



Australian Government


**Australian Institute of
Health and Welfare**

Health-adjusted life expectancy in Australia: expected years lived in full health

2011



The Australian Institute of Health and Welfare is a major national agency whose purpose is to create authoritative and accessible information and statistics that inform decisions and improve the health and welfare of all Australians.

© Australian Institute of Health and Welfare 2017 

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

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

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 (PDF)

ISSN 2006-4508 (Print)

ISBN 978-1-76054-260-3 (PDF)

ISBN 978-1-76054-261-0 (Print)

Suggested citation

Australian Institute of Health and Welfare 2017. Health-adjusted life expectancy in Australia: expected years lived in full health 2011. Australian Burden of Disease Study series no.16. BOD 17. Canberra: AIHW.

Australian Institute of Health and Welfare

| | |
|-------------------|-------------------|
| Board Chair | Director |
| Mrs Louise Markus | Mr Barry Sandison |

Any enquiries relating to copyright or comments on this publication should be directed to:

Website and Publishing Unit

Australian Institute of Health and Welfare

GPO Box 570

Canberra ACT 2601

Tel: (02) 6244 1000

Email: info@aihw.gov.au

Published by the Australian Institute of Health and Welfare.

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

Contents

| | |
|---|----|
| Acknowledgments..... | iv |
| Abbreviations..... | iv |
| Summary..... | v |
| Introduction..... | 1 |
| HALE over the lifecourse..... | 3 |
| HALE and life expectancy at birth..... | 3 |
| HALE and life expectancy at older ages..... | 3 |
| Changes in HALE between 2003 and 2011..... | 4 |
| Changes in HALE at birth..... | 4 |
| Changes in HALE at age 65..... | 4 |
| HALE across the states and territories..... | 5 |
| HALE at birth..... | 5 |
| HALE at age 65..... | 5 |
| HALE by remoteness..... | 7 |
| HALE by socioeconomic group..... | 9 |
| Conclusion..... | 11 |
| Appendix A: Technical note..... | 12 |
| Methods overview..... | 12 |
| Life expectancy and person-years lived..... | 12 |
| Data sources..... | 12 |
| Estimating the average health of the population..... | 13 |
| Data sources..... | 13 |
| Calculating HALE..... | 13 |
| Calculating HALE for remoteness areas and socioeconomic groups..... | 14 |
| Format of results..... | 15 |
| What other HALE information could be available?..... | 17 |
| Appendix B: Tables..... | 18 |
| References..... | 21 |
| List of tables..... | 22 |
| List of figures..... | 23 |

Acknowledgments

This report was authored by Karen Bishop of the Burden of Disease and Mortality Unit of the Australian Institute of Health and Welfare (AIHW) under the direction of Michelle Gourley and Lynelle Moon. Valuable analytical contributions were made by Julianne Garcia and Melissa Goodwin of the Burden of Disease and Mortality Unit at the AIHW.

The report was reviewed by Geoff Neideck, David Whitelaw and Louise York of the AIHW and Justine Boland and James Eynstone-Hinkins of the Australian Bureau of Statistics—their contributions are also gratefully acknowledged.

Abbreviations

| | |
|------|--|
| ABDS | Australian Burden of Disease Study |
| ABS | Australian Bureau of Statistics |
| ACT | Australian Capital Territory |
| AIHW | Australian Institute of Health and Welfare |
| HALE | health-adjusted life expectancy |
| LE | life expectancy |
| NSW | New South Wales |
| NT | Northern Territory |
| Qld | Queensland |
| SA | South Australia |
| Tas | Tasmania |
| Vic | Victoria |
| WA | Western Australia |
| YLD | years lived with disability |

Summary

As Australians are living longer, it is important to understand whether people are spending more years in good health or more years living with illness. The measure of health-adjusted life expectancy (HALE) can be used to understand this.

HALE extends the concept of life expectancy by considering the time spent living with disease and injury. It 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.

This report presents estimates of HALE for the Australian population in 2011 and 2003. Estimates are also presented by state/territory, remoteness and socioeconomic group for 2011.

Overall, this report finds that Australians are living longer and with more years in good health. However, some of the additional years lived are spent living with disease and injury, and this varies across demographic groups.

- Life expectancy in Australia for males born in 2011 was 79.9 years and for females it was 84.3 years. In the same year, HALE of Australians at birth—that is, the estimated number of years a person could expect to live in full health—was 70.9 for males and 74.4 for females. In other words, 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.
- People aged 65 in 2011 could expect just over three-quarters of their remaining years to be lived in full health.
- While life expectancy continues to increase in Australia, HALE has also increased. Males born in 2011 expected 1.7 more years in full health than males born 8 years earlier in 2003, and females born in 2011 expected 1.2 more years in full health than females born in 2003. These gains in healthy years are comparable to the gains in life expectancy.
- Despite people living longer and living more years in full health, people expected the same percentage of their lives in 2003 and 2011 in full health: 89% for males and 88% for females.
- The Northern Territory had the shortest HALE of all jurisdictions in 2011: males and females expected shorter lives, had the shortest HALE and also expected the greatest percentage of their lives to be lived in ill health.
- People in *Remote and very remote* areas fared worse than people in *Major cities*—they had both shorter life expectancy and expected more of their lives in ill health. Those living in *Major cities* expected to live more years in full health than those in *Remote and very remote* areas: 5.5 more years for males and 6.9 more years for females.
- People in the highest socioeconomic group (least disadvantaged) expected more years in full health than those in the lowest socioeconomic group: 7.0 more years for males and 4.8 more years for females. Furthermore, people in the highest socioeconomic group expected to live a greater percentage of their lives in full health (90%) compared with those in the lowest group (88%).

A summary of these results is in Table S1.

Table S1: Life expectancy and HALE at birth, males and females, by jurisdiction, remoteness area and socioeconomic group, 2011

| | Males | | Females | |
|------------------------------|---------------------------|--------------|---------------------------|--------------|
| | LE (years) ^(a) | HALE (years) | LE (years) ^(a) | HALE (years) |
| Jurisdiction | | | | |
| New South Wales | 79.9 | 71.1 | 84.2 | 74.5 |
| Victoria | 80.5 | 71.4 | 84.5 | 74.5 |
| Queensland | 79.5 | 70.4 | 84.0 | 74.2 |
| Western Australia | 80.1 | 71.3 | 84.8 | 75.0 |
| South Australia | 79.8 | 70.5 | 84.2 | 74.1 |
| Tasmania | 78.7 | 70.4 | 82.6 | 72.6 |
| Australian Capital Territory | 81.2 | 72.3 | 85.1 | 74.6 |
| Northern Territory | 74.7 | 64.9 | 80.0 | 68.4 |
| Remoteness area | | | | |
| Major cities | 80.6 | 71.7 | 84.8 | 75.0 |
| Inner regional | 78.9 | 69.5 | 83.7 | 73.8 |
| Outer regional | 78.2 | 69.8 | 83.3 | 73.6 |
| Remote and very remote | 75.3 | 66.2 | 79.7 | 68.1 |
| Socioeconomic group | | | | |
| Q1 (lowest) | 77.3 | 67.8 | 82.7 | 72.2 |
| Q2 | 78.5 | 68.9 | 83.5 | 73.2 |
| Q3 | 79.8 | 70.8 | 84.4 | 74.4 |
| Q4 | 81.6 | 72.7 | 85.3 | 75.4 |
| Q5 (highest) | 83.0 | 74.8 | 86.0 | 77.0 |
| Australia | 79.9 | 70.9 | 84.3 | 74.4 |

(a) Life expectancy data from ABS 2013a, 2017a, 2017b.

Source: Table B1.

Introduction

Australians experience one of the highest life expectancies in the world—but are longer lives also healthier lives?

Over many decades, life expectancy in Australia has increased, which means that, on average (and with all else being equal), people are living longer. With increasing life expectancy, it is important to differentiate the years expected in full health and ill health in the years of life gained.

Life expectancy measures the average number of years a person can expect to live, regardless of their experience of disease or injury (see Box 1). During their lifetime, a person can spend time in different states of health. Health-adjusted life expectancy (HALE) extends the concept of life expectancy by considering the time spent living with the health consequences associated with disease and injury. It 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. HALE is measured for a reference year based on the morbidity and mortality experienced by the population at that time.

Box 1: Life expectancy and HALE

Life expectancy at birth is the average number of years that a newborn could expect to live if they experienced the age-specific mortality rates of the time they are born. It is a useful measure of a population's health in that it is an indicator of mortality conditions. Life expectancy at any age is the average number of remaining years a person of that age can expect to live if the age-specific mortality rates of the time applied in their lifetime.

Like life expectancy, HALE at birth is an indicator of health in a population, but incorporates both morbidity and mortality. HALE at age 65 reflects the health-related quality of life as the population ages. For example, this can be gauged by the percentage of the remaining life expectancy to be lived in full health.

This report mainly describes HALE at birth and HALE at age 65, where:

- HALE at birth represents the average number of years of full health that a newborn in a particular year could expect to live, if they experienced the mortality rates and morbidity rates for that year.
- HALE at age 65 represents the number of years during the remaining expected lifetime that people at this age could expect to live in full health.

Monitoring trends in life expectancy and HALE together allows the assessment of whether or not years of life gained are healthy years. Measures of the difference between life expectancy and HALE (as either the percentage or difference in years spent in ill health) can provide insight into the relative health status of different populations as well as valuable information for policy formulation and health service planning. Furthermore, these estimates can be compared over time and between population groups.

This report describes estimates of HALE for the Australian population in 2011 and 2003, and compares states and territories, remoteness areas and socioeconomic groups in 2011. It uses years lived with disability from the Australian Burden of Disease Study 2011 (AIHW 2016a) to estimate the impact of ill health in the reference year. Life expectancy estimates were used for estimating the impact of mortality in the reference year and were sourced from the Australian Bureau of Statistics.

HALE differs from disability-free life expectancy in that HALE includes the full experience of ill health and the impact of the health-related consequences, while disability-free life expectancy encompasses a broader scope of functional limitations of disability and selected long-term conditions.

In this report on HALE, full health refers to living without the health consequences of disease and injury; in other AIHW reports, disability-free life expectancy refers to living without the functional limitations of disability. See Appendix A for more about the differences between HALE and disability-free life expectancy.

HALE over the lifecycle

HALE and life expectancy at birth

Life expectancy in Australia for males born in 2011 was 79.9 years and 84.3 years for females (ABS 2013a). HALE for these babies was 70.9 years for males and 74.4 years for females (Figure 1 and Table B1). Equivalently, males and females could expect to spend 10.0 and 9.9 years of their lives in ill health, respectively. From another perspective, males and females expected to live 89% and 88% of their lives, respectively, in full health. While females born in 2011, on average expected to live 4.4 years longer than males, they also expected 3.5 more years of healthy life than males.

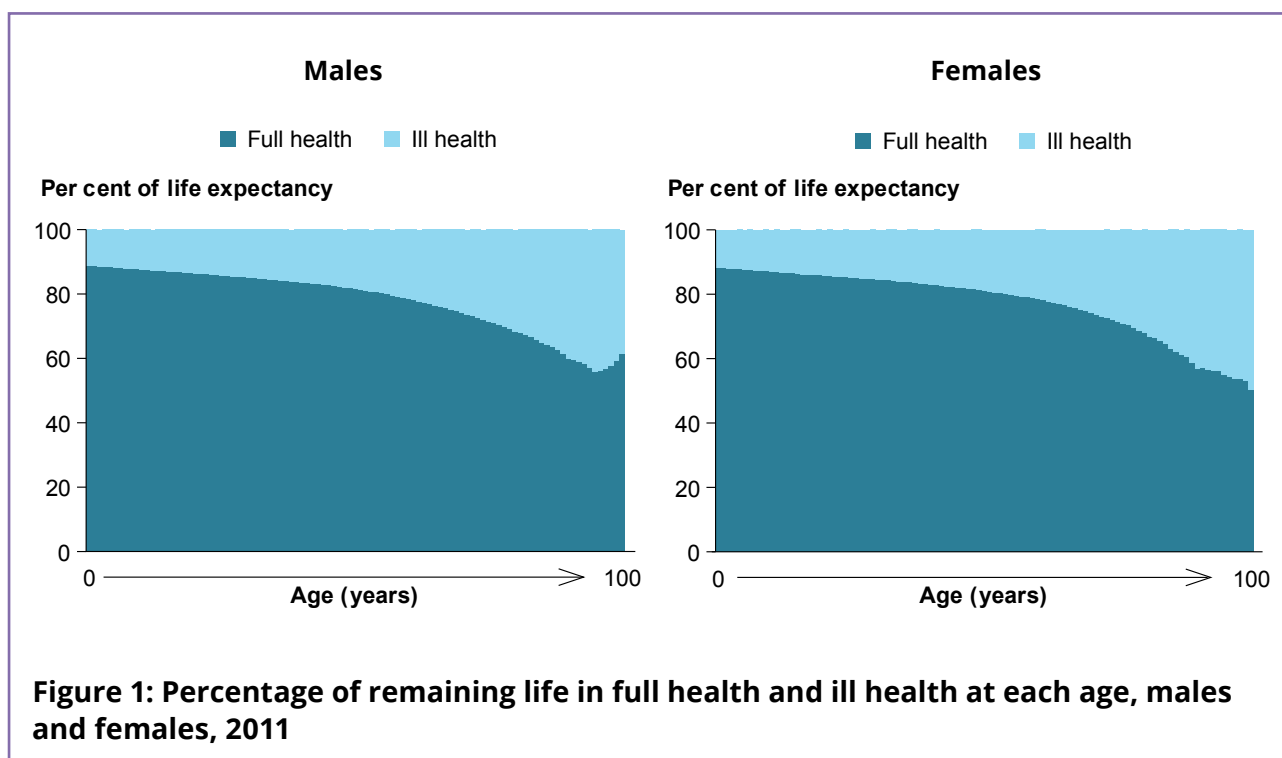
HALE and life expectancy at older ages

Life expectancy data show that males and females aged 65 in 2011 could expect to live to ages 84.1 and 87.0, respectively, while those aged 85 could expect to live to 91.1 and 92.2 years, respectively (Table B2). These longer life spans result from declining mortality rates at older ages which in turn lead to increases in the elderly population in Australia.

As age is a major risk factor for a multitude of diseases, it is not surprising that older people expect a higher percentage of their remaining life expectancy to be lived in ill health (conversely, a lower percentage in full health) compared with younger cohorts.

People aged 65 in 2011 expected to live a little more than three-quarters of their remaining years in full health (76% for males and 77% for females). Males expected 14.6 of their remaining 19.1 years to be lived in full health, while females expected 16.9 of their remaining 22.0 years to be lived in full health (Figure 1 and Table B1).

By age 85, people expected to live less than two-thirds of their remaining lives in full health (64% for males and 63% for females) (Figure 1 and Table B2).



Changes in HALE between 2003 and 2011

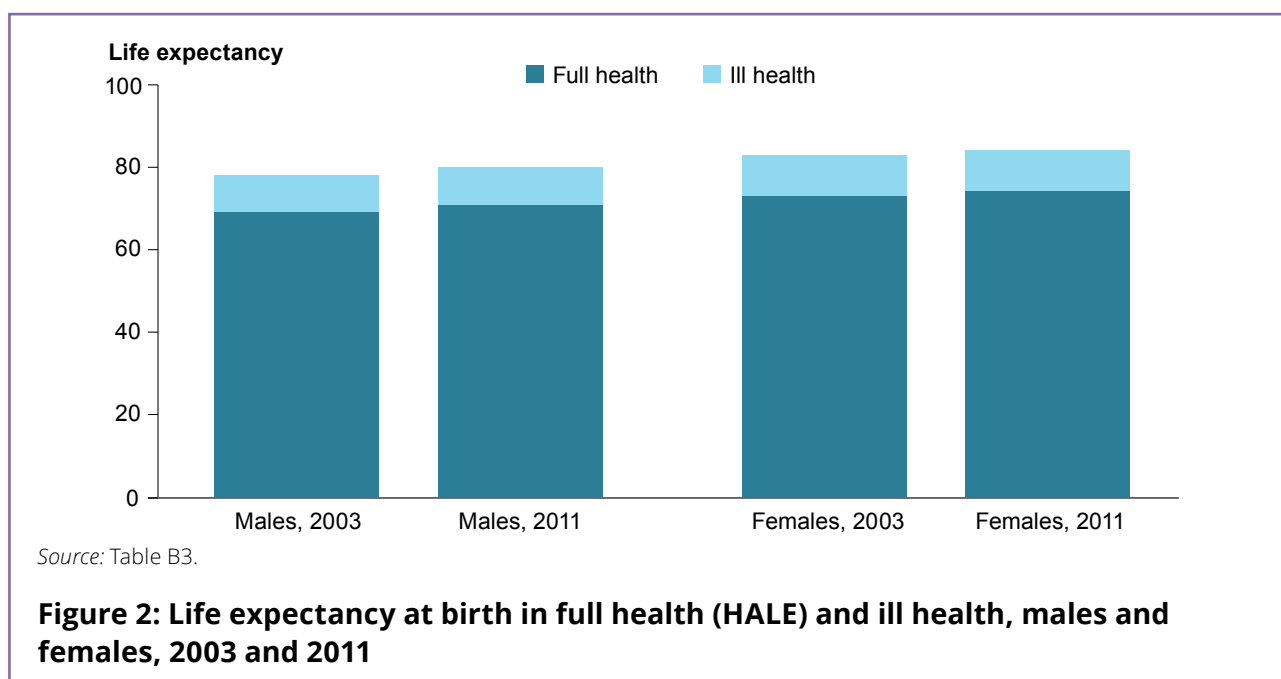
Monitoring changes over time in life expectancy alongside HALE provides a better understanding of the net benefit of longer life expectancy; that is, whether the years of life gained are healthy or unhealthy years.

If, for example, HALE increased more over time than life expectancy, then the years of life gained comprise more years lived in full health. Conversely, if gains in life expectancy were larger than gains in HALE, more of the years gained were expected to be lived in ill health (that is, living with disease or injury).

Changes in HALE at birth

Life expectancy at birth increased between 2003 and 2011 by 1.8 years for males and 1.3 years for females. The majority of this gain was years expected to be lived in full health. Males born in 2011 expected 1.7 more healthy years (from 69.2 years in 2003 to 70.9 years in 2011). For females, the gain was 1.2 healthy years (from 73.2 years in 2003 to 74.4 years in 2011) (Figure 2 and Table B3). Despite the gain in life expectancy being slightly more than the gain in HALE, the additional time expected to be lived in ill health in 2011 compared with 2003 was small (0.1 years for both males and females).

The percentage of remaining years expected to be lived in ill health in 2003 and 2011 was the same in both years for males and females at birth (89% for males and 88% for females) (Table B3). This suggests that HALE is keeping pace with life expectancy and that increases in life expectancy are not associated with increases in time expected to be lived in ill health.



Changes in HALE at age 65

For people aged 65, life expectancy increased between 2003 and 2011 by 1.4 years for males and 0.9 years for females. The corresponding increase in HALE at this age was 1.1 years for males and 0.7 years for females (Table B3). Despite most of the gain being years lived in full health, males aged 65 expected, on average, an additional 0.3 years in ill health and females an additional 0.2 years.

The percentage of remaining years expected to be lived in ill health for males and females aged 65 was the same in 2003 and 2011 (76% for males and 77% for females) (Table B3).

HALE across the states and territories

Life expectancy varied by state and territory. For males born in 2011, it was highest in the Australian Capital Territory (81.2 years) and lowest in the Northern Territory (74.7 years). For females, it was also highest in the Australian Capital Territory (85.1 years) and lowest in the Northern Territory (80.0 years) (Table B1).

HALE also varied between the states and territories which reflects both geographical variation in life expectancy and variation in disease burden.

HALE at birth

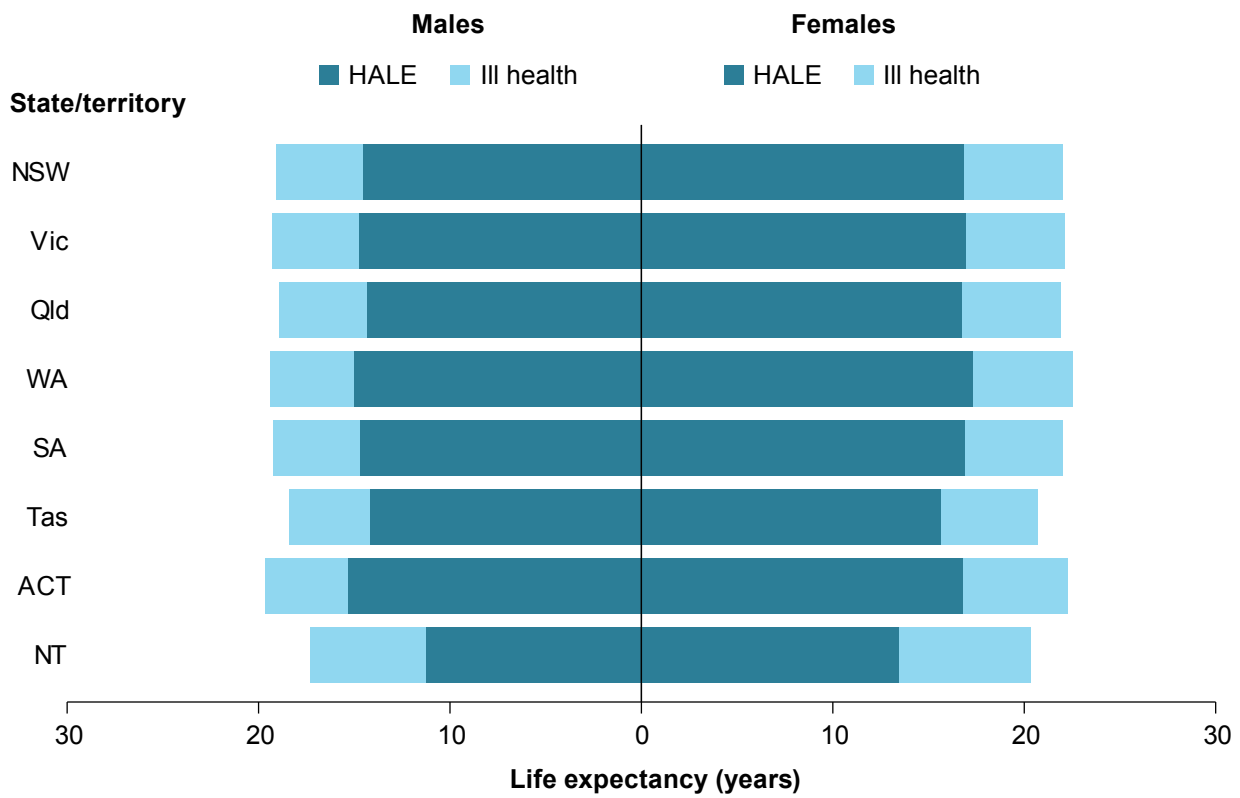
HALE at birth in 2011 in males was highest in the Australian Capital Territory (72.3 years) and lowest in the Northern Territory (64.9 years) (Table B1), giving a gap of 7.4 years of full health between these jurisdictions. For females, the highest HALE was in Western Australia (75.0 years) and the lowest in the Northern Territory (68.4 years), reflecting a gap of 6.6 years of full health.

Considering the percentage of life expected in full health at birth, males in Tasmania expected the highest percentage of life in full health (on average, 90%), as did females in New South Wales (89%) (Table B1). The burden of ill health was greatest for males and females in the Northern Territory who experienced, on average, the lowest percentage of their lives in full health: 87% and 86%, respectively. This burden was further exacerbated for Northern Territorians, having both the lowest life expectancies and the most years anticipated in ill health—9.8 years for males and 11.6 years for females.

The lesser health-related quality of life in the Northern Territory reflects the higher disease burden in this region (AIHW 2016b). This is at least partly due to the higher proportion of Indigenous Australians living in the Northern Territory who have lower life expectancy than non-Indigenous Australians (ABS 2013b).

HALE at age 65

HALE and years lived in ill health for males and females aged 65 in each state and territory are shown in Figure 3. Similar to the findings for HALE at birth, the Northern Territory had the lowest HALE for persons aged 65 (11.2 years for males and 13.5 years for females) and the lowest percentage of remaining life in full health (65% for males and 66% for females) compared with the other jurisdictions. Males and females aged 65 in the other states and territories could expect three-quarters or more of their remaining life in full health (Table B1).



Source: Table B1.

Figure 3: Life expectancy at age 65 in full health (HALE) and ill health, males and females, by state and territory, 2011

HALE by remoteness

There is considerable variation in the burden of disease in the Australian population by remoteness area (AIHW 2016a, 2016b). Consequently, HALE also varied by region of remoteness.

Life expectancy at birth in 2011 was highest in *Major cities* and declined with increasing remoteness. For males, it was 80.6 years in *Major cities* compared with 75.3 years in *Remote and very remote* areas and, for females, these figures were 84.8 and 79.7 years, respectively (Table B1).

Likewise, there was considerable variation in HALE at birth between remoteness areas. Males in *Major cities* expected to live 5.5 more years in full health compared with those in *Remote and very remote* areas (HALE was 71.7 and 66.2 years in these areas, respectively). For females, the gap in HALE between *Major cities* and *Remote and very remote* areas was 6.9 years (HALE was 75.0 and 68.1 years in these areas, respectively) (Table B1).

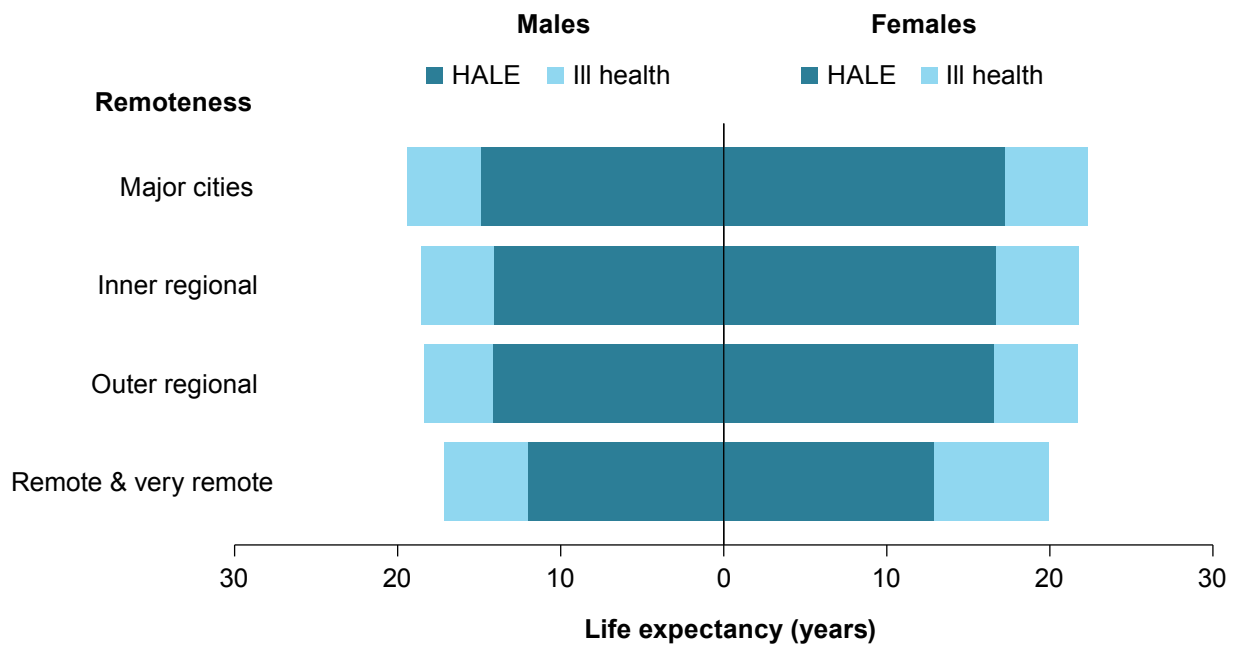
For males and females aged 65, HALE also varied across remoteness areas. Figure 4 shows the life expectancy at age 65 for males and females in each area by the time expected to be lived in full health (HALE) and in ill health.

Life expectancy and HALE at age 65 were shorter in *Remote and very remote* areas for males and females compared with other areas. Males in *Remote and very remote* areas expected 2.8 fewer years remaining in full health compared with males in *Major cities* (HALE was 14.9 and 12.1 years, respectively). For females aged 65, this gap was 4.4 years (HALE was 17.3 and 12.9 years, respectively).

The percentage of remaining life in full health at birth was similar between areas for males: 89% in *Major cities* compared with 88% in *Remote and very remote* areas. For females, these figures were 89% and 85%, respectively.

By age 65, however, the inequality in percentage of expected healthy life remaining was much greater between remoteness areas. Males in *Major cities* expected 77% of their remaining life to be in full health compared with 70% in *Remote and very remote* areas. The difference for females was greater, with 77% of remaining life expected to be in full health in *Major cities* compared with 65% in *Remote and very remote* areas (Table B1).

Differences in HALE between areas and population groups are influenced by the health status of the population in these areas. The disparity in HALE between remoteness areas is amplified by higher rates of illness among Indigenous Australians who make up a greater proportion of the population in remote areas. The largest gap in burden of disease between Indigenous and non-Indigenous Australians was in remote areas. Indigenous Australians in remote areas lost more than twice as many years of healthy life per person (2.4 times) as non-Indigenous Australians (AIHW 2016b).



Source: Table B1.

Figure 4: Life expectancy at age 65 in full health (HALE) and ill health, males and females, by remoteness area, 2011

HALE by socioeconomic group

Life expectancy and many other measures of health vary by socioeconomic group, with the highest group (the least disadvantaged) usually faring better than the lowest (most disadvantaged). HALE is no exception, with the higher socioeconomic group expecting to live more years in full health and a higher percentage of their remaining life expected to be in full health compared with lower socioeconomic groups.

In this report, socioeconomic groups are presented as quintiles where quintile 1 (Q1) represents the 20% of the population with the lowest socioeconomic characteristics. The level of socioeconomic position increases with each quintile through to the 20% of the population with the highest socioeconomic characteristics (Q5).

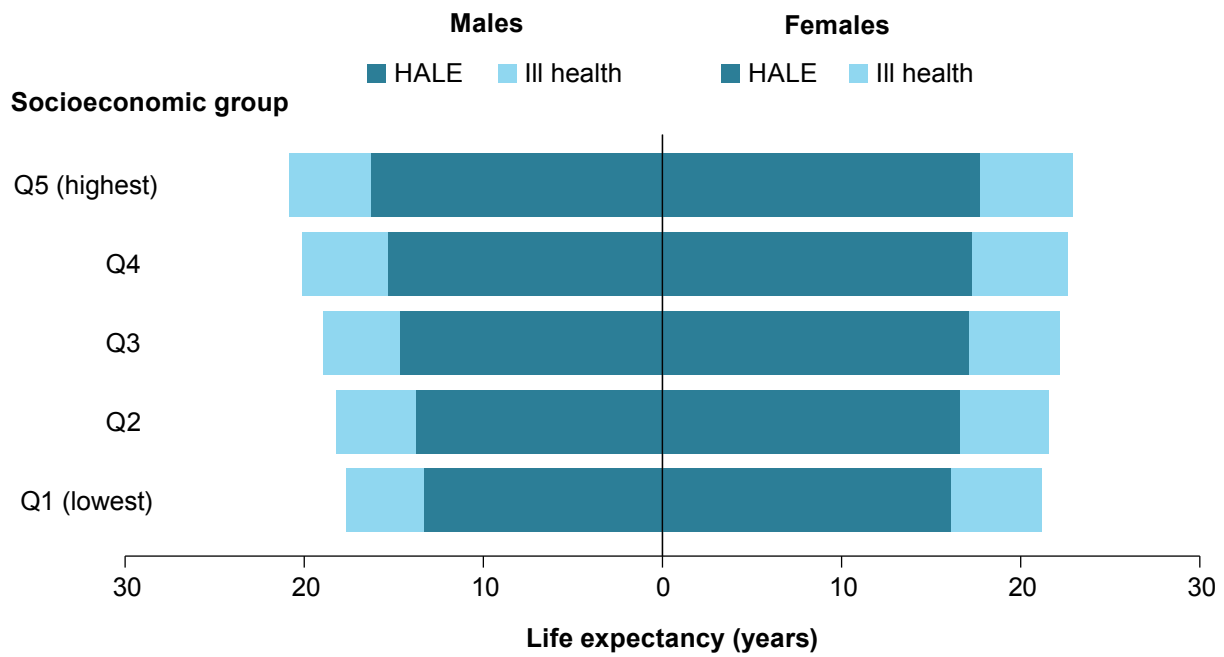
In 2011, life expectancy was longest in the highest socioeconomic group and decreased progressively with decreasing socioeconomic position. For males in the highest group, it was 83.0 years compared with 77.3 years in the lowest group, while for females, these figures were 86.0 years and 82.7 years, respectively (Table B1).

Males born in 2011 in the highest socioeconomic group expected 7.0 more years of healthy life than males in the lowest group (HALE was 74.8 and 67.8 years in these groups, respectively); for females, this gap was 4.8 healthy years (HALE was 77.0 and 72.2 years in these groups, respectively) (Table B1). Males aged 65 in the highest socioeconomic group expected 3.0 more healthy years compared with the lowest group (HALE was 16.3 and 13.3 years, respectively) and, for females, this gap was 1.7 years of healthy life (HALE was 17.8 and 16.1 years, respectively) (Figure 5).

Looking at these results in terms of the percentage of remaining life expected to be lived in full health, there is some variation between socioeconomic groups. Males and females in the highest socioeconomic group expected a greater percentage of their remaining life expectancy to be in full health compared with their counterparts in the lowest group. At birth, males in the highest group expected 90% of their life to be in full health compared with 88% for the lowest group; females in the highest group also expected 90% of their lifetime to be lived in full health compared with 87% for those in the lowest group (Table B1).

Males aged 65 in the highest socioeconomic group expected 78% of their lives remaining in full health while the lowest group expected 76%. The gap was marginal for females: 78% of remaining life was expected to be in full health for the highest socioeconomic group compared with 76% for the lowest group.

In summary, the lowest socioeconomic groups fared worse in that they expected both shorter lives while also expecting a higher burden of ill health during their shorter lives, compared with the highest socioeconomic groups.



Source: Table B1.

Figure 5: Life expectancy at age 65 in full health (HALE) and ill health, males and females, by socioeconomic group, 2011



Conclusion

A key finding of this analysis is that with continuing increases in life expectancy, HALE has also increased. Despite comparable gains in life expectancy and HALE over time, HALE was disproportionate across demographic groups; some population groups expected to spend a greater percentage of their lives living with illness compared with other groups.

People in *Remote and very remote* areas fared worse than people in *Major cities* in that they had both shorter life expectancy and expected a higher burden of ill health during their shorter lives. Likewise, people in the lowest socioeconomic group fared worse than their counterparts in the highest socioeconomic group.

Monitoring changes over time in HALE alongside life expectancy may help to inform health policy and planning. If gains in life expectancy increase more rapidly than gains in HALE (reflecting that as we age, more of the time gained is expected to be living with illness), this may have implications for health planning and future costs to the health system and demand for aged care and other services, particularly for the elderly.

Appendix A: Technical note

To estimate health-adjusted life expectancy (HALE), Australian life expectancy data were adjusted in proportion to the average health of the population. Years lived with disability (YLD) rates from the Australian Burden of Disease Study (ABDS) 2011 were used to estimate the average health of the Australian population. YLD reflect the amount of time spent in a state of less than full health. This *Technical note* describes the methods and data sources used to produce estimates of HALE in Australia for 2011 and 2003, and by state and territory, remoteness area and socioeconomic group in 2011.

Methods overview

HALE refers to the average number of years, at each age or age group, expected to be lived in full health; that is, without the health consequences of disease and injury.

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

Measures of HALE are calculated by adjusting estimates of the life expectancy of the population of interest proportionately to the average health of individuals in each age group.

Life expectancy and person-years lived

Life tables are statistical models used to describe the mortality of a population. They include estimates of the remaining years of life at each age (the life expectancy) and the number of person-years lived at each age (or age group) in the reference year by a hypothetical cohort that experiences the mortality rates of the population of interest.

Data from the life tables used as inputs to HALE calculations are:

- the number of survivors at exact age x for a period of n years, ${}_n l_x$. This measure is calculated using the mortality experienced in the population of interest for the reference period; it does not take into account future potential improvements in mortality
- the number of person-years lived in the interval from exact age x for n years, symbolised as ${}_n L_x$. This reflects the total years spent in the age group by the whole population
- the expectation of life at exact age x , represented by e_x .

Note, these inputs can be further subscripted with s , reflecting that the estimates are sex specific.

Data sources

Life expectancy and person-years lived for these calculations were sourced from the Australian Bureau of Statistics (ABS). The estimates for 2011 were based on life tables for 2010–2012 for Australia and all states and territories (ABS 2013a). For 2003, the estimates were based on life tables for 2002–2004 (ABS 2007). For HALE estimates for remoteness areas and socioeconomic groups, customised life tables provided by the ABS were used (ABS 2017a, 2017b).

Estimating the average health of the population

YLD measure the non-fatal health loss in burden of disease analysis. YLD rates provide an estimate of the average experience of health loss for each person in that population. They can be interpreted as the percentage of the year each person spends, on average, in ill health; thereby providing a measure of average health in the population during that year.

For these calculations, we used the YLD rates from the ABDS 2011 in which YLD rates directly measure the YLD experienced by the population in 2011 and 2003 from all illnesses, diseases and injuries. YLD are estimated from the prevalence of around 320 disease outcomes, adjusted according to the proportion and severity of the outcome and the duration spent living with the health consequences of disease and injury. One year lived with disability represents the equivalent of 1 year spent in ill health from any illness, disease or injury.

The total YLD rate, averaged for the population, is used here to reflect the average health of the population for the year. For HALE, sex- and age-specific rates are used.

Based on the YLD rates, the average health in each age group x , H_x , is assigned a value between 0 and 1 which is derived directly from rate of non-fatal burden in each age group. It is calculated as:

$$H_x = 1 - p_x$$

where p_x represents the average health loss (YLD rate) at age x .

Data sources

The data used to estimate the prevalence of 'average health' came from the ABDS 2011. YLD rates for 2011 by sex and age are from AIHW (2016b). YLD rates by age and sex for 2003 national estimates, and 2011 states and territories, remoteness areas and socioeconomic groups are based on unpublished Australian Institute of Health and Welfare (AIHW) analysis of the ABDS 2011 database.

YLD estimates for the Australian population and the methods for estimating these are described elsewhere (AIHW 2016a, 2016c).

Calculating HALE

To calculate HALE, the person-years lived in each age group (estimated from the ${}_nL_x$ data from the life table as described above) are adjusted to account for the time spent in ill health (as described by the average health of the population above). That is, for each age group, the ${}_nL_x$ column is multiplied by H_x to give the person-years in each age group spent in full health.

For national and state and territory estimates, we used the full version of the ABS life tables (ABS 2007, 2013b). In these tables, person-years lived are estimated for each single year of age; that is, n is equivalent to 1. The YLD rates from the ABDS have an interval of $n = 5$ years; that is, they are reported in 5-year age groups to 100+, except for infants (under 1 year) and children aged 1–4. To align these 2 data sets, we applied the YLD rate for the age group to all corresponding single year ages in the life table.

Life table methods were used to calculate a revised life expectancy, where the person-years were adjusted to reflect only the time spent in full health. The specific calculations are shown in Box 1.

Box 1: Calculating HALE using Sullivan's method

$$HALE_{x,s} = \left(\sum_{x=0}^{100} (L'_{x,s}) \right) / l_{x,s}$$

and

$$L'_{x,s} = L_{x,s} (1 - p_{x,s})$$

$$L'_{x,s} = L_{x,s} (H_{x,s})$$

where:

HALE is health-adjusted life expectancy

x is the exact age for which life expectancy or HALE is to be estimated

s refers to sex

$L_{x,s}$ refers to the number of person-years lived in the age group x , for sex, s

$L'_{x,s}$ refers to the health-adjusted number of person-years lived in the age group x , for sex, s

$l_{x,s}$ is the number of survivors in the age group x (as described above for the life table), for sex, s

$p_{x,s}$ represents the proportion of prevalence of ill health, estimated by YLD rate for each age group x , for sex, s

$H_{x,s}$ represents the complement of $p_{x,s}$ and is the average level of health-related quality of life; it has a value between 0 and 1, where a value of 1 indicates full health.

Calculating HALE for remoteness areas and socioeconomic groups

The HALE estimates for remoteness areas and socioeconomic groups required life table information specific to these areas. We used customised life expectancy data (ABS 2017a, 2017b) for estimating HALE for:

- 4 remoteness areas—*Major cities, Inner regional, Outer regional and Remote and very remote* (combined)—based on the Australian Statistical Geographical Standard 2011
- 5 socioeconomic groups based on the 2011 Socio-Economic Indexes for Areas (SEIFA) Index of Relative Disadvantage, where the highest socioeconomic group represents the least disadvantaged areas and the lowest socioeconomic group the most disadvantaged areas.

Life expectancy estimates for these population groups were available for infants, children (aged 1–4) and then in 5-year age groups to 85 and over. YLD rates from the ABDS 2011 for infants and children aged 0–4 were recalculated to align with the customised life table data. In addition, we recalculated YLD rates for the 4 remoteness groups to align with the customised life table data.

The same methods as described above were applied to calculate HALE for these population groups.

Note on derivation of socioeconomic groups

The AIHW calculates socioeconomic differences using SEIFA indexes divided into population-based quintiles. With this approach, approximately one-fifth of the population is allocated to each quintile regardless of the underlying geographical area. In this report, the YLD rates used to estimate the proportion of ill health in the 5 socioeconomic groups were derived this way.

Life expectancy inputs for the calculation of HALE by socioeconomic area were calculated by the ABS using a slightly different approach to forming socioeconomic quintiles. This method allocates one-fifth of the geographical areas to each quintile according to their ranking in relative socioeconomic disadvantage. As a result, the quintiles used to calculate life expectancy by socioeconomic group may be different.

The impact of these differences on HALE estimates is not known.

Format of results

The format of the results in this report are directly related to the availability of the input data: life expectancy and YLD rates. For example, HALE estimates were calculated up to ages 100 and over for national and state and territory populations (using single year age groups), and to 85 and over for remoteness areas and socioeconomic groups (using 5-year age groups except for infants and children aged 1–4).

The HALE estimates for remoteness areas and socioeconomic groups by age groups are described in the report to align with the national and state and territory estimates. For example, HALE for ages 65–69 for remoteness areas or socioeconomic groups is reported here as HALE for age 65.

Box 2 provides a worked example of how HALE is estimated.

Box 2: How is HALE estimated?

HALE, using Sullivan's method, is estimated by adjusting the number of person-years lived from the life table, to reflect the portion of that time lived in full health.

A life table describes, for a hypothetical population, the total number of person-years lived at each age in a given (reference) year, based on the mortality rates for that year. For example, if an individual died during the reference year, the amount of time lived was less than 1 year. When the total amount of time lived by the population in the reference year is averaged over the whole population, the result is the amount of years lived per person; that is, the life expectancy.

In the reference year, an individual may live some days in full health and some days in ill health. The total amount of time spent in these health states was estimated in the ABDS 2011 for every occurrence of every disease (see AIHW 2016a, 2016c). These amounts were then added together for the whole population to indicate the amount of time in the reference year that people spent in ill health; that is, the total YLD.

In calculating HALE, the number of person-years lived, after the influence of mortality, is adjusted by subtracting the years spent in ill health (using YLD rates). The result is the equivalent number of person-years lived in full health. As above for life expectancy, averaging this over the whole population results in the number of years lived in full health per person, or HALE. That is:

the average length of time (in years) that an individual, at a specific age can, on average, expect to live in full health considering the disease prevalence and mortality rates for the reference year.

The time lived in full health can be thought of as the equivalent portion of the year that is lived without the health consequences of disease and injury.

Example HALE calculation

The calculations are made using life expectancy and YLD estimates by age and sex groups. Consider a YLD rate for a reference year and age group that is 150 YLD per 1,000 persons. In other words, on average, people in that age group spent 0.15 of the year or 15% of the year in ill health. This is equivalent to living, on average, 0.85 of the year, or 85% of the year, in full health. That is, the average health of the population in this age group for the reference year is:

$$H_x = 1 - 0.15 = 0.85$$

Consider also that the life table describes the population in this age group living a total of 350,000 person-years in the reference year. We know from the YLD rate for this age group, there is, on average, full health for 85% of these person-years.

Therefore 85% of these 350,000 person-years, or 297,500 person-years are lived in full health. These calculations are applied for each sex and age group and then life table methods are used to calculate the adjusted person-years lived (in full health) and the adjusted life expectancy. This (adjusted) version of the life expectancy is that which is lived in full health, or HALE.

The AIHW has also reported on disability-free life expectancy; that is, the estimated time a person can expect to live without disability (AIHW 2017). This measure is different to HALE, as described in Box 3.

Box 3: Differences between HALE and disability-free life expectancy

The AIHW recently published estimates of disability-free life expectancy (the number of years that a person, on average, will live without experiencing disability) in Australia (AIHW 2017).

The results showed that a boy born in 2015 could expect to live 63 years free of disability and a girl, 65 years. Considering even the difference in reference years, this is substantially shorter than the HALE at birth estimates reported here for 2011: 70.9 years for males and 74.4 years for females. The sizeable differences are largely due to the types of measures and how their impact on quality of life is considered.

HALE covers the full experience of the health consequences of disease and injury, while disability-free life expectancy encompasses a broader scope of functional limitations of disability and selected long-term conditions considered to have equal impact.

In this report on HALE, the status of full health refers to living without the health consequences of disease and injury, where the time each person spent with a disease or injury was adjusted by the severity of the particular state of ill health experienced in the year.

Disability for disability-free life expectancy was estimated using the ABS Survey of Disability, Ageing and Carers (ABS 2016). Disability was identified as having a limitation, restriction or impairment, which has lasted, or is likely to last, for at least 6 months and restricts everyday activities. This could include, for example, loss of sight not corrected by glasses or lenses, chronic or recurrent pain or discomfort causing restriction, nervous or emotional condition causing restriction or any other long-term condition resulting in a restriction. Importantly, the limitations associated with certain activities were not weighted to reflect different levels of limitation. That is, all disabilities, regardless of their actual impact, were weighted the same.

Note too, this measure of disability does not necessarily equate to poor health or illness. Functional limitations associated with disability can be stable and the person may enjoy good health, particularly where there is no need for medical services and they can participate in many aspects of life.

Prevalence rates of disability in 2015 (AIHW 2017) were larger in almost all age groups for males and females compared with the prevalence rates of ill health adjusted for severity (YLD rates) from the ABDS (AIHW 2016a). The non-adjustment for severity of disability in calculating disability-free life expectancy contributes to the high rates of disability. This, in turn, influences the size of the differences in life expected without disability and life expected in full health (HALE).

What other HALE information could be available?

HALE estimates can be calculated for specific diseases. This could be used, for example, to compare HALE among people with and without a specific disease.

HALE can also be calculated for different population groups, such as Indigenous Australians, provided life tables and YLD estimates are available. HALE estimates for Indigenous Australians were out of scope for this report but could form the basis of a future report using estimates from the AIHW's ABDS and ABS Indigenous life tables.

Appendix B: Tables

Table B1: Life expectancy, HALE and percentage of life expected to be lived in full health, at birth and age 65, males and females, by jurisdiction, remoteness area and socioeconomic group, 2011

| Jurisdiction | At birth | | | | | | At age 65 ^(a) | | | | | |
|------------------------------|---------------------------|--------------|-----------------------|---------------------------|--------------|-----------------------|---------------------------|--------------|-----------------------|---------------------------|--------------|-----------------------|
| | Males | | | Females | | | Males | | | Females | | |
| | LE (years) ^(b) | HALE (years) | LE in full health (%) | LE (years) ^(b) | HALE (years) | LE in full health (%) | LE (years) ^(b) | HALE (years) | LE in full health (%) | LE (years) ^(b) | HALE (years) | LE in full health (%) |
| New South Wales | 79.9 | 71.1 | 88.9 | 84.2 | 74.5 | 88.5 | 19.1 | 14.6 | 76.3 | 22.0 | 16.9 | 76.6 |
| Victoria | 80.5 | 71.4 | 88.7 | 84.5 | 74.5 | 88.2 | 19.3 | 14.8 | 76.5 | 22.1 | 17.0 | 76.7 |
| Queensland | 79.5 | 70.4 | 88.5 | 84.0 | 74.2 | 88.3 | 18.9 | 14.3 | 75.9 | 21.9 | 16.7 | 76.4 |
| Western Australia | 80.1 | 71.3 | 89.0 | 84.8 | 75.0 | 88.4 | 19.4 | 15.0 | 77.4 | 22.6 | 17.3 | 76.9 |
| South Australia | 79.8 | 70.5 | 88.3 | 84.2 | 74.1 | 88.0 | 19.2 | 14.7 | 76.6 | 22.0 | 16.9 | 76.9 |
| Tasmania | 78.7 | 70.4 | 89.5 | 82.6 | 72.6 | 87.8 | 18.4 | 14.2 | 77.0 | 20.7 | 15.7 | 75.7 |
| Australian Capital Territory | 81.2 | 72.3 | 89.1 | 85.1 | 74.6 | 87.7 | 19.7 | 15.4 | 78.1 | 22.3 | 16.8 | 75.4 |
| Northern Territory | 74.7 | 64.9 | 86.8 | 80.0 | 68.4 | 85.5 | 17.3 | 11.2 | 65.0 | 20.3 | 13.5 | 66.2 |
| Remoteness area | | | | | | | | | | | | |
| Major cities | 80.6 | 71.7 | 88.9 | 84.8 | 75.0 | 88.5 | 19.4 | 14.9 | 76.7 | 22.3 | 17.3 | 77.3 |
| Inner regional | 78.9 | 69.5 | 88.0 | 83.7 | 73.8 | 88.1 | 18.6 | 14.1 | 76.0 | 21.8 | 16.7 | 76.8 |
| Outer regional | 78.2 | 69.8 | 89.2 | 83.3 | 73.6 | 88.4 | 18.4 | 14.2 | 77.2 | 21.7 | 16.6 | 76.5 |
| Remote and very remote | 75.3 | 66.2 | 87.9 | 79.7 | 68.1 | 85.4 | 17.2 | 12.1 | 70.3 | 20.0 | 12.9 | 64.8 |
| Socioeconomic group | | | | | | | | | | | | |
| Q1 (lowest) | 77.3 | 67.8 | 87.6 | 82.7 | 72.2 | 87.3 | 17.7 | 13.3 | 75.5 | 21.2 | 16.1 | 76.2 |
| Q2 | 78.5 | 68.9 | 87.7 | 83.5 | 73.2 | 87.7 | 18.2 | 13.8 | 75.5 | 21.5 | 16.6 | 77.1 |
| Q3 | 79.8 | 70.8 | 88.7 | 84.4 | 74.4 | 88.2 | 18.9 | 14.6 | 77.3 | 22.2 | 17.1 | 77.2 |
| Q4 | 81.6 | 72.7 | 89.1 | 85.3 | 75.4 | 88.3 | 20.1 | 15.3 | 76.4 | 22.6 | 17.3 | 76.4 |
| Q5 (highest) | 83.0 | 74.8 | 90.1 | 86.0 | 77.0 | 89.6 | 20.9 | 16.3 | 78.1 | 22.9 | 17.8 | 77.5 |
| Australia | 79.9 | 70.9 | 88.7 | 84.3 | 74.4 | 88.2 | 19.1 | 14.6 | 76.3 | 22.0 | 16.9 | 76.7 |

(a) For remoteness area and socioeconomic group, the measure for age 65 refers to the measure for the 65–69 age group.

(b) Life expectancy (LE) from ABS 2013b, 2017a, 2017b.

Note: Some numbers do not add due to rounding and per cent calculated on unrounded data.

Sources: AIHW analysis of ABS 2011 database, ABS 2013b, 2017a, 2017b.

Table B2: Life expectancy, HALE and percentage of life expectancy to be lived in full health, at selected ages, males and females, 2011

| Age (years) | Males | | | Females | | |
|-------------|---------------------------|--------------|-----------------------|---------------------------|--------------|-----------------------|
| | LE (years) ^(a) | HALE (years) | LE in full health (%) | LE (years) ^(a) | HALE (years) | LE in full health (%) |
| 0 | 79.9 | 70.9 | 88.7 | 84.3 | 74.4 | 88.2 |
| 1 | 79.3 | 70.2 | 88.6 | 83.5 | 73.7 | 88.2 |
| 5 | 75.3 | 66.4 | 88.1 | 79.6 | 69.8 | 87.7 |
| 10 | 70.4 | 61.6 | 87.5 | 74.6 | 64.9 | 87.1 |
| 15 | 65.4 | 56.8 | 86.9 | 69.7 | 60.2 | 86.3 |
| 20 | 60.5 | 52.3 | 86.3 | 64.7 | 55.5 | 85.8 |
| 25 | 55.7 | 47.7 | 85.6 | 59.8 | 51.0 | 85.2 |
| 30 | 50.9 | 43.3 | 85.0 | 54.9 | 46.4 | 84.6 |
| 35 | 46.1 | 38.9 | 84.3 | 50.0 | 42.0 | 83.9 |
| 40 | 41.4 | 34.6 | 83.5 | 45.2 | 37.5 | 83.0 |
| 45 | 36.7 | 30.3 | 82.7 | 40.4 | 33.2 | 82.1 |
| 50 | 32.1 | 26.2 | 81.5 | 35.6 | 28.9 | 81.2 |
| 55 | 27.6 | 22.1 | 80.2 | 31.0 | 24.8 | 79.9 |
| 60 | 23.3 | 18.2 | 78.4 | 26.4 | 20.7 | 78.5 |
| 65 | 19.1 | 14.6 | 76.3 | 22.0 | 16.9 | 76.7 |
| 70 | 15.3 | 11.3 | 74.0 | 17.8 | 13.2 | 74.2 |
| 75 | 11.7 | 8.3 | 71.4 | 13.8 | 9.9 | 71.6 |
| 80 | 8.6 | 5.9 | 68.3 | 10.2 | 6.9 | 67.9 |
| 85 | 6.1 | 3.9 | 64.6 | 7.2 | 4.5 | 63.0 |
| 90 | 4.3 | 2.6 | 59.7 | 4.9 | 2.8 | 56.8 |
| 95 | 3.1 | 1.7 | 55.7 | 3.4 | 1.9 | 54.9 |
| 100 | 2.3 | 1.4 | 61.5 | 2.5 | 1.3 | 50.4 |

(a) Life expectancy (LE) from ABS 2013b.

Note: Some numbers do not add due to rounding and per cent calculated on unrounded data.

Sources: AIHW analysis of ABDS 2011 database, ABS 2013b.

Table B3: Change in life expectancy and HALE between 2003 and 2011, percentage of life expectancy in full health 2003 and 2011, at birth and age 65, males and females

| Subgroup | Males | | Females | |
|--|----------|-----------|----------|-----------|
| | At birth | At age 65 | At birth | At age 65 |
| Life expectancy (years)^(a) | | | | |
| 2011 | 79.9 | 19.1 | 84.3 | 22.0 |
| 2003 | 78.1 | 17.8 | 83.0 | 21.1 |
| Change in life expectancy | 1.8 | 1.4 | 1.3 | 0.9 |
| HALE (years) | | | | |
| 2011 | 70.9 | 14.6 | 74.4 | 16.9 |
| 2003 | 69.2 | 13.6 | 73.2 | 16.2 |
| Change in HALE | 1.7 | 1.1 | 1.2 | 0.7 |
| LE in full health (%) | | | | |
| 2011 | 88.7 | 76.3 | 88.2 | 76.7 |
| 2003 | 88.6 | 76.2 | 88.2 | 76.6 |

(a) Life expectancy from ABS 2007, 2013b.

Note: Some numbers do not add due to rounding and per cent calculated on unrounded data.

Sources: AIHW analysis of ABDS 2011 database, ABS 2007, 2013b.

References

- ABS (Australian Bureau of Statistics) 2007. Life tables, states, territories and Australia, 2002–2004. Canberra: ABS. ABS cat. no. 3302.0.55.001. Viewed 13 July 2017, <<http://www.abs.gov.au/AUSSTATS/abs@.nsf/allprimarymainfeatures/DFF44A83CB0A4AD9CA25723500786B02?opendocument>>.
- ABS 2013a. Life tables, states, territories and Australia, 2010–2012. Canberra: ABS. ABS cat. no. 3302.0.55.001. Viewed 13 July 2017, <<http://www.abs.gov.au/AUSSTATS/abs@.nsf/allprimarymainfeatures/F117775CD6ED1D69CA257D87000C9EF0?opendocument>>.
- ABS 2013b. Life tables for Aboriginal and Torres Strait Islander Australians, 2010–2012. Canberra: ABS. ABS cat. no. 3302.0.55.003. Viewed 13 July 2017, <<http://www.abs.gov.au/ausstats/abs@.nsf/mf/3302.0.55.003>>.
- ABS 2016. Disability, ageing and carers, Australia: summary of findings 2015. ABS cat. no. 4430.0. Viewed 13 July 2017, <<http://www.abs.gov.au/ausstats/abs@.nsf/PrimaryMainFeatures/4430.0?OpenDocument>>.
- ABS 2017a. Life tables by Index of Relative Socioeconomic Disadvantage (IRSD), 2010–2012. Customised report. Canberra: ABS.
- ABS 2017b. Life tables by remoteness areas, 2010–2012. Customised report. Canberra: ABS.
- AIHW (Australian Institute of Health and Welfare) 2016a. Australian Burden of Disease Study: impact and causes of illness and death in Australia 2011. Australian Burden of Disease Study series no. 3. BOD 4. Canberra: AIHW.
- AIHW 2016b. Australian Burden of Disease Study: impact and causes of illness and death in Aboriginal and Torres Strait Islander people 2011. Australian Burden of Disease Study series no. 6. Cat. no. BOD 7. Canberra: AIHW.
- AIHW 2016c. Australian Burden of Disease 2011: methods and supplementary material. Australian Burden of Disease Study series no. 5. Cat. no. BOD 6. Canberra: AIHW.
- AIHW 2017. Life expectancy and disability in Australia: expected years living with and without disability. Cat. no. DIS 66. Canberra: AIHW.
- Jagger C, Van Oyen H & Robine J 2014. Health expectancy calculation by the Sullivan method: a practical guide (4th edition). Newcastle, United Kingdom: Institute for Ageing, Newcastle University. Viewed 27 February 2017, <http://www.eurohex.eu/pdf/Sullivan_guide_pre%20final_oct%202014.pdf>.

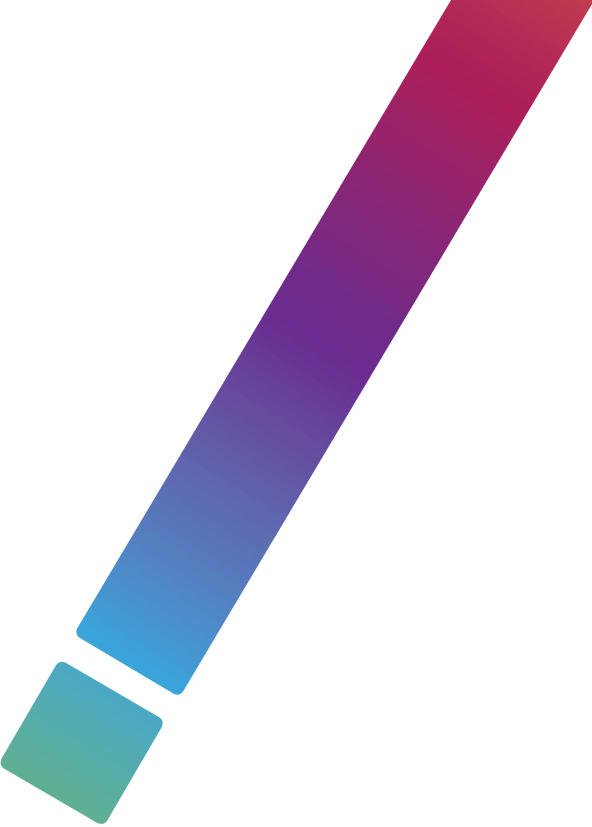
List of tables

| | |
|--|----|
| Table S1: Life expectancy and HALE at birth, males and females, by jurisdiction, remoteness area and socioeconomic group, 2011 | vi |
| Table B1: Life expectancy, HALE and percentage of life expected to be lived in full health, at birth and age 65, males and females, by jurisdiction, remoteness area and socioeconomic group, 2011 | 18 |
| Table B2: Life expectancy, HALE and percentage of life expectancy to be lived in full health, at selected ages, males and females, 2011 | 19 |
| Table B3: Change in life expectancy and HALE between 2003 and 2011, percentage of life expectancy in full health 2003 and 2011, at birth and age 65, males and females. | 20 |



List of figures

| | |
|---|----|
| Figure 1: Percentage of remaining life in full health and ill health at each age, males and females, 2011 | 3 |
| Figure 2: Life expectancy at birth in full health (HALE) and ill health, males and females, 2003 and 2011 | 4 |
| Figure 3: Life expectancy at age 65 in full health (HALE) and ill health, males and females, by state and territory, 2011 | 6 |
| Figure 4: Life expectancy at age 65 in full health (HALE) and ill health, males and females, by remoteness area, 2011 | 8 |
| Figure 5: Life expectancy at age 65 in full health (HALE) and ill health, males and females, by socioeconomic group, 2011 | 10 |



Health-adjusted life expectancy reflects the average length of time an individual can expect to live without disease or injury. This report shows that: health-adjusted life expectancy increased comparably to life expectancy; and that people in *Remote and very remote* areas and people in the lowest socioeconomic group expected both shorter lives and fewer years in full health compared with their counterparts in *Major cities* and the highest socioeconomic group.

aihw.gov.au



Stronger evidence,
better decisions,
improved health and welfare

