

NCD Burden of Disease

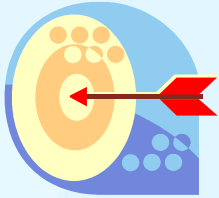
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Learning Objective

At the end of the training, participants will be able to:

- Calculate incidence, prevalence and mortality.
- Apply definitions of DALYs and QALYs.



Lesson Overview

- Why study burden of disease
- Demographic and epidemiologic transition
- Global and national trends in NCDs
- How to measure burden of disease

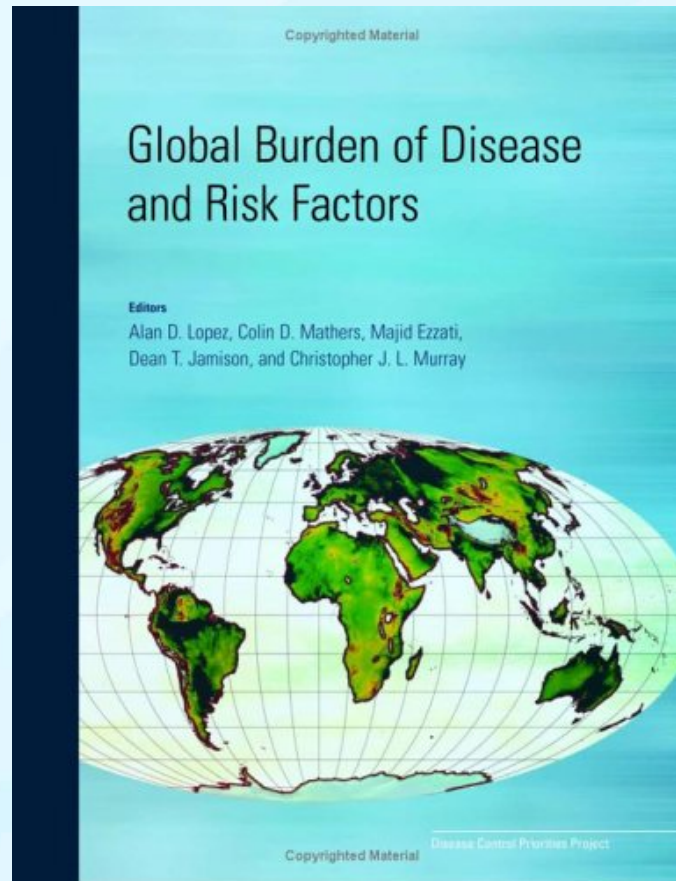


WHY STUDY BURDEN OF DISEASE

What is Burden Of Disease?

Considers health, social, political, environmental and economic factors to determine the cost that disease and disability exert upon the individual and society.

Why Study Burden of Disease?



WHO Global Burden of Disease Study

- WHO assessment of the global burden of disease,
- Features comparisons between deaths, diseases and injuries by region, age, sex and country income
- Provides projections of deaths and burden of disease by cause and region to the year 2030.

WHO Global Burden of Disease Study (*cont.*)

The study contains information on:

- Causes of death in different parts of the world
- Leading causes of death by age, sex and disease
- Numbers of people with various diseases and disabilities
- Number of people who become ill each year
- Causes of loss of health and the actual loss of years of good health

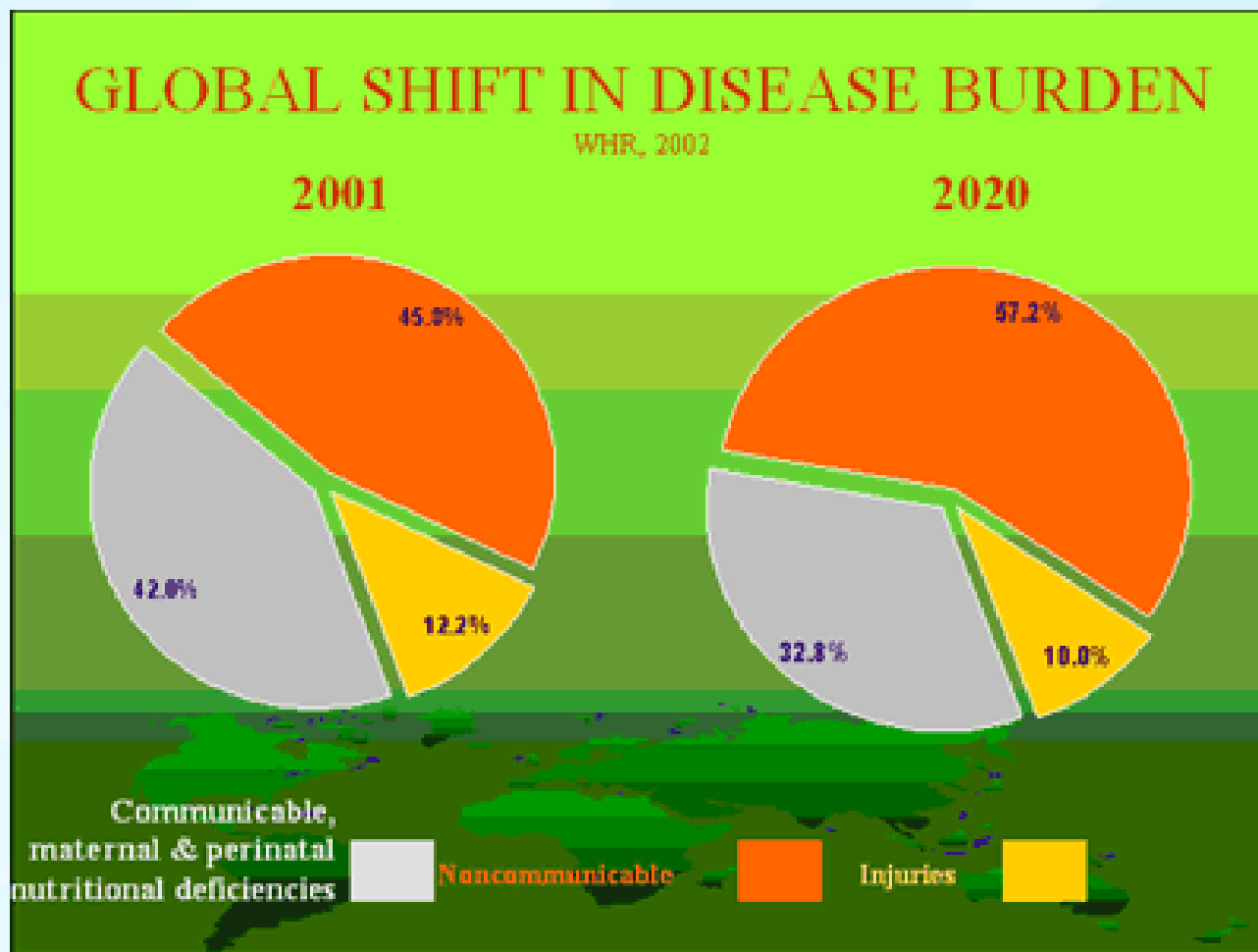
10 Leading Causes of Death in the World

Cause of Death	Deaths in millions	% of deaths
Ischaemic heart disease	7.25	12.8%
Stroke and other cerebrovascular disease	6.15	10.8%
Lower respiratory infections	3.46	6.1%
Chronic obstructive pulmonary disease	3.28	5.8%
Diarrhoeal diseases	2.46	4.3%
HIV/AIDS	1.78	3.1%
Trachea, bronchus, lung cancers	1.39	2.4%
Tuberculosis	1.34	2.4%
Diabetes mellitus	1.26	2.2%
Road traffic accidents	1.21	2.1%

<http://www.who.int/mediacentre/factsheets/fs310/en/index.html>

DEMOGRAPHIC AND EPIDEMIOLOGIC TRANSITION

Shift in Burden of Disease

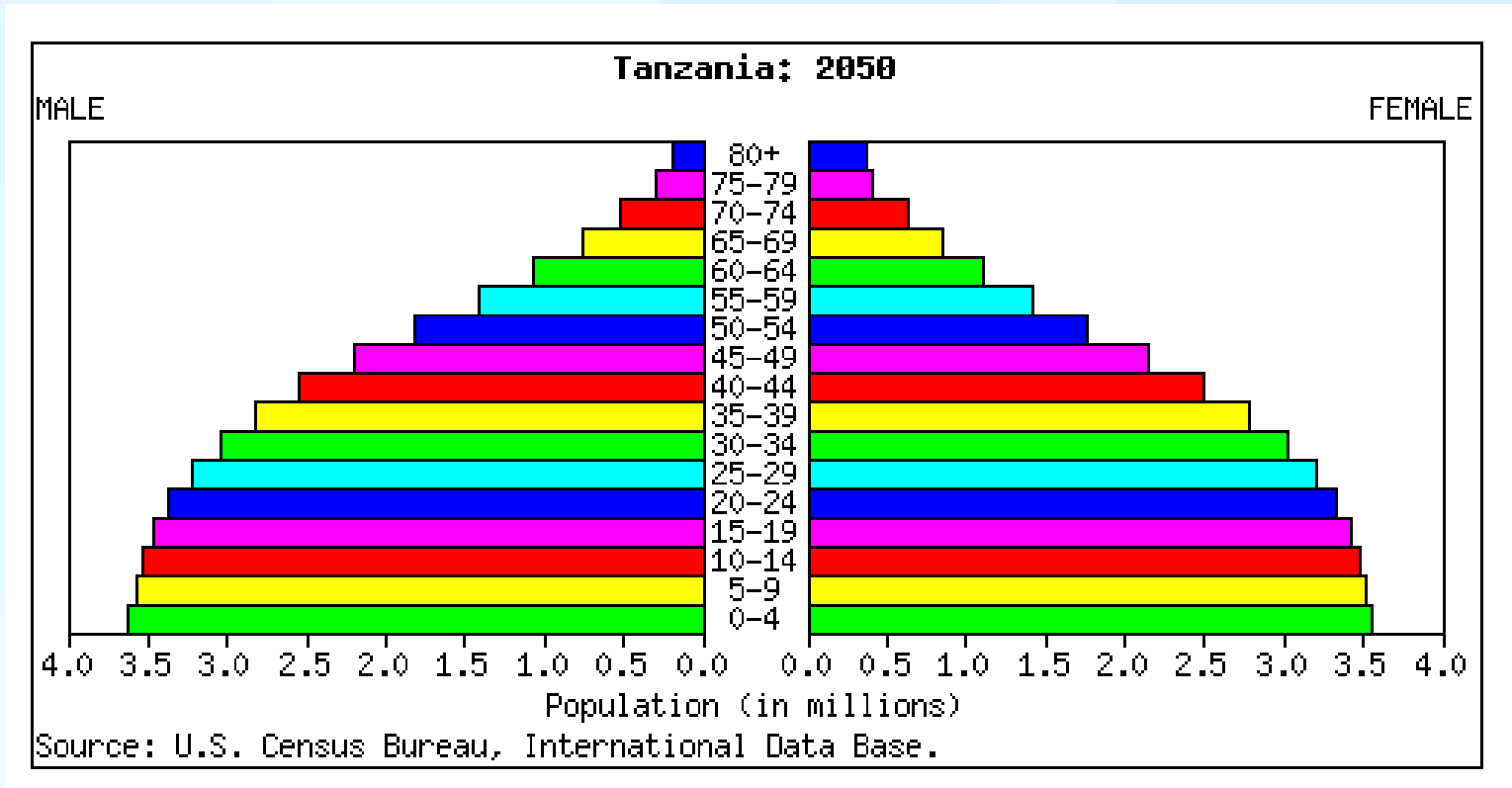


<http://www.ceche.org/publications/infocus/spring2007/slide6.gif>

Demographic Transition

A change in the population dynamics of a country as it moves from high fertility and mortality rates to low fertility and mortality rates.

Demographic Transition in Tanzania

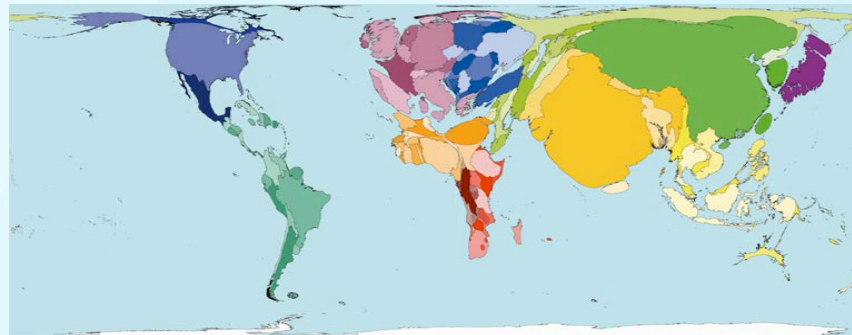


<http://www.nationmaster.com/country/>,

Epidemiologic Transition

A transition from predominance of infectious diseases to chronic or degenerative diseases

- Globalization
- Urbanization
- Tobacco
- Obesity
- Increasing sedentary lifestyles and unhealthy diets



GLOBAL AND NATIONAL TRENDS OF NCDs

Global Trends in Cardiovascular Disease and Cancer

- Deaths from cardiovascular disease are predicted to rise from 17.1 million in 2004 to 23.4 million from 2030.
- Deaths from cancer are predicted to increase from 7.4 million in 2004 to 11.8 million in 2030.

Global Trends in Obesity

- In 2005, about 1.6 billion adults (age 15+) throughout the world were overweight (BMI>25); including 400 million who were obese (BMI>30).
- By 2015, WHO projects that approximately 2.3 billion adults will be overweight and 700 million obese.

Global Trends in Traffic Accidents

- Deaths due to road traffic crashes are predicted to increase from 1.3 million in 2004 globally (ninth leading cause of death) to 2.4 million in 2030 (fifth leading cause of death).



Global Trends in NCDs

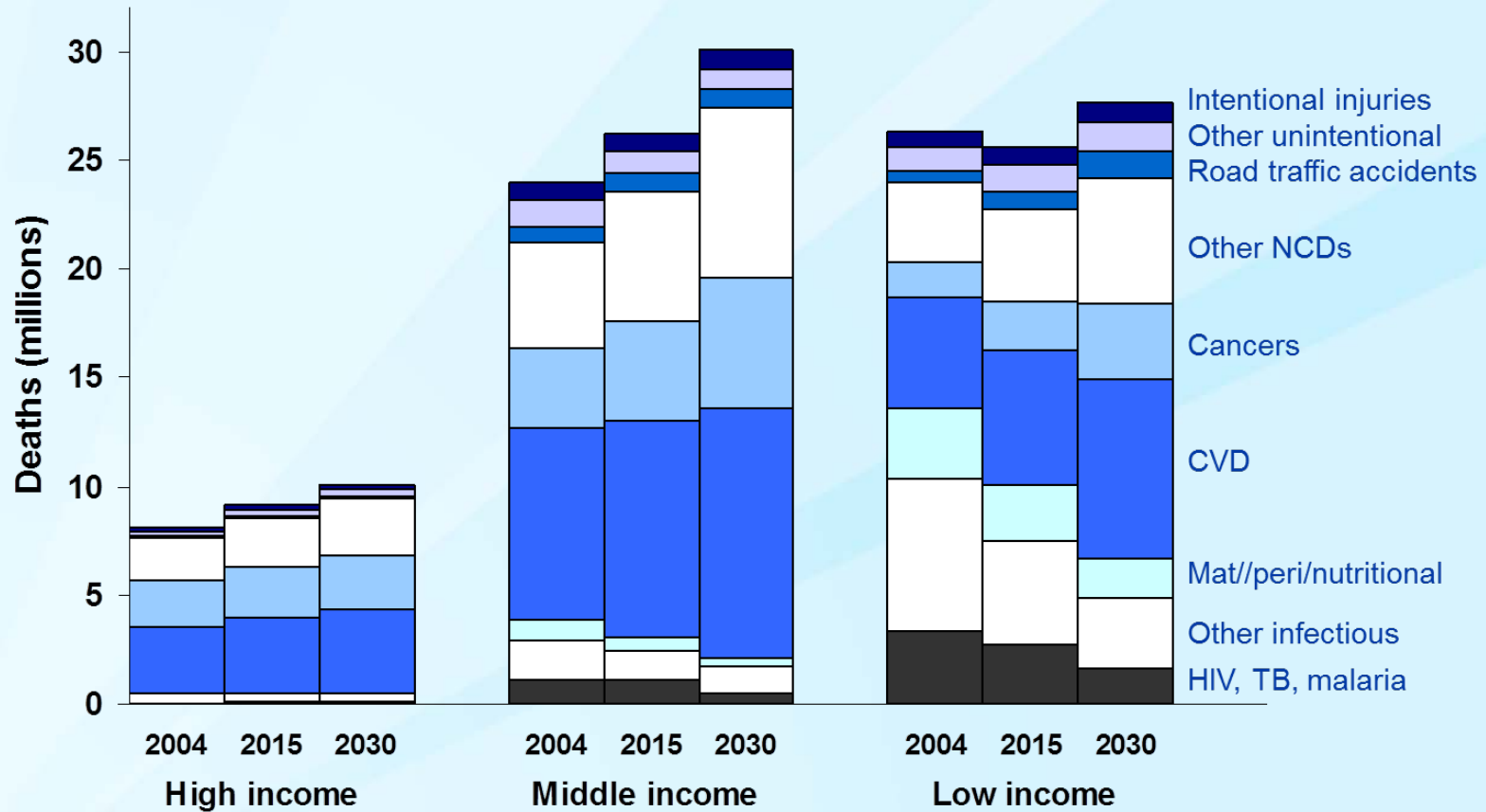
Death trends (2006-2015)

Geographical regions (WHO classification)	2005 Total deaths (millions)	2005 NCD deaths (millions)	2006-15 NCD deaths (millions)	2006-15 Trend: Death from infectious disease	2006-15 Trend: Death from NCD
Africa	10.8	2.5	28	+6%	+27%
Americas	6.2	4.8	53	-8%	+17%
Eastern Mediterranean	4.3	2.2	25	-10%	+25%
Europe	9.8	8.5	88	+7%	+4%
South-East Asia	14.7	8.0	89	-16%	+21%
Western Pacific	12.4	9.7	105	+1	+20%
Total	58.2	35.7	388	-3%	+17%

WHO projects that over the next 10 years, the largest increase in deaths from cardiovascular disease, cancer, respiratory disease and diabetes will occur in developing countries.

WHO Chronic Disease Report, 2005

Projected NCD Deaths in Low, Medium, and High Income Countries



http://www.who.int/whosis/whostat/EN_WHS08_Full.pdf

NATIONAL TRENDS IN NCDS

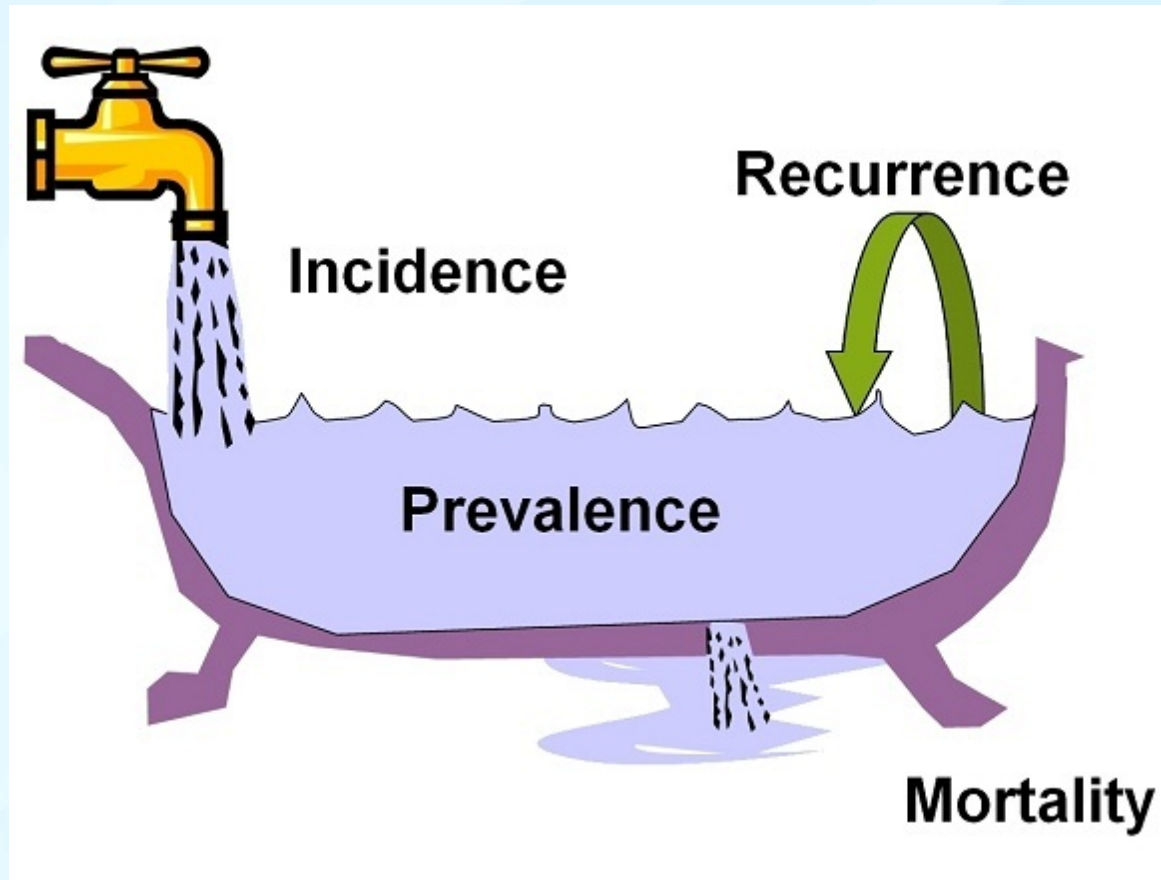
Future Impact of NCD Burden

The results of projections indicate that the already constrained health systems will face a double burden of disease, in which HIV/AIDS and other common infectious diseases will co-exist with the new NCDs.

- What is the social and economic impact of this double burden?

MEASURES USED TO DESCRIBE BURDEN OF DISEASE

Measures of Disease Occurrence



Incidence

The development of new cases of a disease that occur during a specified period of time in previously disease-free or condition-free (“at risk”) individuals.

Approaches to Considering Incidence

Two fundamental approaches to considering the incidence of disease or health condition:

1. Incidence Rate
2. Cumulative Incidence

Incidence Rate

- Frequency with which new events occur in a population
- Typically reported as number of events per 100,000 persons per year:

of new cases of disease in a population in a defined time period/
average size of population during the time period

Incidence Rate Calculation

Example: 110 women develop breast cancer in one year in a population of 342,000 women in country X:

$$110 \div 342,000 = 0.000322 \text{ (incidence)}$$

To calculate the incidence rate per 100,000 in this example:

$$0.000322 \times 100,000 = 32.2$$

- Incidence rate of breast cancer for country X is **32 cases per 100,000** population of women **per year**

Cumulative Incidence Definition

PROPORTION of individuals who become diseased during a specified period of time.

Range: 0 to 1.0

Also referred to as “incidence proportion”.

Cumulative Incidence (CI) Calculation

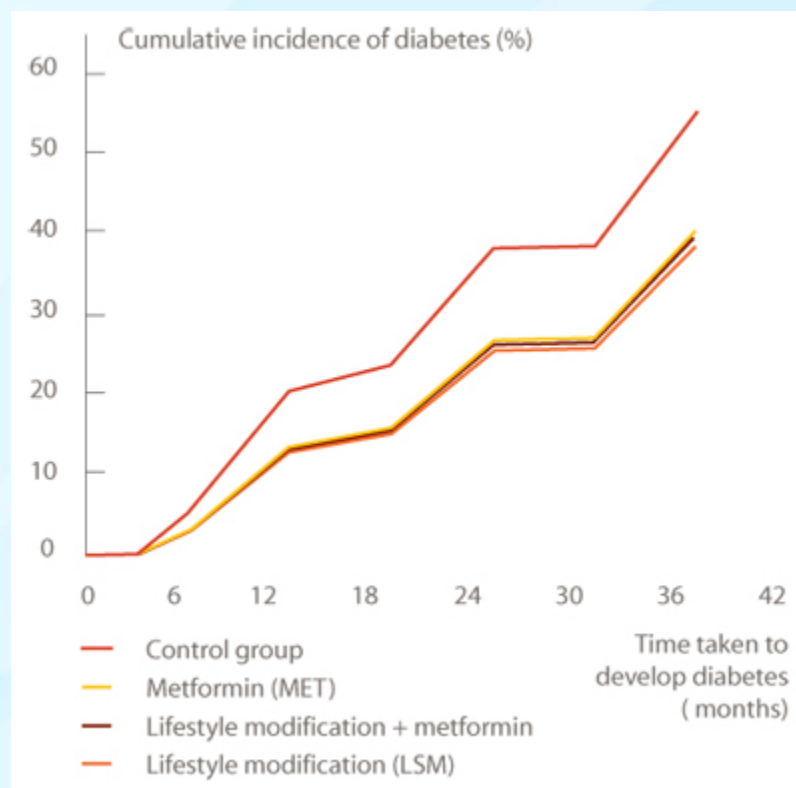
of new cases of disease during a given period/
Size of at-risk population at start of the defined time period

Example: During a 1-year period, 10 out of 100 “at risk” persons developed CVD (cardiovascular disease).

$$CI = 10/100 = 0.10 \text{ or } 10.0\%$$

Example of Cumulative Incidence

Cumulative incidence of diabetes (%) in the Indian Diabetes Prevention Program (for people with IGT)



Ramachandran, A., et al. *Diabetologia* 1996; 49:289-297

Difference between Cumulative Incidence and Incidence Rate

Address Different Questions

- Cumulative Incidence: What is the *risk* that an individual will develop the disease over a given time interval?
- Incidence Rate: How quickly or frequently a disease occurs in a population?



Practice 1

Calculate the incidence rate for Type 2 Diabetes in adults using the following information:

- Population of adults in country Y: 1,750,000
- # of new cases of Type 2 diabetes over the last 5 years:525



Practice 1 - Answer

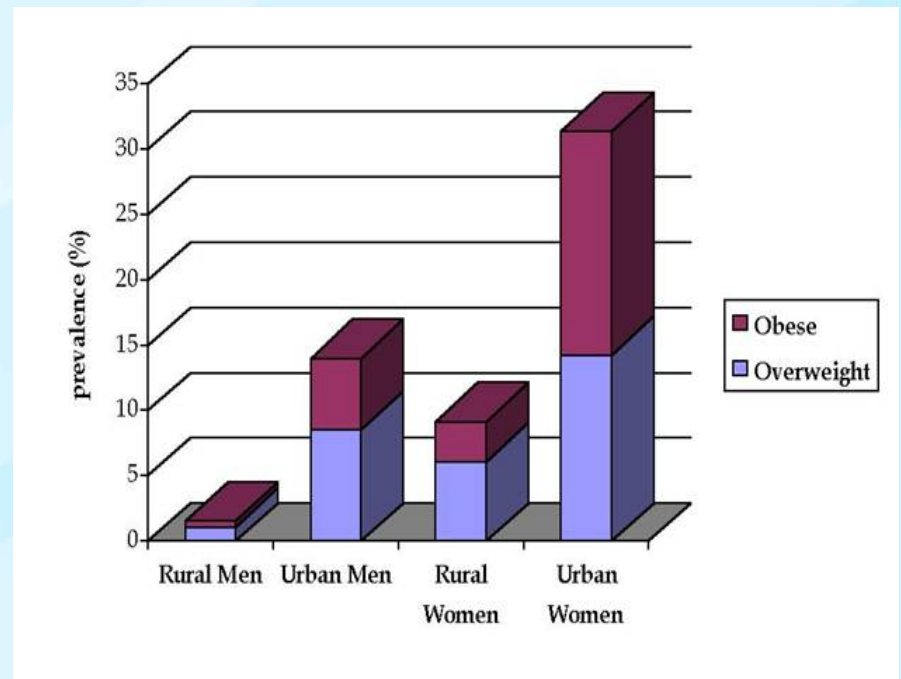
- $525 / 1,750,000 = .0003$
- $.0003 / 5 \text{ years} = .00006$
- $.0006 \times 100,000 = 6$
- The incidence rate would be 6 cases of Type 2 Diabetes per 100,000 adults per year.

Prevalence

- The number of existing cases divided by the population count
- Measured at a point in time rather than over some interval
- Typically shown as a percentage
- Influenced by incidence and survival.
- Like incidence, can be used to describe disease in a population
- Unlike incidence, can be used to describe an attribute such as genetic marker, behavior or risk factor in a population (e.g., smoking, wearing a seatbelt)

Example: Calculating Prevalence

- In a large city, there are 275,000 women and 85,250 of these women are obese.
- $85,250 \div 275,000 = .31$
- Prevalence: $.31 \times 100 = 31\%$
- Approximately 31% of women in this large city are obese.





Practice 2

1. In a small village of 1,143 adults, and 166 of them have hypertension. Calculate the prevalence of hypertension as a percentage.



Practice 2 - Answer

- **Answer:** The prevalence of hypertension is **14.5%**.

Mortality

- Number of deaths per population in a given time or place.
- Also known as “crude death rate”.
- Typically expressed in units of deaths per 100,000 individuals per year:

total number of deaths over specified period x 100,000/
number of total population over same period

Mortality Rate Calculation

Example: 850 deaths per year in a population of 170,000

Mortality rate:

- $(850/170,000) \times 100,000 = 500$ per 100,000 population

Types of Mortality Rates

- **Crude mortality rate:** The total number of deaths per 100,000 people per year.
- **Maternal mortality rate:** The total number of maternal deaths per total number of live births per 100,000 per year.
- **Infant mortality rate:** The total number of infant (children below 1 year) deaths per 1000 live births
- **Child mortality rate:** The total number of child (more than 1 and less than 5 years) deaths per 1000 live births



Practice 3

A region in Country C reported 1,256 smoking-related deaths last year. The population of the region is 78,605 people. Calculate the mortality rate due to smoking in that region.

Answer: The mortality rate due to smoking is approximately _____ per 100,000.

Additional Burden of Disease Measurements

- Years of life lost (YLL)
- Years of life with disability (YLD)
- Disability-adjusted life years (DALY)
- Quality-adjusted life years (QALY)

Years of Life Lost (YLL)

- Measures the years of life lost due to premature mortality
- Based on the number of deaths and the standard life expectancy at age of death
- **Example:** Imagine that the life expectancy for an individual is 75 years, but that person dies at age 70. That death represents 5 Years of Life Lost (YLL).

Years of Life with Disability (YLD)

Measures years of healthy life lost due to living in states of less than full health

Overview of DALYs and QALYs

Summary measures of population health

Estimated by combining morbidity and mortality

- Combined measures of quantity *and* quality of life

Answers two important questions:

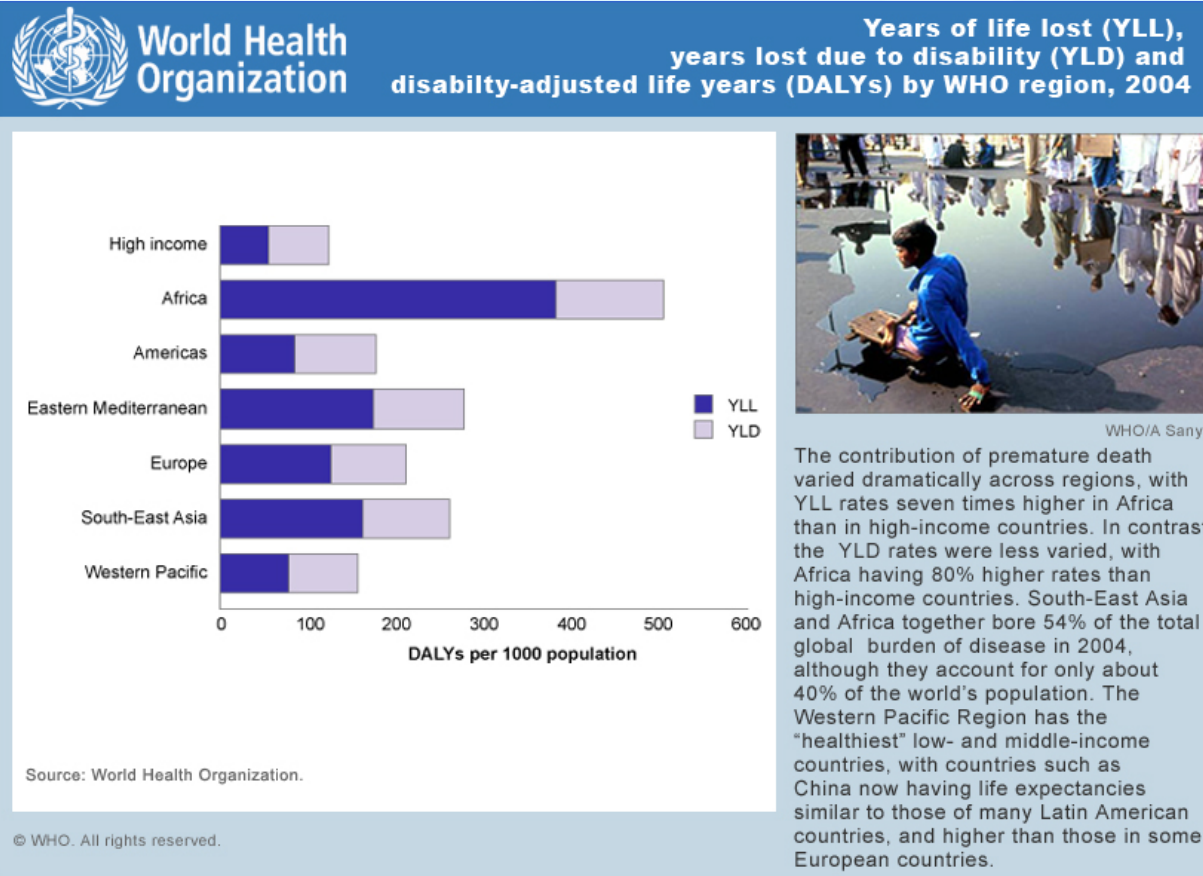
1. What is the total impact of disease and injury in the population?
2. How do we compare the impacts of different diseases, risk factors, and interventions that affect different populations?

Helps inform decisions regarding resource allocation

Disability-Adjusted Life Year (DALY)

- Represents the total number of years lost to illness, disability (health utility), or premature death within a given population
- Allows for comparison of impact of a program and/or diseases across population

Example of DALYs



Leading Causes of Attributable Global Mortality and Burden of Disease, 2004

Attributable Mortality

	%
1. High blood pressure	12.8
2. Tobacco use	8.7
3. High blood glucose	5.8
4. Physical inactivity	5.5
5. Overweight and obesity	4.8
6. High cholesterol	4.5
7. Unsafe sex	4.0
8. Alcohol use	3.8
9. Childhood underweight	3.8
10. Indoor smoke from solid fuels	3.3

59 million total global deaths in 2004

Attributable DALYs

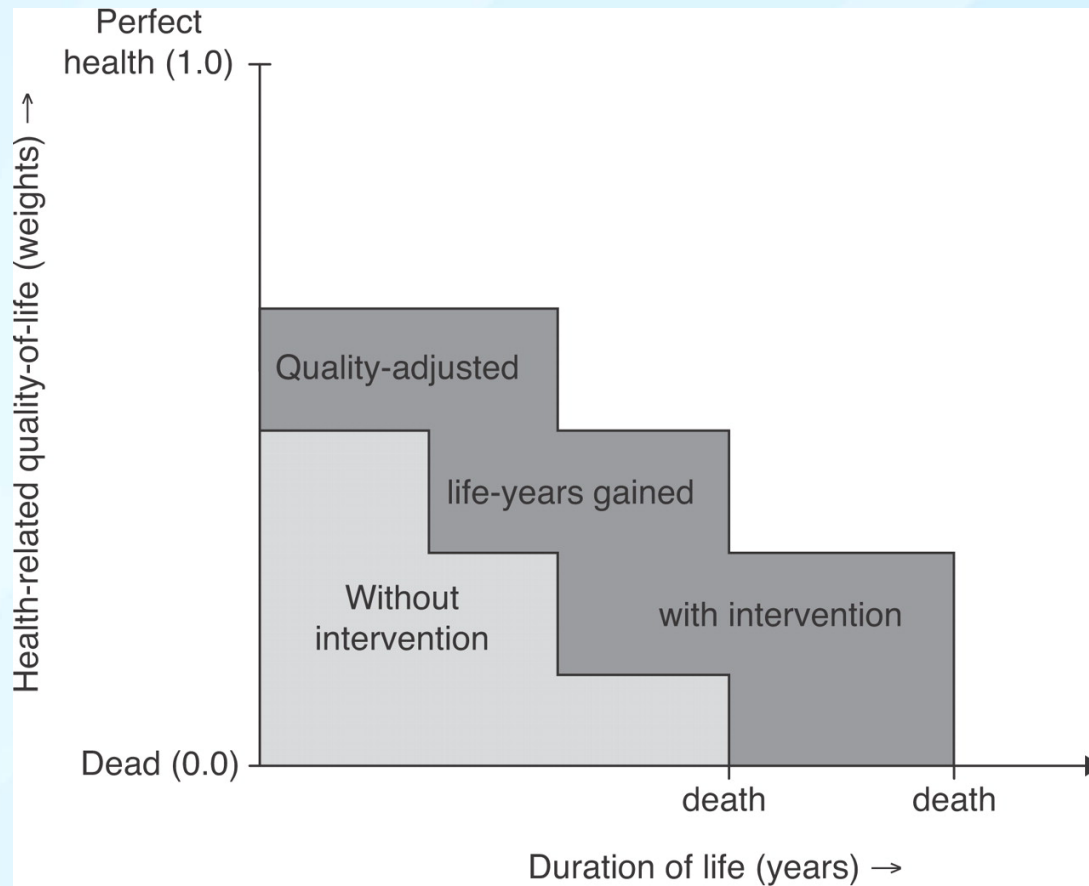
	%
1. Childhood underweight	7.8
2. High blood pressure	7.5
3. Unsafe sex	6.6
4. Unsafe water, sanitation, hygiene	6.1
5. High blood glucose	4.9
6. Indoor smoke from solid fuels	4.8
7. Tobacco use	3.9
8. Physical inactivity	3.8
9. Suboptimal breastfeeding	3.7
10. High cholesterol	3.3

1.5 billion total global DALYs in 2004

Quality-Adjusted Life Year (QALY)

- Gives us an idea of how many extra months or years of life of reasonable quality a person might gain as result of treatment.
- Ratings: negative values below 0 (worst possible health) to 1 (best possible health).
- Makes it possible to summarize effects of an intervention that affects both morbidity and mortality.

Example of QALYs





REVIEW



Review: Questions 1-2

1. Why is studying burden of disease useful?
2. Name at least 4 reasons for epidemiological transition.



Review: Answer 1-2

1. Why is studying burden of disease useful? *It can provide important input for health decision making, planning and priority setting*
2. Name at least 4 reasons for epidemiological transition. *1) globalization, 2) urbanization, 3) tobacco, 4) obesity, 5) increasing sedentary lifestyles and unhealthy diets*



Review: Questions 3-5

3. How do you calculate incidence rate?
4. How do you calculate prevalence?
5. How do you calculate mortality rate?



Review: Answers 3-5

3. How do you calculate incidence rate? *# new cases ÷ size of population*
4. How do you calculate prevalence? *existing cases ÷ population count*
5. How do you calculate mortality rate? *number of deaths over specified period x 100,000/ number of total population over same period*



Review: Questions 6-7

6. What does YLL measure?
7. What does YLD measure?



Review: Answers 6-7

6. What does YLL measure? *YLL measures years of life lost due to premature mortality.*
7. What does YLD measure? *YLD measures years of healthy life lost due to living in states of less than full health (disability).*



Review: Questions 8-9

8. What does DALY represent?
9. What does QALY tell us?



Review: Answers 8-9

8. What does DALY represent? *Disability-adjusted life years DALY represents the total number of years lost to an illness, disability or premature death within a given population.*
9. What does QALY tell us? *Quality-Adjusted Life Year; how many extra months or years of life of reasonable quality a person might gain as result of treatment.*

Half-Truths and Misunderstandings

Half- Truth:

“My grandfather smoked and was overweight –
and lived to 96.”

Reality:

These people are the rare exception

Skill Assessment

1. Work individually to complete the assessment.
2. Use the health data provided by your facilitator to calculate prevalence, incidence and mortality.
3. Use the information provided in your participant guide to answer questions about DALYs and QALYs.
4. Spend 20 minutes completing the assessment.



Centers for Disease Control and Prevention (CDC). Introduction to NCD Epidemiology. Atlanta, Georgia: Centers for Disease Control and Prevention (CDC); 2013.

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