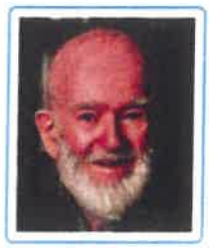
PSM

1 INTRODUCTION TO EPIDEMIOLOGY

Epidemiology 00:00:20



- **John M Last**
  - Defined epidemiology.
  - Defined health education.
- **Epidemiology**: The study of frequency, distribution and determinants of disease or health-related states and events in specified populations and application of the knowledge for disease prevention and control.

3 components in Epidemiology

1. Disease frequency
2. Disease distribution
3. Disease determinants

1. Disease frequency

- Frequency means the number of cases of a disease.
  - New cases: Incidence
  - Existing cases: Prevalence

2. Disease distribution

- How is the disease distributed in terms of time, place and person?
- What time of the year is the disease occurring?
- Is it more seen in winter or summer?
- Is it more affecting the males, females, children or the elderly?
- **Example**: In 2019 November COVID-19 came but as epidemiologists, we were calling it pneumonia of unknown origin is seen in Wuhan, China during winter months affecting the male population working in the bird market.

3. Disease determinants

- The determinant is given by why and how.
- To understand analytical epidemiology.

Tools of Measurement in Epidemiology 00:05:25

PYQ: FMGE 2020
PYQ: NEET PG 2018

- Rate
- Ratio
- Proportion
  - To express the frequencies
  - Each of these has a numerator and a denominator.
- In rate - the numerator is part of the denominator.
  - Multiplier can be 1000 or 10,000 or one lakh.
- Proportion - numerator is part of the denominator.
  - Multiplier in proportion is always 100.
- Ratio - numerator is not a part of the denominator.
  - Sex ratio = Number of females per 1000 number of males
  - So, the numerator is not a part of the denominator.

Incidence Vs Prevalence 00:08:36

PYQ: AIIMS 2020
PYQ: FMGE 2023

- Incidence = Total number of new cases of any disease occurring in a community in a year / the total population at risk in a year in that particular community * 1000.
- The multiplier in incidence is 1000.
- Incidence is the rate.

- Prevalence = Total number of existing cases (new + old) / total population of the community * 100
- The multiplier in prevalence is 100.
- Prevalence is a proportion.

PYQ: FMGE 2019, 2020

PYQ: INICET 2021

Q. The following is true about prevalence and incidence

A. Both are rates

B. Prevalence is a rate but incidence is not

C. Incidence is a rate but prevalence is not

D. Both are not rates

Important Information 00:11:44

	Incidence	Prevalence
Definition	New cases	New cases + Old cases (total caseload)
Expressed as	Rate	Proportion
Calculated as	Cohort study	Cross-sectional study
Effect of duration	No effect	Increases with duration
Purpose	For prevention and control of disease	Administrative and planning purposes

Relationship between incidence and prevalence

- Prevalence = Incidence X Duration

00:13:35

	Incidence		Prevalence
1. Effective treatment (cures the disease)	Same	P=I x D	↓ ses as D ↓ ses
2. New treatment prevents death but does not cure the disease (a person will live longer with disease e.g. ART)	Same	P=I x D	↑ ses as D ↑ ses
3. New treatment cures the disease	Same	P=I x D	↓ ses as D ↓ ses
4. Easily curable or fatal disease	Same	P=I x D	↓ ses as D ↓ ses
5. New prevention modality (e.g. New vaccine in the market)	Decreases	P=I x D	↓ ses

Q. If prevalence is very low as compared to the incidence for a disease, it implies

A. Disease is very fatal and /or easily curable

B. Disease is non-fatal

C. Calculation of incidence and prevalence is wrong

D. Nothing can be said as they are independent

Q. A new drug has been introduced into the market which is found to decrease mortality, but it does not cure the disease. Which of the following is a true statement regarding prevalence and incidence?

A. Decrease in incidence

B. Decrease in prevalence

C. Increase in incidence

D. Increase in prevalence

2 CLASSIFICATION/COHORT STUDY

Classification of study designs

00:00:20
PYQ: FMGE 2019
PYQ: INICET 2021

Study designs

1. **Observational studies**
   a. Descriptive eg. case report, case service
   b. Analytical eg. cross sectional, ecological, cohort & case control study
2. **Interventional / Experimental study**
   a. RCT
   b. Field trial
   c. Community trial

- Analytical study : comparison group is always present
- In descriptive, there is no comparison group.

Descriptive study design

- Describing a disease in terms of time, place, and person i.e studies distribution of a disease.
- Case report
- Case series
  - A case report is an individual case study.
  - An aggregation of case reports is known as a case series.

Analytical study design

- The reason why and how disease occurs i.e studies determinants of a disease
  - Cohort study
  - Case-control study
  - Cross-sectional study
  - Ecological study
- In descriptive the buzzword is distribution
- In analytical the buzzword is determinant

Interventional / Experimental study

- Randomized Control Trial- RCT - Drug trials
- Field trials - Vaccine trials
- Community trials - Preventive trials

Hypothesis

00:06:19

- An assumption yet to be verified.
- Three steps:
  - Formulation of hypothesis: Descriptive epidemiology
  - Test hypothesis: Analytical epidemiology
  - Confirm hypothesis: Experimental and interventional epidemiology

Types of Studies	SYNONYMS Observational Studies	Unit of Study
Descriptive studies Analytical studies		
1. Ecological	Correlation, geographic, aggregate	Populations
2. Cross sectional	Prevalence	Individuals

3. Case control	Case reference	Individuals
4. Cohort	Follow-up	Individuals
	Experimental Studies (Intervention Studies)	
1. Randomized control trials	Clinical trials	Patients
2. Field trials	Vaccine trials	Healthy people
2. Community trial	Community studies	Communities

Q. Studying the distribution of disease or health-related characteristics in the human population and identifying characteristics with which disease seem to be associated is

a. **Descriptive epidemiology**
b. Experimental epidemiology
c. Analytical epidemiology
d. Interventional epidemiology

Q. Which of the following is an example of a longitudinal observational and analytical study?

a. Case-control study
b. **Cohort study**
c. Randomized controlled trial
d. Ecological study

Unit of study 00:11:27

TYPE OF STUDY	UNIT
ECOLOGICAL/CORRELATION	Population
CROSS-SECTIONAL	Individual
CASE-CONTROL/CASE REFERENCE	Individual
COHORT	Individual
RANDOMIZED CONTROL TRIALS	Patients
FIELD TRIAL	Healthy individuals
COMMUNITY TRIAL	Community

- All study designs have individuals as a unit of study except ecological.
- In the ecological study, the population is the unit of study.

Approach to Identify Study Design 00:12:23

1. Identify exposures and outcomes
2. Start of study
3. Direction of study
   - Forward
   - Backward
   - Same point of time
4. Comparison groups
   - Exposed vs non-exposed
   - Diseased vs non-diseased
5. Buzzwords: Distribution, descriptive, history, follow-up, matching
6. Rare exposure, Rare diseases, Rare individuals

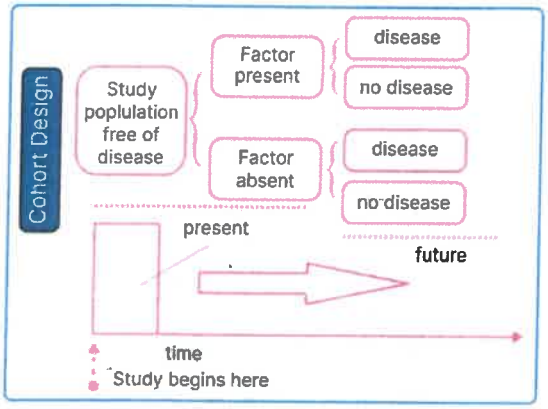
Cohort Study

00:16:40

- A cohort means a group of individuals who share a common characteristic.
  - For Example:
    - → Birth cohort - all children are born in a particular hospital in Delhi today.
    - → Marriage cohort - all those who are getting married together.
- Type - observational analytical study.

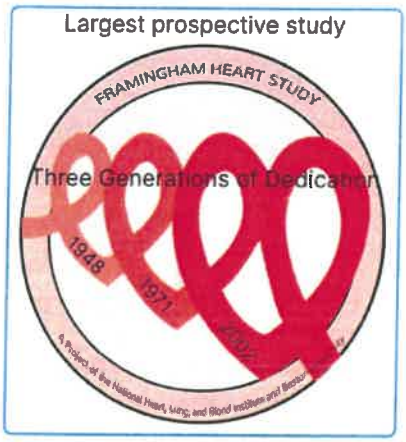
Basic design

- When is the study starting?
- What are you comparing / whether we have a comparison group or not
- Direction of study
  - Are we going forward? Are we standing at the same point or are we going backwards?
- For example, now it is 2023 when the study begins – present time.
- With a study population that does not have a disease
  - Let's say a group of medical college students who are admitted in 2023 first year.
- Dividing them into factor present and factor absent.
  - I.e., the exposed group and the non-exposed
  - Factor present means exposed / risk factor present.
  - Factor absent means no risk factor.
  - For example, if we were studying alcohol.
    - → Factors present - alcohol consumption present.
    - → Factor absent means no alcohol.
- The study is going forward.
- We are looking at the outcome – the occurrence of disease in the exposed group and no disease in the non-exposed.
- Basic design : comparison of exposed v/s non exposed groups



Synonyms for a cohort study

- Moving forward with time → Prospective cohort study.
- Moving with time → concurrent study
- Cause-to-effect
- Moving from risk factor to outcome → risk factor to disease.
- Exposure to an outcome
- Follow-up study
- Forward-looking study
- Incidence study



Steps of the cohort study

1. Selection of study subjects
2. Obtaining data on exposure
3. Selection of comparison group (non-exposed)
4. Follow up.
5. Analysis

The analysis is a measure of the strength of association in the form of relative risk, attributable risk, and population-attributable risk.

Advantages of a cohort study

- Establishes temporality.
  - Temporality means cause precedes effect.
    - → Before lung cancer, the person has smoked.
    - → Before CVD happened, the person was drinking.
  - Most important of Hill's criteria of causality.
- Calculates the incidence of a disease.
- It studies multiple outcomes.

Advantages	Disadvantages
Establishes temporality	Time taking
Multiple outcomes	Expensive
Incidence can be calculated	Sample size: larger
Direct estimate of relative risk	Common administrative problems

- Hawthorne bias
  - Subjects modify their behavior upon being observed.
  - Example – smokers quit smoking in between
- Attrition bias - loss to follow-up.

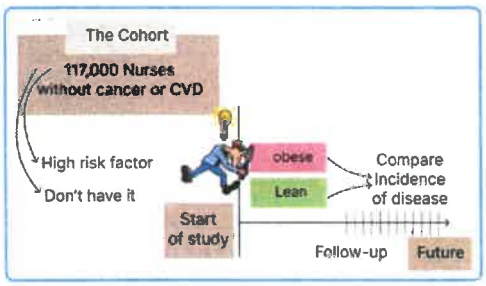
Rare exposures e.g. occupational studies	Not suitable for rare diseases
Minimizes bias (i.e. recall bias)	Hawthrone bias/Attrition bias

Q. All are advantages of cohort study except
a. Almost no recall bias
b. Presence of Hawthrone effect
c. Temporarily can be studied
d. Incidence can be calculated

Types of Cohort Study

00:33:13
PYQ: AIIMS 2019
PYQ: FMGE 2021

- **Prospective cohort study**
  - Concurrent - moving forward with time.
- **Retrospective cohort study**
  - Non- concurrent study.
  - We are moving at the opposite time.
- **Mixed cohort study**
  - Both retrospective + prospective.
- A group of nurses who do not have Cancer or CVD - cohort.
- A cohort study always **compares exposed with non-exposed.**
- Obesity is exposed – a high-risk factor.
- Lean - non-exposed
- The study is going forward → This is a prospective cohort study.



Retrospective Cohort Study

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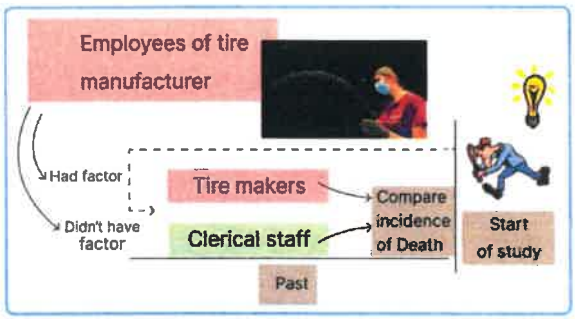
- Cohort - employees of tire manufacturer
- Tire makers - exposed
- Clerical staff - non-exposed
- It is cohort as it compares exposed and non-exposed and looks at the incidence.
- We start at the present and retrospectively analyze.



Steps of a retrospective cohort study

1. Start from the present date.
2. Use historical data.
3. A factory register of a group of workers in 2010.
4. Based on historical data, divide the cohort into exposed and non-exposed.
   a. Exposed – tire makers.
   b. Non-exposed- clerical staff.
5. Come forward
6. The outcome is determined at the time the study begins.

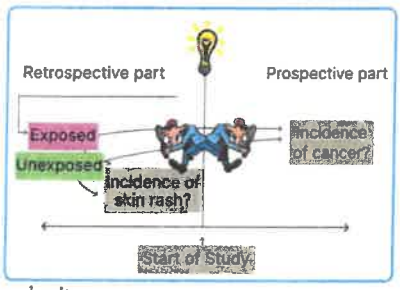
PYQ: NEET 2021

- Be it prospective or retrospective, cohorts always compare exposed with non-exposed.

Advantages of a retrospective cohort

- Saving money and time
- No loss to follow-up - reduce attrition bias.
- No Hawthorne bias.
- Calculates incidence.
- Establish temporality.
- A Retrospective cohort is much better than a prospective cohort.
  - In case-control outcome has already occurred.
  - We are comparing diseased and non-diseased.

Mixed cohort study 00:42:23



- Bidirectional
- Also called Ambispective cohort

Example,

- We start the study in 2023.
- We go back into the past - historical data.
- Divided cohort into exposed and non-exposed.
- We come forward and look at the incidence of skin rash at the time the study started.
- This part is a retrospective cohort study.
- Now we have two groups- those who have a skin rash and those who do not.
- They are followed into the future to see how many go on to develop cancer and how many don't.
- This part is a prospective cohort study.

MCQs

Q. In a study begun in 1965, a group of 3000 adults in Baltimore were asked about alcohol consumption. The occurrence of cancer was studied in the group between 1981 and 1995. Which type of study is this?

Ans:

- The study moves forward.
- And compares exposed and non-exposed (alcohol)
- This is a **prospective cohort study.**
- This is a **horizontal study design** as the study moves forward.
- When the outcomes are looked at fixed time intervals (every 6 months or every year) - it is called Longitudinal Study
- A longitudinal Study is a type of cohort study only (prospective)

Q. 500 women aged 40 - 54 who present for routine checkups are asked about their meat consumption. 20% of the women turned out to be vegetarian. During the ensuing five years, five vegetarians and 43 non-vegetarians develop colorectal cancer. Which type of study is this?

Ans:

- Here, exposure is vegetarian/non-veg.
- Outcome - colorectal cancer
- Follow up of 5 years.
- So, this is a **prospective cohort study.**

Q. A study is being conducted to find association between aniline dye exposure and bladder cancer among workers who have worked in he factory for >20 years. For the study purpose two groups were formed. One group directly handling dyes and other group involving office workers not directly exposed to dye. Years of occupation including other exposure details were collected by examining past records of the factory. What type of study is this?

Ans:

- **Retrospective cohort study**

Q. After a retrospective cohort study if another study is done in the forward direction for another 15-20 years it is known as?

Ans:

- Here, we have both retrospective and prospective components.
- So, this is a **mixed cohort study or an ambispective cohort study.**

The measure of Strength of the Association of Cohort Study 00:51:44

1. Relative risk (Risk Ratio)
2. Attributable risk
3. Population Attributable Risk - PAR

PYQ: NEET PG 2020

Relative risk

- Association between smoking and CVD

PYQ: NEET PG 2018, 2021, 2022

PYQ: FMGE 2020, 2022

- 2*2 table

	Outcome- CVD		
Risk Factor -Smoking	**YES**	**NO**	**Total**
YES	a	b	a+b
NO	c	d	c+d

Relative risk or risk ratio = incidence among exposed / incidence among non-exposed.

- Incidence among exposed = a / a+b
- Incidence among non-exposed = c / c+d

Interpretation of relative risk

- Relative risk
  - > 1 - positive association (risk factor)
  - = 1 - no association
  - < 1 - negative association
- Suppose the relative risk is 4.5 - that means those who smoke are at 4.5 times higher risk of developing CVD.
- Positive association means it is a risk factor.
- Negative association means an inverse association, or it is a protective factor.
- In a study, the association between herbal tea and diabetes was studied, and the risk ratio was found to be 0.8. RR < 1 → This means herbal tea is a protective factor for diabetes.

Attributable risk PYQ: NEET PG 2018, 2020 (00:55:52)

AR = (incidence among exposed - incidence among non-exposed) / incidence among exposed * 100

- Expressed as a percentage.
- Suppose AR is 75% in a study of smoking and lung cancer, that means 75% of lung cancers are attributed to smoking.
- Of use to epidemiologists

Population Attributable Risk - PAR

	Outcome- CVD		
Risk Factor -Smoking	**YES**	**NO**	**Total**
YES	a	b	a+b
NO	c	d	c+d
Total	a+c	b+d	

PAR = incidence among the total population - incidence among exposed / incidence among total population * 100

- Total population = a+b+c+d
- incidence among total population = a +c / a+b+c+d
- incidence among non-exposed = c / c+d

PAR = [(a+c/a+b+c+d)-(c/c+d)]/(a +c/a+b+c+d)* 100

Interpretation of PAR

- In a study of smoking and lung cancer.
- If PAR - 90 %
- It means if smoking is eliminated as a risk factor there will be a 90% reduction in the annual incidence of lung cancer cases in the population.
- PAR is of importance to policymakers.
- Here, PAR is 90% implies smoking cessation is important in lung cancer reduction.
  - Incidence of disease among exposed vs incidence of disease among non-exposed: **relative risk**
  - How much of the disease is attributed to a particular exposure: **attributable risk**
  - If smoking is eliminated as a risk factor there will be a 90% reduction in the annual incidence of lung cancer cases: **population-attributable risk**
  - **Example:**
    → Community physician/epidemiologist: **attributable risk**
    → Policymakers (smoking cessation program): **population attributable risk**

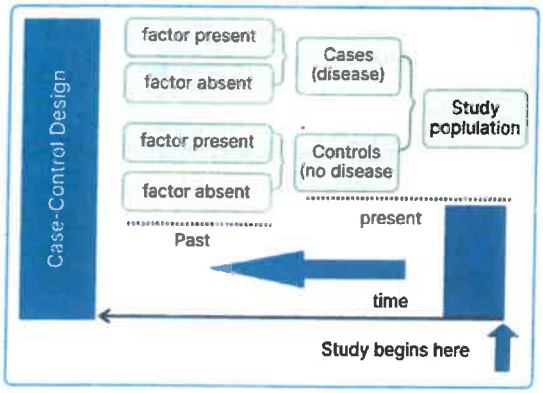
3 CASE CONTROL, CROSS SECTIONAL & ECOLOGICAL STUDY

Case-Control Study

00:00:32

PYQ: FMGE 2020, 2021, 2023 | PYQ: NEET PG 2019, 2022 | PYQ: INICET 2021

- Type - observational analytical study.
- Basic design: comparison between diseased vs non-diseased.
- Start at present time
- Cases - diseased
- Controls - non- diseased
- Study proceeds retrospectively i.e. backward
- In the retrospective cohort study also, we start at the present time and move backward, but there, we were comparing exposed and non-exposed.
- In case-control, study is started at present time, compare diseased v/s non diseased at present time



Synonyms of a Case-Control Study

- Retrospective study
- Backward-looking study
- Outcome to exposure
- Disease to risk factor
- Effect to the cause
- Trohoc - opposite of cohort

Steps of a Case-Control Study

00:03:21

1. Selection of cases and control
2. Matching
3. Measurement of exposure
4. Analysis and interpretation

- For 1 case : maximum 4 controls can be taken if the cost of collecting cases & control is equal
- 1:1 is also sufficient
- **Matching** means Cases and control are similar to almost all the factors that can affect the outcome of the study, except the disease under study
- Matching eliminates all the known confounders in the study.
- The Dolls and Hills study is an example of a case-control study.

Q. Which of the following is not a part of the case-control study?

A. Strength of association
B. Follow-up
C. Matching
D. Selection of study objects

Advantages and Disadvantages of Case-Control Study

00:05:59

Advantages	Disadvantages
Easy to carry out	Recall bias
Rapid and inexpensive	Selection of appropriate control groups may be difficult
Sample size: smaller	Incidence cannot be calculated
Investigate rare diseases	