Data inputs and assumptions in calculating the non-fatal burden in burden of disease studies

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Disability Adjusted Life Years (DALY)

Fatal burden of disease ⟶ Years of life lost

Non-fatal burden of disease ⟶ Years lived with disability

years of life lost (YLLs) + years lived with disability (YLDs)

Year lived with disability (YLD)

DALY = YLL + (YLD)

Years of healthy life lost due to disability

$$= \Sigma \,(\mathbf{p} \times \mathbf{dw})$$

p – prevalence
dw – disability weight

Calculating YLD

$$\Sigma\ (\mathbf{n} \times \mathbf{dw})$$

n – number of cases
dw – disability weight

What you need

⇒ Prevalence data for country by age category and gender

⇒ Disability weights

⇒ Severity distribution

Prevalence data

Prevalence data can be obtained from:

- Disease surveillance
- Administrative data (e.g. hospital discharge data)
- Epidemiological studies
- Health surveys

Note: all data must reflect the total population

Disability weights

- Disability weights provide the bridge between mortality and non-fatal outcomes in DALYs

- Value between 0 (full health) and 1 (death)

- Disability weights reflect the severity of outcomes as percentage reduction from perfect health

e.g., if weight for heart failure due to ischemic heart disease were 0.10, then 10 people living with ischemic heart disease would be equivalent to the loss of one year due to premature mortality

- Several sets of disability weights exist of which the GBD disability weights are used most widely.
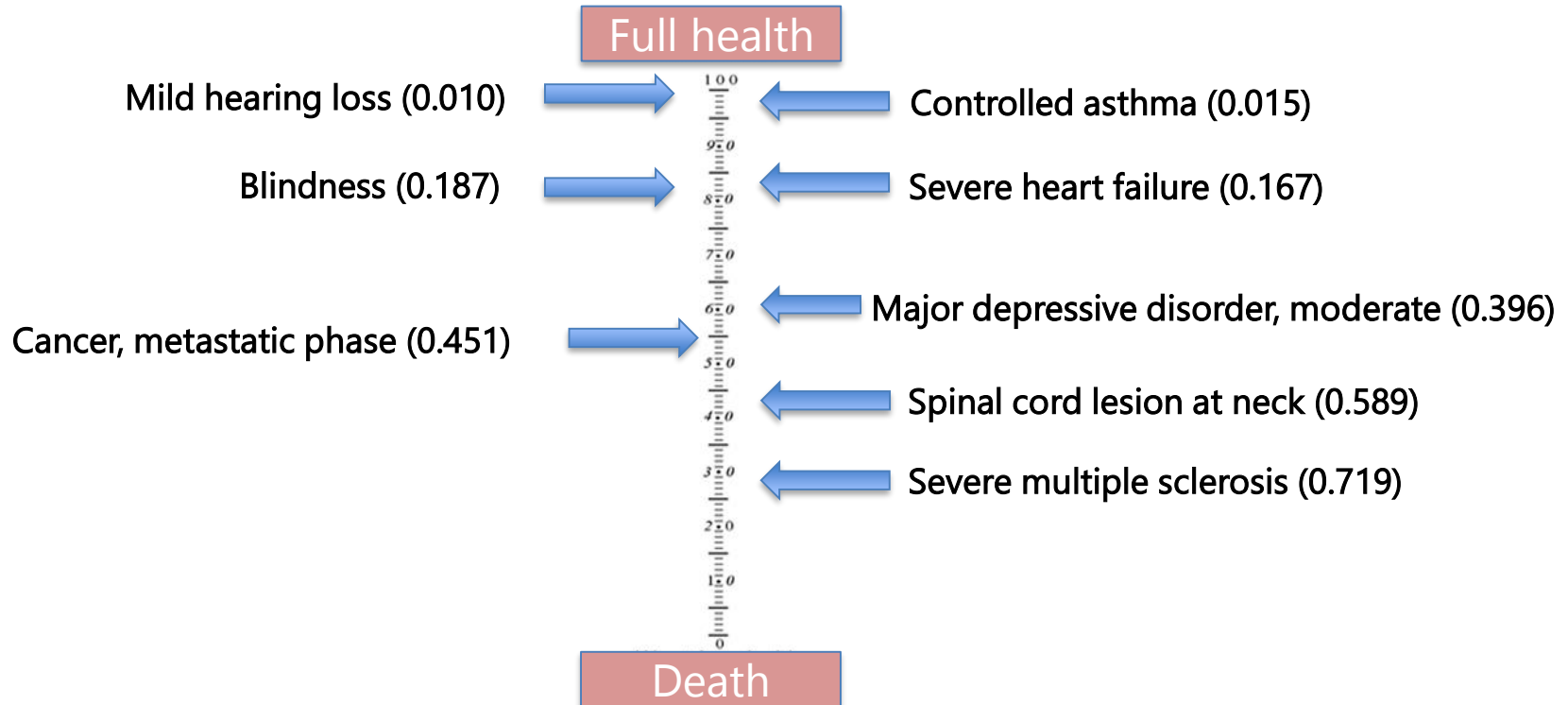
GBD disability weights

- Disability weights are based on the health state valuation of a panel judges
- 30,230 respondents from >175 countries
- Paired comparison and population health equivalence questions
- ~220 health states

The first person	The second person
is paralysed from the neck down and cannot feel or move the arms and legs.	is short of breath and feels tired when at rest. The person avoids any physical activity, for fear of worsening the breathing problems.

Who do you think **is healthier overall**, the first person or the second person?

Examples of disability weights

Full health

Mild hearing loss (0.010) → Controlled asthma (0.015)

Blindness (0.187) → Severe heart failure (0.167)

Major depressive disorder, moderate (0.396)

Cancer, metastatic phase (0.451) → Spinal cord lesion at neck (0.589)

Severe multiple sclerosis (0.719)

Death

Severity level

- Many diseases result in a spectrum of severity of functional limitations

- For many diseases disability weights are available for more than one level of severity

	Disability weight
Mild heart failure due to ischemic heart disease	0.041
Moderate heart failure due to ischemic heart disease	0.072
Severe heart failure due to ischemic heart disease	0.179

Severity distribution

- Provides mapping of prevalence data to disability weights
- Can be obtained from empirical measurement of variation of severity across individuals (e.g. cohort studies)
- Data should provide information on functional outcome

Heart failure due to ischemic heart disease

23% → Mild

22% → Moderate

55% → Severe
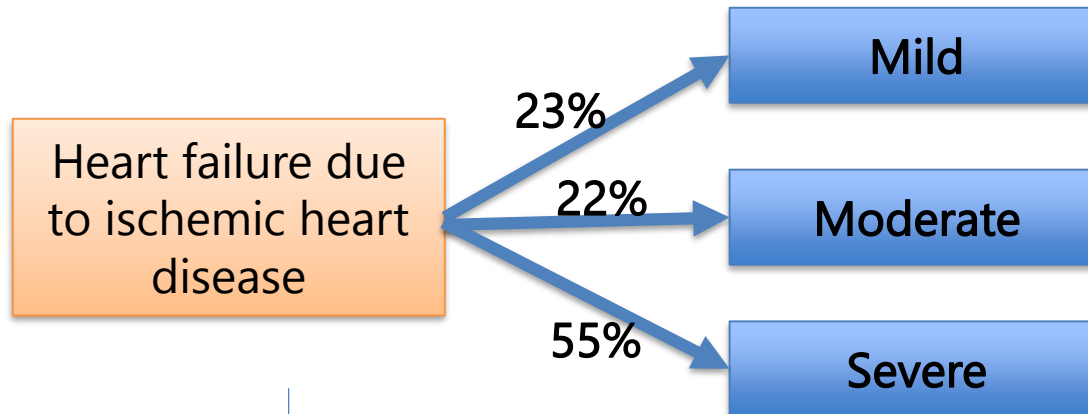
Severity distribution data

- Patient data with information on functional outcome
  - E.g. disease specific functional outcome scales
    (GOSE for traumatic brain injury)
  - E.g. health-related quality of life data
    - *(EQ-5D, SF-12 etc.)*

- Use existing severity distributions
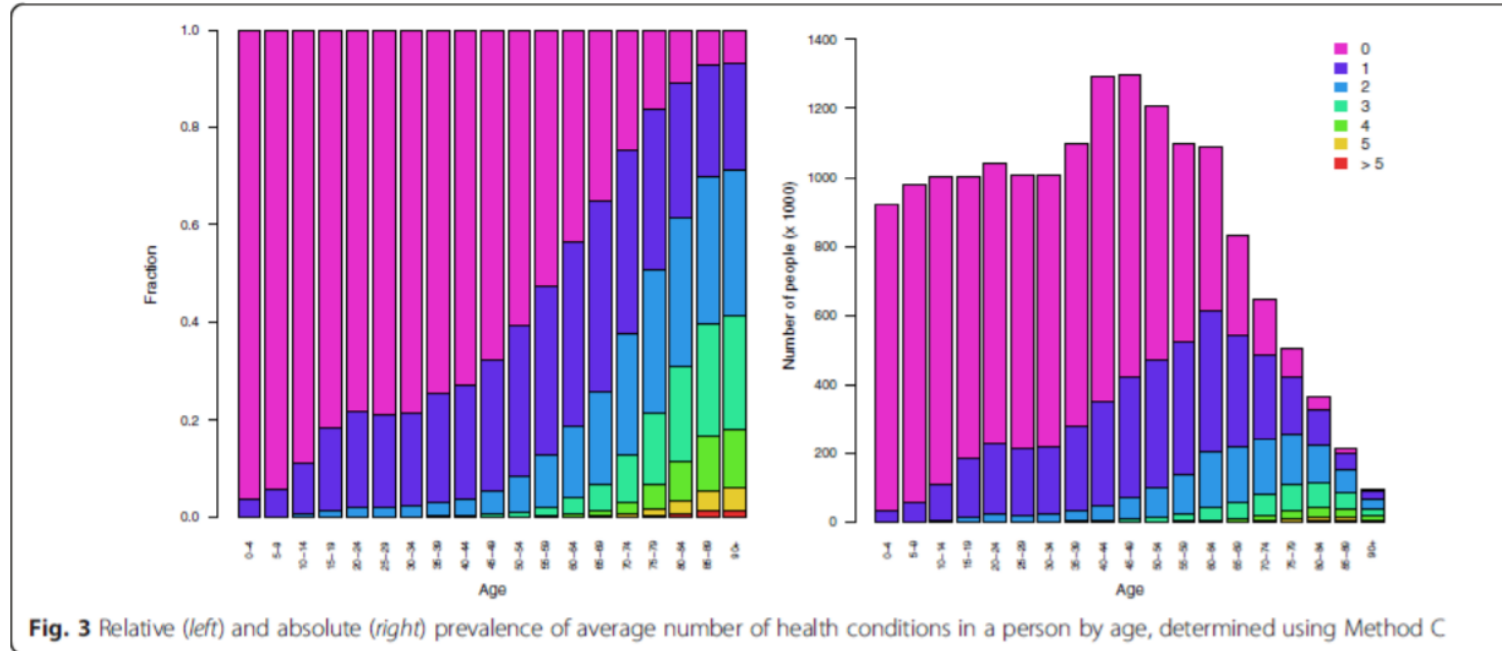 - E.g. Global burden of disease study

Calculating YLD

$$\Sigma\,(\mathbf{n}\times\mathbf{dw})$$

n – number of cases
dw – disability weight

What you need? How to obtain it?

$\Rightarrow$ Prevalence data for country by age category and gender

$\Rightarrow$ Disability weights

$\Rightarrow$ Severity distribution

Multi-morbidity

Fig. 3 Relative (*left*) and absolute (*right*) prevalence of average number of health conditions in a person by age, determined using Method C

Hilderink et al. (2016). Accounting for multimorbidity can affect the estimation of the Burden of Disease: a comparison of approaches

Multi-morbidity adjustment

- Assumption: Each person can only contribute to his/her overall YLD with a maximum weight of 1

- Given a year of interest, an individual weight of more than one would mean that a (living but ill) person has a loss of more than one year compared to the loss of a person that died

- If we won´t adjust for multi-morbidity, then we would run into danger that we overestimate the disease specific contribution of one person

Dealing with uncertainties

- **Uncertainty analysis**

  = *uncertainty propagation, probabilistic sensitivity analysis*

  - e.g. Monte Carlo simulations

- **Sensitivity analysis**

  = *variable importance analysis*

  - contribution of uncertainty in inputs to uncertainty in output

- **Scenario analysis**

  - comparison of multiple, discrete scenarios

In summary - interpretation of DALYs

↑ **DALY** = **YLL** + **YLD**

High number of deaths

High life expectancy assumed

Death at young age