

# Disability-Adjusted Life Years (DALYs): A Primer

## What is a DALY?

The Disability-Adjusted Life Year (DALY) is a measure, or *metric*, that quantifies the burden of a negative event on society (i.e., natural disasters, injuries, illnesses). In essence, one DALY is one year of healthy life lost as a result of death or disability.

The DALY was originally developed at Harvard University in 1990 for the World Bank. The World Health Organization (WHO) adopted this new metric in its *Global Burden of Disease* reports in order to quantify and compare the societal burden of different diseases. DALYs are best presented as population rates in order to support these comparisons.

## Why use DALYs?

The DALY can be used to quantify the human impact of injury deaths and disability, and to make comparisons with other causes or across populations.

## How do DALYs work?

The DALY is calculated as the sum of years of life lost (YLLs) and years lived with disability (YLDs):

$$\text{DALY} = \text{YLL} + \text{YLD}$$

Unlike the calculation for Potential Years Life Lost, where the same average life expectancy is applied to each case (e.g., 85 years of age), the YLL assumes that everyone who has died has also lost years of life, even if they have exceeded the average life expectancy.

YLL is the number of deaths (N) multiplied by the standard life expectancy at age of death (L):

$$\text{YLL} = \text{N} \times \text{L}$$

YLD is the number of incident cases (I) multiplied by the disability weight (DW) multiplied by the average disability duration of the case (AD):

$$\text{YLD} = \text{I} \times \text{DW} \times \text{AD}$$

## Using DALYs

Used to quantify the human impact of injury deaths and disability

Emphasizes death and disability of younger age groups

Stronger emphasis on more severe injuries and deaths

Should not be used to compare causes of injury that are age-specific

Deaths and hospitalizations are most often used as a measures of incident cases for injury.

WHO's DALY calculator is a convenient tool that takes mortalities and hospitalizations per age group as its inputs, and outputs the total DALYs. DALY rates can then be obtained by dividing the DALYs per age group by the population of that age group.

The methodology for calculating DALYs has changed over time. To account for this, the WHO includes multiple forms of the DALY in its *Global Burden of Disease* reports.

Some of these variations include:

- **Different disability weights**—weights are constructed using qualitative surveys to gauge opinions of disability severity for people living with specific conditions.
- **Prevalence instead of incidence**—all current cases versus all new cases.
- **Time discounting**—DALYs in the future are considered to be worth less than DALYs in the present due to anticipated technological and medical advances.
- **Age weighting**—DALYs that occur during the younger years (e.g., ages 10-55 years, when an individual is a more active member of society in terms of contributions, employment, etc.) carry additional weighting because of the higher potential loss of productivity.

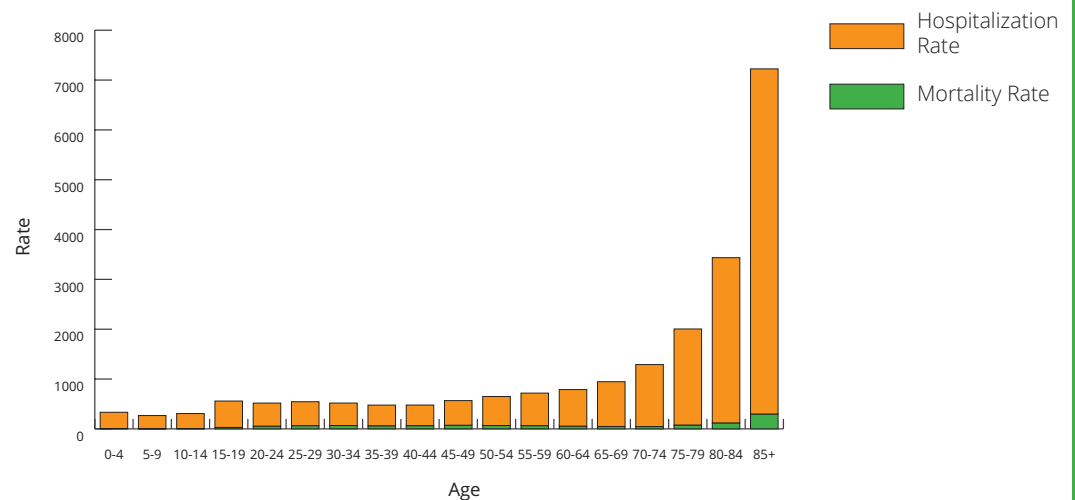
## How can we apply DALYs?

In injury prevention, DALYs are used to identify the human impact of injury-related deaths and disabilities, used to determine effectiveness of programs and interventions, as well as resource allocation.

## Example: Injury Mortality and Hospitalization in British Columbia

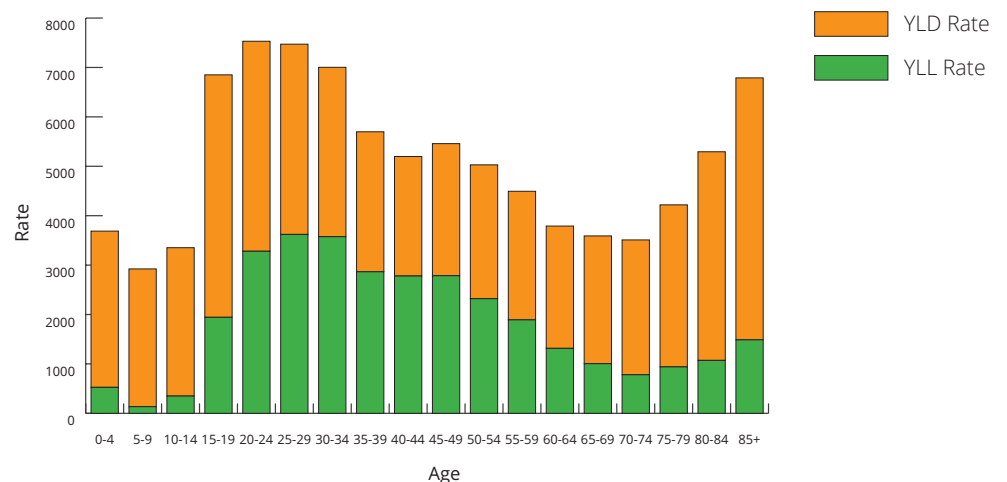
Looking at unintentional injury mortality and hospitalization rates for British Columbia in 2016 (Figure 1), the burden of injury appears to be low among the younger age groups and increases exponentially after 65 years of age. Here, the burden due to hospitalization by far outweighs the burden due to death.

**Figure 1: Unintentional injury mortality and hospitalization rates per 100,000 population, BC, 2016**



An entirely different picture is seen, however, when DALYs are used to describe the burden of unintentional injury (Figure 2). Overall, the Years of Life Lost (YLL) (mortality) account for 43% of the DALY rate, and is much higher among the middle age groups than among the younger and the older age groups. Among the younger ages groups, this reflects the very low mortality rate, whereas among the older age groups, this reflects the fewer years of life left to lose.

**Figure 2: DALYs (YLL + YLD) per 100,000 population for all unintentional injury causes, BC, 2016**



Compared with the mortality rate, which only considers the total number of cases, the DALY quantifies the total number of years of life lost as a result of these deaths. The DALY also puts more emphasis on both the deaths and the disability occurring among younger age groups, as those who are younger have more years of healthy life to lose. This is particularly important to note when comparing causes that affect different age ranges. DALYs should not be used to compare causes of injury that are age-specific; for example, falls among older adults with self-harm among youth.

### REFERENCES

- Bhalla, K., Harrison, J.E. (2016). Burden Calculator: a simple and open analytical tool for estimating the population burden of injuries. *Injury Prevention*, 22, 23-26.
- Murray, C.J., Ezzati, M., Flaxman, A.D., Lim, S., Lozano, R., Michaud, C., Naghavi, M., Salomon, J.A., Shibuya, K., Vos, T., Wikler, D., Lopez, A.D. (2012). GBP 2010: design, definitions, and metrics. *Lancet*, 380(9859), 2063-2066.
- Murray, C.J.L., Lopez A.D. (1996). Global Burden of Disease and Injury Series. Harvard School of Public Health on Behalf of the World Health Organization and the World Bank. Cambridge, MA: Harvard School of Public Health.
- WHO. National Tools. 2019. [ONLINE] Available at: [https://www.who.int/healthinfo/global\\_burden\\_disease/tools\\_national/en/](https://www.who.int/healthinfo/global_burden_disease/tools_national/en/) [Accessed June 2019].