Chapter 1

Introduction

The Singapore Burden of Disease (SBoD) 2004 Study is the first comprehensive assessment of the magnitude and distribution of health problems in Singapore, in order to:

- Identify key health problems to help guide priority setting in public health policies, resource allocation and research;
- Provide a baseline for projecting health trends at national level, and for assessing improvements in health of Singaporean and performance of Singapore's healthcare system performance over time.

To achieve these goals, our specific objectives were to calculate and report:

1) Burden of premature mortality and disability for over 130 specific causes in 2004 by age group and sex;
2) Health-adjusted life expectancy for Singapore in 2004; and
3) Burden of premature mortality and disability attributable to major modifiable health risks in 2004.

This report presents the main findings of the SBoD 2004 Study for the first two specific objectives above. The third objective will be covered in a separate report.

Details of the methodology are presented in section 2. Section 3 presents the results of the burden of premature mortality and disability for specific causes including the health-adjusted life expectancy for Singapore in 2004. A general discussion of the major findings and conclusions are provided in Section 4. Technical notes on the methods used for estimating the disability burden for each of the major cause groups are set out in Appendix. Finally, summaries of the disease and injury categories classified using the Ninth Revision International Classification of Diseases (ICD-9) (WHO 1977) , disability weights applied, primary data sources used to construct the core set of results, as well as detailed tabulations of the core results are included in Annex tables.

Chapter 2

Methods

The SBoD 2004 Study is mainly based on the methods developed for the Global Burden of Disease (GBD) study (Murray & Lopez 1996). The advantage of using this methodology is that it allows the quantification of all states of ill health by combining mortality, morbidity, and disability using a single measure known as the disability-adjusted life year (DALY). The DALY is a health gap measure that combines time lost due to both premature mortality and non-fatal conditions. It 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 other than good health. 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 equivalent 'healthy' years lost due to disability or ill-health (YLD) for incident cases of the health condition:

$$DALY = YLL + YLD$$

where YLL = number of deaths x standard life expectancy at age of death and
YLD = incidence x duration x severity weight

The DALY is described in detail in Murray & Lopez (1996).

2.1 Social values used in SBoD 2004 Study

Summary measures of population health require several explicit social values choices in their computation. One consideration is the application of different weights to healthy years of life lost at different ages. Another consideration is whether a discount rate should be applied to the years of life lost in the future in order to estimate the net present value of life lost. In the SBoD 2004 Study, age weighting was not performed but a 3% time discount rate was used. With this discount rate, a year of healthy life gained in 10 years' time is worth 24% less than one gained now. The choice of social value parameters has been the topic of much debate. Further discussion on social value choices can be found in a published book (Murray et al. 2002).

2.1.1 Standard life expectancy used to estimate mortality burden

We used the highest life expectancy observed for any nation-that is, the 82.5 years life expectancy of women in Japan-as in the GBD study. The male-female 'biological' difference in survival potential was set at 2.5 years. The standard expectations were thus based on a model life table – namely, Coale and Demeny West level 26 (Coale & Guo 1989), which has a life expectancy at birth for females of 82.5 years. Given that there is no male schedule with a life expectancy of 80 years, the standard life expectancy at birth for men of 80 years was based on the female schedule of Coale and Demeny West level 25 (Mathers et al. 2001).

2.1.2 Disability weights

The DALY uses explicit preference values for different health states known as "disability weights". The disability weights quantify societal preferences for different health states. They 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 optimal health. They were derived from panels of health experts from around the world using Person Trade-Off (PTO) methods for 22 indicator conditions, followed by a deliberative process allowing members of the panel to alter their initial valuations after hearing arguments from other panel members (Murray & Lopez 1996).

We did not conduct a study to determine local disability weights for the range of health states relevant to Singapore. Instead, we used primarily a combination of disability weights from the Netherlands study (Stouthard et al. 1997) and the original GBD study (Murray & Lopez 1996). For some mental disorders, or health states with no equivalent in either the Dutch or GBD set of weights, or where the weights in the published materials seem

implausible, derived weights from the burden of disease and injury in Australia 2003 study (Begg et al. 2007) were adopted. The disability weights for DALY calculation are expressed on a scale from zero to one, with zero representing a state of optimal health (no loss) and one representing a state equivalent to death. The complete list of disability weights used is in Annex table 2.

2.1.3 Discounting

The DALY measures the future stream of health years of life lost as a result of each incident case of disease or injury. This means that the DALY is an incidence-based measure. The SBoD 2004 Study used a 3 per cent discount rate to DALYs in the future to estimate the net present value of DALYs.

2.1.4 Age weighting

Unlike the GBD study, age weights were not used in the SBoD 2004 Study. This implies that DALYs lost at every age-group was treated equally.

2.2 Population

The source of estimates of 2004 Singapore resident population data was the Department of Statistics, Singapore.

2.3 Deaths

The law requires all deaths occurring in Singapore to be registered with the Singapore Registry of Births and Deaths (RBD) within 3 days of occurrence. More than 99% of all deaths in Singapore are certified by medical doctors and coroners. The compulsory reporting of deaths coupled with a high proportion of deaths certification by trained medical personnel have allowed for a complete and reasonably high accuracy of ascertainment of cause of death in Singapore.

Death records from the RBD for 2004 were the source for cause-specific death rates by sex and age, required for YLL estimation in the SBoD 2004 Study. Standard adjustments for ill-defined diseases and injury (ICD-9: 780-799, E980-E989) and garbage codes for malignant neoplasm (cancers with site ill-defined) and cardiovascular diseases (heart failure, cardiac arrest and ill-defined cardiovascular diseases) used in the GBD 2000 project (Mathers et al. 2002) were similarly applied here. Deaths due to these ill-defined conditions and garbage codes accounted for less than 3% of the total deaths in 2004.

2.4 Years of life lost

YLL is the mortality component of DALY. It is determined by the average life expectancy at age of death, using the standard expected years of life lost (SEYLL) method. The YLL is calculated from the expected remaining years, as specified by a normative survivorship derived from a model life table. The standard life table known as West Level 26 – with a life expectancy at birth of 82.5 years in women and 80 years in men, was used in the calculation. In the SBoD 2004 Study, the YLL was calculated with discounting of 3%.

2.5 Years lost as a result of disability or ill-health

YLD is the disability component of DALY. The calculation of YLD requires the 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 disability weight that measures the loss of healthy life using an average health state weight. The basic formula for calculating the YLD is:

$$YLD=I \times DW \times L$$

where I is the number of incident cases in the reference period, DW is the disability weight (in the range 0-1) and L is the average duration of disability (measured in years).

2.6 Disease categories

Using the ICD-9, we defined mutually exclusive categories for more than 130 conditions and their disabling sequelae. The classifications can be found in Annex table 1.

To calculate the YLD for the large number of diseases and injuries and their sequelae, we developed disease models for diseases that contributed significantly to the total morbidity burden. These disease models are discussed in detail in the Appendix.

To complete the total burden picture, we made the following assumptions regarding residual morbidity not covered by these disease models. For high mortality conditions, we assumed that morbidity in the residual category was proportional to its mortality using the average YLD:YLL ratio of the related categories for which we developed the disease models. For low mortality conditions, this method was not appropriate and we mostly developed approximate models from available data. We did not model residual morbidity for nutritional deficiencies and mental disorders since most of the important disabling conditions were already covered by our disease models.

2.7 Incidence and duration

To calculate YLD, we need to determine the number of new cases of a particular disease or its sequelae for the year of interest. We derived numbers of incident cases from disease registries, hospitalisation data or epidemiological studies. In the absence of incidence data, a disease modelling tool – DisMod 2 (Barendregt J et al. 2003) was used to estimate it. DisMod 2 was used to find a set of incidence rates by age that match observed prevalence, given estimates of remission rates and cause-specific mortality risk derived from population data or epidemiological studies.

2.8 Data sources

The SBoD 2004 Study used extensive data from a variety of sources. Annex table 3 includes a list of data sources used. One of the guiding principles of this study has been to estimate disease burden based on judicious use of the best available reliable information. The general approach we adopted in our YLD calculations was to use incidence data where available from sources such as the national disease registries (i.e. Singapore Cancer Registry, Singapore Stroke Registry, Singapore Renal Registry, Singapore Acute Myocardial Infarction Registry, Singapore Birth Defects Registry) and the infectious diseases reporting and investigation system for infectious diseases notifiable under the Infectious Disease Act. For diseases for which there were no disease registries or notification systems, we used prevalence estimates from population health surveys (e.g. 2004 National Health Survey, 2003 National Mental Health Survey on Anxiety and Depression in Adult Singaporeans), and we derived incidence using DisMod 2. In instances where information was not available from disease registries or health surveys, we relied on information from health service use databases, as well as local or international population-based epidemiological studies.

In our YLD calculations, at times, there was a need to link data from two or more different sources or over long periods of time, using a unique-identification-number. Patients can be assured that the Singapore Burden of Disease and Injury Working Group adheres to strict confidentiality protocols in handling these data.