

# 1 Introduction

## 1.1 Purpose and background

Mortality and fertility rates are decreasing across the globe, resulting in ageing populations and higher life expectancies. Developments in knowledge and medical technology are contributing to a growing demand for health services and, in some cases, to higher costs of providing these services. These and other factors are placing increasing pressure on health budgets. In Australia and elsewhere there will be increasing focus on making choices, while seeking both optimum health gain for health expenditure and fair and equitable access to health interventions. Additionally, there is increasing public and policy concern to ensure that non-fatal conditions (such as mental health problems and musculoskeletal disorders) are appropriately reflected in health planning and priority setting.

Evidence-based evaluation of policies to improve health and reduce inequalities, and the prioritising and resourcing of these policies, requires four basic types of information:

- a detailed assessment of the magnitude and impact of health problems in the population, including information on the causes of loss of health in the population (both in terms of diseases and injury, and risk factors or broader determinants), in order to address the questions of what can be done to improve health and what are the best buys for the health dollar;
- information on health expenditure and health infrastructure (a national system of health accounts) detailing the availability of resources for health improvement and what the resources are currently used for;
- information on the cost-effectiveness of available technologies and strategies for improving health; and
- information on inequalities in health status, health determinants, and access to and use of health services (including both prevention and treatment services).

Good information is available in Australia on disease causes of mortality, but these data provide, at best, only indirect information on the health of the living and the causes of poor health. Most 'health' data in Australia relate to the health care system, and then mainly its inputs and throughputs. We know far more about the costs of health care and the numbers of patients treated than we do about the health impacts of the treatments and the health of the population in general.

This report addresses the first of these information needs by providing the first detailed and internally consistent estimates for Australia of the incidence, prevalence, duration, mortality and disease burden for an exhaustive and mutually exclusive set of disease and injury categories. It uses a summary measure for disease burden which can also be used to measure the health outcomes for cost-effectiveness analyses, allowing the linkage of information on burden of disease, costs and health outcomes. This report also takes first steps towards addressing the fourth of these needs with an analysis of inequalities in mortality burden according to socioeconomic status.<sup>1</sup>

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<sup>1</sup> Superscript numbers refer to technical notes in Appendix A. These contain additional explanatory or technical information.

Murray and Lopez (1996a) developed a new summary measure of population health, the Disability-Adjusted Life Year or DALY, to provide information to support health policy and priority setting at a global level. This was used to provide a comprehensive assessment of the global burden of disease and injury in 1990 (World Bank 1993, Murray & Lopez 1996a, 1996b) and has been adopted by the World Health Organization (WHO) to inform global health planning (WHO 1999a). The DALY was designed:

- to allow estimates of health impact to be mapped to causes, whether in terms of disease and injury, or risk factors and broader social determinants;
- to provide a common metric for estimating population health impact and cost-effectiveness of interventions;
- to use common values and health standards for all regions of the world<sup>2</sup>; and
- to provide a common metric for fatal and non-fatal health outcomes.

### **Box 1.1: Is it useful to know the size of health problems?**

*Some health economists have expressed concerns that burden of disease analyses may tempt planners to set priorities in terms of size of problem, arguing that priority setting requires knowledge only of cost-effectiveness ratios at the margins of current activity (Williams 1999, Mooney et al. 1997). While it is certainly true that burden of disease estimates without economic analyses are insufficient to make decisions on resource allocation, there are good reasons to do both.*

*First, a vast amount of work is needed to evaluate the cost-effectiveness of the myriad of existing and potential health interventions. A lot of this work will need to be replicated in different countries to incorporate context-specific effectiveness and costing data. Burden of disease assessments help to choose those interventions for cost-effectiveness analyses that potentially can result in large health gains<sup>3</sup>. The DALY was explicitly designed to address this need (Bobadilla et al. 1994, Murray and Lopez 1996a, Ad Hoc Committee on Health Research Relating to Future Intervention Options 1996). Burden of disease analysis will be particularly important for attempts at the macro-evaluation and planning models required to make big steps in addressing the evaluation backlog. Burden of disease studies of the type reported here provide a good understanding of how to model diseases in a consistent way – this is very important for achieving standard approaches to modelling health outcomes in cost-effectiveness studies.*

*Secondly, the size of problem is very relevant to monitoring and evaluating progress towards societal goals. If our goal is to reduce unemployment, we need to monitor the level of unemployment as well as the marginal cost of creating or finding jobs. Similarly, societal priorities are informed by the burden of disease and injury as well the marginal costs of interventions.*

*Thirdly, where there are large or lumpy fixed costs associated with doing each additional activity, it is not only the marginal cost-effectiveness that needs to be taken into account, but also the size of each of the problems that can potentially be addressed. Examples where this occurs include policy attention for major national health priorities, training of health professionals and research and development.*

*According to economic theory, the greatest benefit is obtained from the intervention where there is the greatest net present value. This does not always correspond with the highest cost-effectiveness ratio as it reflects both the ratio and the absolute magnitude of the program. Burden of disease analysis may provide a good first approximation to the potential magnitude of the benefit.*

*The size of the health problem is also very relevant to priority setting if equity is to be taken into consideration. For example, suppose decision makers were told that an additional year of Indigenous life could be purchased for \$5,500 and an additional year of non-Indigenous life could be purchased for \$5,000 at the margin. They would surely also wish to know the relative size of the burden of disease in each population and, after financing the health program or shifting some resources, the changes in the overall burden of disease for each population.*

Increasingly, there is recognition that future progress in population health must address health-related quality of life as well as quantity of life. In the last decade, health policy makers have shown a marked increase in interest in the development, calculation and use of summary health measures that combine mortality and morbidity (see Section 1.3). The DALY methodology provides a way to link information on disease causes and occurrence to information on both short-term and long-term health outcomes, including impairments, functional limitations (disability) and, potentially, restrictions in participation in usual roles (handicap), and death. The burden of disease methodology is designed to inform health policy in relation to the prevention and treatment (cure or reduction in severity) of adverse health outcomes. It is not designed to inform policy for the provision of social support or welfare services for people with long-term disability or handicap.

## 1.2 Australian Burden of Disease and Injury Study

The Australian Burden of Disease and Injury Study has been carried out by the Australian Institute of Health and Welfare (AIHW) using methods largely based on those developed for the Global Burden of Disease study. The project commenced in June 1998 and part-funding was contributed by the Commonwealth Department of Health and Aged Care. The Victorian Department of Human Services has also carried out a state-level analysis of the burden of disease for Victoria under the leadership of Dr Theo Vos. The two project teams have worked closely together and shared methods and analyses. The Australian studies have adapted the DALY methodology to suit the Australian context and the need for greater detail in measuring the size of health problems that are important in Australia.

The Australian Burden of Disease and Injury project had three major aims:

- to review the Global Burden of Disease (GBD) methodology and its applicability for Australian analyses and, where possible, improve the methods to make full use of Australia's relatively rich sources of population health data;
- to systematically compile and assess data on incidence, prevalence, case fatality and severity for diseases and injury; and
- to estimate the burden of disease in Australia for diseases and injury, key risk factors and selected priority populations (quintiles of socioeconomic disadvantage in the first instance).

This report presents a detailed analysis of the findings of the Australian Burden of Disease and Injury project. Details of the methods are presented in Chapter 2, which may be skipped on first reading by those readers more interested in the results. Chapters 3 and 4 provide overviews of the burden of mortality and disability respectively. Chapters 5 and 6 provide an overview of the total burden of disease and injury in Australia, by cause, age and sex. Chapter 7 provides estimates of the burden of disease and injury attributable to selected risk factors in Australia.

The Australian Burden of Disease and Injury Study is the first attempt in Australia to carry out a systematic and comprehensive national analysis of the incidence, prevalence, remission, case fatality and severity of diseases, ensuring internal consistency and using a common currency to measure the burden of mortality and morbidity. This report provides estimates of burden for 176 disease and injury categories involving analysis of 1,260 stages, severity levels and/or sequelae.

While every attempt has been made to identify the best available information in relation to each disease and injury category, and to consult as widely as possible, it must be

emphasised that the estimates published here should be seen as provisional and developmental. For some conditions, it was not possible to go beyond simple models and assumptions about some key parameters, in the time frame available. For many conditions, all required information was not available and analyses drew on overseas studies or expert opinion. The analyses carried out for this study will provide a framework for more detailed analysis of particular conditions and guidance in identifying data gaps and deficiencies. It is hoped that further improvements over time in methods, models and data will result in increasing accuracy and certainty in estimates of burden of disease in Australia.

#### **Box 1.2: Comments and feedback**

*Comments and feedback on methods and assumptions or on estimates presented in this report are welcome and are a crucial input to improving future estimates. Comments should be sent to:*

*Australian Burden of Disease and Injury Study*

*Australian Institute of Health and Welfare*

*GPO Box 570, Canberra, ACT 2601*

*Australia*

*or e-mailed to: [bod@aihw.gov.au](mailto:bod@aihw.gov.au)*

## **1.3 Disability-Adjusted Life Years**

In order to include the impact of both premature death and health problems among those who are alive, a common currency or metric is required. The DALY uses time as a common currency, as do most other summary measures developed to date. The DALY extends the concept of potential years of life lost due to premature death (PYLL) to include equivalent years of 'healthy' life lost by virtue of being in states of poor health or disability. DALYs for a disease or health condition are calculated as the sum of the years of life lost due to premature mortality (YLL) in the population and the years lost due to disability (YLD) for incident cases of the health condition:

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

The loss of healthy life due to non-fatal health conditions (YLD) requires estimation of the incidence of the health condition (disease or injury) in the specified time period. For each new case, the number of years of healthy life lost is obtained by multiplying the average duration of the condition (to remission or death) by a severity weight that quantifies the equivalent loss of healthy years of life due to living with the health condition or its sequelae. The DALY is described in detail in Murray and Lopez (1996a).

The Australian studies depart from the GBD methods in the following areas (see Chapter 2 for further details):

- Australian cohort life expectancies for 1996 are used to calculate years of life lost due to mortality;
- age weights are not used;

**One DALY is one lost year of 'healthy' life.**

- disability weights for non-fatal health outcomes are derived from a recent Dutch study, supplemented by weights used in the Global Burden of Disease Study for some conditions; and
- some adjustments are made for the effects of comorbidity between conditions.

## 1.4 Summary measures of health

The simplest and most widely used method for producing population health statistics is to aggregate data on individuals in order to generate statistics like the proportion of the population (or of a particular age-sex group) suffering from a particular health problem or in a particular health state. This approach rapidly becomes unwieldy when a number of problems are being monitored and we want to make comparisons over time, across population groups, or before and after some health intervention. We are then faced with an explosion in the numbers of statistics that must be compared.

Summary measures of population health are measures that combine information on mortality and non-fatal health outcomes to represent population health in a single number (Field and Gold 1998). In the past decade, there has been a marked increase in interest in the development, calculation and use of summary measures. Their range of potential applications include:

- comparing of health conditions or overall health status between two populations or the same population over time;
- quantifying health inequalities;
- ensuring that non-fatal health outcomes receive appropriate policy attention;
- measuring the magnitude of different health problems using a common currency;
- analysing the benefits of health interventions for use in cost-effectiveness studies;
- providing information to assist in setting priorities for health planning, public health programs, research and development, and professional training (Murray, Salomon & Mathers 1999).

Two classes of summary measure have been developed: health expectancies (e.g. disability-free life expectancy, active life expectancy) and health gaps (disability-adjusted life years, healthy life years etc.). Both classes of summary measure use time (lived in health states or lost through premature death) as an appropriate common metric for measuring the impact of mortality and non-fatal health outcomes.

*Health expectancies* are population indicators that estimate the average time (in years) that a person could expect to live in a defined state of health. Examples include disability-free life expectancy (DFLE), active life expectancy and disability-adjusted life expectancy. These extend the concept of life expectancy to refer to expectations of various states of health, not just of life per se. During the last ten years, the International Network on Health Expectancy (REVES) has promoted and developed the concept and methods and it is now widely used at national level and by the Organization for Economic Co-operation and Development (OECD) to report on population health (Mathers & Robine 1993, OECD 1998).

Measures of potential years of life lost due to premature mortality have been used for many years to measure the mortality burden of various causes of death. These all measure the gap in years between age at death and some arbitrary standard age before which death is considered 'premature' (typically 65 years or 75 years). *Health gaps* extend the notion of mortality gaps to include time lived in states other than excellent health. The most widely

### Box 1.3: Health gaps and health expectancies

The relationship between health expectancies and health gaps can be illustrated using a population survival curve (Mathers 1997a). The survival curves in Figure 1.1 are constructed by following a birth cohort over time and plotting for each year (age) the proportion who are still alive and the proportion who are in good health. The curve bounding area C is the usual survival curve of the type typically used to construct a life table and the total area (A+B) underneath it represents life expectancy at birth. Health expectancies are measures of the area underneath the survival curve that either give zero weight to years lived in the area labelled B (as in DFLE) or take some proportion of area B to represent its equivalent years of good health. Health gaps measure the difference between the population experience and some ideal or goal for population health. Thus if the ideal was taken to be 95 years of good health followed by death, then the mortality gap would be area C in Figure 1.1. The health gap would be area C plus some proportion of area B representing the equivalent lost years of good health.

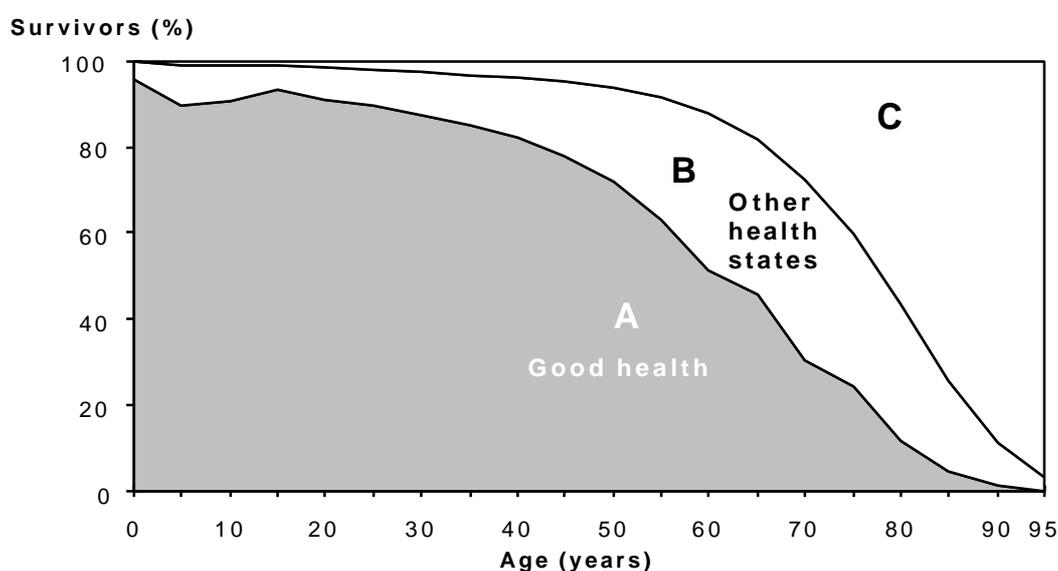
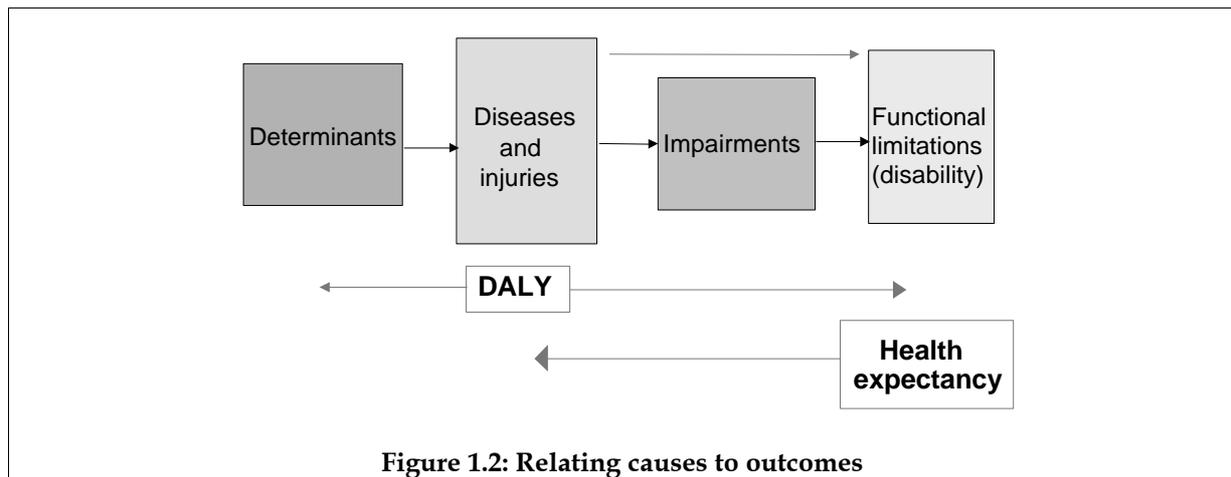


Figure 1.1: Population survival curves, health expectancies and health gaps

known of these is the disability-adjusted life year or DALY. These have been used to guide World Bank investment policies for health and to inform global priority setting for health research and international health programs (World Bank 1993, Ad Hoc Committee on Health Research Relating to Future Intervention Options 1996, WHO 1999a). Time-based health gap measures offer the possibility of using a common metric for population health and for the outcomes of interest in randomised control trials, in cohort studies and in some health services administrative datasets.

Figure 1.2 shows a simplified schema relating causes (determinants, diseases and injuries) to impairments and disability. DALY calculations start from information on diseases and injuries (incidence, prevalence and duration) and estimate the associated impairments and disability in order to quantify the total burden. Using attributable fraction methods, it is also possible to estimate the attributable burden of specific risk factors or health determinants.

Health expectancy calculations, on the other hand, have generally started with population data on disabilities (the right-most box in Figure 1.2) in order to estimate expectations of years lived in various health states. Attempts have been made to relate health expectancies



back to disease and risk factor causes using data from population disability surveys on the health conditions contributing to the disability (Mathers 1992, Bone et al. 1995, Nusselder et al. 1996, Mathers 1997b). However, there are severe problems with the quality and comparability of self-reported data on the disease and injury causes of disability which limit the usefulness of such data for analysis of the non-fatal outcomes for most diseases and injury (Mathers 1997b, 1999b).

All summary measures of population health involve explicit or implicit social value choices. For example, mortality-based indicators do not evaluate non-fatal loss of health, potential years of life lost indicators ignore deaths beyond an arbitrary age (e.g. 65 years), and disability-free life expectancy indicators do not place any positive value on years lived with disability.

In particular, health gap measures such as the DALY measure the gap between a population's actual health status and some 'ideal' or reference status. In developing the DALY indicator, Murray and Lopez (1996a) identified five value choices that should be explicitly made:

- How long 'should' people in good health expect to live? This must be decided in order to calculate how many years are lost through death at any given age (see Section 2.4).
- How should we compare years of life lost through death with years lived with poor health or disability of various levels of severity? Issues involved in making these 'health state valuation' choices are discussed in the next section (Section 1.5).
- Is a year of healthy life gained now worth more to society than a year of healthy life gained in 20 years' time? This value choice (the discount rate) is discussed in Section 1.6.
- Are lost years of healthy life valued more at some ages than others? Is a year of life at young adult ages valued more than in old age or infancy? This value choice is discussed in Section 1.7.
- Are all people equal? Should these values be determined at local or national level for country analyses and at national or international level for cross-national comparisons?

Murray (1996) explicitly sought to build egalitarian principles into the DALY, and the Global Burden of Disease Study used the same values for all regions of the world. It used the same life expectancy 'ideal' standard for all population subgroups, whether or not their current life expectancy was lower than that of other groups. It excluded all non-health characteristics (such as race, socioeconomic status or occupation) apart from age and sex from consideration in calculating lost years of healthy life. Most importantly, it used the

same 'disability weight' for everyone living a year in a specified health state. The meaning and estimation of these disability weights is described in the following section.

## 1.5 Comparing time lived in different health states

In order to use time as a common currency for non-fatal health states and for years of life lost due to mortality, we must define, measure and numerically value time lived in non-fatal health states. The 'valuation' of time lived in non-fatal health states formalises and quantifies social preferences for different states of health as health state *weights*.

This is a critical step in combining information on mortality and non-fatal health outcomes into summary measures. Without the use of such weights, summary measures of population health cannot be responsive to changes in the severity distribution of health states (Wolfson 1998, Murray, Salomon and Mathers 1999). Depending on how these weights are derived, they are variously referred to as disability weights, quality-adjusted life year (QALY) weights, health state valuations, health state preferences or health state utilities. Most such weights are measured as a number on a scale of 0 to 1, where 0 is assigned to a state comparable to death and 1 is assigned to a state of ideal health.

While death is not difficult to define, non-fatal health states are. Non-fatal outcomes of disease are different from each other in their impact on the individual, and the impact on the individual is mediated by contextual factors including personal characteristics and the physical and social environment. Non-fatal outcomes of disease involve multiple domains of health: on what basis can we weight and then aggregate various aspects of an individual's health such as mobility, anxiety and pain?

### What aspects of health should be included in a weight?

WHO defines health as 'a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity' (WHO 1946). This definition is so broad that it could be read as equating health with total wellbeing or quality of life. The latter concepts include domains of wellbeing such as economic wellbeing, life satisfaction and spiritual or existential wellbeing that are usually seen as being distinct from health (although influenced by it and influencing it). The inclusion of these aspects of wellbeing in the WHO definition has made the development of practical measures of health difficult to achieve.

One common approach is to describe health as a profile of levels on a series of domains. The SF-36 is an example of such an instrument, with eight domains covering self-perceived health, vitality, bodily pain, mental health, physical functioning, social functioning, and role limitations (Ware & Sherbourne 1992). SF-36 domains are scored on continuous scales from 0 to 100, resulting in a large number of potential health states. Health state profiles intended for use with health state valuations tend to use a more limited number of levels in each domain<sup>4</sup>.

Ideally, any weighting exercise for use in burden of disease analysis or economic evaluation should measure preferences for clearly defined health states. The Global Burden of Disease Study asked participants in weighting exercises to make a composite judgement on the severity distribution of the condition and the preference for time spent in each severity level<sup>5</sup>. This was to a large extent necessitated by the lack of population information on the severity distribution of most conditions at the global and regional level. The Netherlands has also carried out a project to measure weights for 53 diseases of public health importance using a methodology consistent with the GBD study (Stouthard et al. 1997). This study used

more specific disease stages or severity levels so that judgements were not required on the distribution of disease stages or severity levels in the population. In addition, the Dutch defined each disease stage in terms of the associated average levels of disability, handicap, mental wellbeing, pain and cognitive impairment using a modified version of the EuroQol health status instrument (see Section 2.5 for details). Some examples of disability weights from the Dutch study are shown in Table 1.1.

**Table 1.1: Some examples of disability weights from the Dutch study**

Weight	Disease stage, severity level or sequela
0.00 – 0.01	Gingivitis, dental caries
0.01 – 0.05	Mild asthma, mild vision loss, mild hearing loss, basal cell skin cancer
0.05 – 0.05	Low back pain, uncomplicated diabetes case, mild stable angina (NYHA 1-2)
0.10 – 0.15	Mild depression, osteoarthritis (radiological grade 2) of hip or knee, epilepsy
0.15 – 0.20	Mild/moderate panic disorder, spina bifida (sacral), HIV seropositive
0.20 – 0.30	Non-invasive breast cancer or tumour < 2 cm (diagnostic/treatment phase), anorexia, mild/moderate obsessive-compulsive disorder
0.30 – 0.40	Moderate depression, multiple sclerosis in relapsing-remitting phase, severe asthma, chronic hepatitis B infection with active viral replication, deafness
0.40 – 0.50	Severe vision loss, medium-level spina bifida (L3–L5), osteoarthritis (grade 3–4), operable small cell lung cancer, moderate intellectual disability (IQ 35–49)
0.50 – 0.65	Paraplegia, AIDS (first stage), severe chronic bronchitis or emphysema
0.65 – 0.80	Disseminated breast cancer, severe depression, moderately severe brain injury resulting in permanent impairments, extreme intellectual disability (IQ<20)
0.80 – 1.00	Severe schizophrenia, disseminated colorectal cancer, severe dementia, alcoholic psychosis, quadriplegia, stroke with multiple permanent impairments, end-stage Parkinson's disease

Source: Stouthard et al. 1997.

In the terminology of the International Classification of Impairments, Disabilities and Handicaps (ICIDH), the term disability has referred to functional limitation at the level of the individual, handicap to the impact of impairments and disabilities in carrying out usual roles, given the particular social context of the individual (WHO 1980). In the current draft revision of the ICIDH, the term disability is used more broadly to refer to impairments, functional limitations and participation restrictions (handicap).<sup>6</sup>

Following the GBD terminology, and consistent with the proposed revision to ICIDH, the term *disability* is used broadly in this report to refer to departures from good or ideal health in any of the important domains of health. These include mobility, self-care, participation in usual activities, pain and discomfort, anxiety and depression, and cognitive impairment, as summarised in the modified EuroQol descriptions used in the Dutch study. The reference state for good or ideal health is defined as a health state where the individual has:

- no pathological processes (disease or disease precursors);
- no mental health problems, no injuries;
- no impairments resulting from congenital, disease or injury causes; and
- no functional limitations resulting from current or former health problems or impairments.

In some contexts, the word 'healthy' is understood to mean 'absence of illness'. In this document, *health* is given a broader meaning. As well as implying absence of illness there are also no impairments or functional limitations due to previous illness or injury.

We thus refer to *disability weights* and *years lost due to disability* (YLD) as shorthand terms for health state preferences and years of healthy life lost due to time lived in states other than the reference state of good health, respectively. A *year of healthy life* refers to a year lived in the reference state of good health. Note that disability (i.e. states other than ideal health) may be short-term or long-term. A day with a common cold is a day with disability.

## How can we obtain weights for time lived in health states?

A number of methods have been developed for measuring preferences for health states. Four general approaches that involve asking people to compare various health states are outlined in the box below. The different methods reflect different concepts of what is being measured (utilities or preferences), differences in application (individual/clinical decision making or health program planning), and in viewpoint (valuing own health states or those of others).<sup>7</sup>

We must ensure that the method used provides the appropriate type of value, is consistent with the uses to which the resulting summary measures will be put, and summarises the preferences of the appropriate people. Burden of disease analyses use the person trade-off (PTO) method, as this more directly attempts to measure social preferences for health states than the other methods.<sup>8</sup> A deliberative approach is used with small groups of people in order to produce weights that meaningfully reflect social preferences for health states. The deliberative approach ensures that the people involved understand and are aware of the implications of their choices.<sup>9</sup>

### Box 1.4: Methods for valuing health states

**Rating scales** – Two health states are displayed on a chart (sometimes a thermometer) with the most preferred health state rated 100, and the least preferred state (or sometimes death) rated 0. Subjects are asked to indicate on the chart where other health states would rank.

**Standard gamble** – Subjects are asked to consider two alternatives. In one alternative their health state is certain (e.g. the state under consideration). In the other alternative there are two possible health states, one better than the certain state (e.g. ideal health) and one worse (e.g. dead) and the probability that the best state occurs is  $p$ . The probability  $p$  is varied until the subject is indifferent between the two alternatives. The probability  $p$  at the point of indifference is the 'utility' of the health state under consideration.

**Time trade-off** – Subjects are asked to choose between one health state for a specified period of time (say 10 years) or a shorter life in good health. The length of the shorter life is varied until the subject is indifferent between the two.

**Person trade-off** – Subjects are asked to choose, as health decision makers or as consumers purchasing an insurance plan, between a lesser health benefit for a larger number of people against a larger benefit for a smaller number of people. An example of person trade-off is to ask subjects to choose between saving a larger number of lives and leaving them in a specified state of less than ideal health and saving a smaller number of lives and restoring them to ideal health.

## Whose weights should be used?

As well as representative samples of the general population, groups asked to numerically value health states may include health professionals with knowledge of health states, or people with direct experience of the health states involved. Whose weights should be used depends on the purpose for which the weights will be used. There is a growing consensus among health economists that health state preferences should reflect the preferences of the general population when they are to be used as part of a process of broad health policy development, priority setting or resource allocation (Gold et al. 1996, Ubel, Richardson and Menzel 1999).<sup>10</sup> However, the preferences of the individual come into play when deciding on choices or allocations for an individual client or patient.

The GBD weighting studies used small groups of health experts who were asked to determine weights for a set of indicator health conditions using PTO methods in a deliberative process (Murray 1996). Health experts were used for convenience reasons due to the practical difficulties in ensuring that lay persons fully understood the impact and severity distribution of the conditions being valued. The Dutch disability weight study attempted to address this problem by defining the distribution of health states associated with a disease stage, sequela or severity level using the modified EuroQol health profile to describe the health states. The Dutch project used three panels of physicians with broad medical knowledge and experience and one lay panel comprising people with an academic background but no medical knowledge (Stouthard et al. 1997). Few differences were seen in the average PTO preferences assigned by the lay panel compared with those of the panels of medical experts. The Dutch study concluded that it makes little difference whether the valuation panel is composed of health care experts or lay people, as long as accurate functional health state descriptions are included in the specifications of the health problems being valued.

Another aspect of the question of whose weights to use is whether social preferences for health states vary within or across populations. It seems very possible that health state preferences could vary markedly between populations that have different cultural beliefs, conceptualisations of health, and expectations for health and wellbeing. To date, however, there is little empirical evidence that social preferences for health states derived using deliberative methods vary markedly across populations. The GBD carried out health state preference studies in over ten countries and found surprisingly high levels of consistency between weights for 22 indicator conditions spanning a wide range of severity (Murray & Lopez 1996a).<sup>11</sup>

## Interpreting disability weights

The disability weights used in DALY calculations quantify societal preferences for different health states. They range from 0 representing a state of good or ideal health (preferred to all other states) to 1 representing states equivalent to being dead. These weights do not represent the lived experience of any disability or health state, or imply any societal value of the person in a disability or health state. Rather they quantify societal preferences for health states in relation to the societal 'ideal' of good health.

Thus a weight for paraplegia of 0.57 does not mean that a person in this health state is 'half dead', that they experience their life as halfway between life and death, or that society values them as a person less than anyone else. It means that, on average, society judges a year with blindness (weight 0.43) to be preferable to a year with paraplegia (weight 0.57), and a year with paraplegia to be preferable to a year with unremitting unipolar major depression (weight 0.76). It also means that, on average, society would prefer a person to

have a year in good health followed by death than a year with paraplegia followed by death. As well, society would prefer a person to live three years with paraplegia followed by death than have one year of good health followed by death (3 years  $\times$  (1-0.57) = 1.3 'healthy' years is greater than 1 year of good health).

All other things being equal, society would prefer to prevent or cure a case of paraplegia (weight 0.57) rather than a case of low back pain (weight 0.06), if each case could be restored to full function for the same cost and there were insufficient resources to do both. However, the use of health state preferences and DALY or QALY measures to quantify loss of health or health gain carries no implication that society will necessarily choose the maximisation of health gain as the main or only goal for the health system<sup>12</sup>. Additionally, the disability weights should not be further interpreted as giving a value to the maximum benefit obtained by saving the life of a person with that health problem, but leaving them in the health state. We should not interpret a weight of 0.5 for paraplegia as meaning that saving the life of a paraplegic person (but not changing their disability status) is given only half the value of saving the life of a person in good health (Menzel et al. 1999, Nord et al. 1999).

## 1.6 Discounting

The DALY measures the future stream of healthy years of life lost due to each incident case of disease or injury. It is thus an incidence-based measure rather than a prevalence-based measure. The GBD applied a 3% time discount rate to years of life lost in the future to estimate the net present value of years of life lost. With this discount rate, a year of healthy life gained in 10 years' time is worth 24% less than one gained now.<sup>13</sup>

Discounting of future benefits is standard practice in economic analysis<sup>14</sup> and there are some specific arguments for applying discounting to the DALY in measuring population health (Murray and Acharya 1997):

- to be consistent with measurement of health outcomes in cost-effectiveness analyses;
- to prevent giving excessive weight to deaths at younger ages (without discounting, a death at age zero results in 50% more YLL than a death at age 25 and 100% more than a death at age 40); and
- the disease eradication/research paradox: assuming that investment in research or disease eradication has a non-zero chance of succeeding, then without discounting, all current expenditure should be shifted to such investment because the future stream of benefits is infinite. This is a particular case of the excessive sacrifice argument.<sup>15</sup>

A number of people have argued that discounting should not be applied to future health gains or losses<sup>16</sup> and discounting is rarely used by epidemiologists and demographers for summary health measures. Murray and Acharya (1997) concluded that the strongest argument for discounting is the disease eradication/research paradox and that the social discount rate should be smaller than average individual discount rates. They noted, however, that the choice of a discount rate for health benefits, even if technically desirable, may result in morally unacceptable allocations between generations. Because the discount rate issue is not easily resolved, the GBD published discounted and undiscounted estimates of the global burden.

A discount rate of 5% per annum has been standard in much health economic and other social policy analyses for many years. Environmentalists and renewable energy analysts have argued in recent decades for lower discount rates for social decisions<sup>17</sup>. The World Bank Disease Control Priorities Study and the Global Burden of Disease project both used a

3% discount rate.<sup>18</sup> The US Panel on Cost-Effectiveness in Health and Medicine recently recommended that a 3% real discount rate be used in health economic analyses to adjust both costs and health outcomes (Gold et al. 1996), but that the sensitivity of the results to the discount rate should be examined. As discussed in Section 2.3, the Australian Burden of Disease Study has used a 3% discount rate.

## 1.7 Age weights

The Global Burden of Disease Study weighted a year of healthy life lived at young ages and older ages lower than for other ages.<sup>19</sup> This choice was based on a number of studies that have indicated there is a broad social preference to value a year lived by a young adult more highly than a year lived by a young child or at older ages (Murray and Lopez 1996a). Not all such studies agree that young ages as well as older ages should be given less weight or on the relative magnitude of the differences.

The age weights are the single most controversial value choice built into the DALY. Criticisms of the age weights have fallen into five categories:

- age-weighting is unacceptable on equity grounds (every year of life is of equal value a priori) (Anand and Hanson 1997);
- the age weights are arbitrary and have not been validated for large populations;
- the age weights do not reflect social values (for example the DALY values the life of a newborn about equally to that of a 20 year old whereas the empirical data suggest a 4-fold difference (Bobadilla 1996);
- when applied to discounted YLL, the age weights result in higher weights being given to all ages from 0–27 (Barendregt et al. 1996); and
- they add an extra level of complexity to the burden of disease analysis which obscures the method, and makes little overall difference to the rankings.

Murray and Acharya (1997) have argued that age weights are not in themselves inequitable, because everyone potentially lives through every age, and that they do reflect legitimate societal priorities. As discussed in Section 2.3, the Australian burden of disease studies use uniform age weights so that a year of healthy life is valued equally at all ages.