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

\[ YLL = N \times L_x \]

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

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

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

- **YLD** = Years of life lived with disability
- **I** = Number of incident cases in the population
- **DW** = Disability weight
- **d** = 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
<table>
<thead>
<tr>
<th>Disability weight</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>0.00-0.02</strong></td>
<td>Vitiligo on face, weight-for-height less than 2 standard deviations</td>
</tr>
<tr>
<td><strong>0.02-0.12</strong></td>
<td>Watery diarrhoea, severe sore throat, severe anaemia</td>
</tr>
<tr>
<td><strong>0.12-0.24</strong></td>
<td>Radius fracture, infertility, erectile dysfunction, rheumatoid arthritis, angina</td>
</tr>
<tr>
<td><strong>0.24-0.36</strong></td>
<td>Below-the-knee amputation, deafness</td>
</tr>
<tr>
<td><strong>0.36-0.50</strong></td>
<td>Rectovaginal fistula, mild mental retardation, Down syndrome</td>
</tr>
<tr>
<td><strong>0.50-0.70</strong></td>
<td>Major depression, blindness, paraplegia</td>
</tr>
<tr>
<td><strong>0.70-1.00</strong></td>
<td>Active psychosis, dementia, severe migraine, quadriplegia</td>
</tr>
</tbody>
</table>
## Value Choices for the DALY

<table>
<thead>
<tr>
<th>Component</th>
<th>Choice</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

[Graph showing the effect of discounting and age weights on YLL per death for different scenarios labeled YLL(0,0), YLL(3,1), YLL(3,0) for males and females.]
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

- Healthy
  - Incidence
  - Remission
- Diseased
  - Case fatality
- Dead from disease
- Dead from all other causes
  - All other mortality

Measurement and Health Information
# Approximate number of data sources, GBD 2000-2002

<table>
<thead>
<tr>
<th>Mortality - causes of death</th>
<th>Approximate total datasets used</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>Epidemiological studies/register/HS data etc</td>
<td>10,052</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>
</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><strong>World</strong></td>
<td><strong>770</strong></td>
<td><strong>535</strong></td>
<td><strong>8,747</strong></td>
<td><strong>10,052</strong></td>
</tr>
</tbody>
</table>
Burden of disease by region, 2002

HIV/AIDS
Other infectious and parasitic*
Maternal, perinatal and nutritional
Cardiovascular diseases
Cancers
Neuropsychiatric
Other noncommunicable
Unintentional injuries
Intentional injuries

High income
Europe and Central Asia
Latin America and Caribbean
Middle East and North Africa
East Asia and Pacific
South Asia
Sub-Saharan Africa

DALYs per 1,000
### Leading Causes of Mortality and Burden

Global estimates for 2002

<table>
<thead>
<tr>
<th>Mortality</th>
<th>DALYs</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Ischaemic heart disease</td>
<td>• Perinatal conditions</td>
</tr>
<tr>
<td>• Cerebrovascular disease</td>
<td>• Lower respiratory infections</td>
</tr>
<tr>
<td>• Lower respiratory infections</td>
<td>• HIV/ AIDS</td>
</tr>
<tr>
<td>• HIV/ AIDS</td>
<td>• Depression</td>
</tr>
<tr>
<td>• COPD</td>
<td>• Diarrhoeal diseases</td>
</tr>
<tr>
<td>• Perinatal conditions</td>
<td>• Ischaemic heart disease</td>
</tr>
<tr>
<td>• Diarrhoeal diseases</td>
<td>• Cerebrovascular disease</td>
</tr>
<tr>
<td>• Tuberculosis</td>
<td>• Malaria</td>
</tr>
<tr>
<td>• Malaria</td>
<td>• Road traffic accidents</td>
</tr>
<tr>
<td>• Lung Cancer</td>
<td>• Tuberculosis</td>
</tr>
<tr>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>12.6</td>
<td>6.5</td>
</tr>
<tr>
<td>9.7</td>
<td>6.1</td>
</tr>
<tr>
<td>6.8</td>
<td>5.7</td>
</tr>
<tr>
<td>4.9</td>
<td>4.5</td>
</tr>
<tr>
<td>4.8</td>
<td>4.2</td>
</tr>
<tr>
<td>4.3</td>
<td>3.9</td>
</tr>
<tr>
<td>3.2</td>
<td>3.3</td>
</tr>
<tr>
<td>2.7</td>
<td>3.1</td>
</tr>
<tr>
<td>2.2</td>
<td>2.6</td>
</tr>
<tr>
<td>2.2</td>
<td>2.3</td>
</tr>
<tr>
<td>Disease Model</td>
<td>Global Incidence (millions)</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>7.6</td>
</tr>
<tr>
<td>HIV infection</td>
<td>4.7</td>
</tr>
<tr>
<td>AIDS</td>
<td>3.1</td>
</tr>
<tr>
<td>Diarrhoeal diseases</td>
<td>4,371</td>
</tr>
<tr>
<td>Measles</td>
<td>31.3</td>
</tr>
<tr>
<td>Meningitis</td>
<td>0.7</td>
</tr>
<tr>
<td>Hepatitis B and C</td>
<td>1.1</td>
</tr>
<tr>
<td>Malaria</td>
<td>382.0</td>
</tr>
<tr>
<td>Schistosomiasis</td>
<td>22.5</td>
</tr>
<tr>
<td>Iodine deficiency</td>
<td>802.2</td>
</tr>
</tbody>
</table>
Causes of health states

Underlying disease and injury causes according to ICD rules

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

Health state

- 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)

- Low and middle income
- High income
## Deaths and DALYs due to leading 5 global risks

<table>
<thead>
<tr>
<th>Risk</th>
<th>Deaths (M)</th>
<th>%</th>
<th>DALYs (M)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>3.7</td>
<td>6.7%</td>
<td>137.8</td>
<td>9.5%</td>
</tr>
<tr>
<td>Unsafe sex</td>
<td>2.9</td>
<td>5.2%</td>
<td>91.9</td>
<td>6.3%</td>
</tr>
<tr>
<td>Blood pressure</td>
<td>7.1</td>
<td>12.8%</td>
<td>64.3</td>
<td>4.4%</td>
</tr>
<tr>
<td>Tobacco</td>
<td>4.9</td>
<td>8.8%</td>
<td>59.1</td>
<td>4.1%</td>
</tr>
<tr>
<td>Alcohol</td>
<td>1.8</td>
<td>3.2%</td>
<td>58.3</td>
<td>4.0%</td>
</tr>
<tr>
<td><strong>Joint effects</strong></td>
<td><strong>31%</strong></td>
<td></td>
<td><strong>25%</strong></td>
<td></td>
</tr>
</tbody>
</table>
For more information

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

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