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# Disability-Adjusted Life Years: An Indicator to Measure Burden of Disease in Québec

**SYNTHESIS**

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This summary is based on the methodological report published under the same title. It covers all the content of the original report in a concise form. Interested readers may refer to the full report for more information relating to the indicator, methodology used, and complete results.

This synthesis is also available in French under the title *Les années de vie corrigées de l'incapacité : un indicateur pour évaluer le fardeau de la maladie au Québec – Synthèse*.

*This document is available in its entirety in electronic format (PDF) on the Institut national de santé publique du Québec Web site at: <http://www.inspq.qc.ca>.*

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# Introduction

In the early 1990s, the World Bank and World Health Organization (WHO) launched the Global Burden of Disease Study. The purpose of this study was to objectively assess global health status using available disease and injury–related disability and mortality data (Murray and Lopez, 1996). An indicator called **disability-adjusted life years** was created to compare estimates for individual diseases and rank their impact on the health status of the population studied.

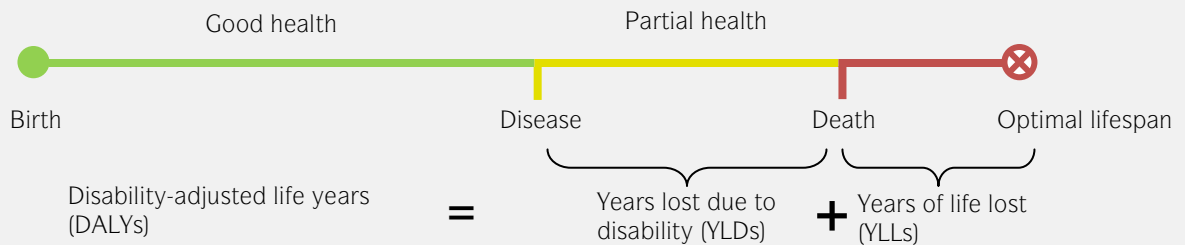
Since then, many countries have adopted this indicator to produce estimates for their specific territory. Québec now joins this list with the publication of a methodological report, which has **two objectives**: to introduce the disability-adjusted life years indicator and to adapt the methodology to produce Québec estimates for the 2002–2006 period.

## Definition of key concepts

The **disability-adjusted life year** is a burden of disease measure that quantifies premature death from various causes and the gap between current functional health status and a hypothetical ideal (Lopez et al., 2006). The twin dimensions of mortality and functional health are expressed in years of life lost and years lost due to disability (Figure 1).

**Years of life lost** represent years of life lost through “premature” death. Premature death is measured in deaths that occur before a certain optimal lifespan that has been pre-established for each age group.

**Years lost due to disability** represent years of healthy life lost because of time spent in a state of functional health that is less than optimal because of a particular disease.



**Figure 1** Classic illustration of the concepts of years lost due to disability, years of life lost, and disability-adjusted life years

Source: Jenkins, 2001.

## Methodology

**We selected ten health problems** because of their importance in terms of mortality or their general impact on health status: malignant neoplasms, hypertensive disease, ischaemic heart disease, cerebrovascular disease, chronic obstructive pulmonary disease, asthma, diabetes, osteoarthritis, and mental and behavioural disorders.<sup>1</sup> The total of all health problems is also presented in order to better describe the specific impact of each problem.

**DALYs** are the sum of years of life lost through death (YLLs) and years lost due to disability (YLDs), which quantify mortality and functional health components, respectively.

**YLLs** are based on the age of death and estimated optimal life expectancy at a given age. For example, the death of a 15 year-old would be counted as 62 years of life lost. For **YLDs**, various data are needed on each health problem, which for Québec are generally not available. YLDs are therefore estimated using 2004 data (WHO, 2011) for one of the WHO health regions (AMR-A) created for the burden of disease study.<sup>2</sup>

**Data** for these calculations are provided by the Ministère de la Santé et des Services sociaux and the WHO.

This methodology has various **limitations**, which may affect how precisely health burdens and their components are measured.

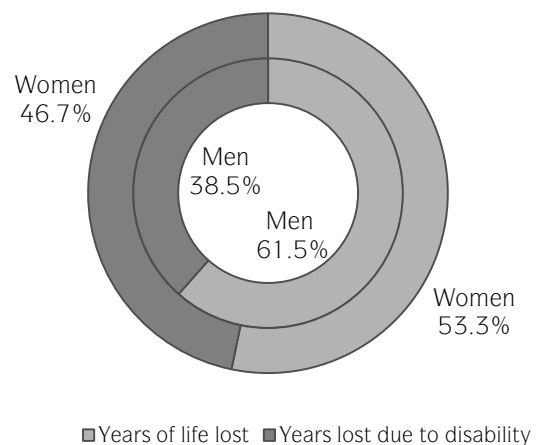
## Results

### Mortality: a significant part of the burden of disease in Québec

In Québec, in the 2002 to 2006 period, the burden of all diseases was estimated to be 1,486,563 DALYs per year, which works out to 197 DALYs per 1,000 people.

**Most of this burden is accounted for by mortality: 57% of DALYs are from YLLs.**

The burden of disease appears to be slightly greater for women than for men: 201 DALYs are lost per 1,000 women versus 194 DALYs per 1,000 men. Among men, mortality (62%) accounts for a greater share of the burden than functional health (39%) (Figure 2). Among women, the distribution is more balanced, with mortality accounting for 53% and functional health 47%.



**Figure 2** Distribution of years of life lost and years lost due to disability by sex, Québec, 2002 to 2006

Last of all, we note that **the impact of all health problems on functional health and mortality increases with age** and that this trend is more pronounced with respect to mortality after age 30. At age 45, mortality begins to have a greater impact than that of functional health.

<sup>1</sup> Diseases were defined according to *International Statistical Classification of Diseases and Related Health Problems, 10<sup>th</sup> ed., (ICD-10)* (WHO, 1993).

<sup>2</sup> Our way of estimating YLDs was been used in other scientific studies, such as McKenna et al. (2005), Kominski et al. (2002), and Schopper et al. (2000), but has never to our knowledge been used in Canada.

## A major burden distributed across a few disease categories

### The ten health problems we studied represent 59% of the disease burden and 66% of the mortality burden in Québec.

Malignant neoplasms, mental and behavioural disorders, and ischaemic heart diseases account for the most DALYs (Table 1). At the opposite end, hypertensive disease and asthma account for the fewest. While much of the burden of suicide, ischaemic heart disease, malignant neoplasms, hypertensive disease, and cerebrovascular disease is expressed in terms of mortality, a reduction in mortality would probably have no effect on diseases such as osteoarthritis, asthma, and mental and behavioural disorders, since more than 90% of the burden of these conditions is expressed in YLDs.

When we compare disease burden by sex, we note differences of magnitude for three of the problems we considered: ischaemic heart disease, suicide and mental and behavioural disorders. Ischaemic heart disease and suicide seem to constitute a heavier burden for men, while mental and behavioural disorders seem to affect women to a greater extent.

The health problems with the greatest impact on the functional health of men and women alike are mental and behavioural disorders (1<sup>st</sup> place), osteoarthritis (2<sup>nd</sup> place), and tumours (3<sup>rd</sup> place). For YLLs, malignant neoplasms and ischaemic heart disease are in first and second place, respectively, while third place is occupied by cerebrovascular disease among women and suicide among men.

## Mental health among young adults is a cause for concern

Examination of YLLs by cause for certain age groups reveals that **suicide is responsible for significant life year losses among 15- to 29-year-olds**: 9 YLLs per 1,000 individuals in this age group are attributable to suicide, as opposed to 6 YLLs per 1,000 in the rest of the population. In Québec, suicide constitutes a significant cause of premature mortality both for men and women, as do malignant neoplasms among women.

Mental and behavioural disorders affect YLDs for all age groups, but are mainly a factor for 15- to 29-year-olds, who show a related disability burden of 56 YLDs per 1,000 individuals. **Mental and behavioural disorders represent 90% of YLDs among 15- to 29-year-olds.**

**Table 1** Distribution of years of life lost, years lost due to disability, and disability-adjusted life years for each health problem, both sexes combined, Québec, 2002 to 2006

Health condition	YLLs (%)	YLDs (%)	DALYs (number)
Malignant neoplasms	89.4	10.6	338,722
Mental and behavioural disorders	9.8	90.2	177,143
Ischaemic heart disease	92.6	7.4	114,344
Chronic obstructive pulmonary disease	52.5	47.5	56,170
Suicide	95.0	5.0	49,954
Cerebrovascular disease	73.2	26.8	43,398
Osteoarthritis	0.5	99.5	41,987
Diabetes	52.5	47.5	41,557
Asthma	5.9	94.1	13,821
Hypertensive disease	78.5	21.5	4,249
Other health conditions	48.0	52.0	605,217
<b>All causes</b>	<b>57.3</b>	<b>42.7</b>	<b>1,486,563</b>

## Conclusion

DALYs represent an alternative way of drawing up an overall picture of a population's health status using the information available. They can be used to evaluate the burden of a broad range of health problems, risk factors, and certain socioeconomic characteristics in the population. They can also be broken down in a variety of useful ways (e.g., by health problem, sex, age, and mortality/functional health component).

Disability-adjusted life years aid public health decision-making by demonstrating that the burden of certain diseases is expressed primarily in functional health, while for others it is concentrated in mortality. For a variety of reasons however, it is critical that this disease burden metric be placed in context by providing additional information on the scale of the problems under consideration and the effectiveness, risks, and costs associated with interventions, as well as ethical and policy-based considerations.

For more on this study, refer to the publication: Martel S. and C. Steensma (2012). Disability-Adjusted Life Years: An Indicator to Measure Burden of Disease in Québec, Institut national de santé publique du Québec, 70 p.

## References

- JENKINS, E. (2001). *Évaluation objective de l'importance relative des maladies, des blessures et de leurs déterminants*, Population and Public Health Branch, Health Canada (PowerPoint presentation).
- KOMINSKI, G.F. et al. (2002). "Assessing the burden of disease and injury in Los Angeles County using disability-adjusted life years," *Public Health Reports*, March–April 2002, Vol. 117, pp. 185–191.
- LOPEZ A.D et al. (2006). *Global Burden of Disease and Risk Factors*, New York: Oxford University Press and the World Bank, 475 pp.
- MCKENNA, M.T. et al. (2005). "Assessing the burden of disease in the United States using disability-adjusted life years," *American Journal of Preventive Medicine*, Vol. 28, No. 5, pp. 415–423.
- MURRAY, C.J.L. AND A.D. LOPEZ (1996). *The Global Burden of Disease: A Comprehensive Assessment of Mortality and Disability from Diseases, Injuries, and Risk Factors in 1990 and Projected to 2020*, Global Burden of Disease and Injury Series, Volume I, World Health Organization, 1,022 pp.
- WORLD HEALTH ORGANIZATION (2011) [online]. "Disease and injury regional estimates," [http://www.who.int/healthinfo/global\\_burden\\_disease/estimates\\_regional/en/index.html](http://www.who.int/healthinfo/global_burden_disease/estimates_regional/en/index.html) (Page consulted April 2011).
- WORLD HEALTH ORGANIZATION (1993). *International Statistical Classification of Diseases and Related Health Problems, 10<sup>th</sup> ed.*, Vol. 1, Geneva, 1,335 pp.
- SCHOPPER, D. et al. (2000). "Estimating the burden of disease in one Swiss canton: what do disability adjusted life years (DALY) tell us?" *International Journal of Epidemiology* 29, pp. 871–877.

# Quick Indicator Reference

## YEARS OF LIFE LOST

**Acronyms:** YLL (English) or AVP (*années de vie perdues* - French)

**Formula:** Death \* optimal life expectancy at average age of death

**Interpretation:** Years of life lost due to premature death

**Component:** Mortality

**Source:** Québec data

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## YEARS LOST DUE TO DISABILITY

**Acronyms:** YLD (English) or AVI (*années vécues avec de l'incapacité* - French)

**Formulas:**

- If the  $(YLD/YLL)_{AMR-A}$  ratio < 10:

$$YLD_{\text{Québec}} = (YLD/YLL)_{AMR-A} * YLL_{\text{Québec}}$$

- If the  $(YLD/YLL)_{AMR-A}$  ratio  $\geq 10$  or  $YLL_{AMR-A} = 0$ :

$$YLD_{\text{Québec}} = YLD \text{ rate}_{AMR-A} * \text{Population}_{\text{Québec}}$$

**Interpretation:** Years of healthy life lost due to time spent in a state of sub-optimal functional health

**Component:** Functional health

**Source:** WHO AMR-A sub-region data and Québec data

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## DISABILITY-ADJUSTED LIFE YEARS

**Acronyms:** DALY (English) or AVCI (*années de vie corrigées de l'incapacité* - French)

**Formula:** YLL + YLD

**Interpretation:** Number of years of healthy life lost due to premature death or time spent in a state of sub-optimal functional health

**Components:** Functional health and mortality



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