

Statistical methods in epidemiology

Statistical Methods in Epidemiology

Definition:

- Statistical methods in epidemiology involve the application of statistical principles and techniques to understand the distribution and determinants of diseases in populations.
- These methods help in designing studies, analyzing data, interpreting results, and making decisions for public health.

Core Elements:

A. Study Design

- Statistical methods begin with selecting an appropriate study design.
- **Common types include:**

1. Descriptive Studies

- Focus on *who, what, when, and where* of disease occurrence
- Use measures such as rates and proportions
- Describe disease patterns in populations

2. Analytical Studies

- Examine causes or risk factors of diseases
- Include:
 - Cohort studies
 - Case-control studies
 - Cross-sectional studies

3. Experimental Studies

- Involve active intervention by the researcher
- Include randomized controlled trials (RCTs)
- Participants are randomly assigned to intervention or control groups

B. Data Collection and Management

- Accurate and systematic data collection is essential and includes:

1. Identification of variables:

- Exposures
- Outcomes
- Confounders

2. Ensuring data quality:

- Minimizing bias
- Handling missing data

3. Use of databases and statistical tools:

- Epi Info
- SAS

C. Descriptive Statistics

- Used to summarize and describe data:
- **Measures include:**
 - Mean
 - Median
 - Mode
 - Standard deviation
 - Prevalence and incidence rates
- Helps understand the basic characteristics of the data

D. Inferential Statistics

- Used to draw conclusions about a population from a sample:
- **Key techniques include:**
 - Hypothesis testing (null and alternative hypotheses)
 - Confidence intervals (range of expected true values)
 - p-values (probability that results occurred by chance)

E. Regression Analysis

- Used to assess relationships between variables:
 - **Linear regression** – for continuous outcomes
 - **Logistic regression** – for binary outcomes (e.g., disease vs. no disease)
 - **Cox proportional hazards model** – for survival or time-to-event data

F. Bias and Confounding

- **Statistical methods help to:**
 - Detect bias (systematic errors)
 - Control confounding through:
 - Stratification
 - Multivariable regression models

G. Modeling and Simulation

➤ Used for:

- Disease prediction
- Estimating disease burden
- Simulating the impact of interventions
- Applying statistical or mathematical models

H. Sensitivity Analysis

- Tests the robustness of results
- Examines how changes in assumptions or methods affect conclusions

Incidence and Prevalence

These are fundamental epidemiological measures used to describe the frequency of disease in a population.

A. Incidence

Definition:

Incidence measures the number of **new cases** of a disease that occur in a defined population over a specified period of time.

A. Incidence Proportion (Cumulative Incidence):

$$\text{Cumulative Incidence} = \frac{\text{Number of new cases during a specified time period}}{\text{Number of people at risk at the beginning of the period}}$$

- It is a proportion, ranging from 0 to 1 (or expressed as a percentage).
- Best used in closed populations (no loss to follow-up, no new entries).

B. Incidence Rate (Incidence Density):

$$\text{Incidence Rate} = \frac{\text{Number of new cases}}{\text{Total person-time at risk}}$$

- Person-time = sum of time each individual was at risk before developing the disease or being censored.
- Useful in dynamic populations or studies with variable follow-up.

B. Prevalence

Definition:

Prevalence measures the **total number of existing cases** (both new and old) of a disease in a population at a specific point in time (point prevalence) or over a period of time (period prevalence).

A. Point Prevalence:

$$\text{Point Prevalence} = \frac{\text{Number of existing cases at a specific time}}{\text{Total population at that time}}$$

B. Period Prevalence:

$$\text{Period Prevalence} = \frac{\text{Number of people who had the disease at any time during a period}}{\text{Average population during that period}}$$

Differences between Incidence and Prevalence:

Feature	Incidence	Prevalence
Counts	New cases only	All cases
Time	Over a period	At a point or during a period
Use	For studying disease etiology	For planning health services
Affected by	Disease risk	Both incidence and duration

Relationship:

$$\text{Prevalence} \approx \text{Incidence} \times \text{Average Duration of Disease}$$

Relative Risk (RR)**Definition:**

- Relative risk is a ratio that compares the risk of an outcome (usually disease) in the exposed group to the risk in the unexposed group.

Formula:

$$\text{RR} = \frac{\text{Incidence in Exposed Group}}{\text{Incidence in Unexposed Group}}$$

Interpretation:

- RR = 1:** No association; risk is the same in both groups.
- RR > 1:** Positive association; exposure increases risk.
- RR < 1:** Negative association; exposure may be protective.

Example (Cohort Study):

Group	Developed Disease	Did Not Develop Disease	Total
Exposed	a	b	a + b
Unexposed	c	d	c + d

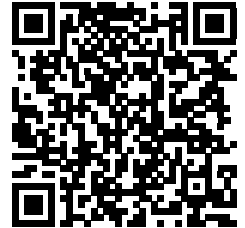


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