; 2.9%)	Other musculoskeletal (10.5; 2.8%)	Lower respiratory infections (4.2; 2.2%)
10th	Other gastrointestinal infections (1.9; 2.7%)	Attention deficit hyperactivity disorder (2.0; 2.9%)	Acne (4.5; 2.9%)	Coronary heart disease (12.7; 2.8%)	Alcohol use disorders (8.3; 2.6%)	Osteoarthritis (11.4; 2.8%)	Dementia (13.3; 2.9%)	Hearing loss (10.3; 2.7%)	Bowel cancer (4.1; 2.1%)

lbw = low birthweight.

Figure D2: Leading causes of total burden (DALY '000; proportion %), by age group: females, 2015—nature of injury, including other causes

Rank	Age group (years)								
	Under 5	5–14	15–24	25–44	45–54	55–64	65–74	75–84	85+
1st	Other disorders of infancy (7.1; 12.5%)	Asthma (7.0; 12.4%)	Anxiety disorders (14.5; 11.3%)	Anxiety disorders (36.3; 9.5%)	Back pain and problems (18.2; 6.7%)	Other musculoskeletal (22.6; 6.9%)	COPD (23.0; 6.4%)	Dementia (33.6; 9.7%)	Dementia (59.7; 20.0%)
2nd	Pre-term/lbw complications (7.0; 12.3%)	Anxiety disorders (6.1; 10.8%)	Depressive disorders (11.4; 8.9%)	Back pain and problems (30.4; 7.9%)	Other musculoskeletal (17.7; 6.5%)	Osteoarthritis (20.6; 6.3%)	Other musculoskeletal (21.1; 5.9%)	Coronary heart disease (29.8; 8.6%)	Coronary heart disease (40.0; 13.4%)
3rd	Birth trauma/ asphyxia (6.2; 10.9%)	Depressive disorders (4.7; 8.3%)	Other injuries (10.5; 8.2%)	Depressive disorders (30.1; 7.8%)	Anxiety disorders (17.1; 6.2%)	Lung cancer (18.3; 5.6%)	Osteoarthritis (20.7; 5.8%)	COPD (25.2; 7.3%)	Stroke (24.2; 8.1%)
4th	Other congenital conditions (2.9; 5.0%)	Dental caries (2.9; 5.2%)	Asthma (9.2; 7.1%)	Other musculoskeletal (19.1; 5.0%)	Breast cancer (15.5; 5.6%)	Breast cancer (18.2; 5.5%)	Lung cancer (20.6; 5.8%)	Stroke (19.1; 5.5%)	COPD (14.2; 4.8%)
5th	Cardiovascular defects (2.5; 4.3%)	Conduct disorder (2.8; 4.9%)	Back pain and problems (7.7; 6.0%)	Asthma (19.1; 5.0%)	Depressive disorders (14.1; 5.1%)	Back pain and problems (17.8; 5.4%)	Coronary heart disease (20.3; 5.7%)	Other musculoskeletal (13.7; 4.0%)	Atrial fibrillation (8.3; 2.8%)
6th	SIDS (2.3; 4.1%)	Other injuries (2.5; 4.5%)	Bipolar affective disorder (5.9; 4.6%)	Other injuries (15.7; 4.1%)	Osteoarthritis (11.1; 4.0%)	COPD (13.3; 4.0%)	Breast cancer (15.1; 4.2%)	Lung cancer (12.2; 3.5%)	Hearing loss (7.4; 2.5%)
7th	Asthma (2.0; 3.6%)	Acne (2.5; 4.5%)	Polycystic ovarian syndrome (5.3; 4.1%)	Poisoning (14.0; 3.6%)	COPD (10.5; 3.8%)	Coronary heart disease (12.2; 3.7%)	Rheumatoid arthritis (14.9; 4.2%)	Osteoarthritis (11.6; 3.3%)	Chronic kidney disease (7.2; 2.4%)
8th	Other neurological conditions (1.9; 3.3%)	Back pain and problems (2.2; 4.0%)	Alcohol use disorders (5.0; 3.9%)	Bipolar affective disorder (11.1; 2.9%)	Asthma (9.4; 3.4%)	Rheumatoid arthritis (11.3; 3.4%)	Back pain and problems (13.3; 3.7%)	Hearing loss (10.0; 2.9%)	Lower respiratory infections (6.8; 2.3%)
9th	Other injuries (1.6; 2.8%)	Epilepsy (1.8; 3.3%)	Acne (4.0; 3.1%)	Polycystic ovarian syndrome (10.2; 2.6%)	Lung cancer (8.5; 3.1%)	Anxiety disorders (11.0; 3.3%)	Dementia (12.6; 3.5%)	Rheumatoid arthritis (9.9; 2.9%)	Other musculoskeletal (5.5; 1.8%)
10th	Other gastrointestinal infections (1.6; 2.7%)	Dermatitis and eczema (1.8; 3.2%)	Other musculoskeletal (3.8; 3.0%)	Migraine (9.5; 2.5%)	Poisoning (7.3; 2.7%)	Depressive disorders (9.7; 2.9%)	Type 2 diabetes (11.0; 3.1%)	Bowel cancer (9.4; 2.7%)	Non-rheumatic valvular disease (5.3; 1.8%)

lbw = low birthweight.

Figure D3: Leading causes of non-fatal burden (YLD '000; proportion %), by age group: males, 2015—nature of injury, including other causes

Rank	Age group (years)								
	Under 5	5–14	15–24	25–44	45–54	55–64	65–74	75–84	85+
1st	Asthma (2.6; 16.4%)	Asthma (8.9; 16.0%)	Alcohol use disorders (11.1; 11.1%)	Back pain and problems (29.2; 10.4%)	Back pain and problems (18.9; 12.2%)	Other musculoskeletal (19.0; 11.0%)	Other musculoskeletal (17.9; 9.7%)	COPD (11.6; 9.2%)	Dementia (10.3; 18.0%)
2nd	Other gastrointestinal infections (1.5; 9.7%)	Anxiety disorders (7.0; 12.6%)	Depressive disorders (8.3; 8.2%)	Alcohol use disorders (26.7; 9.6%)	Other musculoskeletal (14.9; 9.6%)	Back pain and problems (18.2; 10.6%)	COPD (17.4; 9.4%)	Coronary heart disease (10.6; 8.4%)	Coronary heart disease (4.6; 8.0%)
3rd	Dermatitis and eczema (1.0; 6.3%)	Conduct disorder (4.6; 8.3%)	Back pain and problems (7.7; 7.6%)	Depressive disorders (25.9; 9.3%)	Anxiety disorders (11.7; 7.5%)	Osteoarthritis (11.3; 6.6%)	Back pain and problems (13.5; 7.3%)	Hearing loss (10.3; 8.2%)	Hearing loss (4.0; 7.1%)
4th	Autism spectrum disorders (0.9; 5.5%)	Depressive disorders (4.1; 7.3%)	Anxiety disorders (7.1; 7.0%)	Anxiety disorders (22.8; 8.1%)	Depressive disorders (10.4; 6.7%)	Type 2 diabetes (11.0; 6.4%)	Coronary heart disease (13.1; 7.1%)	Other musculoskeletal (9.6; 7.6%)	COPD (3.6; 6.3%)
5th	Intellectual disability (0.8; 5.0%)	Autism spectrum disorders (3.6; 6.4%)	Asthma (6.9; 6.8%)	Other musculoskeletal (18.5; 6.6%)	Rheumatoid arthritis (7.1; 4.6%)	Rheumatoid arthritis (10.5; 6.1%)	Type 2 diabetes (11.0; 6.0%)	Dementia (9.3; 7.4%)	Other musculoskeletal (3.0; 5.3%)
6th	Anxiety disorders (0.8; 4.9%)	Dental caries (3.1; 5.5%)	Drug use disorders (5.6; 5.5%)	Drug use disorders (14.7; 5.2%)	Osteoarthritis (6.9; 4.4%)	Coronary heart disease (8.7; 5.1%)	Osteoarthritis (10.8; 5.9%)	Back pain and problems (6.2; 5.0%)	Atrial fibrillation (2.0; 3.4%)
7th	Other neurological conditions (0.7; 4.2%)	Attention deficit hyperactivity disorder (2.0; 3.5%)	Other musculoskeletal (5.1; 5.1%)	Asthma (13.7; 4.9%)	Alcohol use disorders (6.8; 4.4%)	COPD (8.3; 4.8%)	Rheumatoid arthritis (10.7; 5.8%)	Osteoarthritis (5.4; 4.3%)	Macular degeneration (1.8; 3.1%)
8th	Other congenital conditions (0.6; 3.7%)	Back pain and problems (1.9; 3.4%)	Acne (4.5; 4.4%)	Schizophrenia (12.4; 4.4%)	Asthma (5.7; 3.6%)	Anxiety disorders (6.5; 3.8%)	Hearing loss (9.4; 5.1%)	Type 2 diabetes (4.9; 3.9%)	Prostate cancer (1.7; 3.1%)
9th	Protein-energy deficiency (0.5; 3.1%)	Acne (1.9; 3.4%)	Bipolar affective disorder (4.3; 4.3%)	Bipolar affective disorder (10.2; 3.7%)	Type 2 diabetes (5.3; 3.4%)	Hearing loss (6.2; 3.6%)	Dementia (6.0; 3.2%)	Rheumatoid arthritis (4.8; 3.8%)	Severe tooth loss (1.6; 2.8%)
10th	Conduct disorder (0.5; 3.0%)	Dermatitis and eczema (1.9; 3.4%)	Autism spectrum disorders (3.9; 3.9%)	Dental caries (8.2; 2.9%)	Coronary heart disease (3.9; 2.5%)	Asthma (6.1; 3.6%)	Severe tooth loss (5.6; 3.1%)	Atrial fibrillation (4.4; 3.5%)	Back pain and problems (1.5; 2.7%)

Figure D4: Leading causes of non-fatal burden (YLD '000; proportion %), by age group: females, 2015—nature of injury, including other causes

Rank	Age group (years)								
	Under 5	5–14	15–24	25–44	45–54	55–64	65–74	75–84	85+
1st	Asthma (1.9; 13.8%)	Asthma (6.8; 14.4%)	Anxiety disorders (14.5; 13.7%)	Anxiety disorders (36.3; 12.4%)	Back pain and problems (18.1; 10.6%)	Other musculoskeletal (21.4; 11.6%)	Osteoarthritis (20.7; 11.6%)	Dementia (14.1; 9.6%)	Dementia (28.7; 26.6%)
2nd	Other gastrointestinal infections (1.5; 10.7%)	Anxiety disorders (6.1; 12.9%)	Depressive disorders (11.4; 10.8%)	Back pain and problems (30.2; 10.3%)	Anxiety disorders (17.1; 10.0%)	Osteoarthritis (20.6; 11.2%)	Other musculoskeletal (19.9; 11.2%)	COPD (12.9; 8.8%)	Hearing loss (7.4; 6.9%)
3rd	Dermatitis and eczema (0.9; 6.9%)	Depressive disorders (4.7; 9.9%)	Asthma (8.8; 8.3%)	Depressive disorders (30.1; 10.3%)	Other musculoskeletal (17.0; 9.9%)	Back pain and problems (17.8; 9.7%)	Rheumatoid arthritis (14.3; 8.0%)	Other musculoskeletal (12.1; 8.2%)	COPD (6.9; 6.4%)
4th	Other neurological conditions (0.9; 6.7%)	Dental caries (2.9; 6.2%)	Back pain and problems (7.7; 7.3%)	Asthma (18.4; 6.3%)	Depressive disorders (14.1; 8.2%)	Rheumatoid arthritis (11.2; 6.1%)	Back pain and problems (13.2; 7.4%)	Osteoarthritis (11.5; 7.8%)	Coronary heart disease (6.0; 5.5%)
5th	Other congenital conditions (0.7; 5.0%)	Conduct disorder (2.8; 5.9%)	Bipolar affective disorder (5.9; 5.6%)	Other musculoskeletal (18.3; 6.3%)	Osteoarthritis (11.1; 6.5%)	Anxiety disorders (11.0; 6.0%)	COPD (10.1; 5.7%)	Hearing loss (10.0; 6.8%)	Osteoarthritis (4.7; 4.4%)
6th	Anxiety disorders (0.6; 4.3%)	Acne (2.5; 5.4%)	Polycystic ovarian syndrome (5.3; 5.0%)	Bipolar affective disorder (11.1; 3.8%)	Asthma (8.9; 5.2%)	Depressive disorders (9.7; 5.3%)	Type 2 diabetes (8.3; 4.7%)	Rheumatoid arthritis (9.3; 6.3%)	Other musculoskeletal (3.9; 3.7%)
7th	Protein-energy deficiency (0.5; 3.5%)	Back pain and problems (2.2; 4.6%)	Alcohol use disorders (5.0; 4.7%)	Polycystic ovarian syndrome (10.2; 3.5%)	COPD (8.3; 4.9%)	Asthma (8.3; 4.5%)	Severe tooth loss (7.3; 4.1%)	Coronary heart disease (7.1; 4.8%)	Macular degeneration (3.4; 3.2%)
8th	Epilepsy (0.5; 3.3%)	Dermatitis and eczema (1.8; 3.8%)	Acne (4.0; 3.8%)	Migraine (9.5; 3.2%)	Rheumatoid arthritis (6.8; 4.0%)	Type 2 diabetes (7.4; 4.0%)	Dementia (6.8; 3.8%)	Back pain and problems (6.3; 4.3%)	Severe tooth loss (3.1; 2.9%)
9th	Intellectual disability (0.4; 3.0%)	Epilepsy (1.7; 3.6%)	Other musculoskeletal (3.8; 3.6%)	Eating disorders (8.9; 3.0%)	Migraine (4.4; 2.6%)	COPD (7.3; 4.0%)	Hearing loss (6.6; 3.7%)	Severe tooth loss (5.7; 3.9%)	Atrial fibrillation (3.0; 2.8%)
10th	Rheumatoid arthritis (0.4; 2.8%)	Other musculoskeletal (1.3; 2.7%)	Eating disorders (3.8; 3.6%)	Rheumatoid arthritis (7.1; 2.4%)	Type 2 diabetes (4.4; 2.5%)	Genital prolapse (5.5; 3.0%)	Coronary heart disease (6.0; 3.4%)	Type 2 diabetes (4.7; 3.2%)	Protein-energy deficiency (2.3; 2.1%)

Figure D5: Leading causes of fatal burden (YLL '000; proportion %), by age group: males, 2015—nature of injury, including other causes

Rank	Age group (years)								
	Under 5	5–14	15–24	25–44	45–54	55–64	65–74	75–84	85+
1st	Pre-term/lbw complications (10.1; 18.5%)	Other injuries (3.2; 28.3%)	Other injuries (29.9; 55.8%)	Other injuries (58.2; 32.1%)	Coronary heart disease (24.6; 15.1%)	Coronary heart disease (35.0; 14.6%)	Coronary heart disease (39.9; 14.1%)	Coronary heart disease (37.2; 14.9%)	Coronary heart disease (26.1; 18.9%)
2nd	Other disorders of infancy (8.0; 14.8%)	Brain/CNS cancer (0.9; 7.8%)	Poisoning (4.8; 8.9%)	Poisoning (37.5; 20.7%)	Other injuries (21.6; 13.2%)	Lung cancer (23.4; 9.8%)	Lung cancer (31.1; 11.0%)	Lung cancer (18.8; 7.5%)	Dementia (15.2; 11.0%)
3rd	Birth trauma/ asphyxia (6.2; 11.4%)	Other cancers (0.8; 7.1%)	Drowning/ submersion (1.6; 2.9%)	Coronary heart disease (11.6; 6.4%)	Poisoning (13.3; 8.1%)	Chronic liver disease (13.8; 5.8%)	COPD (15.4; 5.5%)	Dementia (16.2; 6.5%)	Stroke (11.3; 8.2%)
4th	SIDS (3.9; 7.1%)	Drowning/ submersion (0.6; 5.3%)	Traumatic brain injury (1.5; 2.9%)	Chronic liver disease (4.8; 2.7%)	Chronic liver disease (10.2; 6.2%)	Other injuries (12.0; 5.0%)	Bowel cancer (14.3; 5.1%)	Stroke (15.4; 6.2%)	COPD (7.5; 5.5%)
5th	Cardiovascular defects (3.4; 6.3%)	Acute lymphoblastic leukaemia (0.6; 5.1%)	Other cancers (1.4; 2.7%)	Brain/CNS cancer (4.0; 2.2%)	Lung cancer (9.2; 5.6%)	Bowel cancer (12.0; 5.0%)	Prostate cancer (11.6; 4.1%)	COPD (15.4; 6.1%)	Prostate cancer (7.2; 5.2%)
6th	Other injuries (2.8; 5.1%)	Other blood/ metabolic disorders (0.5; 4.3%)	Epilepsy (1.3; 2.3%)	Bowel cancer (3.7; 2.1%)	Bowel cancer (7.1; 4.4%)	Liver cancer (9.2; 3.8%)	Stroke (11.4; 4.0%)	Prostate cancer (12.9; 5.2%)	Lung cancer (4.5; 3.3%)
7th	Other congenital conditions (2.2; 4.1%)	Cerebal palsy (0.4; 3.6%)	Other neurological conditions (1.2; 2.2%)	Drowning/ submersion (3.7; 2.0%)	Stroke (4.1; 2.5%)	Pancreatic cancer (7.5; 3.1%)	Pancreatic cancer (8.6; 3.0%)	Bowel cancer (10.3; 4.1%)	Chronic kidney disease (4.3; 3.1%)
8th	Other neurological conditions (1.6; 3.0%)	Cardiovascular defects (0.4; 3.5%)	Burn injuries (1.0; 1.9%)	Cardiomyopathy (3.3; 1.8%)	Brain/CNS cancer (3.9; 2.4%)	Stroke (7.5; 3.1%)	Dementia (7.4; 2.6%)	Chronic kidney disease (6.5; 2.6%)	Lower respiratory infections (4.0; 2.9%)
9th	Drowning/ submersion (1.5; 2.7%)	Other neurological conditions (0.2; 2.2%)	Cardiomyopathy (0.9; 1.7%)	Other cardiovascular diseases (3.1; 1.7%)	Liver cancer (3.4; 2.1%)	COPD (7.1; 3.0%)	Chronic liver disease (6.7; 2.4%)	Type 2 diabetes (5.8; 2.3%)	Bowel cancer (3.6; 2.6%)
10th	Other chromosomal abnormalities (1.2; 2.3%)	Epilepsy (0.2; 2.2%)	Internal/ crush injury (0.8; 1.5%)	Other blood/ metabolic disorders (2.9; 1.6%)	Pancreatic cancer (3.3; 2.0%)	Brain/CNS cancer (6.2; 2.6%)	Other injuries (6.6; 2.3%)	Parkinson disease (5.1; 2.1%)	Parkinson disease (2.8; 2.1%)

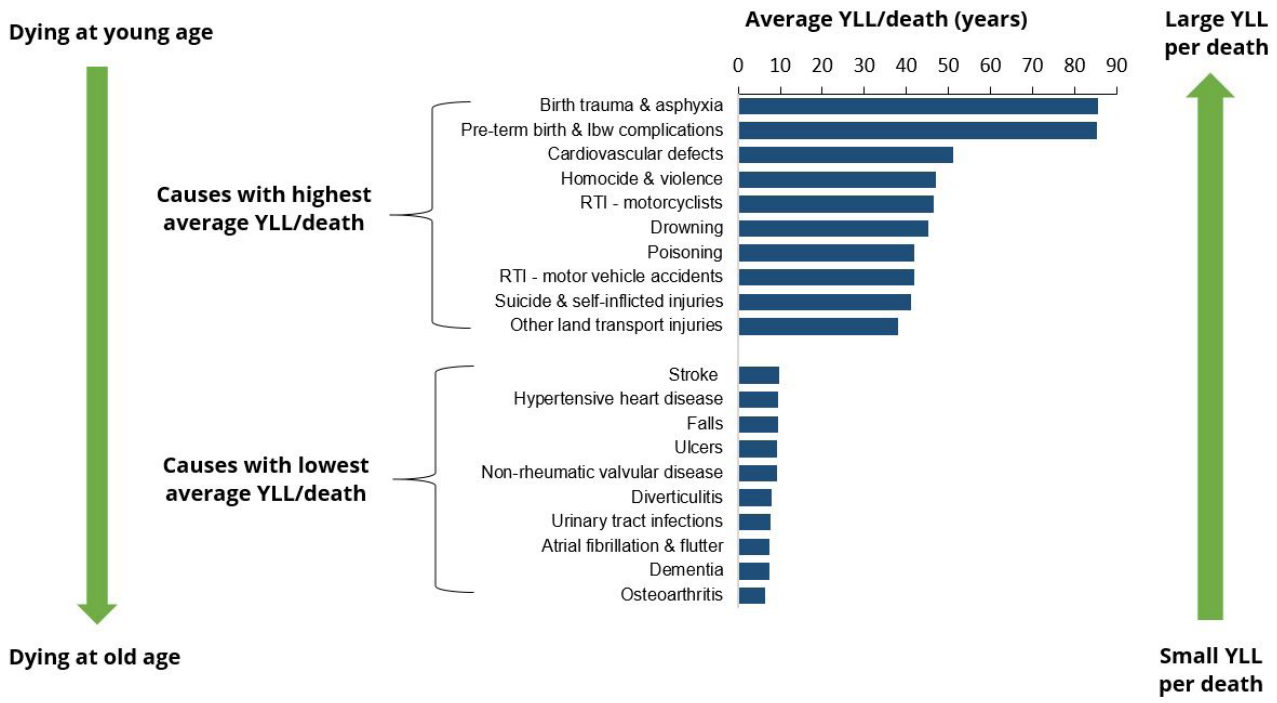
lbw = low birthweight; CNS = central nervous system.

Figure D6: Leading causes of fatal burden (YLL '000; proportion %), by age group: females, 2015—nature of injury, including other causes

Rank	Age group (years)								
	Under 5	5–14	15–24	25–44	45–54	55–64	65–74	75–84	85+
1st	Other disorders of infancy (6.9; 15.8%)	Other injuries (2.5; 26.4%)	Other injuries (10.3; 46.7%)	Other injuries (15.4; 16.8%)	Breast cancer (13.7; 13.3%)	Lung cancer (18.1; 12.4%)	Lung cancer (20.2; 11.3%)	Coronary heart disease (22.7; 11.3%)	Coronary heart disease (34.0; 17.9%)
2nd	Pre-term/lbw complications (6.8; 15.8%)	Other cancers (0.7; 7.5%)	Poisoning (2.0; 8.9%)	Poisoning (13.7; 15.0%)	Lung cancer (8.4; 8.2%)	Breast cancer (15.9; 11.0%)	Coronary heart disease (14.3; 8.0%)	Dementia (19.5; 9.7%)	Dementia (31.0; 16.3%)
3rd	Birth trauma/ asphyxia (6.2; 14.3%)	Brain/CNS cancer (0.6; 6.8%)	Epilepsy (0.8; 3.4%)	Breast cancer (7.1; 7.8%)	Poisoning (7.2; 7.0%)	Coronary heart disease (8.7; 6.0%)	COPD (12.9; 7.2%)	Stroke (16.6; 8.3%)	Stroke (22.1; 11.6%)
4th	SIDS (2.3; 5.4%)	Other blood/ metabolic disorders (0.5; 5.3%)	Other cancers (0.7; 3.1%)	Bowel cancer (4.0; 4.4%)	Bowel cancer (5.9; 5.8%)	Bowel cancer (7.4; 5.1%)	Breast cancer (12.7; 7.1%)	COPD (12.3; 6.1%)	COPD (7.3; 3.8%)
5th	Cardiovascular defects (2.2; 5.2%)	Acute lymphoblastic leukaemia (0.4; 4.3%)	Traumatic brain injury (0.4; 2.0%)	Chronic liver disease (3.2; 3.5%)	Other injuries (5.6; 5.5%)	COPD (6.0; 4.1%)	Bowel cancer (9.0; 5.0%)	Lung cancer (11.9; 5.9%)	Lower respiratory infections (6.6; 3.4%)
6th	Other congenital conditions (2.2; 5.1%)	Other neurological conditions (0.4; 4.3%)	Other cardiovascular diseases (0.4; 1.9%)	Brain/CNS cancer (3.0; 3.3%)	Coronary heart disease (5.1; 4.9%)	Stroke (5.4; 3.7%)	Stroke (8.3; 4.6%)	Bowel cancer (8.6; 4.3%)	Chronic kidney disease (5.6; 3.0%)
7th	Other injuries (1.6; 3.6%)	Drowning/ submersion (0.3; 3.4%)	Acute lymphoblastic leukaemia (0.4; 1.9%)	Other cardiovascular diseases (2.6; 2.8%)	Chronic liver disease (4.5; 4.4%)	Chronic liver disease (5.4; 3.7%)	Pancreatic cancer (6.1; 3.4%)	Breast cancer (7.5; 3.7%)	Atrial fibrillation (5.3; 2.8%)
8th	Other blood/ metabolic disorders (1.1; 2.6%)	Poisoning (0.3; 2.7%)	Drowning/ submersion (0.4; 1.8%)	Coronary heart disease (2.4; 2.7%)	Stroke (3.0; 2.9%)	Pancreatic cancer (4.4; 3.0%)	Dementia (5.8; 3.2%)	Chronic kidney disease (5.8; 2.9%)	Bowel cancer (4.4; 2.3%)
9th	Other chromosomal abnormalities (1.1; 2.4%)	Other cardiovascular diseases (0.2; 2.6%)	Cerebal palsy (0.3; 1.5%)	Lung cancer (2.3; 2.5%)	Pancreatic cancer (2.6; 2.5%)	Ovarian cancer (4.3; 3.0%)	Ovarian cancer (5.3; 2.9%)	Pancreatic cancer (5.0; 2.5%)	Non-rheumatic valvular disease (3.9; 2.0%)
10th	Drowning/ submersion (1.0; 2.3%)	Lower respiratory infections (0.2; 2.6%)	Brain/CNS cancer (0.3; 1.5%)	Melanoma (2.0; 2.2%)	Ovarian cancer (2.5; 2.4%)	Poisoning (4.1; 2.8%)	Chronic kidney disease (3.6; 2.0%)	Type 2 diabetes (4.4; 2.2%)	Type 2 diabetes (3.7; 1.9%)

lbw = low birthweight; CNS = central nervous system.

Figure D7: Causes with the highest and lowest average years of life lost (YLL) per death, 2015



lbw = low birthweight; RTI = road traffic injuries.

Notes

1. Excludes diseases with fewer than 100 deaths and residual ('other') diseases.
2. Average YLL is standardised to the GBD standard reference life table (Murray, Ezzati et al. 2012) with a maximum life expectancy of 86.02 years at birth and a life table cap at age 105 years with a life expectancy of 1.63 years.

Table D1: Number and percentage of YLL and deaths, by age group and sex, 2015

	Males				Females				Persons			
Age group (years)	Deaths	%	YLL	%	Deaths	%	YLL	%	Deaths	%	YLL	%
Under 1	521	0.6	44,816	3.3	422	0.5	36,300	3.7	943	0.6	81,117	3.4
1–4	114	0.1	9,579	0.7	83	0.1	6,974	0.7	197	0.1	16,554	0.7
5–14	146	0.2	11,192	0.8	122	0.2	9,317	0.9	268	0.2	20,509	0.9
15–24	811	1.0	53,580	3.9	331	0.4	22,046	2.2	1,142	0.7	75,627	3.2
25–44	3,605	4.5	181,359	13.2	1,844	2.4	91,433	9.3	5,449	3.5	272,792	11.6
45–64	13,032	16.2	403,201	29.3	8,002	10.4	248,233	25.2	21,034	13.4	651,435	27.6
65–74	14,755	18.3	282,386	20.6	9,399	12.2	179,028	18.2	24,154	15.4	461,415	19.6
75–84	22,292	27.7	250,123	18.2	18,216	23.7	200,346	20.4	40,508	25.8	450,469	19.1
85–94	22,350	27.8	129,727	9.4	30,636	39.9	168,962	17.2	52,986	33.7	298,690	12.7
95+	2,793	3.5	8,126	0.6	7,688	10.0	21,652	2.2	10,481	6.7	29,778	1.3
Total	**80,419**	**100.0**	**1,374,090**	**100.0**	**76,743**	**100.0**	**984,293**	**100.0**	**157,162**	**100.0**	**2,358,384**	**100.0**

Note: Numbers and percentages for age groups may not add up to the total due to rounding.

Table D2: Number and proportion (%) of deaths, fatal and non-fatal burden attributable to each risk factor, 2015

Risk factor	Deaths		YLL		YLD	
	Number	% of total deaths	Number	% of total YLL	Number	% of total YLD
Behavioural						
Tobacco use	20,933	13.3	323,477	13.7	119,758	5.0
Dietary risks	19,876	12.6	261,820	11.1	84,923	3.5
Physical inactivity	7,079	4.5	85,847	3.6	35,311	1.5
Alcohol use	6,355	4.0	131,156	5.6	82,549	3.4
Illicit drug use	2,486	1.6	87,129	3.7	40,958	1.7
Child abuse & neglect	788	0.5	34,737	1.5	68,014	2.8
Unsafe sex	367	0.2	9,793	0.4	2,297	0.1
Intimate partner violence	223	0.1	8,542	0.4	26,536	1.1
Metabolic						
High blood pressure	19,519	12.4	215,623	9.1	58,271	2.4
Overweight & obesity	14,165	9.0	215,704	9.1	183,714	7.7
High blood plasma glucose	10,265	6.5	126,201	5.4	96,639	4.0
High cholesterol	8,686	5.5	114,512	4.9	26,538	1.1
Impaired kidney function	7,691	4.9	72,389	3.1	25,311	1.1
Low bone mineral density	860	0.5	6,337	0.3	10,867	0.5
Iron deficiency	29	0.0	155	0.0	17,119	0.7
Environmental						
Air pollution	2,566	1.6	29,015	1.2	8,674	0.4
Occupational exposures & hazards	1,978	1.3	42,850	1.8	51,461	2.1
High sun exposure	1,912	1.2	32,942	1.4	4,243	0.2
Joint effect	**74,775**	**47.6**	**1,097,464**	**46.5**	**684,954**	**28.6**

Figure D8: Leading risk factor contribution to non-fatal burden (YLD '000; proportion %), for males, by age group, 2015

Rank	Age group (years) 0–14	15–24	25–44	45–64	65–74	75–84	85–94	95+
1st	Child abuse/neglect (1.2; 1.6%)	Alcohol (12.2; 12.1%)	Alcohol (30.2; 10.8%)	Overweight/obesity (37.2; 11.4%)	Overweight/obesity (23.9; 13.0%)	Overweight/obesity (13.0; 10.3%)	Overweight/obesity (4.1; 7.6%)	Overweight/obesity (0.3; 7.3%)
2nd	Overweight/obesity (0.9; 1.3%)	Illicit drug use (6.2; 6.1%)	Illicit drug use (16.0; 5.7%)	Blood glucose (20.9; 6.4%)	Tobacco (18.2; 9.9%)	Tobacco (11.3; 8.9%)	Tobacco (4.0; 7.6%)	Blood pressure (0.2; 6.0%)
3rd	Blood glucose (0.3; 0.4%)	Occupational (3.4; 3.4%)	Occupational (12.7; 4.5%)	Tobacco (20.5; 6.3%)	Diet (14.9; 8.1%)	Diet (9.1; 7.2%)	Blood pressure (3.7; 6.9%)	Tobacco (0.2; 4.9%)
4th	Alcohol (0.2; 0.2%)	Child abuse/neglect (3.1; 3.1%)	Child abuse/neglect (9.9; 3.5%)	Diet (20.1; 6.1%)	Blood glucose (14.6; 7.9%)	Blood pressure (8.7; 6.9%)	Diet (3.3; 6.2%)	Diet (0.2; 4.8%)
5th		Overweight/obesity (1.0; 1.0%)	Overweight/obesity (8.6; 3.1%)	Occupational (15.7; 4.8%)	Blood pressure (10.6; 5.7%)	Blood glucose (8.1; 6.4%)	Blood glucose (2.5; 4.7%)	Physical inactivity (0.2; 4.5%)
6th		Blood glucose (0.9; 0.9%)	Tobacco (6.1; 2.2%)	Alcohol (11.5; 3.5%)	Physical inactivity (4.9; 2.6%)	Physical inactivity (3.9; 3.1%)	Physical inactivity (2.0; 3.8%)	Kidney function (0.2; 4.4%)
7th			Blood glucose (5.3; 1.9%)	Blood pressure (9.8; 3.0%)	Cholesterol (4.0; 2.2%)	Kidney function (3.7; 3.0%)	Kidney function (2.0; 3.7%)	Blood glucose (0.1; 3.4%)
8th			Diet (3.7; 1.3%)	Cholesterol (7.3; 2.2%)	Kidney function (3.0; 1.6%)	Cholesterol (3.2; 2.5%)	Cholesterol (1.4; 2.7%)	Cholesterol (0.1; 2.1%)
9th			Blood pressure (1.4; 0.5%)	Child abuse/neglect (6.3; 1.9%)	Alcohol (2.7; 1.5%)	Alcohol (1.9; 1.5%)	Alcohol (0.9; 1.6%)	Alcohol (0.1; 2.0%)
10th			Cholesterol (1.0; 0.3%)	Physical inactivity (5.2; 1.6%)	Air pollution (1.6; 0.9%)	Air pollution (1.3; 1.0%)	Bone density (0.7; 1.3%)	Bone density (0.1; 1.6%)

Figure D9: Leading risk factor contribution to non-fatal burden (YLD '000; proportion %), for females, by age group, 2015

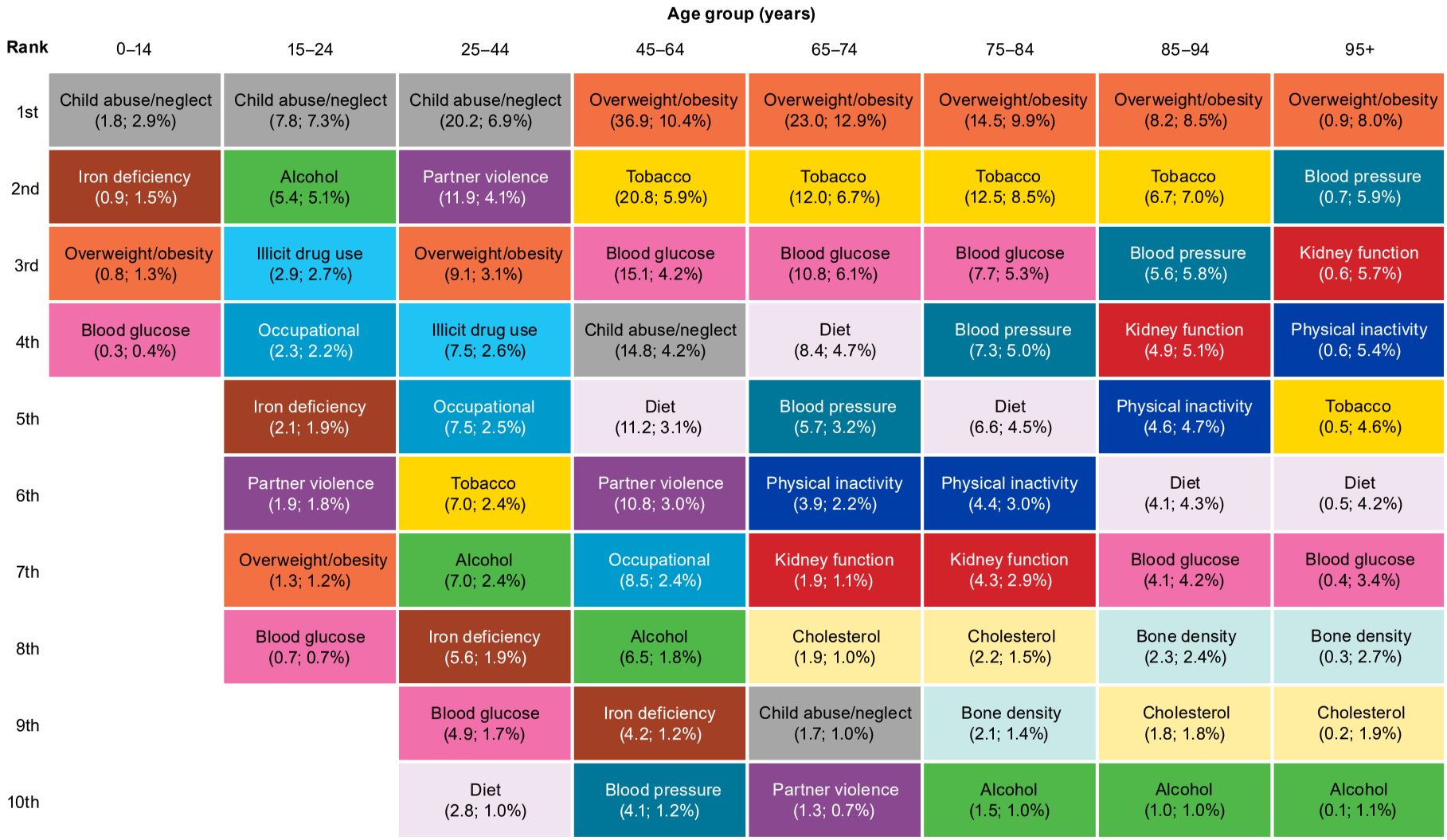


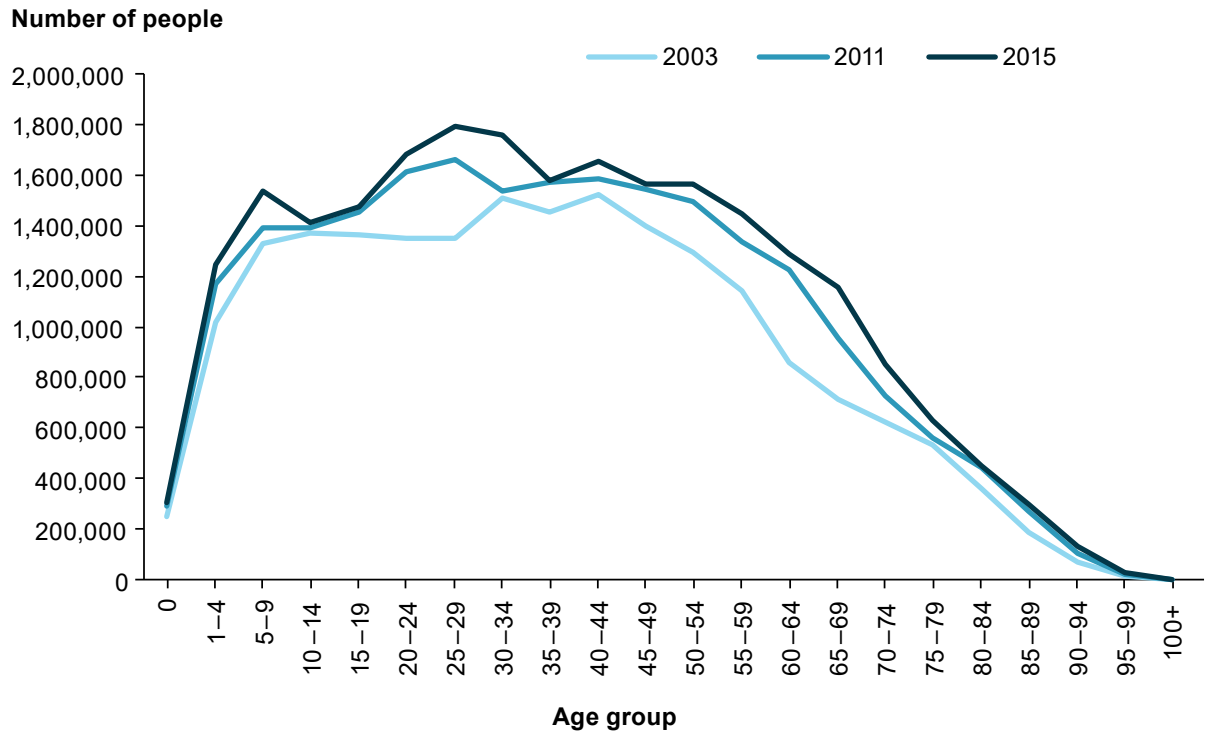
Figure D10: Leading risk factor contribution to fatal burden (YLL '000; proportion %), for males, by age group, 2015

Rank	Age group (years)							
	0–14	15–24	25–44	45–64	65–74	75–84	85–94	95+
1st	Blood glucose (0.2; 0.4%)	Alcohol (8.0; 14.9%)	Illicit drug use (30.8; 17.0%)	Tobacco (72.2; 17.9%)	Tobacco (57.6; 20.4%)	Tobacco (41.4; 16.6%)	Blood pressure (18.2; 14.0%)	Blood pressure (1.4; 17.7%)
2nd		Illicit drug use (6.3; 11.8%)	Alcohol (24.9; 13.7%)	Diet (64.0; 15.9%)	Diet (39.6; 14.0%)	Diet (31.5; 12.6%)	Diet (17.9; 13.8%)	Diet (1.3; 16.5%)
3rd		Child abuse/neglect (4.8; 9.0%)	Diet (14.8; 8.1%)	Overweight/obesity (51.0; 12.7%)	Overweight/obesity (34.9; 12.4%)	Blood pressure (29.4; 11.7%)	Tobacco (15.8; 12.2%)	Tobacco (0.7; 8.7%)
4th		Occupational (2.9; 5.4%)	Child abuse/neglect (11.7; 6.5%)	Blood pressure (41.4; 10.3%)	Blood pressure (31.0; 11.0%)	Overweight/obesity (25.2; 10.1%)	Blood glucose (9.1; 7.0%)	Cholesterol (0.7; 8.1%)
5th		Blood glucose (0.2; 0.5%)	Tobacco (9.5; 5.3%)	Cholesterol (35.6; 8.8%)	Blood glucose (20.5; 7.3%)	Blood glucose (18.7; 7.5%)	Overweight/obesity (9.0; 6.9%)	Kidney function (0.6; 7.3%)
6th			Overweight/obesity (9.4; 5.2%)	Alcohol (32.8; 8.1%)	Alcohol (13.2; 4.7%)	Kidney function (11.8; 4.7%)	Cholesterol (8.3; 6.4%)	Blood glucose (0.5; 6.7%)
7th			Blood pressure (8.6; 4.7%)	Blood glucose (21.2; 5.3%)	Cholesterol (12.5; 4.4%)	Cholesterol (11.7; 4.7%)	Kidney function (7.7; 5.9%)	Overweight/obesity (0.4; 5.4%)
8th			Cholesterol (8.6; 4.7%)	Illicit drug use (20.8; 5.2%)	Physical inactivity (10.4; 3.7%)	Physical inactivity (10.7; 4.3%)	Physical inactivity (5.8; 4.5%)	Physical inactivity (0.3; 4.3%)
9th			Occupational (7.0; 3.9%)	Physical inactivity (13.9; 3.4%)	Occupational (9.1; 3.2%)	Alcohol (8.3; 3.3%)	Alcohol (3.7; 2.8%)	Alcohol (0.3; 3.2%)
10th			Physical inactivity (3.2; 1.7%)	Occupational (11.9; 3.0%)	Kidney function (8.4; 3.0%)	Occupational (5.5; 2.2%)	Air pollution (2.6; 2.0%)	Air pollution (0.2; 2.4%)

Figure D11: Leading risk factor contribution to fatal burden (YLL '000; proportion %), for females, by age group, 2015

Rank	Age group (years)							
	0–14	15–24	25–44	45–64	65–74	75–84	85–94	95+
1st	Blood glucose (0.4; 0.8%)	Child abuse/neglect (2.5; 11.4%)	Illicit drug use (9.4; 10.3%)	Tobacco (42.0; 16.9%)	Tobacco (36.5; 20.4%)	Tobacco (28.4; 14.2%)	Blood pressure (27.6; 16.4%)	Blood pressure (4.1; 19.1%)
2nd	Child abuse/neglect (0.2; 0.5%)	Alcohol (2.0; 8.9%)	Alcohol (6.2; 6.8%)	Overweight/obesity (26.9; 10.9%)	Overweight/obesity (20.3; 11.3%)	Blood pressure (24.3; 12.1%)	Diet (22.4; 13.3%)	Diet (3.3; 15.3%)
3rd		Illicit drug use (1.5; 6.7%)	Diet (5.1; 5.6%)	Diet (22.7; 9.1%)	Diet (17.7; 9.9%)	Diet (21.5; 10.7%)	Tobacco (14.1; 8.4%)	Kidney function (1.7; 7.8%)
4th		Partner violence (1.0; 4.6%)	Child abuse/neglect (4.7; 5.1%)	Alcohol (13.8; 5.6%)	Blood pressure (14.7; 8.2%)	Overweight/obesity (20.3; 10.1%)	Overweight/obesity (12.9; 7.6%)	Cholesterol (1.7; 7.8%)
5th		Blood glucose (0.3; 1.6%)	Partner violence (3.9; 4.3%)	Blood pressure (13.0; 5.2%)	Blood glucose (10.9; 6.1%)	Blood glucose (15.0; 7.5%)	Kidney function (12.4; 7.3%)	Blood glucose (1.4; 6.5%)
6th		Occupational (0.2; 0.9%)	Tobacco (3.9; 4.3%)	Blood glucose (10.8; 4.3%)	Physical inactivity (7.5; 4.2%)	Kidney function (11.1; 5.6%)	Blood glucose (11.9; 7.0%)	Overweight/obesity (1.3; 6.1%)
7th		Overweight/obesity (0.1; 0.6%)	Overweight/obesity (3.8; 4.1%)	Physical inactivity (9.8; 3.9%)	Alcohol (6.4; 3.5%)	Physical inactivity (10.8; 5.4%)	Cholesterol (10.9; 6.4%)	Tobacco (1.2; 5.4%)
8th		Sun exposure (0.1; 0.6%)	Physical inactivity (2.3; 2.5%)	Cholesterol (9.7; 3.9%)	Cholesterol (4.8; 2.7%)	Cholesterol (8.0; 4.0%)	Physical inactivity (9.7; 5.7%)	Physical inactivity (1.2; 5.4%)
9th		Physical inactivity (0.1; 0.5%)	Cholesterol (2.2; 2.4%)	Illicit drug use (9.0; 3.6%)	Kidney function (4.6; 2.6%)	Alcohol (6.3; 3.2%)	Alcohol (4.7; 2.8%)	Alcohol (0.6; 3.0%)
10th		Unsafe sex (0.1; 0.3%)	Unsafe sex (2.1; 2.3%)	Kidney function (4.1; 1.7%)	Sun exposure (2.1; 1.2%)	Air pollution (2.9; 1.5%)	Air pollution (3.3; 2.0%)	Air pollution (0.5; 2.3%)

Figure D12: Population of Australia, persons, by age group, 2003, 2011 and 2015



Source: ABS 2017a.

Table D3: Population of Australia (number and %), persons, by age group, 2003, 2011 and 2015

	2003		2011		2015	
Age group (years)	**Number**	**%**	**Number**	**%**	**Number**	**%**
0	248,959	1.3	290,397	1.3	308,094	1.3
1–4	1,020,177	5.2	1,167,717	5.2	1,247,007	5.2
5–9	1,329,682	6.7	1,387,634	6.2	1,536,065	6.4
10–14	1,370,851	7.0	1,387,865	6.2	1,411,238	5.9
15–19	1,360,368	6.9	1,453,459	6.5	1,472,753	6.2
20–24	1,350,012	6.8	1,611,663	7.2	1,682,092	7.1
25–29	1,349,310	6.8	1,658,170	7.4	1,793,349	7.5
30–34	1,508,950	7.7	1,536,161	6.9	1,754,258	7.4
35–39	1,451,812	7.4	1,573,910	7.0	1,575,080	6.6
40–44	1,520,976	7.7	1,587,244	7.1	1,656,563	6.9
45–49	1,395,676	7.1	1,541,837	6.9	1,564,889	6.6
50–54	1,297,378	6.6	1,494,063	6.7	1,561,110	6.5
55–59	1,144,182	5.8	1,335,993	6.0	1,447,433	6.1
60–64	861,077	4.4	1,226,000	5.5	1,284,129	5.4
65–69	711,646	3.6	954,260	4.3	1,157,316	4.9
70–74	625,179	3.2	727,671	3.3	850,655	3.6
75–79	532,369	2.7	558,341	2.5	630,662	2.6
80–84	362,670	1.8	444,032	2.0	449,613	1.9
85–89	187,557	1.0	272,273	1.2	301,440	1.3
90–94	72,895	0.4	103,493	0.5	133,758	0.6
95–99	16,707	0.1	24,789	0.1	29,698	0.1
100+	2,304	0.0	3,052	0.0	3,582	0.0
Total	**19,720,737**	**100.0**	**22,340,024**	**100.0**	**23,850,784**	**100.0**

Source: ABS 2017a.

Table D4: Life expectancy, HALE and HALE (%), at birth and age 65, by sex, jurisdiction, remoteness area and socioeconomic area, 2015

	At birth						At age 65[a]					
	Males			Females			Males			Females		
	LE (years)[b]	HALE (years)	HALE (%)[c]	LE (years)[b]	HALE (years)	HALE (%)[c]	LE (years)[b]	HALE (years)	HALE (%)[c]	LE (years)[b]	HALE (years)	HALE (%)[c]
Jurisdiction												
New South Wales	80.4	71.6	89.0	84.6	74.5	88.1	19.5	15.0	76.7	22.2	16.8	75.8
Victoria	81.2	72.0	88.7	84.7	74.7	88.1	19.9	15.3	76.7	22.2	16.9	76.3
Queensland	80.1	71.2	88.9	84.5	74.4	88.0	19.5	14.8	76.0	22.3	16.8	75.5
Western Australia	80.3	71.8	89.4	84.8	75.3	88.8	19.6	15.1	77.1	22.6	17.4	76.9
South Australia	80.4	71.1	88.4	84.5	74.2	87.8	19.6	14.9	76.1	22.3	17.1	76.5
Tasmania	78.8	69.9	88.8	82.9	73.0	88.0	18.5	14.2	76.7	21.2	15.9	75.1
Australian Capital Territory	81.3	72.6	89.2	85.2	74.5	87.5	19.8	15.3	77.1	22.6	16.8	74.2
Northern Territory	75.6	66.8	88.4	78.7	68.6	87.2	17.5	12.1	68.9	18.9	12.5	66.2
Remoteness area												
Major cities	81.4	72.4	89.0	85.1	75.1	88.2	20.1	15.4	76.7	22.5	17.2	76.2
Inner regional	79.3	70.3	88.7	83.8	73.7	88.0	19.0	14.5	76.4	21.9	16.7	76.4
Outer regional	78.4	69.7	88.9	83.5	73.9	88.5	18.6	14.2	76.4	21.7	16.6	76.7
Remote and Very remote	76.6	67.2	87.7	80.1	69.3	86.5	18.2	13.0	71.5	20.2	14.1	69.6
Socioeconomic area												
1 Lowest	77.5	68.3	88.1	82.7	71.8	86.8	18.1	13.5	74.8	21.2	15.7	73.8
2	79.0	69.8	88.3	83.6	73.2	87.5	18.6	14.2	76.0	21.6	16.2	75.1
3	80.4	71.4	88.8	84.3	74.4	88.3	19.5	15.0	76.9	22.0	17.0	77.2
4	82.3	73.4	89.2	85.6	76.0	88.8	20.7	15.9	76.5	22.9	17.7	77.0
5 Highest	83.9	75.7	90.2	86.8	77.6	89.5	21.7	17.1	78.7	23.6	18.4	78.0
Australia	**80.4**	**71.5**	**88.9**	**84.6**	**74.4**	**87.9**	**19.6**	**15.0**	**76.4**	**22.3**	**16.8**	**75.5**

(a) For remoteness area and socioeconomic area, measures for age 65 refer to the age group 65–69.

(b) Life expectancy (LE) from ABS 2013b, 2017b, 2017c, 2017d, 2018a, 2018b.

(c) HALE (%) refers to percentage of life expectancy in full health.

Sources: AIHW analysis of ABDS 2015 database; ABS 2013b, 2017b, 2017c, 2017d, 2018a, 2018b.

Table D5: Change in life expectancy and HALE between 2003 and 2015, percentage of life expectancy in full health 2003, 2011 and 2015, at birth and age 65, males and females

	Males			Females		
Time point	Life expectancy (years)[(a)]	HALE (years)	LE in full health (%)	Life expectancy (years)[(a)]	HALE (years)	LE in full health (%)
			At birth			
2003	78.1	69.5	89.0	83.0	73.1	88.0
2011	79.9	71.2	89.1	84.3	74.3	88.2
2015	80.4	71.5	88.9	84.6	74.4	87.9
Change (2003 to 2015)	2.3	2.0	–0.1	1.6	1.3	–0.1
			At age 65			
2003	17.8	13.5	75.8	21.1	16.0	75.6
2011	19.1	14.6	76.4	22.0	16.7	75.9
2015	19.6	15.0	76.4	22.3	16.8	75.5
Change (2003 to 2015)	1.8	1.5	0.6	1.2	0.9	–0.0

LE = life expectancy.

(a) ABS 2007, 2013b, 2017b.

Note: A negative number for change between 2003 and 2015 indicates a smaller percentage of remaining life expectancy in full health in 2015 compared with 2003.

Sources: AIHW analysis of ABDS 2015 database; ABS 2007, 2013b, 2017b.

Table D6: Life expectancy[(a)], HALE and percentage of remaining life expectancy in full health at selected ages, males and females, 2015

	Males			Females		
Age (years)	LE (years)	HALE (years)	LE in full health (%)	LE (years)	HALE (years)	LE in full health (%)
0	80.4	71.5	88.9	84.6	74.4	87.9
5	75.8	66.9	88.3	79.9	69.8	87.3
10	70.8	62.1	87.7	74.9	64.9	86.7
15	65.9	57.3	87.0	70.0	60.1	85.9
20	61.0	52.7	86.5	65.0	55.5	85.4
25	56.2	48.2	85.8	60.1	51.0	84.8
30	51.3	43.7	85.3	55.2	46.4	84.1
35	46.6	39.3	84.4	50.3	41.9	83.4
40	41.8	35.0	83.6	45.4	37.5	82.6
45	37.1	30.7	82.7	40.6	33.1	81.6
50	32.5	26.5	81.5	35.9	28.9	80.4
55	28.1	22.5	80.0	31.3	24.7	79.0
60	23.8	18.6	78.1	26.7	20.7	77.5
65	19.6	15.0	76.4	22.3	16.8	75.5
70	15.7	11.6	74.1	18.0	13.2	73.3
75	12.1	8.7	71.7	14.0	9.9	70.6
80	8.9	6.1	69.0	10.4	7.0	67.3
85	6.2	4.1	66.3	7.3	4.6	62.9
90	4.3	2.6	61.0	4.9	2.8	56.8
95	3.0	1.7	57.4	3.3	1.8	54.5
100	2.1	1.2	56.5	2.3	1.2	52.7

(a) ABS 2007, 2013b, 2017b.

Table D7: LE[(a)], HALE, ill health (years) and percentage healthy years, at birth and age 65, males and females, *Major cities* and *Remote and very remote* areas, 2011 and 2015

	2011				2015				Change over time			
	LE	HALE	Ill health	%FH	LE	HALE	Ill health	%FH	LE	HALE	Ill health	% FH
At birth					**Males**							
Major cities	80.6	72.0	8.6	89.3	81.4	72.4	9.0	89.0	0.8	0.4	0.3	−0.3
Remote and very remote	75.3	66.8	8.6	88.6	76.6	67.2	9.5	87.7	1.3	0.4	0.9	−0.9
Gap	−5.3	−5.2	−0.1	−0.7	−4.8	−5.2	0.5	−1.3	0.5	−0.1	0.6	−0.6
Age 65												
Major cities	19.4	14.9	4.5	76.7	20.1	15.4	4.7	76.7	0.7	0.5	0.2	0.0
Remote and very remote	17.2	12.4	4.7	72.4	18.2	13.0	5.2	71.5	1.0	0.6	0.5	−0.9
Gap	−2.2	−2.5	0.3	−4.3	−1.9	−2.4	0.5	−5.2	0.3	0.1	0.3	−0.9
At birth					**Females**							
Major cities	84.8	75.0	9.8	88.5	85.1	75.1	10.0	88.2	0.3	0.1	0.2	−0.3
Remote and very remote	79.7	68.2	11.4	85.6	80.1	69.3	10.8	86.5	0.4	1.1	−0.6	0.9
Gap	−5.1	−6.8	1.6	−2.9	−5.0	−5.8	0.9	−1.8	0.1	1.0	−0.8	1.2
Age 65												
Major cities	22.3	17.1	5.3	76.5	22.5	17.2	5.4	76.2	0.2	0.1	0.1	−0.3
Remote and very remote	20.0	13.0	6.9	65.3	20.2	14.1	6.1	69.6	0.2	1.1	−0.8	4.3
Gap	−2.3	−4.1	1.6	−11.2	−2.3	−3.1	0.7	−6.6	0.0	1.0	−0.9	4.6

LE = life expectancy; FH = full health.

(a) ABS 2017d, 2018b.

Note: Gap refers to measure in *Remote and very remote* areas minus measure in *Major cities*. A negative number indicates the measure was higher in *Major cities*.

Sources: AIHW analysis of ABDS 2015 database; ABS 2017d, ABS 2018b.

Table D8: LE[(a)], HALE, ill health (years) and percentage healthy years, at birth and age 65, males and females, highest and lowest socioeconomic groups, 2011 and 2015

	2011				2015				Change over time			
	LE	HALE	Ill health	%FH	LE	HALE	Ill health	%FH	LE	HALE	Ill health	% FH
At birth					**Males**							
1 Lowest	77.3	68.7	8.6	88.8	77.5	68.3	9.2	88.1	0.2	–0.4	0.6	–0.7
5 Highest	83.0	74.8	8.2	90.2	83.9	75.7	8.3	90.2	0.9	0.9	0.1	0.0
Gap	–5.7	–6.1	0.4	–1.4	–6.4	–7.4	0.9	–2.1	–0.7	–1.3	0.5	–0.7
Age 65												
1 Lowest	17.7	13.6	4.1	77.1	18.1	13.5	4.5	74.8	0.4	–0.1	0.4	–2.3
5 Highest	20.9	16.2	4.7	77.6	21.7	17.1	4.6	78.7	0.8	0.9	–0.1	1.1
Gap	–3.2	–2.6	–0.6	–0.5	–3.6	–3.6	–0.1	–3.9	–0.4	–1.0	0.5	–3.4
At birth					**Females**							
1 Lowest	82.7	72.7	10.0	88.0	82.7	71.8	10.9	86.8	0.0	–0.9	0.9	–1.2
5 Highest	86.0	76.7	9.2	89.3	86.8	77.6	9.1	89.5	0.8	0.9	–0.1	0.2
Gap	–3.3	–4.0	0.8	–1.3	–4.1	–5.8	1.8	–2.7	–0.8	–1.8	1.0	–1.4
Age 65												
1 Lowest	21.2	16.2	4.9	76.8	21.2	15.7	5.6	73.8	0.0	–0.5	0.7	–3.0
5 Highest	22.9	17.5	5.5	76.1	23.6	18.4	5.2	78	0.7	0.9	–0.3	1.9
Gap	–1.7	–1.3	–0.6	0.7	–2.4	–2.7	0.4	–4.2	–0.7	–1.4	1.0	–4.9

LE = life expectancy; FH = full health.

(a) ABS 2017c, 2018a.

Note: Gap refers to measure in *Remote and very remote* areas minus measure in *Major cities*. A negative number indicates the measure was higher in *Major cities*.

Source: AIHW analysis of ABDS 2015 database, ABS 2017c, ABS 2018a.

Table D9: Decomposition of changes in DALY between 2003 and 2015

Disease group	Actual 2003 DALY	Expected 2015 DALY with population growth[a]	% change due to increasing population	Expected 2015 DALY with increasing and ageing population[b]	% change from 2003 due to population ageing	Actual 2015 DALY	% change from 2003 due to disease[c]	Total % change from 2003
Blood/metabolic	44,073	53,303	20.9	56,993	8.4	60,346	7.6	36.9
Cancer	772,986	934,869	20.9	1,027,669	12.0	868,153	-20.6	12.3
Cardiovascular	738,982	893,744	20.9	1,011,043	15.9	646,384	-49.3	-12.5
Endocrine	96,224	116,376	20.9	128,476	12.6	124,151	-4.5	29.0
Gastrointestinal	128,160	155,000	20.9	166,171	8.7	159,608	-5.1	24.5
Hearing/vision	74,648	90,281	20.9	100,387	13.5	98,719	-2.2	32.2
Infant/congenital	121,730	147,224	20.9	149,448	1.8	103,844	-37.5	-14.7
Infections	92,720	112,138	20.9	121,171	9.7	97,161	-25.9	4.8
Injuries	356,938	431,691	20.9	432,423	0.2	405,961	-7.4	13.7
Kidney/urinary	38,600	46,684	20.9	52,578	15.3	64,282	30.3	66.5
Mental	472,655	571,641	20.9	561,301	-2.2	572,775	2.4	21.2
Musculoskeletal	531,161	642,400	20.9	676,326	6.4	611,288	-12.2	15.1
Neurological	215,765	260,952	20.9	286,561	11.9	346,124	27.6	60.4
Oral	84,782	102,537	20.9	107,738	6.1	107,307	-0.5	26.6
Reproductive/maternal	36,508	44,154	20.9	45,228	2.9	46,834	4.4	28.3
Respiratory	285,051	344,748	20.9	368,941	8.5	357,636	-4.0	25.5
Skin	65,867	79,661	20.9	79,984	0.5	81,842	2.8	24.3
Total	**4,156,850**	**5,027,405**	**20.9**	**5,372,439**	**8.3**	**4,752,415**	**-14.9**	**14.3**

(a) Estimated by increasing DALY from 2003 by 20.9% to match the rise in the Australian population between 2003 and 2015.

(b) Estimated by applying age-specific rates from 2003 to the 2015 population.

(c) Estimated by subtracting the actual 2015 DALY estimate from the expected 2015 estimate, given population growth and ageing; expressed as a percentage increase from 2003.

Table D10: Decomposition of changes in YLD between 2003 and 2015

Disease group	Actual 2003 YLD	Expected 2015 YLD with population growth[a]	% change due to increasing population	Expected 2015 YLD with increasing and ageing population[b]	% change from 2003 due to population ageing	Actual 2015 YLD	% change from 2003 due to disease[c]	Total % change from 2003
Blood/metabolic	16,954	20,505	20.9	21,989	8.8	26,172	24.7	54.4
Cancer	45,287	54,772	20.9	60,836	13.4	64,663	8.5	42.8
Cardiovascular	139,982	169,298	20.9	192,867	16.8	138,876	-38.6	-0.8
Endocrine	43,971	53,180	20.9	57,465	9.7	76,663	43.7	74.3
Gastrointestinal	47,386	57,310	20.9	59,727	5.1	59,222	-1.1	25.0
Hearing/vision	74,648	90,281	20.9	100,387	13.5	98,719	-2.2	32.2
Infant/congenital	17,607	21,294	20.9	21,179	-0.7	18,723	-13.9	6.3
Infections	26,282	31,786	20.9	32,125	1.3	34,189	7.9	30.1
Injuries	54,435	65,835	20.9	67,737	3.5	71,742	7.4	31.8
Kidney/urinary	11,137	13,470	20.9	15,160	15.2	16,689	13.7	49.9
Mental	456,138	551,666	20.9	540,587	-2.4	558,596	3.9	22.5
Musculoskeletal	516,760	624,983	20.9	656,685	6.1	594,566	-12.0	15.1
Neurological	124,819	150,959	20.9	163,725	10.2	177,933	11.4	42.6
Oral	84,626	102,348	20.9	107,527	6.1	107,058	-0.6	26.5
Reproductive/maternal	35,625	43,086	20.9	44,151	3.0	46,025	5.3	29.2
Respiratory	179,639	217,260	20.9	226,127	4.9	228,580	1.4	27.2
Skin	62,018	75,006	20.9	74,568	-0.7	75,613	1.7	21.9
Total	**1,937,315**	**2,343,040**	**20.9**	**2,442,841**	**5.2**	**2,394,031**	**-2.5**	**23.6**

(a) Estimated by increasing DALY from 2003 by 20.9% to match the rise in the Australian population between 2003 and 2015.

(b) Estimated by applying age-specific rates from 2003 to the 2015 population.

(c) Estimated by subtracting the actual 2015 DALY estimate from the expected 2015 estimate, given population growth and ageing; expressed as a percentage increase from 2003.

Table D11: Decomposition of changes in YLL between 2003 and 2015

Disease group	Actual 2003 YLL	Expected 2015 YLL with population growth[a]	% change due to increasing population	Expected 2015 YLL with increasing and ageing population[b]	% change from 2003 due to population ageing	Actual 2015 YLL	% change from 2003 due to disease[c]	Total % change from 2003
Blood/metabolic	27,119	32,798	20.9	35,004	8.1	34,173	–3.1	26.0
Cancer	727,698	880,098	20.9	966,833	11.9	803,489	–22.4	10.4
Cardiovascular	599,000	724,446	20.9	818,176	15.6	507,509	–51.9	–15.3
Endocrine	52,253	63,196	20.9	71,011	15.0	47,488	–45.0	–9.1
Gastrointestinal	80,774	97,691	20.9	106,445	10.8	100,386	–7.5	24.3
Hearing/vision	0	0	—	0	—	0	—	—
Infant/congenital	104,123	125,929	20.9	128,269	2.2	85,121	–41.4	–18.2
Infections	66,438	80,351	20.9	89,046	13.1	62,972	–39.2	–5.2
Injuries	302,504	365,856	20.9	364,686	–0.4	334,219	–10.1	10.5
Kidney/urinary	27,463	33,214	20.9	37,417	15.3	47,593	37.1	73.3
Mental	16,516	19,975	20.9	20,714	4.5	14,178	–39.6	–14.2
Musculoskeletal	14,401	17,417	20.9	19,641	15.4	16,722	–20.3	16.1
Neurological	90,946	109,993	20.9	122,836	14.1	168,190	49.9	84.9
Oral	156	189	20.9	211	14.5	249	24.0	59.4
Reproductive/maternal	883	1,068	20.9	1,077	1.1	809	–30.4	–8.4
Respiratory	105,412	127,488	20.9	142,814	14.5	129,056	–13.1	22.4
Skin	3,849	4,656	20.9	5,416	19.8	6,229	21.1	61.8
Total	**2,219,535**	**2,684,365**	**20.9**	**2,929,598**	**11.0**	**2,358,384**	**–25.7**	**6.3**

(a) Estimated by increasing DALY from 2003 by 20.9% to match the rise in the Australian population between 2003 and 2015.

(b) Estimated by applying age-specific rates from 2003 to the 2015 population.

(c) Estimated by subtracting the actual 2015 DALY estimate from the expected 2015 estimate, given population growth and ageing; expressed as a percentage increase from 2003.

Table D12: Changes in total attributable burden between 2003 and 2015, by risk factor exposure

Risk factor	2003 attributable DALY	2015 attributable DALY	Change in attributable DALY	Change in attributable DALY (%)	2003 attributable DALY ASR	2015 attributable DALY ASR	Change in ASR	Rate ratio 2015:2003
Dietary risks								
Diet low in fruit	73,017	65,666	-7,351	-10.1	3.6	2.5	-1.2	0.7
Diet low in vegetables	63,060	55,354	-7,706	-12.2	3.1	2.0	-1.1	0.7
Diet low in whole grains & high fibre cereals	85,727	76,656	-9,070	-10.6	4.3	2.9	-1.4	0.7
Diet low in legumes	48,634	36,252	-12,382	-25.5	2.4	1.4	-1.0	0.6
Diet low in nuts and seeds	87,949	61,308	-26,641	-30.3	4.4	2.3	-2.1	0.5
Diet low in milk	9,860	10,293	433	4.4	0.5	0.4	-0.1	0.8
Diet low in fish & seafood	9,196	5,555	-3,642	-39.6	0.5	0.2	-0.2	0.5
Diet low in polyunsaturated fats	36,294	28,717	-7,577	-20.9	1.8	1.1	-0.7	0.6
Diet high in red meat	10,691	13,655	2,964	27.7	0.5	0.5	-0.0	1.0
Diet high in processed meat	60,811	58,755	-2,056	-3.4	3.0	2.2	-0.8	0.7
Diet high in sodium	53,556	56,728	3,172	5.9	2.7	2.1	-0.6	0.8
Diet high in sugar sweetened beverages	7,111	8,192	1,081	15.2	0.4	0.3	-0.0	0.9
Tobacco use								
Tobacco use (excluding second-hand smoke)	425,939	439,553	13,614	3.2	21.1	16.3	-4.9	0.8
Second-hand smoke	8,565	3,682	-4,883	-57.0	0.4	0.1	-0.3	0.3
Overweight & obesity								
Overweight	157,113	177,342	20,229	12.9	7.8	6.6	-1.2	0.8
Obesity	156,322	222,077	65,755	42.1	7.8	8.2	0.5	1.1

(Continued)

Table D12 (continued): Changes in total attributable burden between 2003 and 2015, by risk factor exposure

Risk factor	2003 attributable DALY	2015 attributable DALY	Change in attributable DALY	Change in attributable DALY (%)	2003 attributable DALY ASR	2015 attributable DALY ASR	Change in ASR	Rate ratio 2015:2003
Illicit drug use								
Opioid use	33,119	46,691	13,572	41.0	1.7	2.0	0.3	1.2
Amphetamine use	15,020	26,219	11,199	74.6	0.8	1.1	0.4	1.5
Cocaine use	12,427	14,616	2,190	17.6	0.6	0.6	-0.0	1.0
Cannabis use	8,937	10,585	1,647	18.4	0.5	0.5	-0.0	1.0
Other illicit drug use	7,671	6,661	-1,010	-13.2	0.4	0.3	-0.1	0.7
Unsafe injecting practices	12,625	23,315	10,690	84.7	0.6	0.9	0.3	1.4
Impaired kidney function								
Chronic kidney disease stage 1–3	39,312	44,809	5,497	14.0	1.9	1.5	-0.4	0.8
Chronic kidney disease stage 4–5	32,701	52,891	20,190	61.7	1.6	1.9	0.3	1.2

Notes

1. Rates were age-standardised to the 2001 Australian Standard Population and are expressed per 1,000 population.
2. Rate ratios divide 2015 ASRs by corresponding 2003 ASRs.
3. Rate differences subtract 2015 ASRs from the corresponding 2003 ASRs.

Table D13: Decomposition of changes in selected risk factors between 2003 and 2015

Risk factor	Actual 2003 DALY	Expected 2015 DALY due to population growth[a]	% change due to increasing population	Expected 2015 DALY due to increasing and ageing population[b]	% change from 2003 to 2015 due to population ageing	Expected 2015 DALY due to risk factor exposure[c]	% change due to risk factor exposure	Actual 2015 DALY	% change from 2003 due to linked diseases[d]
Tobacco use	434,504	525,501	20.9	581,744	12.9	514,620	–11.5	443,235	–16.1
Overweight & obesity	313,434	379,076	20.9	415,310	11.6	428,302	3.1	399,419	–7.2
All dietary risks	388,292	469,611	20.9	525,463	14.4	543,718	3.5	346,742	–56.8
High blood pressure	338,032	408,824	20.9	464,371	16.4	414,469	–10.7	273,894	–51.3
Alcohol use	195,622	236,590	20.9	243,781	3.7	225,322	–7.6	213,705	–5.4
High cholesterol	208,712	252,422	20.9	282,428	14.4	260,898	–7.6	141,050	–85.0
Illicit drug use	89,799	108,605	20.9	108,041	–0.6	102,228	–5.4	128,087	20.2
Physical inactivity	115,334	139,487	20.9	156,015	14.3	155,580	–0.3	121,158	–28.4
Occupational exposures & hazards	86,955	105,166	20.9	108,593	3.9	110,256	1.5	94,311	–16.9
Child abuse & neglect[a]	83,754	101,295	20.9	99,514	–2.1	99,514	0.0	102,751	3.2
Impaired kidney function	72,013	87,095	20.9	101,071	19.4	102,638	1.6	97,700	–5.1
Intimate partner violence	29,232	35,354	20.9	34,887	–1.6	36,125	3.5	35,078	–3.0
High sun exposure[a]	31,028	37,526	20.9	40,621	10.0	40,621	0.0	37,185	–9.2
Unsafe sex	12,834	15,521	20.9	15,659	1.1	15,436	–1.4	12,090	–27.7

(a) The same PAFs have been used in 2003, 2011 and 2015 and any change in attributable burden is due to changes in the ASRs of the linked disease.

(b) Estimated by applying age-specific rates from 2003 to 2015 population.

(c) Percentage change due to risk factor exposure is equal to the percentage change in total PAF.

(d) Estimated by subtracting the actual 2015 attributable DALY estimate from the expected 2015 estimate, given risk factor exposure; expressed as a percentage increase from 2003.

Table D14: Age-standardised YLD rates, by disease group and state or territory, 2015

Disease group	NSW	Vic	Qld	WA	SA	Tas	ACT	NT	Australia
Blood/metabolic	1.0	0.9	1.2	1.1	1.3	1.0	1.7	2.3	1.0
Cancer	2.4	2.3	2.5	2.4	2.3	2.4	2.4	2.1	2.4
Cardiovascular	5.1	4.5	5.6	4.6	5.4	3.8	4.5	11.5	5.1
Endocrine	3.0	3.0	2.7	2.9	3.0	2.9	2.6	3.0	2.9
Gastrointestinal	2.4	2.4	2.4	2.4	2.4	2.4	2.3	2.4	2.4
Hearing/vision	3.4	3.7	4.0	3.4	3.4	4.1	3.9	4.8	3.6
Infant/congenital	0.8	0.7	0.9	0.8	1.0	0.8	0.7	0.8	0.8
Infections	1.4	1.3	1.7	0.9	1.8	1.0	1.3	2.4	1.4
Injuries	2.8	2.6	3.3	2.5	2.8	2.9	2.7	5.7	2.9
Kidney/urinary	0.6	0.6	0.7	0.6	0.6	0.8	0.4	2.4	0.6
Mental	23.1	26.0	22.6	24.5	25.4	18.8	24.4	21.0	24.0
Musculoskeletal	23.8	23.0	22.3	22.0	24.8	30.5	24.2	17.2	23.3
Neurological	6.8	6.4	6.7	5.9	7.2	7.2	6.6	8.2	6.6
Oral	4.2	4.5	4.4	3.3	4.1	5.0	3.0	5.3	4.2
Reproductive/maternal	1.1	1.1	1.9	0.7	1.4	1.1	0.8	1.4	1.9
Respiratory	9.0	9.7	8.9	8.6	9.2	10.2	9.9	7.1	9.1
Skin	3.2	3.4	3.1	3.0	3.4	3.6	3.1	2.9	3.2
All diseases	**94.0**	**96.0**	**94.9**	**89.5**	**99.4**	**98.6**	**94.5**	**100.5**	**95.3**

Note: Rates were age-standardised to the 2001 Australian Standard Population and expressed per 1,000 population.

Table D15: Age-standardised YLL rates, by disease group and state or territory, 2015

Disease group	NSW	Vic	Qld	WA	SA	Tas	ACT	NT	Australia
Blood/metabolic	1.5	1.2	1.2	1.3	1.2	1.9	1.2	3.4	1.3
Cancer	30.6	27.9	31.0	29.0	30.9	35.2	27.0	40.7	30.0
Cardiovascular	18.4	17.3	18.7	18.0	18.8	23.0	15.2	34.4	18.4
Endocrine	1.7	1.5	1.8	2.0	1.8	2.4	1.6	5.0	1.8
Gastrointestinal	4.0	3.5	3.8	3.7	4.1	3.6	2.7	6.4	3.8
Hearing/vision	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Infant/congenital	3.6	2.8	4.8	2.9	3.2	4.5	3.9	6.6	3.6
Infections	2.1	2.3	2.5	2.6	2.3	2.6	1.7	4.8	2.3
Injuries	12.4	12.5	16.1	17.9	13.3	15.4	10.9	29.0	14.0
Kidney/urinary	1.7	1.5	1.8	1.9	1.6	1.7	1.2	8.0	1.7
Mental	0.6	0.6	0.4	0.5	0.6	1.0	0.6	0.5	0.5
Musculoskeletal	0.6	0.7	0.6	0.6	0.6	1.0	0.3	1.6	0.6
Neurological	6.0	5.9	6.0	5.7	6.7	8.0	5.7	6.5	6.0
Oral	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Reproductive/maternal	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Respiratory	4.9	4.1	5.0	4.1	5.1	5.9	3.6	11.9	4.7
Skin	0.2	0.2	0.2	0.1	0.3	0.4	0.3	0.4	0.2
All diseases	**88.2**	**81.9**	**93.9**	**90.2**	**90.6**	**106.8**	**76.0**	**159.0**	**89.0**

Note: Rates were age-standardised to the 2001 Australian Standard Population and expressed per 1,000 population.

Table D16: Age-standardised YLD rates, by disease group and remoteness, 2015

Disease group	Major cities	Inner regional	Outer regional	Remote and very remote	Australia	Rate ratio	Rate difference
Blood/metabolic	1.0	0.9	0.9	0.9	1.0	0.9	–0.1
Cancer	2.4	2.4	2.4	2.4	2.4	1.0	0.0
Cardiovascular	4.9	5.1	5.7	8.4	5.1	1.7	3.5
Endocrine	2.8	3.1	3.5	4.0	2.9	1.4	1.2
Gastrointestinal	2.4	2.4	2.4	2.3	2.4	1.0	0.0
Hearing/vision	3.4	4.1	4.5	3.6	3.6	1.1	0.2
Infant/congenital	0.8	0.9	0.8	1.8	0.8	2.2	1.0
Infections	1.4	1.3	1.8	2.6	1.4	1.9	1.2
Injuries	2.6	3.2	3.6	5.0	2.9	1.9	2.4
Kidney/urinary	0.5	0.4	0.5	1.2	0.6	2.7	0.8
Mental	24.7	22.8	20.6	22.4	24.0	0.9	–2.2
Musculoskeletal	22.5	25.9	23.1	27.5	23.3	1.2	5.0
Neurological	6.6	7.2	6.4	6.0	6.6	0.9	–0.5
Oral	3.9	4.9	5.3	5.5	4.2	1.4	1.6
Reproductive/maternal	1.3	1.5	1.4	1.4	1.9	1.1	0.2
Respiratory	9.1	9.3	9.2	10.6	9.1	1.2	1.6
Skin	3.2	3.4	3.2	3.2	3.2	1.0	0.1
All diseases	**93.2**	**98.7**	**95.1**	**108.9**	**95.3**	**1.2**	**15.8**

Notes

1. Rate ratios calculated as *Remote and very remote* rate divided by M*ajor cities* rate.
2. Rate differences calculated as *Remote and very remote* rate minus *Major cities* rate.
3. Rates were age-standardised to the Australian population as at 30 June 2001 and expressed per 1,000 population.

Table D17: Age-standardised YLL rates, by disease group and remoteness, 2015

Disease group	Major cities	Inner regional	Outer regional	Remote and very remote	Australia	Rate ratio	Rate difference
Blood/metabolic	1.2	1.7	1.5	2.3	1.3	2.0	1.2
Cancer	28.3	33.1	34.2	34.0	30.0	1.2	5.7
Cardiovascular	17.0	19.9	21.5	30.3	18.4	1.8	13.4
Endocrine	1.6	1.8	2.0	4.0	1.8	2.4	2.3
Gastrointestinal	3.5	4.2	4.6	5.9	3.8	1.7	2.4
Infant/congenital	3.3	3.9	4.6	5.3	3.6	1.6	2.1
Infections	2.2	2.4	2.5	4.3	2.3	1.9	2.1
Injuries	11.8	17.1	21.1	31.1	14.0	2.6	19.3
Kidney/urinary	1.5	1.7	2.2	6.0	1.7	3.9	4.5
Mental	0.5	0.6	0.8	1.0	0.5	2.0	0.5
Musculoskeletal	0.5	0.8	0.7	1.3	0.6	2.4	0.7
Neurological	6.0	6.3	5.7	5.8	6.0	1.0	–0.3
Oral	0.0	0.0	0.0	0.0	0.0	0.0	–0.0
Reproductive/maternal	0.0	0.1	0.0	0.1	0.0	2.8	0.0
Respiratory	4.1	5.5	6.1	8.0	4.7	1.9	3.9
Skin	0.2	0.2	0.3	0.3	0.2	1.4	0.1
All diseases	**81.7**	**99.3**	**107.9**	**139.6**	**89.0**	**1.7**	**57.9**

Notes

1. Rate ratios calculated as *Remote and very remote* rate divided by M*ajor cities* rate.
2. Rate differences calculated as *Remote and very remote* rate minus *Major cities* rate.
3. Rates were age-standardised to the Australian population as at 30 June 2001 and expressed per 1,000 population.

Table D18: Age-standardised YLD rates, by disease group and socioeconomic group, 2015

Disease group	1 Lowest	2	3	4	5 Highest	Australia	Rate ratio	Rate difference
Blood/metabolic	1.1	0.9	1.1	0.8	1.0	1.0	1.2	0.1
Cancer	2.3	2.3	2.3	2.4	2.5	2.4	0.9	–0.2
Cardiovascular	5.7	5.3	4.9	4.8	4.5	5.1	1.3	1.2
Endocrine	4.3	2.8	3.0	2.6	1.9	2.9	2.2	2.3
Gastrointestinal	2.4	2.4	2.4	2.4	2.4	2.4	1.0	0.0
Hearing/vision	4.4	3.8	3.3	3.5	3.2	3.6	1.4	1.2
Infant/congenital	0.9	0.8	0.7	0.7	0.8	0.8	1.2	0.1
Infections	1.7	1.4	1.4	1.3	1.2	1.4	1.4	0.5
Injuries	3.2	3.0	2.9	2.6	2.5	2.9	1.3	0.8
Kidney/urinary	0.8	0.6	0.6	0.6	0.4	0.6	1.7	0.3
Mental	26.8	27.7	26.4	22.3	17.1	24.0	1.6	9.8
Musculoskeletal	27.1	24.8	23.0	21.0	20.3	23.3	1.3	6.9
Neurological	7.3	7.5	6.7	5.8	5.8	6.6	1.3	1.5
Oral	4.8	5.1	4.1	3.9	3.2	4.2	1.5	1.6
Reproductive/maternal	1.3	1.3	1.3	1.3	1.2	1.9	1.1	0.1
Respiratory	10.5	9.6	9.2	8.6	7.9	9.1	1.3	2.7
Skin	3.1	3.4	3.0	3.2	3.2	3.2	0.9	–0.2
All diseases	**107.7**	**102.8**	**96.6**	**87.9**	**79.0**	**95.3**	**1.4**	**28.7**

Notes

1. Rate ratios calculated as group 1 rate divided by group 5 rate.
2. Rate differences calculated as group 1 rate minus group 5 rate.
3. Rates were age-standardised to the Australian population as at 30 June 2001 and expressed per 1,000 population.

Table D19: Age-standardised YLL rates, by disease group and socioeconomic group, 2015

Disease group	1 Lowest	2	3	4	5 Highest	Australia	Rate ratio	Rate difference
Blood/metabolic	2.0	1.7	1.2	1.0	0.8	1.3	2.6	1.2
Cancer	34.0	32.7	30.8	27.7	24.1	30.0	1.4	10.0
Cardiovascular	23.7	20.7	18.1	15.4	13.2	18.4	1.8	10.4
Endocrine	2.5	2.1	1.9	1.2	1.0	1.8	2.4	1.5
Gastrointestinal	5.7	4.3	3.7	2.9	2.3	3.8	2.5	3.4
Hearing/vision	0.0	0.0	0.0	0.0	0.0	0.0	—	0.0
Infant/congenital	4.5	4.2	3.1	3.2	2.8	3.6	1.6	1.7
Infections	3.2	2.6	2.1	2.0	1.6	2.3	2.0	1.6
Injuries	18.6	15.3	14.5	11.7	9.7	14.0	1.9	8.9
Kidney/urinary	2.5	2.1	1.7	1.3	1.1	1.7	2.3	1.4
Mental	0.9	0.7	0.4	0.5	0.3	0.5	2.7	0.6
Musculoskeletal	0.8	0.7	0.6	0.5	0.4	0.6	1.9	0.4
Neurological	6.4	6.4	6.1	5.7	5.4	6.0	1.2	1.0
Oral	0.0	0.0	0.0	0.0	0.0	0.0	13.4	0.0
Reproductive/maternal	0.1	0.0	0.1	0.0	0.0	0.0	4.1	0.0
Respiratory	6.7	5.4	4.4	3.9	2.7	4.7	2.5	4.0
Skin	0.3	0.3	0.2	0.2	0.2	0.2	1.6	0.1
All diseases	**111.9**	**99.2**	**88.7**	**77.1**	**65.7**	**89.0**	**1.7**	**46.3**

Notes

1. Rate ratios calculated as group 1 rate divided by group 5 rate.
2. Rate differences calculated as group 1 rate minus group 5 rate.
3. Rates were age-standardised to the Australian population as at 30 June 2001 and expressed per 1,000 population.

Appendix E: List of expert advisors

Table E1: Disease-specific contributors

Expert (group or person)	Organisation
Blood and metabolic disorders	
Assoc. Prof. Scott Bell	The Prince Charles Hospital, Queensland Children's Medical Research Institute, School of Medicine, University of Queensland
Prof. Amanda Lee	School of Public Health and Social Work and School of Exercise and Nutrition Science, Queensland University of Technology
Dr Simon Mcrae	Comprehensive Haemophilia Care, Royal Adelaide Hospital/ The Queen Elizabeth Hospital
Dr John Rowell	Queensland Haemophilia Centre, Royal Brisbane and Women's Hospital
Cancer and other neoplasms	
Cancer and Screening Unit	AIHW
Cancer Monitoring Advisory Group	AIHW advisory group
Prof. James Bishop AO	Victorian Comprehensive Cancer Centre
Dr Pamela Brown	Consultant dermatologist
Dr Keng Chen	Skin and Cancer Foundation
Assoc. Prof. Rosemary Knight	Department of Health
Prof. David Roder	University of South Australia
Dr Timothy Threlfall	WA Cancer Registry
Prof. Christobel Saunders	Harry Perkins Institute of Medical Research
Dr Catherine Shannon	Mater Cancer Care Centre
Assoc. Prof. James St John AM	Cancer Council Victoria (retired)
Assoc. Prof. Chris Stephenson	Deakin University
Cardiovascular diseases	
Cardiovascular, Diabetes & Kidney Unit	AIHW
Cardiovascular Disease Expert Advisory Group: Andrew Tonkin (Chair), Tom Briffa, Derek Chew, Annette Dobson, John Lynch and Mandy Thrift	AIHW advisory group
Dr Judith Katzenellenbogen	University of Western Australia
Endocrine disorders	
Cardiovascular, Diabetes and Kidney Unit	AIHW
Diabetes Expert Advisory Group: Jonathan Shaw (Chair), Stephen Colagiuri, Maria Craig, Wendy Davis, Mark Harris, Greg Johnson, Glynis Ross and Sophia Zoungas	AIHW advisory group

Expert (group or person)	Organisation
Gastrointestinal disorders	
Prof. Jane Andrews	Royal Adelaide Hospital
Dr Paul Clark	University of Queensland
Clinical Assoc. Prof. Peter Katelaris	University of Sydney
Prof. Rupert Leong	University of New South Wales
Dr Suzanne Mahady	University of Sydney
Prof. Geoff McCaughan	Centenary Institute
Dr Stephen Williams	Westmead Hospital
Hearing and vision disorders	
Office of Hearing Services	Department of Health
Prof. Robert Cowan	University of Melbourne/ Macquarie University/ HEARing CRC and HearWorks
Prof. Harvey Dillon	National Acoustic Laboratories, Australian Hearing/ The HEARing CRC
Prof. Louise Hickson	School of Health and Rehabilitation Sciences, University of Queensland/Communication Disability Centre
Prof. Hugh Taylor	Melbourne School of Population and Global Health, The University of Melbourne
Infant and congenital conditions	
Maternal Health, Children, Youth and Families Unit	AIHW
Prof. Nadia Badawi	Grace Centre for Newborn Care, University of Sydney, Children's Hospital at Westmead, Cerebral Palsy Alliance
Clinical Assoc. Prof. Gareth Baynam	Western Australian Department of Health, University of Western Australia
Prof. Carol Bower	Telethon Kids Institute
Dr Adrienne Gordon	University of Sydney
Dr Lisa Hilder	National Perinatal Epidemiology and Statistics Unit, University of New South Wales
Assoc. Prof. Alison Kent	Australian National University/The Canberra Hospital
Dr Karen Walker	Grace Centre for Newborn Care, University of Sydney
Infectious diseases	
Office of Health Protection	Department of Health
Dr Frank Beard	National Centre for Immunisation Research and Surveillance
Dr Paul Kelly	Australian Capital Territory Health
Assoc. Prof. Martyn Kirk	National Centre for Epidemiology and Population Health, Australian National University
Prof. Brett Mitchell	Avondale College of Higher Education
Assoc. Prof. David Wilson	The Kirby Institute, University of New South Wales
Dr Jeannette Young	Queensland Health

Expert (group or person)	Organisation
Injuries	
Prof. James Harrison	Research Centre for Injury Studies, Flinders University
Dr Sophie Pointer	Research Centre for Injury Studies, Flinders University
Prof. Belinda Gabbe	School of Public Health and Preventive Medicine, Monash University
Kidney and urinary diseases	
Cardiovascular, Diabetes and Kidney Unit	AIHW
Chronic Kidney Disease Expert Advisory Group: Steven Chadban (Chair), Jeremy Chapman, Bettina Douglas, Stephen McDonald and David Parker	AIHW advisory group
Prof. David Johnson	Primary Care Education Advisory Committee for Kidney Health Australia (PEAK)
Mental and substance use disorders	
AIHW Mental Health and Palliative Care Unit	AIHW
Ms Jenny Bourke	Telethon Kids Institute
Prof. Louisa Degenhardt	National Drug and Alcohol Research Centre
Dr Alize Ferrari	University of Queensland
Prof. Wayne Hall	University of Queensland
Assoc. Prof. Helen Leonard	Telethon Kids Institute
Prof. John McGrath	University of Queensland
Prof. George Patton	Adolescent Health Research, Royal Children's Hospital Melbourne
Prof. Harvey Whiteford	University of Queensland
Musculoskeletal conditions	
Population Health and Primary Care Unit	AIHW
National Centre for Monitoring Arthritis and Other Musculoskeletal Conditions Advisory Group	AIHW advisory group
Prof. Chris Maher	Director, Musculoskeletal Division Professor, Sydney Medical School, University of Sydney
Prof. Lyn March	Liggins Professor of Rheumatology and Musculoskeletal Epidemiology, University of Sydney
Mr Matthew Montgomery	ABS
Prof. Tania Winzenberg	Professor of Chronic Disease Management, Menzies Institute for Medical Research/School of Medicine, University of Tasmania
Neurological conditions	
Disability and Ageing Unit	AIHW
Prof. Kaarin Anstey	Dementia Collaborative Research Centre–Early Diagnosis and Prevention, Australian National University
Prof. George Mellick	Clinical Neurosciences, Griffith University
Prof. Matthew Kiernan	Brain and Mind Research Institute, University of Sydney
Prof. Andrew Palmer	University of Tasmania

Expert (group or person)	Organisation
Oral disorders	
Assoc. Prof. David Brennan	Australian Research Centre for Population Oral Health
Adjunct Assoc. Prof. Ratilal Lalloo	Australian Research Centre for Population Oral Health
Dr Liana Luzzi	Australian Research Centre for Population Oral Health
Prof. Marco Peres	Australian Research Centre for Population Oral Health
Dr John Rogers	Prevention and Population Health, Mental Health, Wellbeing and Ageing, Victorian Department of Health
Reproductive and maternal conditions	
Assoc. Prof. Georgina Chambers	National Perinatal Epidemiology and Statistics Unit, University of New South Wales
Ms Jane Goller	University of Melbourne
Prof. Caroline Homer	Centre for Midwifery, Child and Family Health, Faculty of Health, University of Technology, Sydney
Assoc. Prof. Michael Nicholl	Sydney Medical School, University of Sydney/ Maternal, Neonatal and Women's Health Network for Northern Sydney Local Health District
Prof. Jeremy Oats	Melbourne School of Population and Global Health, University of Melbourne
Respiratory diseases	
Australian Centre for Asthma Monitoring	AIHW collaborating centre
Prof. Tim Driscoll	Sydney School of Public Health, University of Sydney
Prof. Guy Marks	Woolcock Institute of Medical Research, University of Sydney
Assoc. Prof. Helen Reddel	Woolcock Institute of Medical Research, University of Sydney
Skin disorders	
Indigenous Modelling & Research Unit	AIHW
Dr Pamela Brown	Consultant dermatologist
Dr Keng Chen	Skin and Cancer Foundation
Dr Suzanne Kapp	La Trobe University
Dr Monique Kilkenny	Monash University
Dr Rosana Norman	Queensland University of Technology

Table E2: Mortality contributors

Expert	Organisation
Mr James Eynstone-Hinkins	ABS
Ms Sue Walker	Queensland University of Technology

Table E3: Risk-specific contributors

Expert (group or person)	Organisation
Cardiovascular, Diabetes and Kidney Unit	AIHW
Family, Domestic and Sexual Violence Unit	AIHW
Population Health Unit	AIHW
Tobacco, Alcohol and Other Drugs Unit	AIHW
Chronic Kidney Disease Expert Advisory Group	AIHW advisory group
Mr Paul Atyeo	ABS
Prof Emily Banks	Australian National University
Prof. Tim Driscoll	Sydney School of Public Health, University of Sydney
Ms Louise Gates	ABS
Assoc. Prof. John Goss	University of Canberra
Ms Tracy Hambridge	Food Standards Australia and New Zealand
Dr Ivan Hanigan	Australian National University
Prof. David Johnson	Primary Care Education Advisory Committee for Kidney Health Australia (PEAK)
Dr Grace Joshy	Australian National University
Prof. Amanda Lee	School of Public Health and Social Work and School of Exercise and Nutrition Science, Queensland University of Technology
Prof. Robyn Lucas	National Centre for Epidemiology and Population Health, Australian National University
Prof Dorothea Mackeras	Food Standards Australia and New Zealand
Assoc. Prof. Gavin Pereira	Curtin University
Dr Sarah Perkins-Kirkpatrick	University of New South Wales
Dr Rosemary Stanton	Nutritionist consultant
Dr Fan Xiang	National Centre for Epidemiology and Population Health, Australian National University
Dr Zhiwei Xu	Queensland University of Technology

Acknowledgments

The Australian Burden of Disease Study 2015 was undertaken by members of the Burden of Disease and Mortality Unit of the Australian Institute of Health and Welfare (AIHW).

This report was authored by Karen Bishop, Melanie Dunford, Julianne Garcia, Wendy Ho, Alise Kha, Paula Laws, Vanessa Prescott, Anna Reynolds and Chenkun Zhao under the guidance of Richard Juckes and Lynelle Moon.

Michelle Gourley provided leadership during the early stages of the study, while Gianna Garcia, Miriam Lum On and Kamal Moustafa worked on reviewing methods, searching literature or undertaking preliminary analyses. Melissa Goodwin provided early guidance on non-fatal burden methods review, as well as coordinating and estimating prevalence for cancer and other neoplasms.

The authors would like to acknowledge Jay Hu, the study's systems analyst, who refined the ABDS system capabilities and functioning.

David Whitelaw from the AIHW provided constructive review and advice. Tony Francis and Helen Tse provided valuable assistance with the presentation of information.

This report was prepared under the guidance of the Australian Burden of Disease Expert Advisory Group whose members are Ching Choi (Chair, University of New South Wales), Anthony Barnes (independent consultant), Tony Blakely (University of Otago/University of Melbourne), Justine Boland (Australian Bureau of Statistics), Annette Dobson (University of Queensland), Tim Driscoll (University of Sydney), Sonya Glasson (Department of Health), John Goss (University of Canberra), Paul Kelly (ACT Health), Laura Kirkland (Department of Health Western Australia), Maarit Laaksonen (University of New South Wales), Helen Moore (NSW Health), Bernie Towler (Department of Health), Harvey Whiteford (University of Queensland) and Jeanette Young (Queensland Health).

A full list of contributors to disease and risk factor work is provided in Appendix E. Input from all these individuals and organisations was appreciated.

The Department of Health funded this study.

Abbreviations

ABDS	Australian Burden of Disease Study
ABS	Australian Bureau of Statistics
ACOD	associated causes of death
ACT	Australian Capital Territory
AIHW	Australian Institute of Health and Welfare
ASR	age-standardised rate
COPD	chronic obstructive pulmonary disease
DALY	disability-adjusted life years
GBD	Global Burden of Disease Study
HALE	health-adjusted life expectancy
HIV/AIDS	human immunodeficiency virus/acquired immune deficiency syndrome
ICD	International Statistical Classification of Diseases and Related Health Problems
ICD-10	International Statistical Classification of Diseases and Related Health Problems, Tenth revision
ICD-10-AM	International Statistical Classification of Diseases and Related Health Problems, Tenth revision, Australian modification
IHME	Institute for Health Metrics and Evaluation
METeOR	Metadata Online Registry
MCOD	multiple causes of death
NSW	New South Wales
NT	Northern Territory
OECD	Organisation for Economic Co-operation and Development
PAF	population attributable fraction
PYLL	potential years of life lost
Qld	Queensland
SA	South Australia
SIDS	sudden infant death syndrome

Tas	Tasmania
TMRED	theoretical minimum risk exposure distribution
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

>	greater than
<	less than
—	nil or rounded to zero
. .	not applicable

Glossary

additional diagnosis: A condition or complaint either coexisting with the principal diagnosis or arising during the episode of admitted patient care, episode of residential care or attendance at a health care establishment. METeOR identifier: 514271.

admitted patient: A patient who undergoes a hospital's admission process to receive treatment and/or care. This treatment and/or care is provided over a period of time and can occur in hospital and/or in the person's home (for hospital-in-the-home patients). METeOR identifier: 268957.

age-standardisation: A set of techniques used to remove, as far as possible, the effects of differences in age when comparing 2 or more populations.

age-standardised rate: A rate that takes into account the age structure of the population.

attributable burden: The disease burden attributed to a particular risk factor. It is the reduction in fatal and non-fatal burden that would have occurred if exposure to the risk factor had been avoided (or more precisely had been at its theoretical minimum).

avoidable burden: The reduction in future burden that would occur if current and/or future exposure to a particular risk factor were avoided. Compare with **attributable burden**.

burden of disease (and injury): The quantified impact of a disease or injury on a population, using the disability-adjusted life year (**DALY**) measure. Referred to as the 'burden' of the disease or injury in this report.

chronic: A term meaning persistent and long-lasting.

comorbidity: A situation where a person has 2 or more health problems at the same time.

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

disability-adjusted life years (DALY): Measure (in years) of healthy life lost, either through premature death, defined as dying before the expected life span at the age of death (**YLL**), or, equivalently, through living with ill health due to illness or injury (**YLD**). It is often used synonymously with 'health loss'.

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

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).

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

excess burden: The reduction that would occur in overall disease burden if all groups had the same rate of burden as the least burdened group.

external cause: The environmental event, circumstance or condition as the cause of injury, poisoning and other adverse effect. METeOR identifier: 514295.

fatal burden: The burden from dying 'prematurely' as measured by years of life lost. Often used synonymously with **YLL**, and also referred to as 'life lost'.

health-adjusted life expectancy (HALE): The number of healthy years a person of a particular age can expect to live.

health burden/health loss: The total number of healthy years lost from living with disease/injury (**YLD**) and the total number of years lost from dying early from disease/injury (**YLL**). It is often used synonymously with **DALY**.

health state: Consequences of diseases and conditions reflecting key differences in symptoms and functioning.

hospitalisation: Synonymous with admission and separation; that is, an episode of hospital care that starts with the formal admission process and ends with the formal separation process.

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

International Classification of Diseases (ICD): The World Health Organization's internationally accepted classification of diseases and related health conditions. The tenth revision, Australian modification (ICD-10-AM) is currently in use in Australian hospitals for admitted patients.

life expectancy: The number of years a person of a particular age can expect to live.

linked disease: A disease or condition on the causal pathway of the risk factor, which is therefore more likely to develop if exposed to the risk.

morbidity: Ill health in an individual, and levels of ill health in a population or group.

mortality: Death.

non-admitted patient: A patient who does not undergo a hospital's formal admission process. There are 3 categories of non-admitted patient: emergency department patient, outpatient, and other non-admitted patient (treated by hospital employees off the hospital site—includes community/outreach services). METeOR identifier: 268973.

non-fatal burden: The burden from living with ill health as measured by years lived with disability. Often used synonymously with **YLD**.

population attributable fraction (PAF): The proportion (fraction) of a disease, illness, disability or death in a population that can be attributed to a particular risk factor or combination of risk factors.

premature mortality: Deaths that occur at a younger age than a selected cut-off.

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

principal diagnosis: The diagnosis established after study to be chiefly responsible for occasioning an episode of admitted patient care, an episode of residential care or an attendance at the health care establishment. METeOR identifier: 514273.

rate: One number (the numerator) divided by another number (the denominator). The numerator is commonly the number of events in a specified time. The denominator is the population 'at risk' of the event. Rates (crude, age-specific and age-standardised) are generally multiplied by a number such as 100,000 to create whole numbers.

reference life table: A table that corresponds to the maximum life expectancy for an individual in good health.

relative risk (RR): The risk of an event relative to exposure, calculated as the ratio of the probability of the event's occurring in the exposed group to the probability of its occurring in the non-exposed group. A relative risk of 1 implies no difference in risk; RR <1 implies the event is less likely to occur in the exposed group; RR >1 implies the event is more likely to occur in the exposed group.

risk factor: Any factor that represents a greater risk of a health condition or health event. For example, smoking, alcohol use, high body mass.

sequela: Consequence of diseases; often used in the plural, **sequelae**.

theoretical minimum risk exposure distribution (TMRED): The distribution of exposure to a risk factor that would have the lowest associated population risk.

years lived with disability (YLD): A measure of the years of what could have been a healthy life but were instead spent in states of less than full health. YLD represent non-fatal burden.

years of life lost (YLL): Years of life lost due to premature death, defined as dying before the global ideal life span at the age of death. YLL represent fatal burden.

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Related publications

This report is part of a series. The earlier editions and any published subsequently can be downloaded for free from the AIHW website <https://www.aihw.gov.au/reports-data/health-conditions-disability-deaths/burden-of-disease/reports>. The website also includes information on ordering printed copies.

Two other reports were published concurrently:

- AIHW 2019. Australian Burden of Disease Study 2015: methods and supplementary material. Australian Burden of Disease Study series no. 20. Cat. no. BOD 23. Canberra AIHW.
- AIHW 2019. Australian Burden of Disease Study 2015: summary report. Australian Burden of Disease Study series no. 18. Cat. no. BOD 21. Canberra AIHW.

Data visualisations relating to this report were published separately online as *Australian Burden of Disease Study 2015: data visualisations*.

This report analyses the impact of more than 200 diseases and injuries in terms of living with illness (non-fatal burden) and premature death (fatal burden). The study found that:

- chronic diseases such as cancer, cardiovascular diseases, and musculoskeletal conditions contributed the most burden in Australia in 2015
- 38% of the burden could have been prevented by removing exposure to risk factors such as tobacco use, overweight and obesity, and dietary risks.

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