HealthStats NSW

# Health-adjusted life expectancy (HALE)

## Methods used in HealthStats NSW for deriving HALE from the Australian Burden of Disease Study 2015

### BACKGROUND

Information on the health impacts and distribution of different diseases and injuries is important for monitoring population health and in providing an evidence base to inform health policy and service planning. HealthStats NSW draws together a wide variety of data sources and measures to describe the determinants and outcomes of disease and injury and their distribution among population sub-groups. For monitoring population health, burden of disease analysis moves beyond singular epidemiological measures of mortality, incidence and prevalence.[1,2]

### WHAT EXTRA INFORMATION DOES BURDEN OF DISEASE ANALYSIS PROVIDE FOR MONITORING POPULATION HEALTH?

Burden of disease studies are a systematic, scientific effort to measure the comparative magnitude of health loss due to major disease, injuries and risk factors allowing comparison across location and time. Burden of disease analysis combines health data from many sources and evidence from epidemiological studies to create summary measures that incorporate both the prevalence of a given disease or risk factor and the relative harm it causes. These measures of loss of healthy life provide decision-makers with a common framework for comparison of diseases to inform health policy development, planning and evaluation.[1]

### WHAT ARE THE BURDEN OF DISEASE MEASURES?

The Australian Burden of Disease Study (ABDS) 2015 is the latest version of the ADBS series provided by the Australian Institute of Health and Welfare (AIHW). ABDS is based on methods developed for the "Global Burden of Disease" studies, but has evolved to produce estimates that more accurately reflect the Australian context.

Burden of disease analysis measures the combined impact on the population of living with illness and injury (non-fatal burden) and dying prematurely (fatal burden). More than merely counting deaths and disease prevalence, it takes into account age at death and disease severity. 'Disability-adjusted life years' (DALY) is the main summary measure of the health impact of disease on a population in a given year. It estimates the years of healthy life lost either through premature death (fatal burden measured as "years of life lost" (YLL)) or living with illness, injury or disability (non-fatal burden measured as "years of lived with disability" (YLD)). Thus, one DALY represents one lost year of healthy life. The non-fatal burden measure of illness and injury (YLD) is used as inputs for computing health-adjusted life expectancy (HALE).

### LIFE EXPECTANCY AND HALE

Life expectancy at birth is the average number of years that a newborn is expected to live if current mortality rates in the population continue to apply.[3] Life expectancy can be calculated for people at any age but is usually reported as life expectancy at birth. HALE reflects the average length of time a person can expect to live in full health. This is, the average number of years that a person can expect to live in "full health" by taking into account years lived in less than full health due to disease and/or injury. It captures both fatal and non-fatal health outcomes in a summary measure of average levels of population health.[3]

HALE is comparable across populations and over time. Age-specific health and mortality experiences are applied to a hypothetical population to overcome differences in age composition of the populations being compared.

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. If this proportion increases over time there is a compression of morbidity (that is, an increase in life expectancy with relatively fewer year spent in ill health) whereas a decrease in the proportion indicates an expansion of morbidity (that is, a greater portion of life expectancy spent in poor health).

## MEASURING DISEASE PREVALENCE

In order to measure HALE we need to measure both how many people a disease affects and the overall severity of that disease experienced by people who have it. We combine these to create a measure of disease prevalence (i.e. people living with a disease) weighted by the severity of disease. This measure is available from the Australian Burden of Disease Study (ABDS) 2015 in the form of years lived with disability (YLD).[2,5]

## A STANDARD LIFE TABLE

A standard life table displays the life expectancy for a population at each age or age-group. A life table presents a set of tabulations that describe the probability of dying, the death rate and the number of survivors for each age or age group. Accordingly, life expectancy at birth is an output of a life table.[3] Once we have data from a standard life table and for the severity weighted disease prevalence, HALE may be computed.[4]

## SULLIVAN'S METHOD FOR COMPUTING HALE

Using Sullivan's method,[6,7] HALE is derived by computing the total years lived without disability using a measure of the years lived at each age group (obtained from relevant ABS life tables) and a measure of the years lived with disability (obtained from the latest ABDS).

## EXAMPLE OF HOW TO CALCULATE HALE

Table 1 provides an example of how to calculate HALE. In this example, HALE for males at birth in NSW between 2010 and 2012 was 71.1 years, compared to a standard life expectancy of 79.9 years. This indicates that, at birth, the average male can expect to spend the equivalent of 8.8 years of their expected life with a reduced quality of life due to disability, illness or injury. In other words, 11 per cent of their life expectancy will be spent with reduced quality of life.

| ABRIDGED LIFE TABLE | | | | | DERIVING HALE | | | |
|---|---|---|---|---|---|---|---|---|
| Age group | Survivors | Years lived | Total years lived from age x | Life expectancy | Years lived with disability per person year | Years without disability | Total years without disability from age x | Health-adjusted life expectancy |
| x | $l_x$ | $L_x$ | $\sum L_x$ | $LE_x$ | $YLD_x$ | $YWD_x = (1\text{-}YLD_x)*L_x$ | $\sum YWD_x$ | $HALE_x = (\sum YWD_x) / l_x$ |
| 0 | 100000 | 99630 | 7994387 | 79.9 | 0.026 | 97074 | 7106896 | 71.1 |
| 1-4 | 99585 | 398142 | 7894757 | 79.3 | 0.020 | 390378 | 7009822 | 70.4 |
| 5-9 | 99520 | 497490 | 7496615 | 75.3 | 0.033 | 481015 | 6619444 | 66.5 |
| 10-14 | 99475 | 497254 | 6999125 | 70.4 | 0.043 | 475714 | 6138429 | 61.7 |
| 15-19 | 99421 | 496691 | 6501871 | 65.4 | 0.061 | 466402 | 5662715 | 57.0 |
| 20-24 | 99218 | 495393 | 6005180 | 60.5 | 0.061 | 465103 | 5196314 | 52.4 |
| 25-29 | 98941 | 493929 | 5509787 | 55.7 | 0.076 | 456605 | 4731211 | 47.8 |
| 30-34 | 98620 | 492138 | 5015858 | 50.9 | 0.083 | 451355 | 4274605 | 43.3 |
| 35-39 | 98220 | 489873 | 4523720 | 46.1 | 0.093 | 444270 | 3823251 | 38.9 |
| 40-44 | 97703 | 486803 | 4033847 | 41.3 | 0.096 | 439933 | 3378981 | 34.6 |
| 45-49 | 96970 | 482271 | 3547044 | 36.6 | 0.095 | 436503 | 2939048 | 30.3 |
| 50-54 | 95858 | 475328 | 3064773 | 32.0 | 0.108 | 423756 | 2502545 | 26.1 |
| 55-59 | 94155 | 464843 | 2589445 | 27.5 | 0.113 | 412288 | 2078789 | 22.1 |
| 60-64 | 91615 | 449245 | 2124602 | 23.2 | 0.138 | 387188 | 1666501 | 18.2 |
| 65-69 | 87829 | 425921 | 1675357 | 19.1 | 0.164 | 356243 | 1279313 | 14.6 |
| 70-74 | 82154 | 390810 | 1249436 | 15.2 | 0.192 | 315589 | 923070 | 11.2 |
| 75-79 | 73587 | 337973 | 858626 | 11.7 | 0.229 | 260565 | 607481 | 8.3 |
| 80-84 | 60761 | 260818 | 520653 | 8.6 | 0.288 | 185600 | 346916 | 5.7 |
| 85-89 | 42785 | 163140 | 259835 | 6.1 | 0.348 | 106347 | 161316 | 3.8 |
| 90-94 | 22652 | 72860 | 96695 | 4.3 | 0.414 | 42714 | 54969 | 2.4 |
| 95-99 | 7930 | 20464 | 23835 | 3.0 | 0.496 | 10304 | 12255 | 1.5 |
| 100+ | 1514 | 3371 | 3371 | 2.2 | 0.421 | 1951 | 1951 | 1.3 |

Table 1. Example of calculating HALE for all diseases using an abridged life table for males in NSW, 2010–2012 and 2011 ABDS

## HOW THE COLUMNS OF THE LIFE TABLE ARE COMPUTED AND ANY UNDERLYING ASSUMPTIONS

$l_x$ Number of survivors at age x (x represents the lower end of the age interval for the age groups). This column is taken directly from the ABS life table data.

$L_x$ Number of years lived at age x. This is the sum of the $L_x$ column from the ABS life tables for the age interval being considered.

$\sum L_x$ Total years lived from age x. This is the sum of $L_x$ (derived as explained above) from age x to the last age category being considered (100+ for our example).

$LE_x$ Life expectancy at age x. This is the total years lived from age x, $\sum L_x$, divided by the number of survivors at age x, $l_x$.

$YLD_x$ Years lived with disability at age x per person year. This is the rate of disability experienced by the population at age x per person year. A rate of 1 would indicate that every person at age x experienced the most severe disability possible (this represents very low quality of life).

$YWD_x$ Years lived without disability at age x. This is derived using the rate explained above to calculate the rate of years lived without disability at age x per person year as ($1-YLD_x$) multiplied by the number of years lived at age x, $L_x$).

$\sum YWD_x$ Total years lived without disability from age x. This is the sum of $YWD_x$ from age x to the last age category being considered (100+ for our example).

$HALE_x$ Health-adjusted life expectancy at age x. This is the total years lived without disability from age x, $\sum YWD_x$, divided by the number of survivors at age x, $l_x$.

## DERIVING HALE FOR DIFFERENT DISEASE GROUPS

The ABDS 2015 provided YLD rates for 2015 and 2011 as a rate per 1,000 persons for specific diseases within the disease groups being considered in the study. To obtain the YLD rates for each disease group, we simply sum the rates for each sex and age group for all diseases within each disease group. We then compute disease group specific $YLD_x$, $YWD_x$, $\sum YWD_x$ and $HALE_x$ as described above.

The number of years of healthy life lost to disability is the difference between average life expectancy and health-adjusted life expectancy (Figure 1). Note that when comparing different diseases, some diseases with higher case-fatality rates may appear to have a lower burden in terms of HALE compared to other chronic diseases. For example, cancer appears to have a lower burden than cardiovascular diseases (Figure 1). People in the population as a whole may expect to live longer with disability associated with cardiovascular disease compared with disability associated with cancer, as cancer is more likely to be fatal in the short term (Figure 2). Burden due to death is summarised by years of life lost (YLL) and is higher for cancer than for cardiovascular disease, whereas HALE adjusts life expectancy for lower quality of life due to disease and disability (YLD) which is higher for cardiovascular disease than for cancer.

The burden in terms of HALE in the population is quite small for a number of diseases. A rare disease that is significantly disabling (i.e. having a high YLD) will have a low impact in terms of the total (reduced) HALE across the whole population.

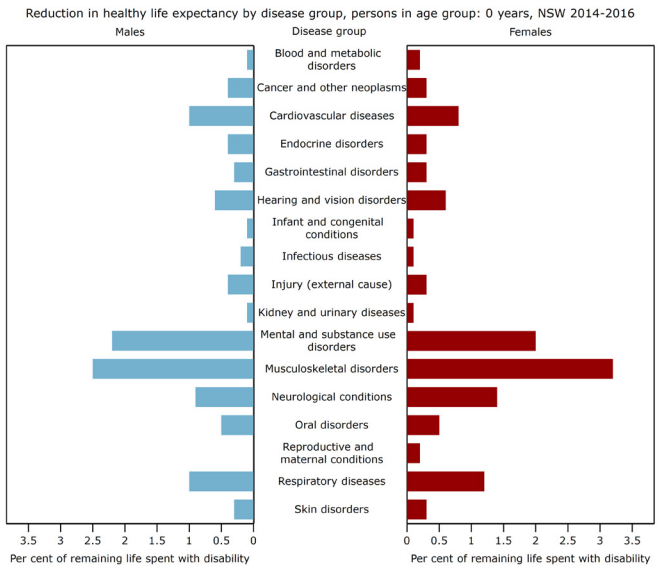


Figure 1. Reduction in healthy life expectancy by disease group for persons at birth, NSW 2014–2016

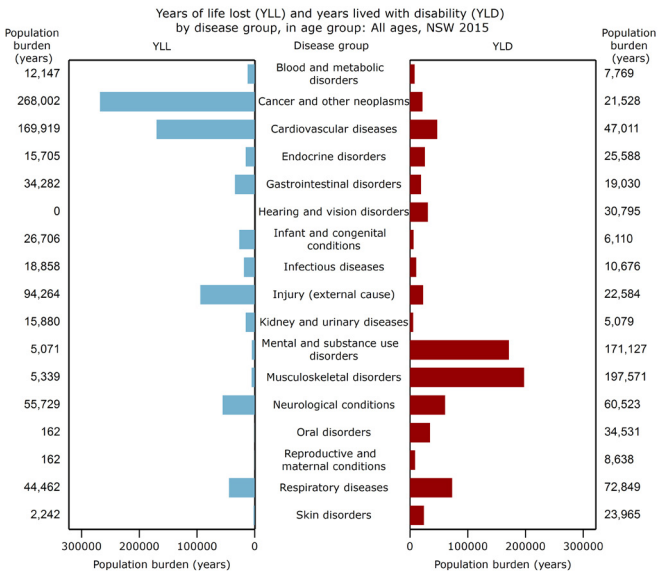


Figure 2. Comparison of YLL and YLD by disease group for persons in all ages, NSW 2015

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