

Health Measures used in epidemiology (Lecture 2)

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Learning Objectives

By the end of the lecture you should be able to:

- 1- Calculate commonly used measures of mortality.
- 2- Know the significance and limitations of calculating each mortality rate.
- 3- Calculate commonly used measures of fertility.
- 4- Know the significance and limitations of calculating each fertility rate.

II. Measures of Mortality

They are the most widely used measures of health status of the population because of their availability.
(Death certificate is a legal requirement in many countries)

1. Crude Death rate (CDR): is defined as the total number of deaths in a calendar year divided by mid year population of that year, multiplied by 1000.

$$\text{Crude Death rate} = \frac{\text{Total number of deaths in a calendar year}}{\text{Mid-year population in the same year}} \times 1,000$$

Limitation of CDR

It is not a sensitive measure of the status of health of the population because it is affected by the age and sex structure of the population

2. Specific mortality rates

- Age specific mortality rate
- Sex specific mortality rate
- Cause specific mortality rate

Age- Specific Mortality Rate(ASMR) is defined as the number of deaths in a specific age group in a calendar year divided by the population in the same age group of that year, multiplied by a constant.

Example:

Number of deaths among adults in the age group 25-34 in a specific city in 2017 = 25

Population in the city in the age 25-34 in 2017 = 300,000

$$\text{ASMR} = \frac{25}{300,000} \times 100,000 = 8.3 / 100,000 \text{ pop}_{25-34\text{year}}$$

Sex- Specific Mortality Rates is defined as the number of deaths in a specific sex in a calendar year divided by the population of the same sex of that year, multiplied by a constant.

Cause-specific Mortality Rate is defined as the number of deaths due to a specific cause in a calendar year divided by the mid year population of that year, multiplied by a constant.

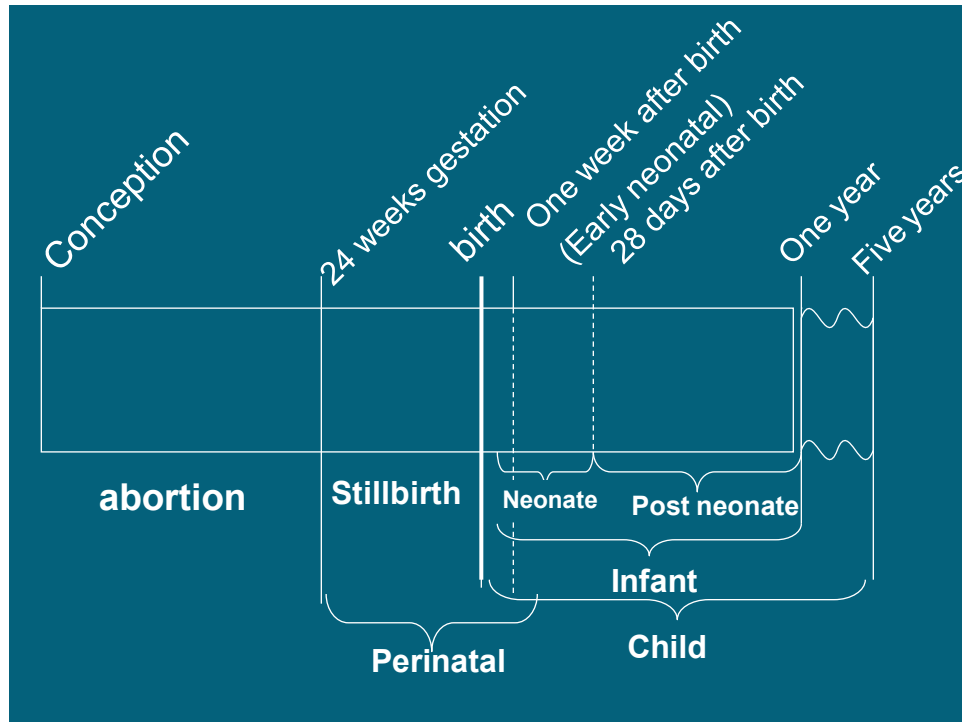
Example

-Number of deaths due to diabetes in City (X) during 2017 = 78

-Population of City (X) in 2017 = 184,252

$$\text{Cause specific death Rate} = \frac{78}{184,252} \times 100,000 = 42.3 / 100,000 \text{pop}$$

3. Mortality in early life



1. **Infant Mortality Rate (IMR)** is defined as number of deaths among infants under one year old in a calendar year per 1,000 live births in that year.

Significance of IMR

- 1- Used for international comparisons.
- 2- It is the **best (the most sensitive) indicator of the status of health** of a country

$$\text{IMR} = \frac{\text{Number of deaths under 1 year during a given Calendar year}}{\text{Number of live births during the same year}} \times 1,000$$

Example

Number of Infant Deaths in city (X) in 2017 = 170

Number of Live Births in city (X) in 2017 = 27,100

$$\text{IMR in 2017} = \frac{170}{27,100} \times 1,000 = 6.3/1,000 \text{ Live births}$$

Infant Mortality Rate is divided into:

- A. Neonatal Mortality Rate (deaths between 0-28 days inclusive)
- B. Post-Neonatal Mortality Rate (deaths between 29 days to < one year)

This is because causes of death within these 2 categories are different.

A. Neonatal Mortality Rate (NMR) is defined as the number of deaths of neonates (i.e., infants of age 28 days or less) that occurred in a calendar year divided by the number of live births in that year, multiplied by 1000

$$\text{NMR} = \frac{\text{Number of deaths between birth-28 days During a calendar year}}{\text{Number of live births during the same year}} \times 1000$$

B-Post neonatal mortality rate (PNMR) is defined as the number of deaths of post- neonates (i.e., infants more than 28 days of age up to one year) that occurred in a calendar year divided by the number of live births in that year, multiplied by 1000

$$\text{PNMR} = \frac{\text{Number of deaths between 29 days- < one year During a calendar year}}{\text{Number of live births during the same year}} \times 1000$$

2. Perinatal Mortality Rate is the number of fetal deaths (still births) plus early neonatal deaths (deaths in first week of life) divided by the number of total births (stillbirths + live births) in a year multiplied by 1000.

Perinatal Mortality rate is considered to be a good indicator of the quality of care received by pregnant women and by newborns after birth.

$$\text{Perinatal Mortality Rate} = \frac{\text{Stillbirths + deaths during first week of life during a calendar year}}{\text{Total births (still births+ live births) during the same year}} \times 1000$$

3. **Still birth Rate** is number of still births in a calendar year per 1,000 total births (still births+ live births) in that year.

$$\text{Stillbirth rate} = \frac{\text{Number of stillbirths during a given Calendar year}}{\text{Total births (still births+ live births) During the same year}} \times 1000$$

- **Stillbirth** is defined as the birth of a newborn with no signs of life at or after 24 weeks' gestation (with more than 500 g birth weight).
- The previous definition recommended by WHO for international comparison is a baby born with no signs of life at or after 28 weeks' gestation

4. Maternal mortality

A. Maternal mortality ratio is the number maternal deaths within a calendar year per 100,000 live births in that year

Number of deaths due to causes related to pregnancy, delivery and the postpartum period during a calendar year

Maternal Mortality= $\frac{\text{Number of deaths due to causes related to pregnancy, delivery and the postpartum period during a calendar year}}{\text{Number of live births during the same year}} \times 100,000$
Ratio

B. Maternal mortality rate is defined as the number of maternal deaths within a calendar year per 100,000 women in the reproductive ages in that year.

Number of deaths due to causes related to pregnancy, delivery and the postpartum period during a calendar year

Maternal Mortality= $\frac{\text{Number of deaths due to causes related to pregnancy, delivery and the postpartum period during a calendar year}}{\text{Number of women in reproductive age (15-44 years) in the same year}} \times 100,000$
Rate

Maternal deaths are deaths of women from any cause related to or aggravated by pregnancy or its management during pregnancy and childbirth or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy.

5. Proportional Mortality Rate is the number of deaths due to a specific cause in a calendar year divided by the total number of deaths in that year, multiplied by 100

$$\text{Proportional Mortality Rate} = \frac{\text{Number of deaths due to specific cause in a calendar year}}{\text{Total number of deaths in the same year}} \times 100$$

6. Case-fatality ratio

$$\text{Case Fatality Ratio} = \frac{\text{Number of deaths due to certain disease}}{\text{Total number of cases of the same disease}} \times 100$$

Case fatality ratio reflects:

- The severity of the disease
- Quality of medical care

III. Measures of Fertility

1. Crude birth rate (CBR) is defined as the number of live births in a calendar year per 1000 midyear population in that year.

$$\text{CBR} = \frac{\text{Number of live births in a calendar year}}{\text{Midyear population in the same Year}} \times 1000$$

❖ **Crude Birth Rate is:**

- 1- The most commonly used measure of fertility.
- 2- It is easy to calculate
- 3- It is not sensitive measure of fertility because the denominator is the total population not the population exposed to the risk of giving birth (women in reproductive age).

2-General Fertility Rate (GFR) is defined as the number of live births in a calendar year per 1000 women in the reproductive age (15-49 years) in that year.

$$\text{GFR} = \frac{\text{Number of live births in a calendar year}}{\text{Number of women in ages 15-49 years in the same year}} \times 1000$$

- GFR is more sensitive measure of fertility than CBR because the denominator is the age-sex group at risk of giving births.
- It is approximately equals to 4 times the crude birth rate.
- Its disadvantage is that it does not consider the marital status

3-Marital specific fertility rate (MSFR) is defined as the number of live births in a calendar year per 1000 married women in the reproductive age (15-49 years) in that year.

$$\text{MSFR} = \frac{\text{Number of live births in a calendar year}}{\text{Number of married women in ages 15-49 years in the same year}} \times 1000$$

4. Age Specific Fertility Rate (ASFR) is number of live births to women in specific age in a calendar year per 1000 women of the same age group in that year.

$$\text{ASFR} = \frac{\text{Number of live births to women in specific age group in a calendar year}}{\text{Number of women in the same age group in the same year}} \times 1000$$

5. Total Fertility Rate (TFR) is the average number of live births per woman completing her reproductive life.

6. The Natural Increase Rate (NIR) refers to the difference between the number of live births and the number of deaths occurring in a calendar year, divided by the mid-year population of that year, multiplied by a factor (usually 1,000).

$$\text{NIR} = \frac{\text{Number of live births in a year} - \text{Number of deaths in the same year}}{\text{Midyear population in that year}} \times 1000$$

NIR = Crude birth rate – Crude death rate