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Section B: Days of Life Lost: Grandfather of DALYs

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Days of Life (DLL)

- Approach of the Ghana Health Assessment Team (1976–1981)
- Forms foundation of the HeaLY/DALY approach
- The DLL index based on estimation of incidence, case fatality, case disability, average age of onset, duration, and local expectation of life
- Summed over the whole population and based on rates per 1,000 population

DLL: Elements 1

- Local Ghana life tables were used to determine the potential at each age
- Morbidity was added
- Estimation of disability done nationally using community and expert opinion
- Each year of life was valued equally
- Discounting of the future stream of losses done at 3% per annum

DLL: Elements 2

- Division of disability into temporary, permanent, and that prior to death
  - These categories introduces a level of detail that was difficult to support with valid data at that time
- Based on clinical approach of disease onset and prospective view
- Date mostly institution based in Ghana

Disability Adjusted Life Years (DALYs)

- First introduction

Disability Adjusted Life Years

- Loss from premature deaths is assessed by evaluating deaths in a year—years of life lost (YLLs)
- Life lost from disability is estimated using years of life lived with disability (YLD)
- The combination of YLLs and YLDs gives DALYs
- Originally a single equation was used to incorporate all technical and value choices

DALYs 2

- DALY calculation uses the age distribution of deaths by cause for a year to estimate standard expected years of life
- Model life table based on very low levels of mortality
- Loss of life from premature mortality is based on the accurate recording of deaths in any year and reflects current mortality experience

DALYs 3

- For disability, DALY method used estimates of incidence, duration, and severity to calculate the time lived with disability across age groups
- The onset of disability, an estimate of its severity at each stage and period of time spent in each stage is estimated to generate YLDs
- Each condition is compared in terms of the extent of the "disability" with death as 1 and perfect health as 0

DALYs 4

- Calculations for DALYs have been expressed in the form of an integral (more later)
- DALYs are good measures of intervention effectiveness
- Tools for internal consistency checks have been developed
  - E.g., DISMOD software
  - http://www.who.int/healthinfo/global_burden_disease/tools_software/en/index.html
- Plethora of literature under Murray & Lopez, et al.

Disability Adjusted Life Year = DALY

$$DALY = YLL + YLD$$

$$YLL = N\,Ce^{(ra)} / (\beta+r)^2 \left[e^{-(\beta+r)(L+a)}\left[-(\beta+r)(L+a)-1\right] - e^{-(\beta+r)a}\left[-(\beta+r)a-1\right]\right]$$

PLUS

$$YLD = I\,DW\left\{K\,Ce^{(ra)} / (\beta+r)^2 \left[e^{-(\beta+r)(L+a)}\left[-(\beta+r)(L+a)-1\right] - e^{-(\beta+r)a}\left[-(\beta+r)a-1\right]\right] + (1-K)(L/r)\left(1-e^{-rL}\right)\right\}$$

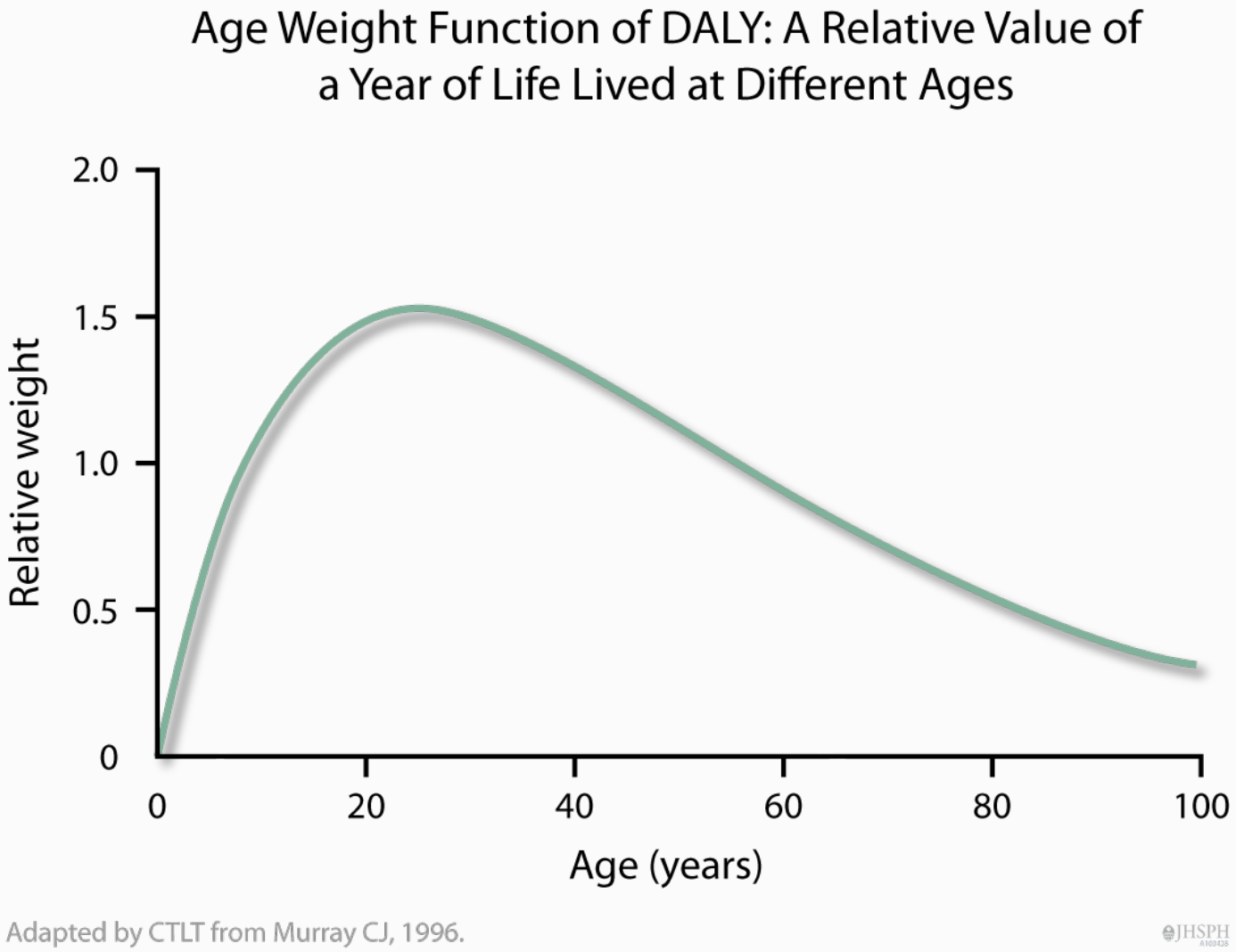
Disability Adjusted Life Year = DALY

- DALY = YLL + YLD
  - N = number of deaths
  - I = number of incident cases
  - L = life expectation or duration of disability
  - DW = disability weight
  - r = discount rate (for GBD=0.03)
  - C = age-weighting correction constant (for GBD=0.1658)
  - ß = parameter for age-weighting function (for GBD=0.04)
  - a = age at onset
  - K = a parameter for setting age-weighting (applied K=1, not applied K=0)

Age Weight Function of DALY

- A relative value of a year of life lived at different ages
  - The age weight function has the following form: $Cxe^{-\beta x}$ where:
    - ß and C are arbitrarily chosen constants
    - x = age in years (starting at birth)
    - *e* = base for natural logarithm (about 2.718)
  - ß was chosen to be 0.04 and C to be 0.1658
    - Thus for age = 5, the relative value was $0.1658*5e^{-0.04*5} = 0.818$
  - Note that when x = 25, $e^{-0.04*25} = e^{-1}$ and $0.1658*25e^{-1} = 1.52$ which maximizes the function for x

Age Weight Function of DALY



Source: Murray C. J. (1996).

Increasing Burden of Injuries

- 1999 disease or injury
  1. Acute lower respiratory infections
  2. HIV/AIDS
  3. Perinatal conditions
  4. Diarrheal diseases
  5. Unipolar major depression
  6. Ischemic heart disease
  7. Cerebrovascular disease
  8. Malaria
  9. Road traffic injuries
  10. Chronic obstructive pulmonary disease
  11. Congenital abnormalities
  12. Tuberculosis
  13. Falls
  14. Measles
  15. Anemia

- 2020 disease or injury
  1. Ischemic heart disease
  2. Unipolar major depression
  3. Road traffic injuries
  4. Cerebrovascular disease
  5. Chronic obstructive pulmonary disease
  6. Lower respiratory infections
  7. Tuberculosis
  8. War
  9. Diarrheal diseases
  10. HIV
  11. Perinatal conditions
  12. Violence
  13. Congenital abnormalities
  14. Self-inflicted injuries
  15. Trachea, bronchus and lung cancers

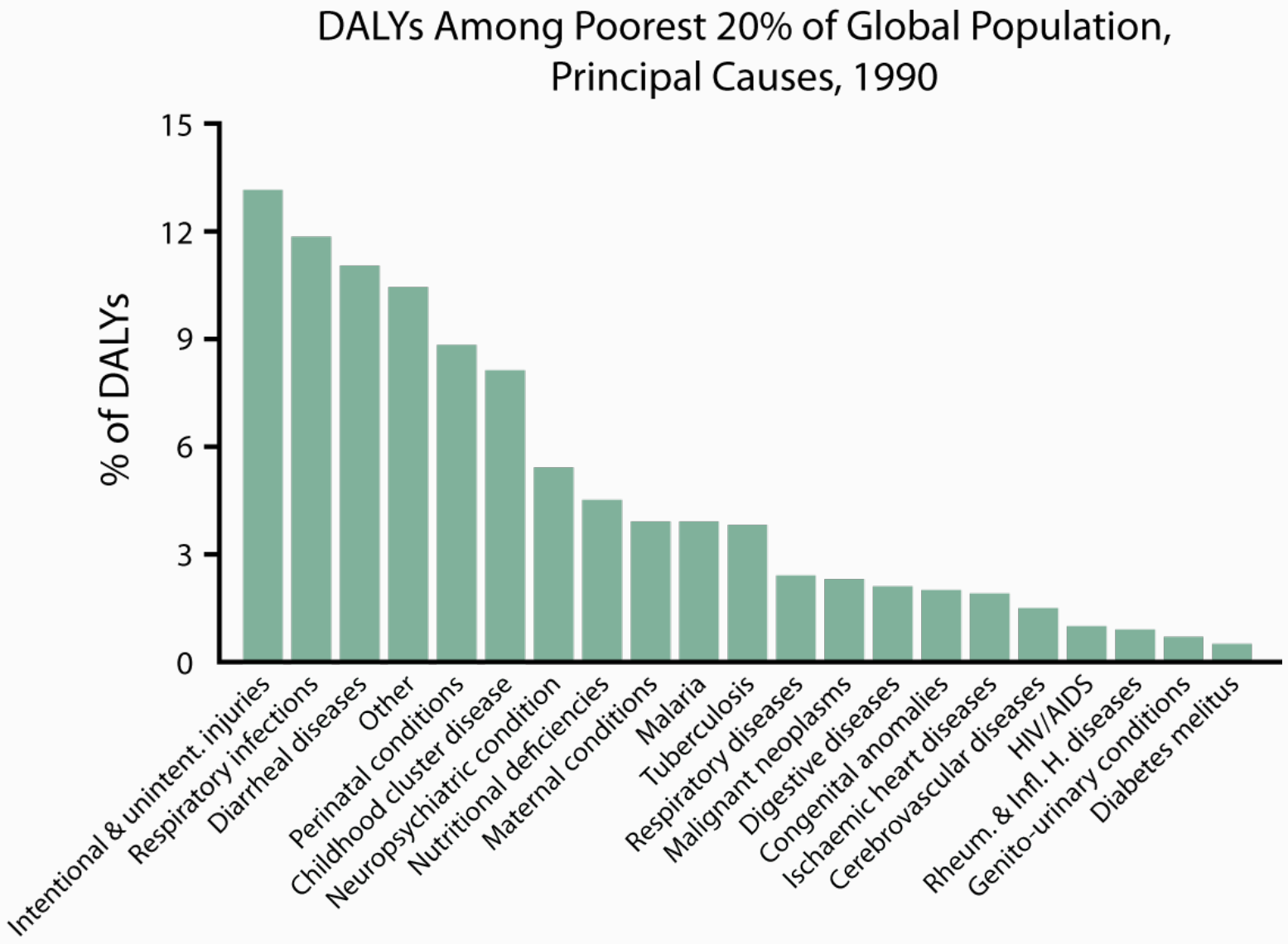
Source: WHO. (2000). *Evidence, information, and policy*.

BOD Rate: DALYs, by Country Income Level

- Burden of disease (BOD) rate (DALYs/100,000 population), by Country Income Level (2000)

	Low and middle income	High income
Communicable diseases (inc., maternal, perinatal, and nutrition)	11,206	863
Non-communicable diseases	10,200	9,664
Injuries	4,198	1,403

DALYs, 1990



Adapted by CTLT from The Burden of Disease among the Global Poor, World Bank, 2000.

Other Indicators

- Not really summary measures

Health-Related Quality of Life

- Refers to how well an individual functions in daily life and the perception of well-being
- In the medical literature for decades, including clinical research literature
- Domains of quality have been defined, such as health perception, functional status, and opportunity, and several instrument have been developed to evaluate them

HRQL 2

- There are disease-specific and general instruments
- Very often self-reported information
- E.g., SF-36, multiple sclerosis, etc.
- We will not be discussing these measures in this course