THE GLOBAL BURDEN OF DISEASE PROJECT AT WHO

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Evidence and Information for Policy Cluster (EIP)
Global Burden of Disease (GBD)

GBD 1990 Study

World Development Report 1993

Murray and Lopez 1996
WHO Updates 2000-2004

Annual revisions GBD 1998 to 2002

World Health Reports 1999 to 2004

Comparative Risk Assessment

Generalized Cost-Effectiveness (WHO-CHOICE)

National BOD manual and tools
www.who.int/evidence/bod
Disease Control Priorities Project

GBD 2001 used as basis

GBD book - documents data, methods and results

www.dcp2.org/pubs/gbd
GBD - current status

WHO
* New projections 2002 to 2030
* Incremental update GBD 2004
* Updates of attributable burden for various risk factors

Harvard
Chris Murray seeking funding for a major GBD update 2007-2009

University of Queensland
Alan Lopez running BOD training workshops and supporting national studies in Asia/Pacific region
GBD Goals

• Measure loss of health due to comprehensive set of disease injury and risk factor causes in a comparable way

• Decouple epidemiological assessment and advocacy

• Inject non-fatal health outcomes into health policy debate

• Use a common metric for burden of disease assessment using summary measure of population health and cost-effectiveness analysis
GBD PHILOSOPHY

• Quantities of interest are total events or states at population level
• Best available data used to make estimates
• Corrections for major known biases to improve cross-population comparability
• Comprehensive set of disease and injury causes – nothing is left out in principle
• No blanks in the tables, only wider uncertainty intervals
• Internal consistency used as a tool to improve validity
Disability Adjusted Life Years

\[ \text{DALY} = \text{YLL} + \text{YLD} \]

*Time is used as the common metric for mortality and health states*

- **YLL**  Years of life lost due to mortality
- **YLD**  Equivalent years of healthy life lost due to disability
Years of Life Lost

\[ \text{YLL} = N \times L_x \]

\text{YLL} = \text{Years of life lost due to premature mortality}
\text{N} = \text{Number of deaths in the population}
\text{L}_x = \text{Standard life expectancy at age of death}
\text{X} = \text{Age of death}

3 deaths at 50 = 3 \times 34 = 102 \text{ YLL}
Years Lived With disability

\[ \text{YLD} = I \times DW \times d \]

\[ \text{YLD} = \text{Years of life lived with disability} \]
\[ I = \text{Number of incident cases in the population} \]
\[ DW = \text{Disability weight} \]
\[ d = \text{Duration of disability [years]} \]

4 cases of mild mental retardation due to lead at birth:
\[ 4 \times 0.36 \times 80 \text{ years} = 115 \text{ YLD} \]
Disability weights

• Quantify preferences for health states in terms of a single number on an interval level scale

• 0 = full health
• 1 = health state equivalent to death

• DW quantify preferences for health states (bigger weight -> more lost health)

• DW say nothing about the value of the person OR their quality of life OR utility
Valuation techniques

- Visual analog scale
- Standard gamble
- Time trade-off
- Person trade-off
- Discrete choice methods
- Willingness-to-pay
Health State Valuation in GBD
1990 -- current

- Disability weights assigned by the expert panels from different regions of the world
- 22 indicator conditions valued using two forms of person trade-off method (PTO)
- Other conditions valued by comparison to the 22 indicator conditions
- Same weights across regions and within population
## GBD disability weights

<table>
<thead>
<tr>
<th>Disability weight</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00-0.02</td>
<td>Vitiligo on face, weight-for-height less than 2 standard deviations</td>
</tr>
<tr>
<td>0.02-0.12</td>
<td>Watery diarrhoea, severe sore throat, severe anaemia</td>
</tr>
<tr>
<td>0.12-0.24</td>
<td>Radius fracture, infertility, erectile dysfunction, rheumatoid arthritis, angina</td>
</tr>
<tr>
<td>0.24-0.36</td>
<td>Below-the-knee amputation, deafness</td>
</tr>
<tr>
<td>0.36-0.50</td>
<td>Rectovaginal fistula, mild mental retardation, Down syndrome</td>
</tr>
<tr>
<td>0.50-0.70</td>
<td>Major depression, blindness, paraplegia</td>
</tr>
<tr>
<td>0.70-1.00</td>
<td>Active psychosis, dementia, severe migraine, quadriplegia</td>
</tr>
</tbody>
</table>
# Value Choices for the DALY

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years lost due to death:</td>
<td>GBD standard life expectancies</td>
</tr>
<tr>
<td>Time discounting:</td>
<td>3%</td>
</tr>
<tr>
<td>Age weighting:</td>
<td>Non-uniform weights give less weight to years lived at younger and older ages</td>
</tr>
<tr>
<td>Disability weights</td>
<td>Largely based on GBD 1990 study with some revisions</td>
</tr>
</tbody>
</table>
Effect of discounting and age weights on YLL per death
GBD Data sources

Mortality

⇒ Death registration, sample registration systems, household surveys, surveillance systems, epidemiological studies, population laboratories

Morbidity/disability

⇒ Disease registers, population based studies, longitudinal studies, health facility data (injuries)
DISMOD disease model
### Approximate number of data sources, GBD 2000-2002

<table>
<thead>
<tr>
<th>Mortality - causes of death</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Death registration data for 2001 or 2002</td>
<td>59</td>
</tr>
<tr>
<td>Death registration data for earlier years</td>
<td>711</td>
</tr>
<tr>
<td>Child &amp; adult mortality - other sources</td>
<td>535</td>
</tr>
<tr>
<td><strong>Epidemiological studies/ registers/ HS data etc</strong></td>
<td></td>
</tr>
<tr>
<td>Group I. Communicable, mat, perinatal, nutr</td>
<td>6,539</td>
</tr>
<tr>
<td>Group II. Non-communicable</td>
<td>2,127</td>
</tr>
<tr>
<td>Group III. Injuries</td>
<td>18</td>
</tr>
<tr>
<td><strong>Approximate total datasets used</strong></td>
<td>10,052</td>
</tr>
</tbody>
</table>
## Numbers of datasets - regional distribution

<table>
<thead>
<tr>
<th>Region</th>
<th>Death registration data</th>
<th>Child/ adult mortality data</th>
<th>Epidemiologic data sources</th>
<th>Total data sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia/Pacific</td>
<td>117</td>
<td>118</td>
<td>1,820</td>
<td>2,055</td>
</tr>
<tr>
<td>Europe</td>
<td>149</td>
<td>22</td>
<td>971</td>
<td>1,142</td>
</tr>
<tr>
<td>High income</td>
<td>142</td>
<td>16</td>
<td>1,830</td>
<td>1,988</td>
</tr>
<tr>
<td>Latin America &amp; Caribbean</td>
<td>286</td>
<td>122</td>
<td>1,311</td>
<td>1,719</td>
</tr>
<tr>
<td>Middle East &amp; North Africa</td>
<td>46</td>
<td>67</td>
<td>645</td>
<td>758</td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>30</td>
<td>190</td>
<td>2,185</td>
<td>2,405</td>
</tr>
<tr>
<td>World</td>
<td>770</td>
<td>535</td>
<td>8,747</td>
<td>10,052</td>
</tr>
</tbody>
</table>
Trends in causes of under 5 mortality, 1990 to 2001

Death rate per 1,000 children aged 0-4

- Malaria
- Diarrhoeal diseases
- Respiratory infections
- Other infectious and parasitic
- Perinatal causes
- Nutritional deficiencies
- Noncommunicable
- Injuries
Leading Causes of Mortality and Burden
Global estimates for 2002

<table>
<thead>
<tr>
<th>Mortality</th>
<th>DALYs</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Ischaemic heart disease</td>
<td>12.6</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>9.7</td>
</tr>
<tr>
<td>Lower respiratory infections</td>
<td>6.8</td>
</tr>
<tr>
<td>HIV/ AIDS</td>
<td>4.9</td>
</tr>
<tr>
<td>COPD</td>
<td>4.8</td>
</tr>
<tr>
<td>Perinatal conditions</td>
<td>4.3</td>
</tr>
<tr>
<td>Diarrhoeal diseases</td>
<td>3.2</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>2.7</td>
</tr>
<tr>
<td>Malaria</td>
<td>2.2</td>
</tr>
<tr>
<td>Lung Cancer</td>
<td>2.2</td>
</tr>
<tr>
<td>Perinatal conditions</td>
<td>6.5</td>
</tr>
<tr>
<td>Lower respiratory infections</td>
<td>6.1</td>
</tr>
<tr>
<td>HIV/ AIDS</td>
<td>5.7</td>
</tr>
<tr>
<td>Depression</td>
<td>4.5</td>
</tr>
<tr>
<td>Diarrhoeal diseases</td>
<td>4.2</td>
</tr>
<tr>
<td>Ischaemic heart disease</td>
<td>3.9</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>3.3</td>
</tr>
<tr>
<td>Malaria</td>
<td>3.1</td>
</tr>
<tr>
<td>Road traffic accidents</td>
<td>2.6</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>2.3</td>
</tr>
</tbody>
</table>
**GBD 2002 - Disease models**

Internally consistent estimates for incidence, prevalence, remission and case fatality

<table>
<thead>
<tr>
<th>Disease Model</th>
<th>Global Incidence (millions)</th>
<th>Global Prevalence (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuberculosis</td>
<td>7.6</td>
<td>Diabetes mellitus</td>
</tr>
<tr>
<td>HIV infection</td>
<td>4.7</td>
<td>Major depressive episodes</td>
</tr>
<tr>
<td>AIDS</td>
<td>3.1</td>
<td>Bipolar affective disorder</td>
</tr>
<tr>
<td>Diarrhoeal diseases</td>
<td>4,371</td>
<td>Schizophrenia</td>
</tr>
<tr>
<td>Measles</td>
<td>31.3</td>
<td>Epilepsy (primary)</td>
</tr>
<tr>
<td>Meningitis</td>
<td>0.7</td>
<td>Alzheimer &amp; other dementias</td>
</tr>
<tr>
<td>Hepatitis B and C</td>
<td>1.1</td>
<td>Migraine</td>
</tr>
<tr>
<td>Malaria</td>
<td>382.0</td>
<td>Hearing loss, adult onset</td>
</tr>
<tr>
<td>Schistosomiasis</td>
<td>22.5</td>
<td>COPD</td>
</tr>
<tr>
<td>Iodine deficiency</td>
<td>802.2</td>
<td>Osteoarthritis</td>
</tr>
</tbody>
</table>
Causes of health states

Underlying disease and injury causes according to ICD rules

Health state

- HIV/AIDS
- Diabetes
- Alcohol use disorder*
- Road traffic accident

- Mobility
- Affect
- Pain
- Cognition
- Self-Care
- Usual Activities
Causes of health states

Risk factors
- Unsafe sex
- Smoking
- Physical inactivity
- Alcohol consumption

Disease and injury causes
- HIV/AIDS
- Diabetes
- Alcohol use disorder
- Coronary heart disease
- Road traffic accident

Health state
- Mobility
- Affect
- Pain
- Cognition
- Self-Care
- Usual Activities
Comparative Risk Assessment

26 global risk factors

World Health Report 2002

CRA books

National assessment tools
Ideal features of risk assessment

- Well defined scope
- Risks assessed irrespective of place in a causal chain
- Risks defined and studied comprehensively and with comparable counterfactuals
- “Common currency” outcome measures, with impact assessed in terms of lost healthy life years
- Protective as well as hazardous factors
- Population-wide risks as well as high-risk individuals
Criteria for selecting risks

- Risk factors quantified by age, sex & region selected on the basis of:
  - potential global impact
  - high likelihood of causality
  - potential modifiability
  - neither too specific or too broad
  - availability of data on risk factor distributions and risk factor-disease relationships
Risks quantified in GBD 2000

Child & maternal under-nutrition
- Childhood and maternal underweight
- Iron deficiency
- Vitamin A deficiency
- Zinc deficiency

Other nutrition-related risks & inactivity
- High blood pressure
- High cholesterol
- Overweight and obesity
- Inadequate fruit and vegetable intake
- Physical inactivity

Addictive substances
- Smoking and oral tobacco
- Alcohol
- Illicit drugs

Sexual and reproductive health risks
- Unsafe sex
- Non-use and ineffective use of contraception

Environmental risks
- Unsafe water, sanitation, and hygiene
- Urban air pollution
- Indoor smoke from solid fuels
- Lead exposure
- Climate change

Occupational risks
- Risk factors for injury
- Carcinogens
- Airborne particulates
- Ergonomic stressors
- Noise

Other selected risks to health
- Contaminated health care injections
- Child sexual abuse

Distributions of risks by poverty
Global distribution of burden of disease attributable to 20 leading selected risk factors

- Underweight
- Unsafe sex
- High blood pressure
- Tobacco
- Alcohol
- Unsafe water, S&H
- High cholesterol
- Indoor smoke from solid fuels
- Iron deficiency
- High BMI
- Zinc deficiency
- Low fruit and vegetables
- Vitamin A deficiency
- Physical inactivity
- Occupational injury risks
- Lead exposure
- Illicit drugs
- Unsafe health care injections
- Lack of contraception
- Childhood sexual abuse

Attributable DALYs (% total 1.44 billion)
# Deaths and DALYs due to leading 5 global risks

<table>
<thead>
<tr>
<th>Risk</th>
<th>Deaths (M)</th>
<th>DALYs (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Underweight</td>
<td>3.7</td>
<td>6.7%</td>
</tr>
<tr>
<td>Unsafe sex</td>
<td>2.9</td>
<td>5.2%</td>
</tr>
<tr>
<td>Blood pressure</td>
<td>7.1</td>
<td>12.8%</td>
</tr>
<tr>
<td>Tobacco</td>
<td>4.9</td>
<td>8.8%</td>
</tr>
<tr>
<td>Alcohol</td>
<td>1.8</td>
<td>3.2%</td>
</tr>
<tr>
<td><strong>Joint effects</strong></td>
<td><strong>31%</strong></td>
<td></td>
</tr>
</tbody>
</table>
For more information

http://www.who.int/evidence/bod

http://www.dcp2.org/pubs/GBD