

Opinion  
Global Health



# Measuring Health Loss in Australia: the Australian Burden of Disease Study

Lynelle Moon , Julianne Garcia , Paula Laws , Melanie Dunford ,  
Miriam Lum On , Karen Bishop , Vanessa Prescott , and Michelle Gourley

Health Group, Australian Institute of Health and Welfare, Canberra, Australia

OPEN ACCESS

Received: Sep 28, 2018

Accepted: Nov 26, 2018

Address for Correspondence:

Paula Laws, PhD

Burden of Disease and Mortality Unit,  
Australian Institute of Health and Welfare,  
GPO Box 570 Canberra, ACT 2601, Australia.  
E-mail: paula.laws@aihw.gov.au

© 2019 The Korean Academy of Medical Sciences.

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<https://creativecommons.org/licenses/by-nc/4.0/>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ORCID iDs

Lynelle Moon   
<https://orcid.org/0000-0002-5820-0596>  
Julianne Garcia   
<https://orcid.org/0000-0002-9327-5905>  
Paula Laws   
<https://orcid.org/0000-0003-4474-9200>  
Melanie Dunford   
<https://orcid.org/0000-0001-6662-5909>  
Miriam Lum On   
<https://orcid.org/0000-0002-0910-3669>  
Karen Bishop   
<https://orcid.org/0000-0003-1758-9598>  
Vanessa Prescott   
<https://orcid.org/0000-0003-2932-0713>  
Michelle Gourley   
<https://orcid.org/0000-0003-2531-5941>

## INTRODUCTION

Burden of disease analysis is well established internationally as the standard summary measure to assess population health. The Global Burden of Disease (GBD) study quantifies the gap between a population's actual health and an ideal level where every individual lives in full health for their estimated life span. It includes both fatal and non-fatal components for each disease and injury, as well as a comprehensive list of risk factors, and provides estimates at the global level, and by individual country.

While the GBD provides country-specific estimates and is important for international comparisons, several countries, including Australia, have undertaken their own national burden of disease studies. These country-specific studies offer particular advantages, including the capacity to add diseases and risk factors of national interest, calculate disease burden estimates for specific population groups and take advantage of detailed data and methodological approaches more appropriate to that country.

Australia has a population of 25.2 million people. Overall, Australians have similar or better health than those in similarly developed countries, including a relatively high life expectancy and low smoking rate.<sup>1</sup> Recent years have seen improvements, such as in the number of years lived in full health, however, further improvements could be made, such as in the rate of obesity. Around 71% of people in Australia live in major cities and the remainder live in regional or remote areas.<sup>1</sup>

## AUSTRALIAN BURDEN OF DISEASE STUDY

The Australian Burden of Disease Study (ABDS) 2011 provides Australian-specific burden of disease estimates for the years 2003 and 2011.<sup>2</sup> Prior to ABDS 2011, there were two national ABDSs for the reference years 1996 and 2003,<sup>3,4</sup> and one for Indigenous Australians.<sup>5</sup>

## DATA AND METHODS DEVELOPMENTS

The ABDS 2011 used and adapted methods from the GBD studies to produce disease and risk factor estimates best suited to the Australian context. It included additional diseases—

**Funding**

Funding for the Australian Burden of Disease Study was provided by the Commonwealth Department of Health and the (former) Australian National Preventative Health Agency (2013-2015).

**Disclosure**

The authors have no potential conflicts of interest to disclose.

**Author Contributions**

Conceptualization: Moon L. Data curation: Garcia J, Dunford M, Bishop K, Prescott V. Formal analysis: Bishop K, Prescott V, Dunford M, Garcia J. Investigation: Moon L, Garcia J, Dunford M, Lum On M, Bishop K, Prescott V, Gourley M. Methodology: Moon L, Garcia J, Dunford M, Lum On M, Bishop K, Prescott V, Gourley M. Project administration: Laws P, Lum On M. Supervision: Moon L, Gourley M. Validation: Bishop K, Prescott V, Dunford M, Garcia J, Gourley M. Visualisation: Laws P, Dunford M, Garcia J. Writing - original draft: Moon L, Garcia J, Laws P, Dunford M. Writing - review and editing: Moon L, Garcia J, Laws P, Dunford M, Lum On M, Bishop K, Prescott V, Gourley M.

such as cancer of unknown primary site—and a risk factor—sun exposure. The study included estimates for over 200 diseases and injuries from 17 disease groups, and for 29 risk factors. Sub-national estimates by state and territory, remoteness area and socioeconomic group were also produced. The overarching methods were developed under the guidance of an expert advisory group. The detailed methods for each disease and risk factor were determined following comprehensive assessment of GBD's methods and consideration of how they could be applied to the Australian study, in conjunction with Australian experts.<sup>6</sup> In summary, the ABDS 2011 used a similar methodological framework to GBD, with adjustments for the Australian context; notably additional diseases and risk factors, more detailed Australian data, enhanced redistribution of deaths, and revised conceptual models for some diseases.<sup>7</sup>

The majority of estimates were derived directly from high-quality Australian data; usually detailed, unit record or linked data. Deaths data for estimating fatal burden were sourced from the National Mortality Database. Data for estimating non-fatal burden came from a variety of sources including national datasets with complete coverage (such as the National Hospital Morbidity Database and the Australian Cancer Database), from registry data, national surveys, linked hospitals and deaths data, and a number of epidemiological studies.

The ABDS used the hybrid approach for calculating disability-adjusted life-years (DALY) consistent with recent global studies: calculating years of life lost (YLL) from an incidence perspective and years lived with disability (YLD) from a prevalence perspective. One key advantage of this approach is that data to calculate the DALY are measured in the reference period (whereas an incidence-based DALY requires projection of the future duration of health loss, and the prevalence-based DALY requires knowledge of deaths that occurred before the reference period).

Methods used to calculate fatal burden estimates in GBD studies were further developed for the ABDS 2011 by using evidence for Australian-specific deaths to better redistribute deaths not appropriate for burden of disease analysis. In ABDS 2011, 85% of redistribution was based on some form of empirical evidence, including use of direct evidence, notably for cancer and heart failure deaths, as well as use of Australian multiple causes of death data for other high-volume diseases.

Other developments since the previous Australian studies included use of the new GBD standard life table which substantially increased the 'ideal' life span. New data sources, greater use of linked data and updated disability weights (from GBD 2013) were also implemented for the 2011 study.

Due to the substantial changes, estimates from previous Australian studies<sup>3,4</sup> as well as Australian estimates from global studies are not comparable with those for the ABDS 2011.<sup>2</sup> However, for the ABDS 2011, estimates were recalculated for 2003 using revised methods. All figures in this paper are taken from the ABDS 2011<sup>2</sup> and detailed methods have been published.<sup>7</sup>

## HEALTH LOSS IN AUSTRALIA IN 2003 AND 2011

Australians lost 4.5 million DALY in 2011, equating to 190 DALY for every 1,000 people. There were substantial gains in the health of Australians, with the DALY rate decreasing

**Table 1.** Change in disease burden (DALY, YLL and YLD) in Australia, 2011 and 2003

Variables	2003, No.	2011, No.	Change, <sup>a</sup> No. (%)	2003 ASR	2011 ASR	Change in ASR <sup>b</sup>
DALY	4,205,223	4,494,427	289,203 (6.9)	210.5	189.9	-20.6
YLD	1,985,866	2,224,326	238,460 (12.0)	99.8	96.0	-3.8
YLL	2,219,357	2,270,101	50,744 (2.3)	110.7	93.9	-16.8

Rates were age standardised to the 2001 Australian standard population, and are expressed per 1,000 population.

DALY = disability-adjusted life-year, YLL = years of life lost, YLD = years lived with disability, ASR = age-standardised rate.

<sup>a</sup>Change in number is 2011 metric (DALY, YLD, or YLL) minus 2003 metric (DALY, YLD, or YLL), expressed as a percentage of 2003 metric; <sup>b</sup>Change in ASR is 2011 age standardised rate minus 2003 age standardised rate.

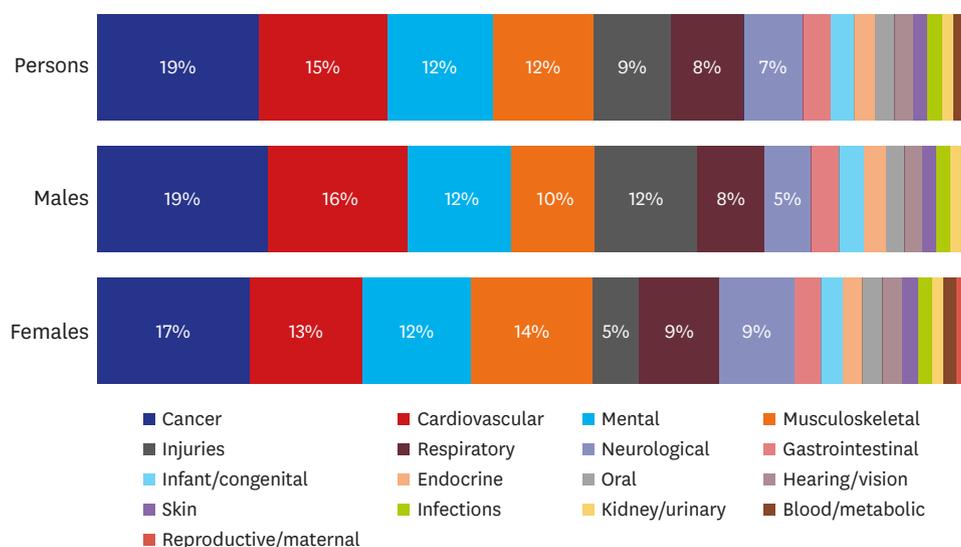
by 15%, from 210 DALY per 1,000 people in 2003 (**Table 1**). This was mainly driven by a reduction in fatal burden due to preventing or delaying deaths from cardiovascular diseases (mostly coronary heart disease and stroke).

In terms of living with disease, there was a 3.8% reduction in non-fatal burden between 2003 and 2011. As the reduction in fatal burden was not off-set by an increase in non-fatal burden, this suggests that the success in reducing premature deaths had not resulted in higher health loss from living with disease.

## CHRONIC DISEASE AND INJURY DOMINATE HEALTH LOSS IN AUSTRALIA

Cancer (19% of total DALY), cardiovascular diseases (15%), mental and substance use disorders (12%), musculoskeletal conditions (12%) and injuries (9%) were the leading causes of total burden in Australia in 2011 at the disease group level (**Fig. 1**). Premature death was mostly responsible for health loss from cancer, cardiovascular diseases and injuries whilst health loss from mental and substance use disorders and musculoskeletal disorders were mainly due to people living with these conditions.

The top 10 diseases accounted for 37% of the total burden (**Table 2**). Coronary heart disease, other musculoskeletal disorders, back pain and problems, chronic obstructive pulmonary disease (COPD) and lung cancer were the top 5 specific causes of burden. Differences in



**Fig. 1.** Leading causes of disease burden, 2011.

**Table 2.** Leading 10 causes of total burden (DALY), by sex, 2011

Rank	Males	DALY	% of total	Females	DALY	% of total	Persons	DALY	% of total
1	Coronary heart disease	226,021	9.4	Coronary heart disease	120,629	5.8	Coronary heart disease	346,651	7.7
2	Lung cancer	94,508	3.9	Other musculoskeletal	96,661	4.6	Other musculoskeletal	183,947	4.1
3	Other musculoskeletal	87,285	3.6	Dementia	95,716	4.6	Back pain and problems	163,788	3.6
4	Suicide & self-inflicted injuries	84,920	3.5	Anxiety disorders	84,922	4.1	COPD	160,346	3.6
5	Back pain and problems	82,143	3.4	Back pain and problems	81,645	3.9	Lung cancer	154,890	3.4
6	COPD	80,951	3.4	COPD	79,395	3.8	Dementia	151,308	3.4
7	Stroke	65,689	2.7	Depressive disorders	73,295	3.5	Anxiety disorders	140,971	3.1
8	Diabetes	59,298	2.5	Stroke	71,081	3.4	Stroke	136,771	3.0
9	Anxiety disorders	56,048	2.3	Breast cancer	70,268	3.4	Depressive disorders	127,659	2.8
10	Dementia	55,593	2.3	Lung cancer	60,382	2.9	Suicide & self-inflicted injuries	113,470	2.5
	Leading 10 diseases	892,456	37.0	Leading 10 diseases	833,994	40.1	Leading 10 diseases	1,679,799	37.4
	All other diseases	1,520,074	63.0	All other diseases	1,247,902	59.9	All other diseases	2,814,627	62.6
	Total	2,412,531	100.0	Total	2,081,896	100.0	Total	4,494,427	100.0

DALY = disability-adjusted life-year, COPD = chronic obstructive pulmonary disease.

health loss were evident between males and females. For example, dementia and anxiety disorders were in the top 5 causes of burden only for females, while suicide and self-inflicted injuries were in the top 5 only for males.

## MENTAL AND MUSCULOSKELETAL DISORDERS CAUSE THE MOST HEALTH LOSS FROM LIVING WITH DISEASE

Mental and substance use disorders and musculoskeletal disorders made up almost half of the non-fatal health loss experienced by Australians in 2011 (24% and 23% of the total YLD, respectively).

The top 10 diseases accounted for 50% of non-fatal burden (**Table 3**). “Other musculoskeletal conditions” (which included ill-defined and unknown types of arthritis; chronic pain in joints, muscles and other soft tissue; and systemic lupus erythematosus) was the leading cause of non-fatal burden for both males and females. This group of conditions (7.8%), back pain and problems (7.3%), anxiety disorders (6.3%), depressive disorders (5.7%) and asthma (4.5%) contributed one-third (32%) of the non-fatal burden.

**Table 3.** Leading 10 causes of non-fatal burden (YLD), by sex, 2011

Rank	Males	YLD	% of total	Females	YLD	% of total	Persons	YLD	% of total
1	Other musculoskeletal	83,023	7.6	Other musculoskeletal	90,083	7.9	Other musculoskeletal	173,106	7.8
2	Back pain and problems	81,510	7.5	Anxiety disorders	84,919	7.5	Back pain and problems	162,393	7.3
3	Anxiety disorders	56,017	5.2	Back pain and problems	80,883	7.1	Anxiety disorders	140,936	6.3
4	Depressive disorders	54,121	5.0	Depressive disorders	72,914	6.4	Depressive disorders	127,034	5.7
5	Asthma	46,487	4.3	Osteoarthritis	56,421	5.0	Asthma	100,017	4.5
6	Coronary heart disease	44,343	4.1	Asthma	53,530	4.7	Osteoarthritis	85,088	3.8
7	Alcohol use disorders	43,416	4.0	Rheumatoid arthritis	51,634	4.5	COPD	84,985	3.8
8	COPD	38,086	3.5	COPD	46,899	4.1	Rheumatoid arthritis	81,036	3.6
9	Hearing loss	35,939	3.3	Dementia	46,385	4.1	Upper respiratory conditions	75,151	3.4
10	Upper respiratory conditions	35,704	3.3	Upper respiratory conditions	39,447	3.5	Coronary heart disease	70,946	3.2
	Leading 10 diseases	518,645	47.7	Leading 10 diseases	623,116	54.8	Leading 10 diseases	1,100,693	49.5
	All other diseases	568,400	52.3	All other diseases	514,165	45.2	All other diseases	1,123,633	50.5
	Total	1,087,045	100.0	Total	1,137,281	100.0	Total	2,224,326	100.0

YLD = years lived with disability, COPD = chronic obstructive pulmonary disease.

**Table 4.** Leading 10 causes of fatal burden (YLL), by sex, 2011

Rank	Males	YLL	% of total	Females	YLL	% of total	Persons	YLL	% of total
1	Coronary heart disease	181,678	13.7	Coronary heart disease	94,026	10.0	Coronary heart disease	275,704	12.1
2	Lung cancer	92,299	7.0	Stroke	63,347	6.7	Lung cancer	151,205	6.7
3	Suicide and self-inflicted injuries	84,178	6.4	Breast cancer	63,026	6.7	Stroke	119,989	5.3
4	Stroke	56,642	4.3	Lung cancer	58,905	6.2	Suicide and self-inflicted injuries	111,920	4.9
5	Bowel cancer	49,443	3.7	Dementia	49,330	5.2	Bowel cancer	85,824	3.8
6	COPD	42,865	3.2	Bowel cancer	36,381	3.9	Dementia	80,650	3.6
7	Prostate cancer	40,191	3.0	COPD	32,496	3.4	COPD	75,361	3.3
8	Poisoning	36,974	2.8	Suicide and self-inflicted injuries	27,741	2.9	Breast cancer	63,368	2.8
9	Chronic liver disease	31,655	2.4	Diabetes	22,996	2.4	Diabetes	54,110	2.4
10	Dementia	31,320	2.4	Pancreatic cancer	19,544	2.1	Poisoning	50,654	2.2
	Leading 10 diseases	647,246	48.8	Leading 10 diseases	467,792	49.5	Leading 10 diseases	1,068,784	47.1
	All other diseases	678,240	51.2	All other diseases	476,823	50.5	All other diseases	1,201,316	52.9
	Total	1,325,486	100.0	Total	944,615	100.0	Total	2,270,101	100.0

YLL = years of life lost, COPD = chronic obstructive pulmonary disease.

## CANCER, CARDIOVASCULAR DISEASE AND INJURIES CAUSE THE MOST PREMATURE DEATHS IN AUSTRALIA

Cancer (34% of YLL), cardiovascular diseases (23%) and injuries (14%) accounted for nearly three-quarters (71%) of fatal burden in 2011. Although injuries ranked third for both males and females, when looking at the number of YLL, males experienced 2.5 times more fatal burden due to injuries than females.

The top 10 diseases accounted for nearly half (47%) of the fatal burden, and coronary heart disease (12%), lung cancer (6.7%), stroke (5.3%), suicide and self-inflicted injuries (4.9%) and bowel cancer (3.8%) contributed one-third (33%) of the fatal burden (Table 4). Although coronary heart disease was the leading cause of fatal burden for males and females, the YLL for males was nearly double that of females. Chronic liver disease was also a considerable contributor to fatal burden for males, but less so for females.

## HEALTH-ADJUSTED LIFE EXPECTANCY (HALE)

HALE reflects the length of time an individual at a specific age can, on average, expect to live in full health; that is, time lived without the health consequences of disease or injury. Life expectancy in Australia for males born in 2011 was 79.9 years and for females it was 84.3 years. HALE of Australians at birth was 70.9 years for males and 74.4 years for females. That is, a boy born in 2011 could expect to live 89% of his life in full health while a girl could expect to live 88% of her life in full health.<sup>8</sup>

## HEALTH LOSS VARIED ACROSS AUSTRALIA

Health loss was notably different across Australia, with the disparity reflecting a complex interaction of demographic, socioeconomic and environmental factors. Very remote areas of Australia experienced 1.7 times the rate of health loss of major cities; and the socioeconomic group with the greatest disadvantage had the highest rate of burden, at 1.5 times the rate of

the least disadvantaged group. Indigenous Australians experienced health loss at a rate that was 2.3 times that of non-Indigenous Australians; with health loss from chronic disease accounting for 70% of the gap in disease burden between Indigenous and non-Indigenous Australians.<sup>9</sup>

## LARGE PROPORTION OF HEALTH LOSS IN AUSTRALIA WAS PREVENTABLE

Risk factors are factors which represent a greater chance of developing or dying from a health condition. At least 31% of the burden in 2011 was preventable, being due to the modifiable risk factors included in the study. The risk factors causing the most health loss were tobacco use (9.0%), overweight and obesity (5.5%), alcohol use (5.1%), physical inactivity (5.0%) and high blood pressure (4.9%). The joint effect of thirteen dietary risk factors, including 'Diet low in fruit' and 'Diet high in processed meat,' was responsible for 7.2% of the burden. The risk factors combined contributed greatly to the burden for endocrine disorders (96%), cardiovascular diseases (69%), cancer (44%), kidney and urinary diseases (42%) and injuries (30%). These results are taken from analyses that used consistent methods for all risk factors,<sup>2</sup> however, some estimates have since been updated.<sup>1</sup>

## FUTURE ABDS WORK

Burden of disease estimates evolve with improved data and information. It is important to continue to enhance methods to produce improved estimates. Findings from the next ABDS, for the reference year 2015, will be published in 2019. This update will include important changes such as estimation of HALE in conjunction with the other estimates, a more comprehensive list of diseases, and risk factors of particular relevance to Australia. Moreover the 2015 study will add an extra time point to provide further information on how the disease burden has changed over time.

Continuing Australian burden of disease estimation and analysis into the future would further enhance the valuable evidence base to support Australian health policy, planning and investment decisions.

## ACKNOWLEDGMENTS

The authors would like to acknowledge all contributors to the ABDS 2011 study including members of the Australian Burden of Disease Study Expert Advisory Group.

## REFERENCES

1. Australian Institute of Health and Welfare. *Australia's Health 2018. Australia's Health Series No. 16. Cat. No. AUS 221*. Canberra: Australian Institute of Health and Welfare; 2018.
2. Australian Institute of Health and Welfare. *Australian Burden of Disease Study 2011: Impact and Causes of Illness and Death in Australia. Australian Burden of Disease Study Series No. 3. Cat. No. BOD 4*. Canberra: Australian Institute of Health and Welfare; 2016.

3. Mathers CD, Vos ET, Stevenson CE, Begg SJ. The Australian Burden of Disease Study: measuring the loss of health from diseases, injuries and risk factors. *Med J Aust* 2000;172(12):592-6.  
[PUBMED](#)
4. Begg SJ, Vos T, Barker B, Stanley L, Lopez AD. Burden of disease and injury in Australia in the new millennium: measuring health loss from diseases, injuries and risk factors. *Med J Aust* 2008;188(1):36-40.  
[PUBMED](#)
5. Vos T, Barker B, Begg S, Stanley L, Lopez AD. Burden of disease and injury in Aboriginal and Torres Strait Islander Peoples: the Indigenous health gap. *Int J Epidemiol* 2009;38(2):470-7.  
[PUBMED](#) | [CROSSREF](#)
6. Australian Institute of Health and Welfare. *Assessment of Global Burden of Disease 2010 Methods for the Australian Context: Australian Burden of Disease Study Working Paper No. 1*. Canberra: Australian Institute of Health and Welfare; 2014.
7. Australian Institute of Health and Welfare. *Australian Burden of Disease Study 2011: Methods and Supplementary Material. Australian Burden of Disease Study No. 5. Cat. No. BOD 6*. Canberra: Australian Institute of Health and Welfare; 2016.
8. Australian Institute of Health and Welfare. *Health-adjusted Life Expectancy in Australia: Expected Years Lived in Full Health 2011. Australian Burden of Disease Study Series No. 16. Cat. No. BOD 17*. Canberra: Australian Institute of Health and Welfare; 2017.
9. Australian Institute of Health and Welfare. *Australian Burden of Disease Study 2011: Impact and Causes of Illness and Death in Aboriginal and Torres Strait Islander People. Australian Burden of Disease Study Series No. 6. Cat. No. BOD 7*. Canberra: Australian Institute of Health and Welfare; 2016.