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The Online R-FETPV 1st Module : Basic Epidemiology and Surveillance Data Analysis

5 April -28 May 2021



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Basic descriptive and analytic statistics for disease outbreak event

CLIP#4

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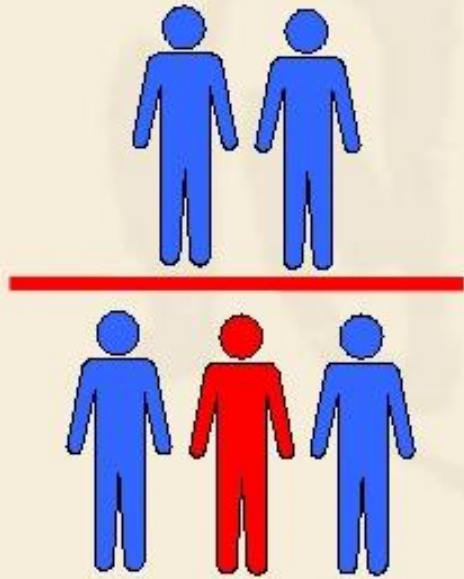


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Definition and use of ratio, proportion and rate



- Count
- Ratio
- Proportion
- Rate

What, who is in the Numerator & denominator?



Example of count, ratio and proportion

Rate

Numerator

- number **EVENTS** observed for a given time

Denominator

- population in which the events occur
(**Population at risk**)
- includes time



Observed in 2005



$$\frac{2}{100} = 0.02 / \text{year}$$

Measures of Disease Occurrence

❖ Two types of measures :

☞ Prevalence (proportion)

- ❖ Use: measures population disease status
- ❖ Types: Point & period

☞ Incidence (rate or risk)

- ❖ Use: Assess frequency of disease onset
- ❖ Types : Cumulative incidence and Incidence density or incidence rate

1. Prevalence—definition

Number of cases of disease at a specific time

Population exposed at that time

- **Definition:** Proportion of a population affected by a disease at a specific time.
- Expressed as a percentage

1. Prevalence—three elements:

- ❖ **Numerator** = existing cases of disease (old and newly diagnosed)
- ❖ **Denominator** = population “at risk ” to have the condition
- ❖ **Time**: point (or sometimes a period) in time to which the prevalence applies

Example of prevalence

Limitation of Prevalence

- ❖ Can be viewed as a slice through the Pop. at a point in time
- ❖ Not take into account the duration of disease
- ❖ Only answer “who has and who do have”, “How often”, “How many” at present,
- ❖ Not answer “when & How likely the disease develop”. Be Not suit for etiological studies

2. Incidence—Definition

- ❖ **Definition:** the number of new cases of a disease that occur during a specified period of time in a population at risk for developing the disease.

$$\text{Incidence} = \frac{\text{No. of new cases}}{\text{Pop. at risk}} \text{ over a time period} \times 10^n$$



2. Incidence — **Three elements**

❖ **Three elements**

- ❧ **A numerator: the No. of *NEW* cases**
- ❧ **A denominator: the population at risk for developing the disease**
- ❧ **Time: the period during which the cases accrue**

Population at risk (PAR)

- ❖ The denominator for incidence is the population at risk
- ❖ Not including
 - ⌘ Existing cases
 - ⌘ Individuals who are not capable of developing the disease.

Specification of a time period

- ❖ **Incidence entails the designation of a time period, e.g. a week, month, year, or n years**
- ❖ **The time of onset or initial definitive diagnosis must be within the period**

2. Incidence — Types

Incidence

```
graph TD; Incidence --> IR[Incidence rate (IR)]; Incidence --> CI[Cumulative incidence (CI)]; IR --- ID[Incidence density (ID)]; IR --- Rate[Rate (speed)]; IR --- Open[For open population]; CI --- IP[Incidence proportion (IP)]; CI --- Risk[Risk (probability)]; CI --- Closed[For closed population];
```

Incidence rate (IR)

Incidence density (ID)

Rate (speed)

For open population

Cumulative incidence (CI)

Incidence proportion (IP)

Risk (probability)

For closed population

2. Incidence — Cumulative Incidence

$$CI = \frac{N_{\text{new cases}}}{N_0}$$

- ❖ **No units**
- ❖ **Theoretical range 0 to 1**
- ❖ **Probability that an individual will become diseased over the specified period**
- ❖ **CI in population = average *risk* for individuals**

2. Incidence — Cumulative Incidence

Attack Rate

- ❖ Be an alternative form of CI
- ❖ Usually used for an outbreak or other acute diseases as a result of a specific exposure (ie, poisoning food, virus, etc)
- ❖ Observed for a short time period
- ❖ Usually expressed for the entire epidemic period (for outbreak), from the first to the last case

2. Incidence — Cumulative Incidence

Attack Rate, example

**Ex: Outbreak of cholera in country X
in March 1-31, 1999**

- ⌘ **Number of new cases = 490**
- ⌘ **Population at risk = 18,600**
- ⌘ **Attack rate = 2.6%**

2. Incidence — Incidence Rate (IR)

Incidence rate

$$IR = \frac{\text{No. of new cases}}{\text{Person} - \text{Time}}$$



- ❖ Units of cases/person-time
- ❖ Theoretical range zero to infinity
- ❖ Numerical value has no meaning at the individual level

Prevalence vs incidence

	Point prevalence	Period prevalence	CI	IR
Numerator	Existing cases (old and new)	Existing and new cases	New cases	New cases
Denominator	Initial Pop.	Mid-point Pop.	Initial or Midyear Pop.	Person-time
Time	One point	A period	A period	A period
Unit	None	None	None	No./PT
Type	proportion	proportion	proportion	rate
Example question	Do you currently have asthma?	Have you had asthma during the last year?	Have you ever had asthma last year?	
Study types	Cross-sectional studies surveillance		closed Cohort studies	Open Cohort studies

Morbidity



Proportion of
illness in a
population

Mortality

Buzzle.com



Incidence of
deaths in a
population

Morbidity Rate

→ Indicates rates of a disease, behavior, or health problem

Morbidity Rate:

Total # of cases of disease/behavior

Estimated total population at the midpoint of time period

Mortality Rate:

Total # of deaths from disease/behavior

Estimated total population at the midpoint of time period

X 100,000

Case-fatality rates

❖ **Case-fatality rate (%) =**

$$\frac{\text{No. of deaths during a specified period of time after disease onset or diagnosis}}{\text{No. of persons with the specified disease}} \times 100$$

What percentage of people diagnosed as having a certain disease die within a certain time after diagnosis?