
DTU

Burden of Disease

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Outline

1. What is Burden of Disease (BoD)?
2. History of BoD
3. Disability-Adjusted Life Years
4. Burden of disease in the context of food safety and nutrition
5. Burden of disease in the context of risk-benefit assessment
6. Take-home messages

WHAT IS HEALTH?

What is health?

Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity

Preamble to the Constitution of WHO as adopted by the International Health Conference, New York, 19 June - 22 July 1946

Why measure health?

Public health policy

Protect and promote population health

Set priorities for control and research

Evidence-based

Nature and size of health problems in the population

Groups that are particular at risk

Trends over time

Compare problems: **relative** impact of diseases

- **Burden of disease**

Comparison of diseases and health states

Which disease is more important? How can we compare?

Figure adapted from Brecht Devleesschauwer

Comparison of diseases and health states

***Simple* measures of health impact**

- Incidence/prevalence
- Mortality
- **Loss of quality of life?**

Figure adapted from Brecht Devleesschauwer

Health metrics

	Health Experience	Health Loss
Mortality	Life Expectancy	Potential Years of Life Lost Standard Expected Years of Life Lost
Morbidity	**Quality-adjusted life year**	Years Lived with Disability
Morbidity + mortality	Active Life Expectancy Disability-free Life Expectancy Healthy Life Years Quality-Adjusted Life Expectancy Disability-Adjusted Life Expectancy	**Disability-Adjusted Life Year**

What is Burden of Disease

Description of death and loss of health due to diseases, injuries and risk factors

Rationale

Available information on the health of populations often fragmented and inconsistent

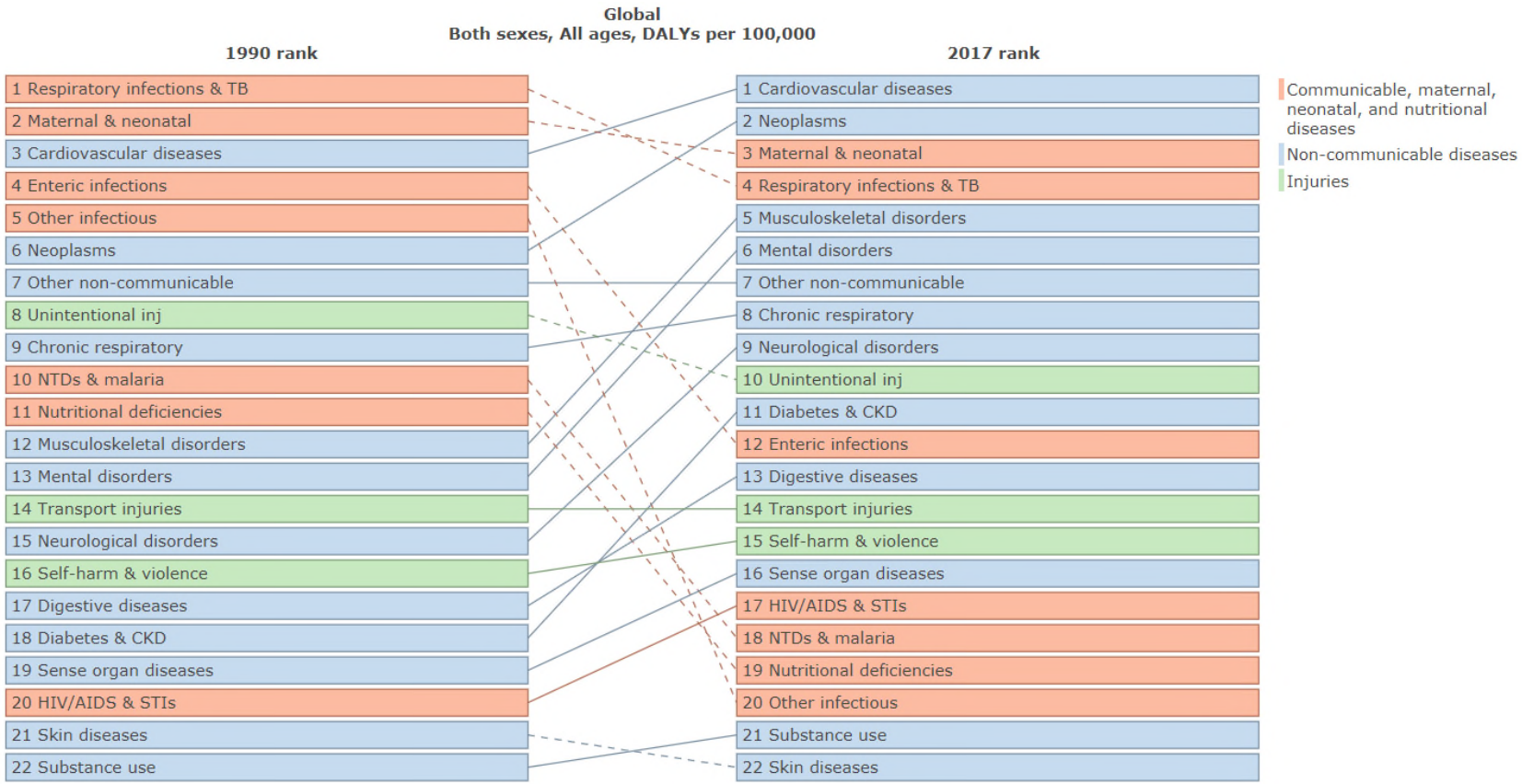
Need for framework to integrate, analyze and disseminate information

Consistent and comparable descriptions of the burden of diseases, injuries and risk factors

Global Burden of Disease (GBD): the history

Figure adapted from Brecht Devleesschauwer

Global Burden of Disease (GBD)



From GBD Compare (IHME): https://vizhub.healthdata.org/gbd-compare/

Global Burden of Disease (GBD)

- Comprehensive and comparable estimates of health impact of diseases and risk factors
- Surveillance of global health over time
- Builds on harmonized approaches to estimate burden using a recognized, accepted **health metric**

Disability-Adjusted Life Year (DALY)

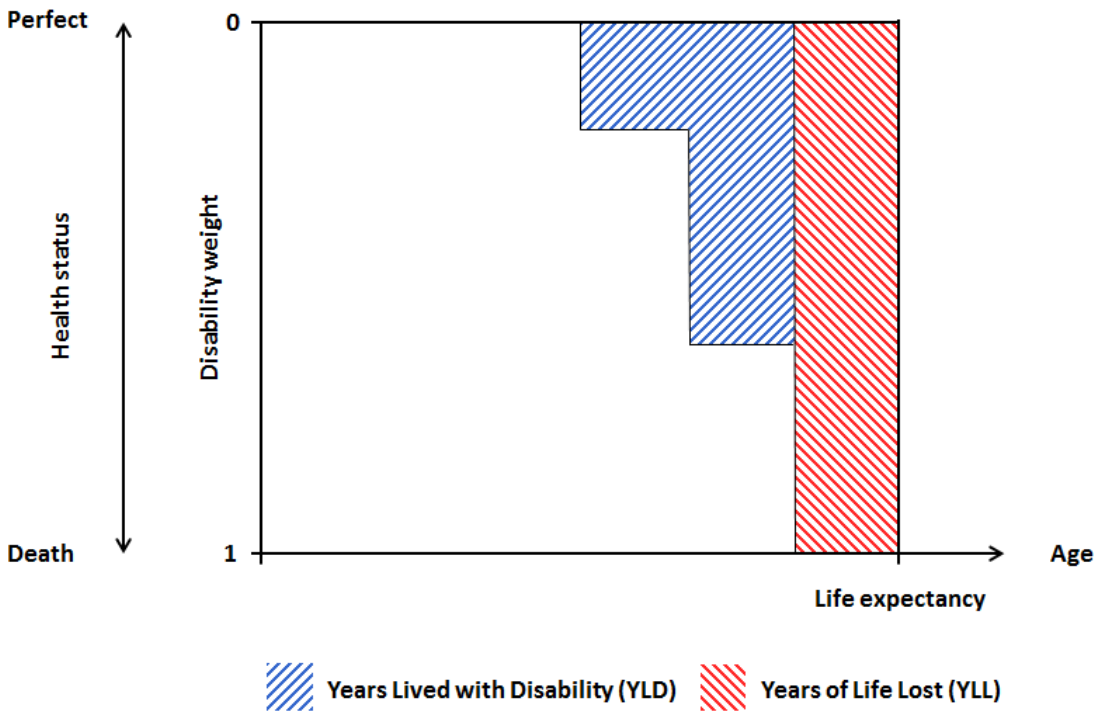
Developed in early 1990's, Harvard School of Public Health (Chris Murray, Alan Lopez) & WHO

Health gap measure: compares a given health state with an ideal state of health and wellbeing

Summary measure of population health: combines incidence, severity, and duration of disease with the years of life lost due to premature death

1 DALY = 1 healthy life year lost

Disability-Adjusted Life Year (DALY)



$$DALY = YLD + YLL$$

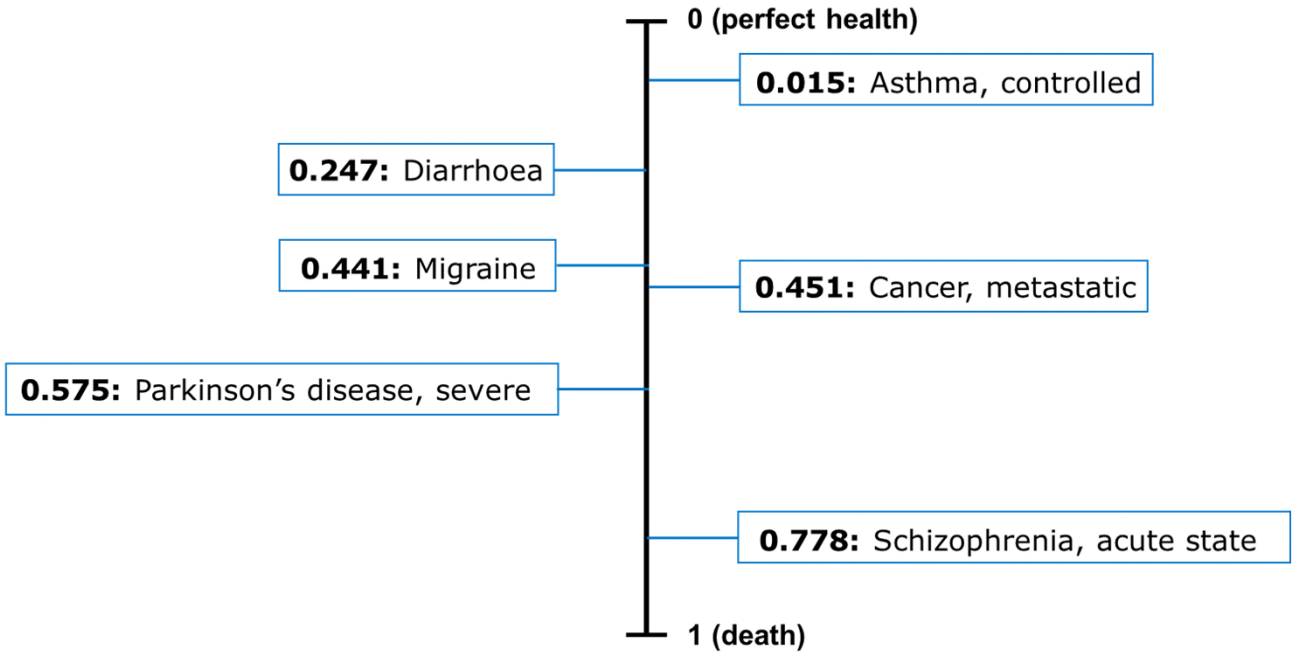
$$YLD = N_{cases} \times D \times DW$$

$$YLL = N_{deaths} \times LE_{residual}$$

N_{cases}: no. of cases (incidence/prevalence)
D: duration
DW: disability weight
N_{deaths}: no. of deaths (mortality)
$LE_{residual}$: residual life expectancy

Disability-Adjusted Life Year (DALY)

Disability weight: *Relative severity of symptom/health state*



Disability weights from: Salomon *et al.* Disability weights for the Global Burden of Disease 2013 study. Lancet Glob Health. 2015 Nov;3(11):e712-23. doi: 10.1016/S2214-109X(15)00069-8.

Disability-Adjusted Life Year (DALY)

Residual life expectancy

Local life expectancy table

- Specific for a certain population
- Reflects local demographics and mortality patterns

"**Standard" life expectancy table**

- Biologically maximum life expectancies
- Assures equity:
  - Each death at a given age is equal
  - Deaths across countries and regions are valued equally

GBD2010: synthetic life expectancy table based on highest observed life expectancies per age group

- LE at birth = **86** (no gender differences)

WHO/GHE: projected frontier life expectancy, 2050

- LE at birth = **92** (no gender differences)

Disability-Adjusted Life Year (DALY)

Disease models / outcome tree

Schematic representation of "**health states**"

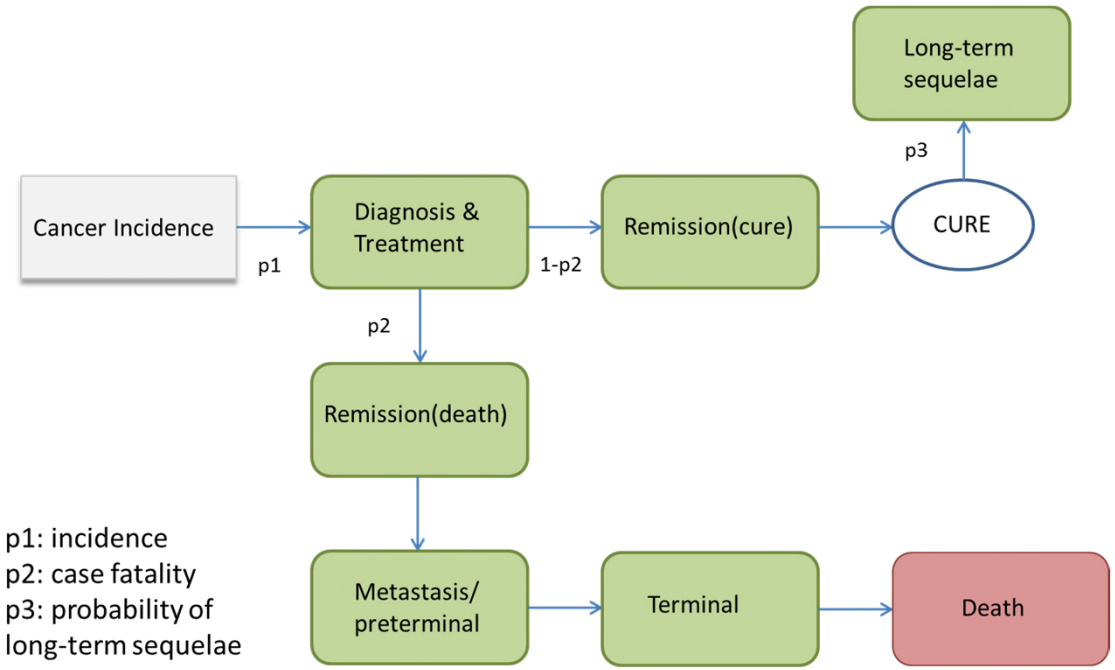
- acute, chronic stages; complications; death
- multiple severity levels

Point of interest

- Outcome-based
- Hazard-based
- Risk factor-based

Disability-Adjusted Life Year (DALY)

Disease models / outcome tree



Thomsen *et al.,* Investigating the risk-benefit balance of substituting red and processed meat with fish in a Danish diet, Food and Chemical Toxicology, Volume 120, 2018, p. 50-63, https://doi.org/10.1016/j.fct.2018.06.063. Supplemental Material A.

Burden of disease in the context of food safety and nutrition

Public health questions

- What's the overall **health impact** of food-associated diseases in our population?
- Which foods/hazards/risk factors are **more important**?
- What can we **do** about it?
- Where should we focus our **resources**?

Attribution of burden of food-associated diseases

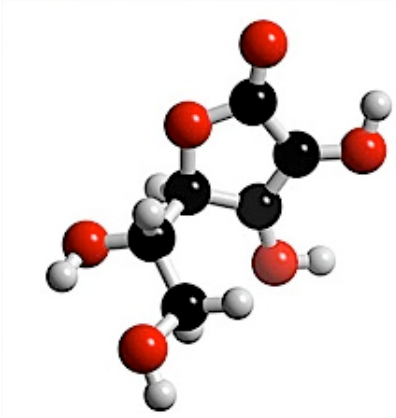
Pathogens

… Salmonella

… Campylobacter

… Listeria

…



Chemicals

… Acrylamide

… Methylmercury

… Lead

…

Nutritional risk factors

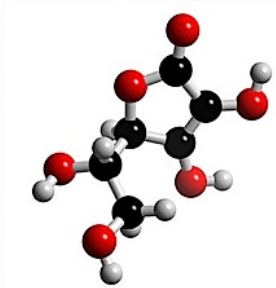
… Trans fatty acids

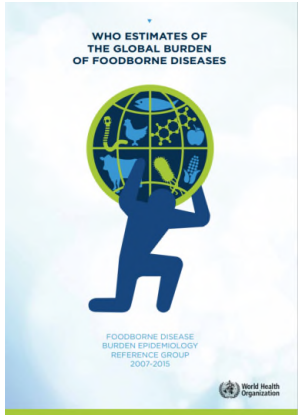
… Low intake of fruits

… Salt

…

Attribution of burden of food-associated diseases





WHO estimates of the global burden of foodborne diseases, 2015

- Global and regional illnesses, deaths and DALYs for 31 foodborne hazards in 2010
- 17 enteric pathogens, 11 parasites, 3 chemicals
- Four metals has been added since (lead, cadmium, methylmercury and arsenic)

The GBD 2017 Study (2018)

- Global, regional and national illnesses, deaths and DALYs for 15 dietary risk factors

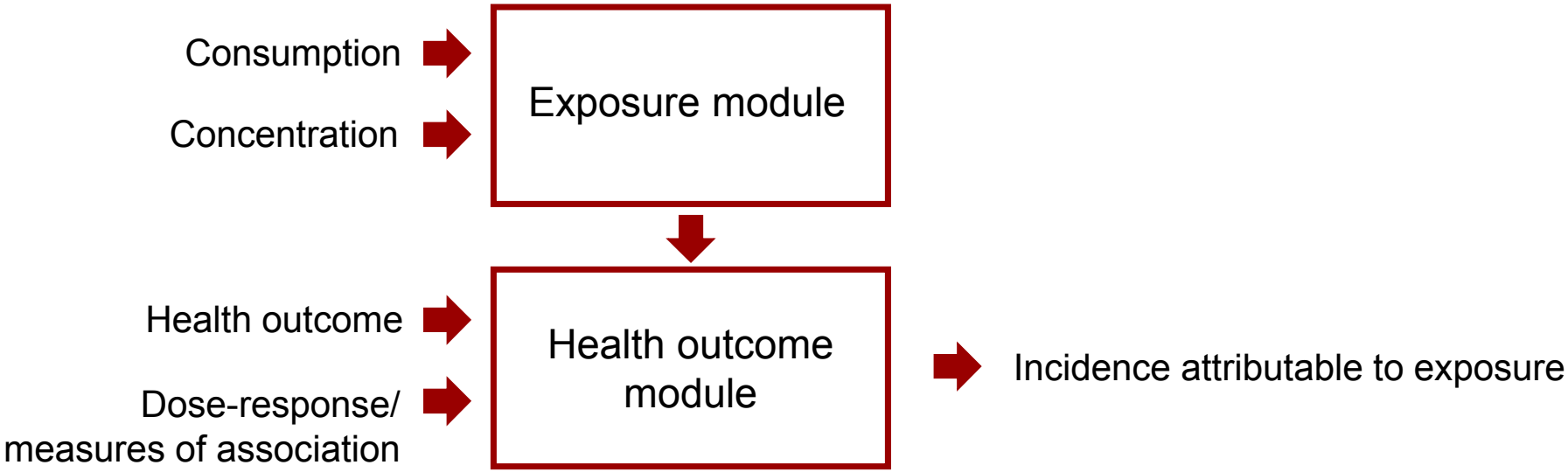
THE LANCET

IHME
Measuring what matters

The Global Burden of Disease Study 2017

Foodborne diseases burden epidemiology reference group 2007-2015. WHO estimates of the global burden of foodborne diseases. World Health Organization, Geneva, Switzerland. 2015. ISBN: 978-92-4-156516-5

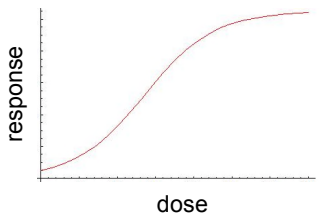
Attribution of burden of food-associated diseases



Attribution of burden of food-associated diseases

Current incidence

Incidence due to exposure



Dose-response function

Association measure from epidemiological study

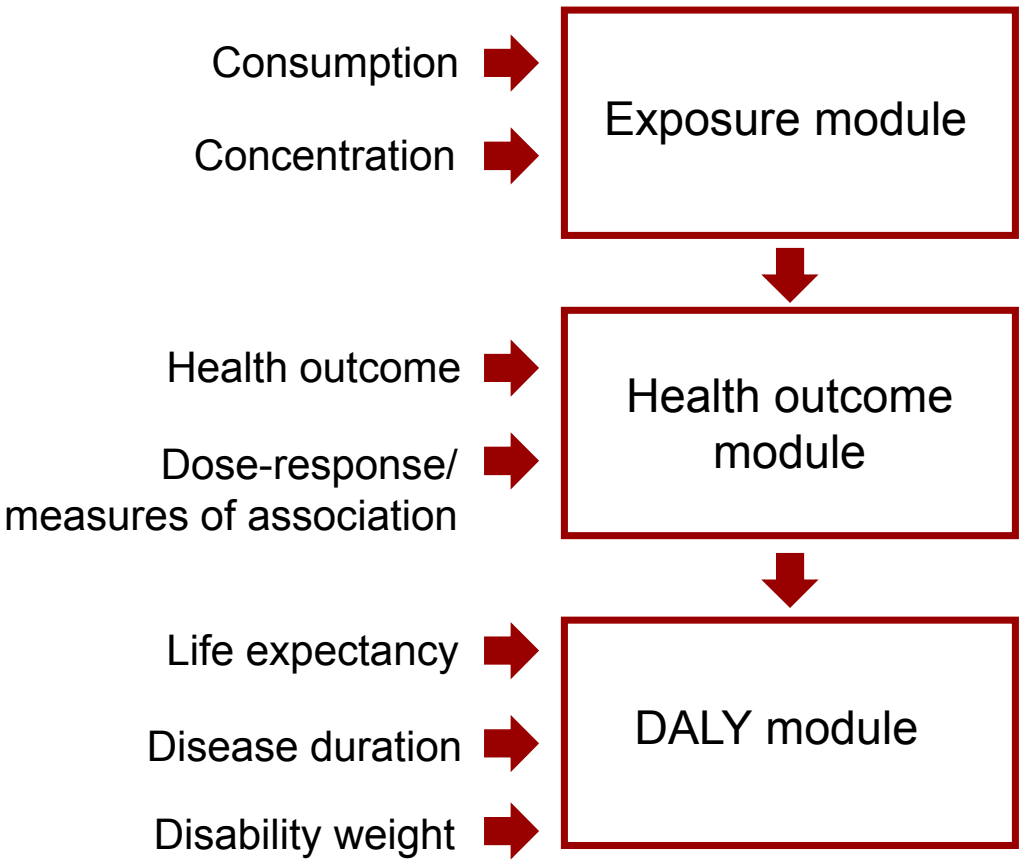
Exposure

Dose-response modelling

TOP-DOWN

BOTTOM-UP

Attribution of burden of food-associated diseases



Burden of disease in the context of RBA

Burden of food-associated disease: health impact of individual hazards or risk factors associated with food consumption in isolation from other factors (e.g. beneficial nutrients in food)

Need for risk-benefit assessment – the full picture

Burden of disease in the context of RBA

Example: Global burden of intellectual disability due to prenatal methylmercury (MeHg) exposure

Global burden of disease: approx. 2 million DALYs per year

- Accounts for nearly one quarter of a million incident cases of intellectual disability per year
- Europe: 12 DALYs/100,000 inhabitants

Fish and seafood are major sources of MeHg

Should people be advised to not eat fish?

Fatty acids (DHA) and other nutrients in fish enhance fetal neurodevelopment

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Global burden of intellectual disability resulting from prenatal exposure to methylmercury, 2015

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Take-home messages

Burden of disease is a quantitative description of death and loss of health due to diseases, injuries and risk factors

Compare relative impact of diseases, e.g. in terms of DALYs

Part of the burden of diseases can be attributed to food-associated hazards and risk factors

Support for decision makers in setting priorities and allocating resources

Risk-benefit assessment adds another layer to the calculations – investigate potential intervention strategies by also accounting for other factors in the food