

1. The GBD's approach to measuring health status

1.1 Why the GBD is different

In general, statistics on the health status of populations suffer from several limitations that reduce their practical value to policy-makers:

- First, they are partial and fragmented. In many countries even the most basic data—the number of deaths from particular causes each year—are not available. Even where mortality data are available, they fail to capture the impact of non-fatal outcomes of disease and injury, such as dementia or blindness, on population health.
- Second, estimates of the numbers killed or affected by particular conditions or diseases may be exaggerated beyond their demographically plausible limits by well-intentioned epidemiologists who also find themselves acting as advocates for the affected populations in competition for scarce resources. If the currently available epidemiological estimates for all conditions were right, some people in a given age group or region would have to die twice over to account for all the deaths that are claimed.
- Third, traditional health statistics do not allow policy-makers to compare the relative cost-effectiveness of different interventions, such as, for example, the treatment of ischaemic heart disease versus long-term care for schizophrenia. At a time when people's expectations of health services are growing and funds are tightly constrained, such information is essential to aid the rational allocation of resources.

The GBD set out to address these problems with three explicit aims:

1. to incorporate non-fatal conditions into assessments of health status;
2. to disentangle epidemiology from advocacy in order to produce objective, independent and demographically plausible assessments of the burdens of particular conditions and diseases; and
3. to measure disease and injury burden in a currency that can also be used to assess the cost-effectiveness of interventions, in terms of the cost per unit of disease burden averted.

1.2 A single measure of disease burden

In order to capture the impact of both premature death and disability in a single measure, a common currency is required. Since the late 1940s, researchers have generally agreed that time is an appropriate currency: time (in years) lost through premature death, and time (in years) lived with a disability. A range of such time-based measures has been developed in

different countries, many of them variants of the so-called Quality-Adjusted Life Year or QALY. For the GBD, an internationally standardized form of the QALY has been developed, called the Disability-Adjusted Life Year (DALY). The DALY expresses years of life lost to premature death and years lived with a disability of specified severity and duration. One DALY is thus one lost year of healthy life. Here, a “premature” death is defined as one that occurs before the age to which the dying person could have expected to survive if they were a member of a standardized model population with a life expectancy at birth equal to that of the world’s longest-surviving population, Japan.

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To calculate total DALYs for a given condition in a population, years of life lost (YLLs) and years lived with disability of known severity and duration (YLDs) for that condition must each be estimated, and then the total summed. For example, to calculate DALYs incurred through road traffic accidents in India in 1990, add the total years of life lost in fatal road accidents and the total years of life lived with disabilities by survivors of such accidents.

1.3 A society’s values are explicitly built into its measures of health status

It might appear that quantifying disease burden is a neutral exercise, entirely free of value choices. However, this is far from the case. Disease burden is, in effect, the gap between a population’s actual health status and some “ideal”, or reference status. In order to measure burden, a society has to decide what the ideal or reference status should be. This involves making five value choices:

- How long “should” people live? If health researchers are to estimate how many years of life are lost through death at any given age, they must decide on the number of years for which a person at that age should expect to survive in the ideal, or reference, population. That could be, for example, 60, 80 or 90 years from birth.
- Are years of healthy life worth more in young adulthood than in early or late life?
- Is a year of healthy life now worth more to society than a year of healthy life in 30 years’ time?
- Are all people equal? For example, should one socioeconomic group’s years of healthy life count for more than another’s?
- How do you compare years of life lost due to premature death and years of life lived with disabilities of differing severities?

Health researchers developing a measure of disease burden must recognize their responsibility to reflect societies' preferred answers to these five questions, but also to guard against and "filter out" unjustifiable preferences such as racism, sexism or economic discrimination that may be institutionalized in certain societies. It is unlikely that any measure can reflect a perfect vision of the ideal society; but its choices should be acceptable to as many people of as many different cultures as possible.

The Egalitarian Principles on which the DALY Is Based

The GBD has sought to develop a measure based on explicit and transparent value choices that may be readily debated and modified. Overall, the DALY has a strongly egalitarian flavour. It is built on the principle that only two characteristics of individuals that are not directly related to their health—their age and their sex—should be taken into consideration when calculating the burden of a given health outcome in that individual. Other characteristics, such as socioeconomic status, race or level of education, are not considered, so, for example, years of healthy life lived by the director of a bank are regarded as no more valuable than those lived by a poor rural peasant. In the remainder of this section, the social choices that affect the DALY are each discussed briefly.

How Long Should People Live?

In accordance with the GBD's egalitarian principles, the study assumes a standard life table for all populations, with life expectancies at birth fixed at 82.5 years for women and 80 years for men. A standard life expectancy allows deaths in all communities at the same age to contribute equally to the burden of disease. Alternatives, such as using different life expectancies for different populations that more closely match their actual life expectancies, interfere with the egalitarian principle. For example, if a 35 year-old woman dies in childbirth in an African country where she might have expected to live another 30 years, her years of life lost would be deemed unfairly to be fewer than those for a 35 year-old woman who dies in childbirth in Japan, when she might otherwise have expected to live another 48 years.

Life expectancy is not equal for men and women. Accordingly, the GBD has given men a lower reference life expectancy than women. However, since much of the difference between men and women is determined by men's higher exposure to various risks such as alcohol, tobacco and occupational injury, rather than purely biological differences, this choice is arguably a form of discrimination against men and could be modified in future revisions of the DALY.

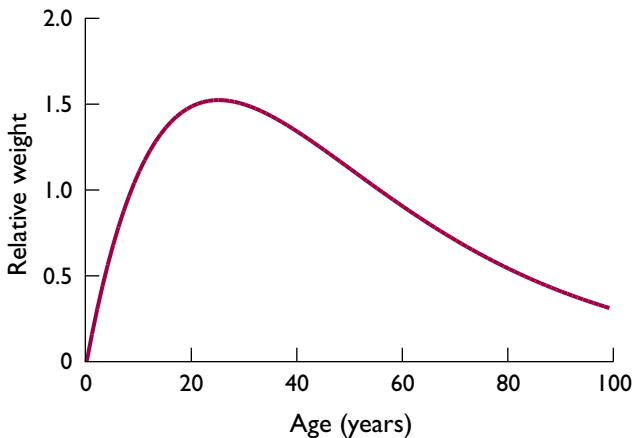
DALYs are intended to be a transparent tool to enhance dialogue on the major health challenges facing humanity.

Are Years of Healthy Life Worth More in Young Adulthood than in Early or Late Life?

If individuals are forced to choose between saving a year of life for a 2 year-old and saving it for a 22 year-old, most prefer to save the 22 year-old. A range of studies confirms this broad social preference to “weight” the value of a year lived by a young adult more heavily than one lived by a very young child or an older adult. Adults are widely perceived to play a critical role in the family, community and society. The GBD researchers therefore incorporated age-weighting into the DALY. They assume that the relative value of a year of life rises rapidly from zero at birth to a peak in the early twenties, after which it steadily declines.

Figure 5 The relative value of a year of life lived at different ages, as incorporated into DALYs

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Is a Year of Healthy Life Now Worth More to Society than a Year of Healthy Life in 30 Years' Time?

If a person is offered \$100 today or \$100 in a year's time, that person is likely to prefer \$100 today. Future dollars are thus discounted—valued lower—against current dollars. Whether a year of healthy life, like a dollar, is also deemed to be preferable now rather than later, is a matter of intense debate among economists, medical ethicists and public health planners, because discounting future health affects both measurements of disease burden and estimates of the cost-effectiveness of an intervention.

There are arguments for and against discounting and *The Global Burden of Disease* discusses them in depth. The GBD researchers decided, however, to discount future life years by 3 per cent per year. This means

that a year of healthy life bought for 10 years hence is worth around 24 per cent less than one bought for now, as discounting is represented as an exponential decay function. Because the impact of discounting is significant, the GBD publishes alternative results based on DALYs without discounting.

Discounting future health reduces the relative impact of a child death compared with an adult death. For example, with age-weighting also incorporated, a year-old girl's death causes a loss of 34 years of life while a 25 year-old woman's death results in a loss of 33 years of life. Discounting also reduces the value of interventions that pay off largely in the future—such as vaccinating against hepatitis B, which may prevent thousands of cases of liver cancer, but some decades later.

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How Do You Compare Time Lost Due to Premature Death with Time Lived with Disability?

While death is not difficult to define, disability is. All non-fatal health outcomes of disease are different from each other in their causes, nature, and their impact on the individual, and the impact on the individual is in turn mediated by the way the surrounding community responds. Yet, in order to quantify time lived with a non-fatal health outcome and assess disabilities in a way that will help to inform health policy, disability must be defined, measured and valued in a clear framework that inevitably involves simplifying reality.

There is surprisingly wide agreement between cultures on what constitutes a severe or a mild disability. For example, a year lived with blindness appears to most people to be a more severe disability than a year lived with watery diarrhoea, while quadriplegia is regarded as more severe than blindness. These judgements must be made formal and explicit if they are to be incorporated into measurements of disease burden.

Two methods are commonly used to formalize social preferences for different states of health. Both involve asking people to make judgements about the trade-off between quantity and quality of life. This can be expressed as a trade-off in time (how many years lived with a given disability would you trade for a fixed period of perfect health?) or a trade-off between persons (would you prefer to save one life-year for 1000 perfectly healthy individuals as opposed to saving one life-year for 2000 individuals in a worse health state?). While such trade-offs may affront our perceptions about what is morally acceptable, they are practised implicitly throughout the world's health care systems. The philosophy of

Table 1 Gauging the severity of disability: disability classes and weights set by the GBD protocol for 22 indicator conditions

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| Disability class | Severity weights | Indicator conditions |
|------------------|------------------|--|
| 1 | 0.00–0.02 | Vitiligo on face, weight-for-height less than 2 standard deviations |
| 2 | 0.02–0.12 | Watery diarrhoea, severe sore throat, severe anaemia |
| 3 | 0.12–0.24 | Radius fracture in a stiff cast, infertility, erectile dysfunction, rheumatoid arthritis, angina |
| 4 | 0.24–0.36 | Below-the-knee amputation, deafness |
| 5 | 0.36–0.50 | Rectovaginal fistula, mild mental retardation, Down syndrome |
| 6 | 0.50–0.70 | Unipolar major depression, blindness, paraplegia |
| 7 | 0.70–1.00 | Active psychosis, dementia, severe migraine, quadriplegia |

Note: These weights were established using the person trade-off method with an international group of health workers who met at WHO in Geneva in August 1995. Each condition is actually a detailed case. For example, angina in this exercise is defined as reproducible chest pain, when walking 50 meters or more, that the individual would rate as a 5 on a subjective pain scale from 0 to 10.

the GBD is that the more explicitly these preferences are set out, the more meaningfully they may be debated.

The GBD therefore developed a protocol based on the person trade-off method. In a formal exercise involving health workers from all regions of the world, the severity of a set of 22 indicator disabling conditions—such as blindness, depression, and conditions that cause pain—was weighted between 0 (perfect health) and 1 (equivalent to death). These weights were then grouped into seven classes where class I has a weight between 0.00 and 0.02 and Class VII a weight between 0.7 and 1 (see Table 1).

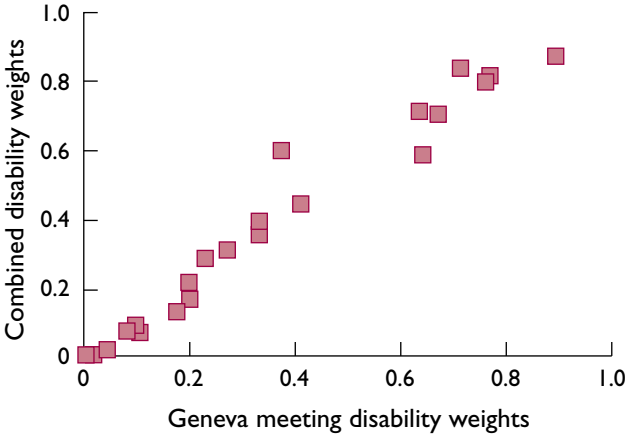
Despite their diverse cultural backgrounds, the participants reached consensus on these weights. Their choices also closely match the pooled results of nine additional exercises with other participants using the same protocol (Figure 6).

In essence, the weight is set by the number of people with a given condition whose claim on a fixed healthcare budget is equal, in the judgement of a participant, to that of 1000 healthy people. For example, if the participant judges that 1000 entirely healthy people would have an equal claim on the resources as 8000 people with some severe disability, the weight assigned to that particular disability is equal to 1 minus 1000 divided by 8000, or 0.875. If 1000 entirely healthy people were judged to have an equal claim on the resources as 2000 people with a particular, less severe, disability, the weight assigned would be equal to 1 minus 1000 divided by 2000, or 0.5.

For the GBD protocol, each participant is asked two versions of the person trade-off question, one about extending life for people in a given health state versus extending life for healthy people, the second about

Figure 6 In close agreement: weights set for 22 indicator disabling conditions based on the combined results of nine exercises using the GBD protocol, compared with the results of the Geneva meeting

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giving health back to people in a given health state versus extending life for healthy people. Two questions are asked because people’s answers to each one are invariably inconsistent with the other, and the process of making them consistent forces the participant to think through the implications of their decision in greater depth.

The implications of choosing between the claims of different groups in a society are profound, so the process of setting weights cannot be undertaken lightly. While some other studies have used relatively rapid methods, such as telephone surveys, the GBD protocol is a deliberative process in which a comparatively small group of participants (between 8 and 12) are confronted with the implications of their decision, encouraged to discuss their choices with their peers, and allowed to revise their initial choices. This is time-consuming: at most 20–25 conditions can be discussed in a full working day. Once the 22 indicator conditions have been weighted, the participants assigned the remaining conditions across the seven classes.

1.4 How much do different value choices affect the results?

To gauge the impact of changing these social choices on the final measures of disease burden, the GBD researchers re-calculated their assessments with alternative age-weighting and discount rates, and with alternative methods for weighting the severity of disabilities.

Overall, the rankings of diseases and the distribution of burden by broad cause Group are largely unaffected by age-weighting and only slightly affected by changing the method for weighting disability. Changes to the discount rate, by contrast, may have a more significant effect on the overall results. A higher discount rate results in an increased burden in older age groups, while a lower discount rate results in an increased burden in younger age groups. Changes in the age distribution of burden, in turn, affect the distribution by cause, because communicable and perinatal conditions are commonest in children while noncommunicable diseases are commonest in older adults. The most significant effect of changing the discount and age weights is to reduce the importance of several psychiatric conditions (Figure 7).

Ultimately, however, the accuracy of the underlying basic epidemiological data from which disease burden is calculated will influence the final results much more than the discount rate, the age weight, or the disability weighting method. If, for example, estimates of the incidence of blindness are off by a factor of two, then it follows that this will be reflected in the results. The GBD researchers conclude that researchers' efforts should be invested in improving the basic data rather than in spending excessive energy on analysing the effects of small adjustments to the measure itself.

Figure 7 Relationship between the rank order of causes of global burden using DALYs calculated without age-weighting and discounting and standard DALYs calculated with age-weighting and a three per cent discount rate, 1990 (highest rank is the largest cause)

