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## Comparison: HeaLYs vs. DALYs, and DALYs vs. QALYs

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# Learning Objectives

- Work out the calculations for HeaLYs, DALYs, and QALYs
- List the main differences among the three measures

# Comparison of HeaLYs and DALYs

- DALYs exactly = HeaLYs when ...
  1. The condition in question is in equilibrium, that is the Incidence, CFR, and Disability variables remain constant during the time intervals under consideration  
*and*
  2. Age weighting is not applied ( $K=0$ )  
*and*
  3. Same measures of disability are used

## Healthy Life Years: HeaLYs

- Healthy life years - HeaLYs lost per 1,000 population per year

$$I * \{ [CFR * \{E(Ao) - [Af - Ao]\}] + [CDR * De * Dt] \}$$

(Expressed as HeaLYs per 1,000 pop per year)

# Variables for HeaLY Estimation

<b>I</b>	<b>Incidence rate per 1,000 population per year</b>	<b>(Per 1,000 per year)</b>
<b>Ao</b>	<b>Average age at onset</b>	<b>(Years)</b>
<b>Af</b>	<b>Average age at death</b>	<b>(Years)</b>
<b>E(Ao)</b>	<b>Expectation of life at age of onset</b>	<b>(Years)</b>
<b>E(Af)</b>	<b>Expectation of life at age of death</b>	<b>(Years)</b>

## Variables for HeaLY Estimation

<b>CFR</b>	<b>Case fatality ratio: proportion of those developing the disease who die from the disease</b>	<b>(0.00-1.00)</b>
<b>CDR</b>	<b>Case disability ratio: proportion of those developing the disease who have disability from the disease</b>	<b>(0.00-1.00)</b>
<b>De</b>	<b>Extent of disability (from none to complete disability equivalent to death)</b>	<b>(0.00-1.00)</b>
<b>Dt</b>	<b>Average duration of disability for those disabled by the disease; a composite of temporary and permanent disability based on the proportion of cases in each category</b>	<b>(Years)</b>

## Interventions May Have the Following Effects on HLL:

<b><u>Sign</u></b>	<b><u>Explanation</u></b>
$\Delta I$	Reduction factor for Incidence among those covered by the intervention
$\Delta CFR$	Reduction factor for Case Fatality Ratio among those covered by the intervention
$\Delta A_f$	Extension factor for Age at death
$\Delta CDR$	Reduction factor for Case Disability Ratio among those covered by the intervention
$\Delta D_e$	Reduction factor for Extent of disability among those covered by the intervention
$\Delta D_t$	Reduction factor for Duration of disability among those covered by the intervention
$PC_1$	Proportion of Population Covered by present health system interventions
$PC_n$	Proportion of Population Covered by proposed health system interventions
$\Delta X_n$	Reduction factor for $X$ among those covered by proposed
<b>YHLG</b>	Years of Healthy Life Gained per thousand per 1000 population per year for preventive interventions (those affecting incidence)

$$= \Delta I * [(CFR * (E(A_0) - (A_f - A_0))) + (CDR * D_e * D_t)]$$



# Disability Adjusted Life Year = DALY

$$\mathbf{DALY = YLL + YLD}$$

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

**Plus**

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

## Disability Adjusted Life Year = DALY

$$\text{DALY} = \text{YLL} + \text{YLD}$$

**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)

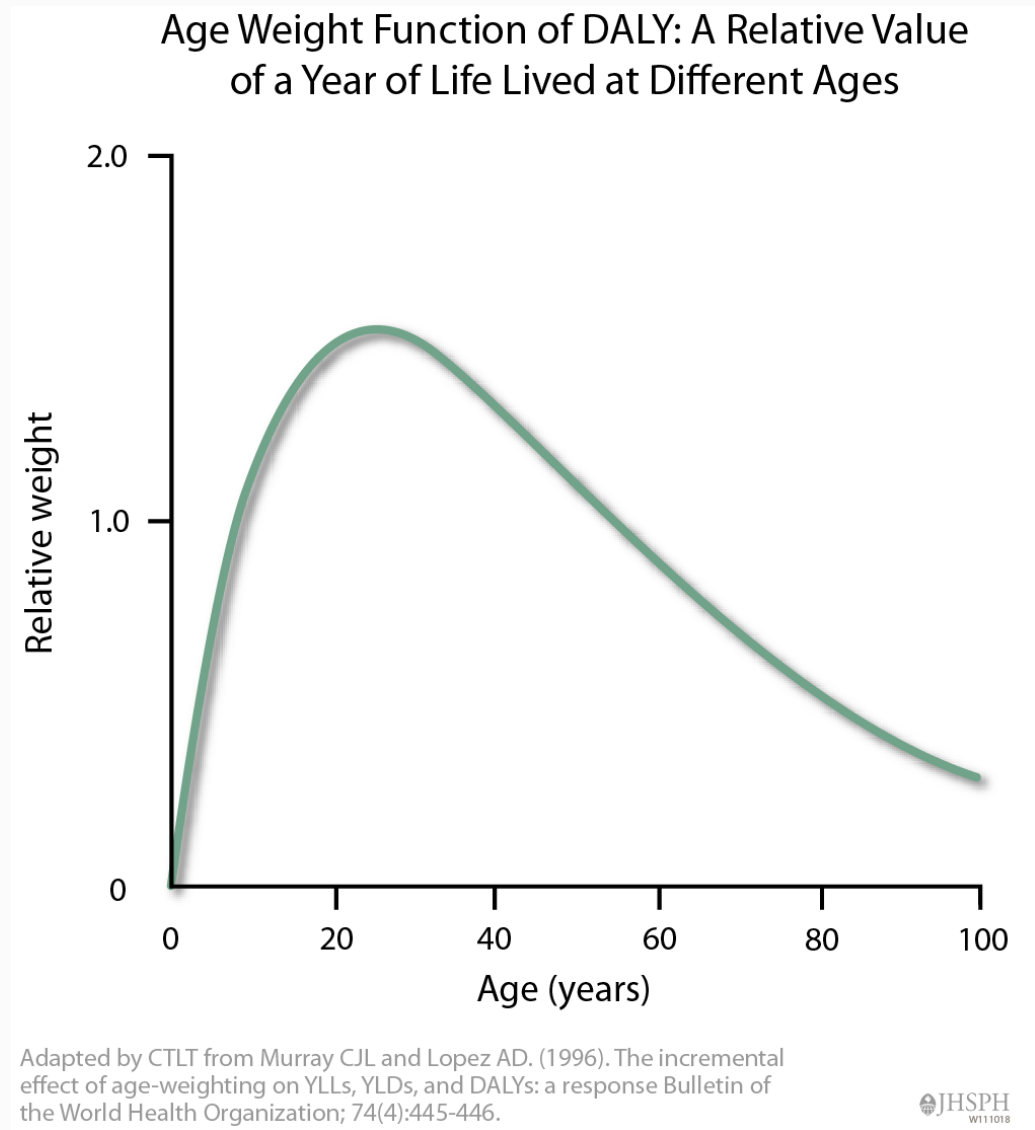
**C** = age-weighting correction constant (for GBD = 0.1658)

**$\beta$**  = parameter for age-weighting function (for GBD = 0.04)

**a** = age at onset

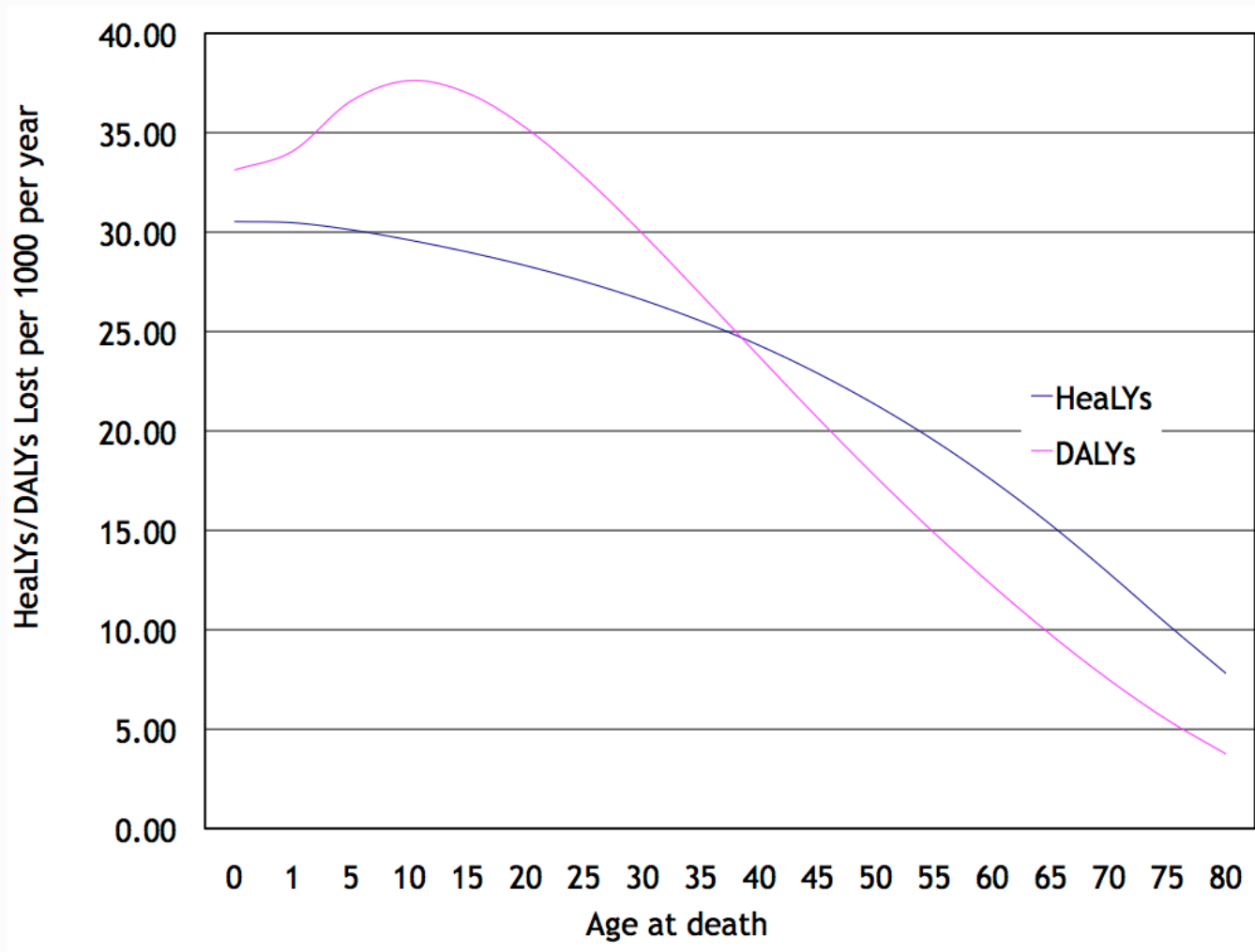
**K** = a parameter for setting age-weighting (applied K=1, not applied K=0)

# Age Weight Function of DALY



# HeaLYs and DALYs Lost from Premature Mortality

- Comparison of discounted HeaLYs and DALYs lost from premature mortality, by age at death

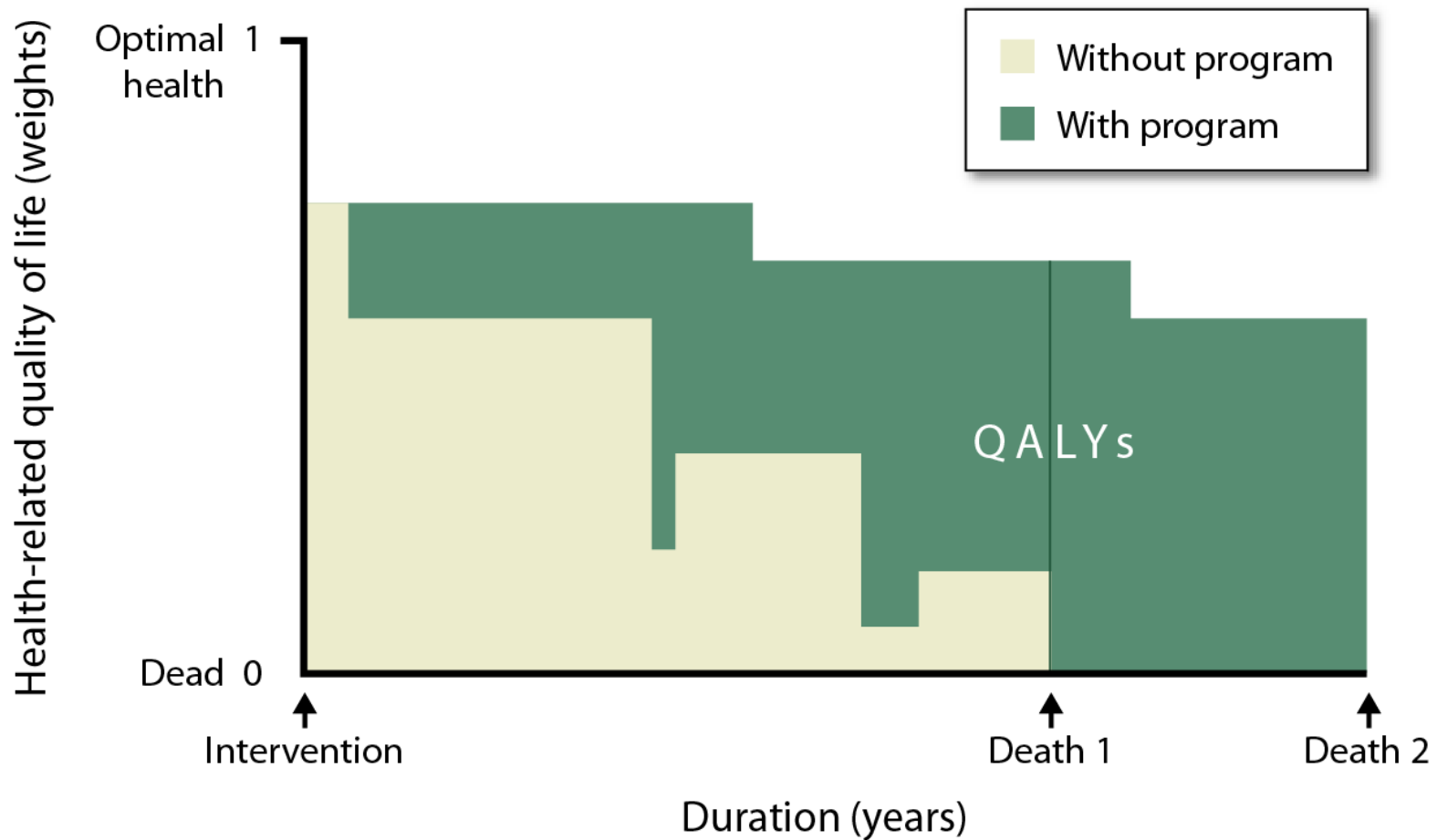


## Comparison of QALYs and DALYs

- DALYs = YLL (years of life lost due to death before expectation of life had the disease not occurred) + YLD (years lived disability \* disability weight)
- QALYs = YLDs when
  1. Age weighting is not applied to YLDs  
*and*
  2. Disability weights are the same  
*and*
  3. Discount rates are the same
- QALYs do not normally count YLL, that is, the remaining life expected at time of death had the disease not occurred, and normally do not discount

# QALYs Gained

## Quality-Adjusted Life Years (QALYs) Gained from an Intervention



Adapted by CTLT from Gold, M.R., et al (1996). *Cost Effectiveness in Health and Medicine*. Oxford University Press.  W111014