

# Observational Epidemiology

Small pox epidemic

Developed  
disease

Did not developed  
disease

Milkmaid women

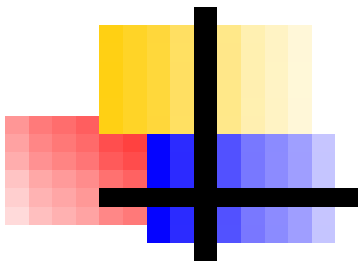
had contact Cow pox

*Hypothesis- Cow pox offers immunity to Small Pox.*

- Is hypothesis true?
- Presence of co- factor Factor\ other than cow pox infection present.....
- Host factors--- only women are protected?
- What percentage of protection does the cow pox offer?

- Whether or not a **statistical association** exists between a disease and suspected factor
- If it does exist, the **Strength of Association**

- Descriptive study- population
- Analytical- Individual



# ANALYTICAL EPIDEMIOLOGY

# Descriptive studies

Hypothesis-

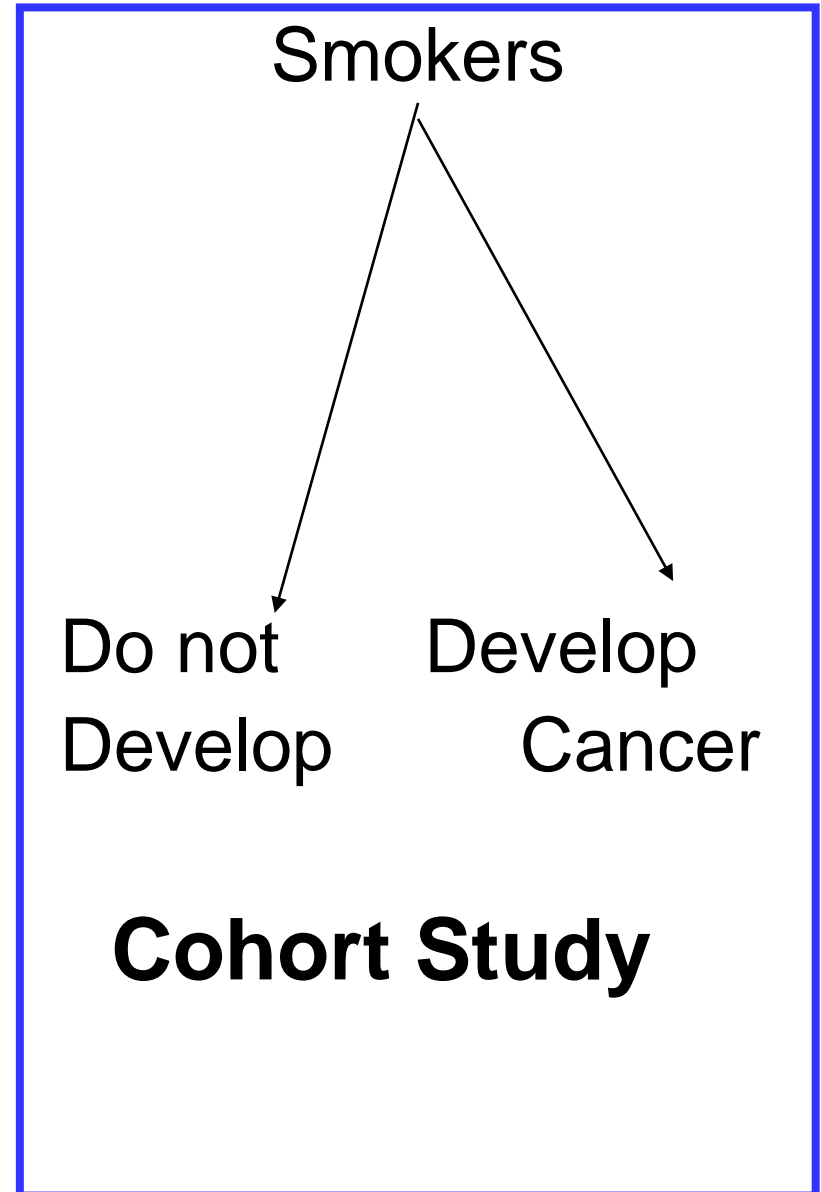
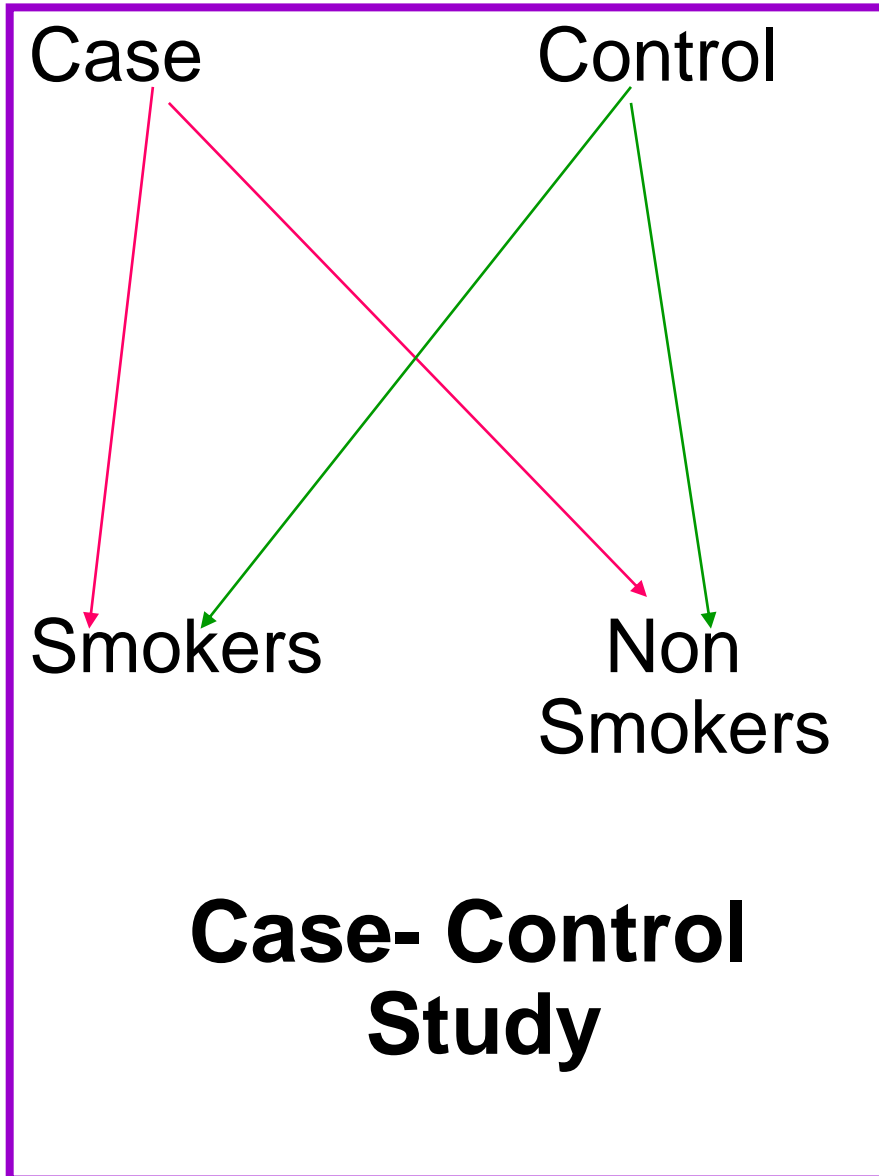
Prevalence of lung CA is higher among smokers

- Hypothesis is a supposition arrived at from observation or reflection.
- It can be accepted or rejected using the technique of analytical epidemiology.

# Cigarette smoking causes lung cancer”

- How many times smokers are at risk of getting lung cancer in comparison with non-smokers?
- Prevalence Rate of lung cancer- what percentage of lung cancer can be attributable to smoking.
- If we prevent smoking from the community- what percentage of decrease in prevalence of lung cancer we can predict?
- The smoking of 30 – 40 cigarettes per day causes lung cancer in 10 percent of smokers after 20 years of exposure





# Descriptive v/s Analytical studies

- Instead of Entire Population Individual subjects are studied.
- However inference is applicable to the population from which subjects are selected.

# Case-Control Studies

## Alternative names

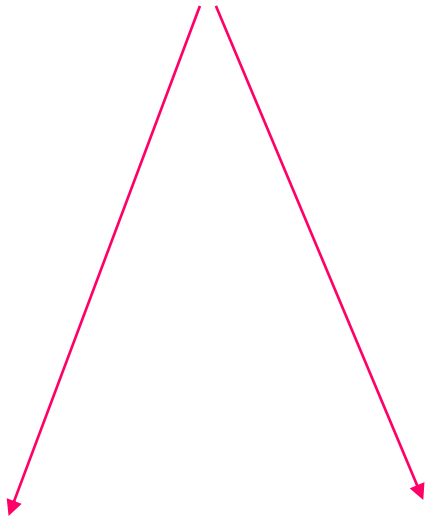
- Retrospective studies
- Comparison studies
- Case reference studies

Common first approach to test the Hypothesis

# Characteristics

- Both exposure and outcome have occurred before the start of the study
- The study proceeds backwards from effect to cause
- It uses a control or comparison group to accept or reject a hypothesis

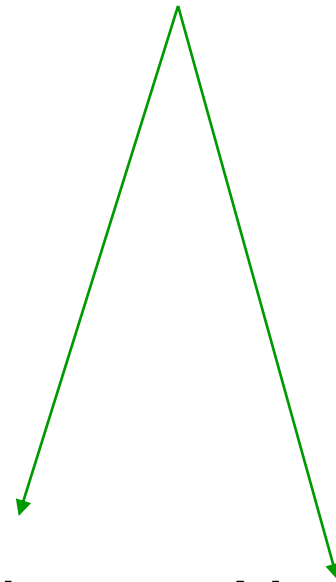
# Case



Smokers

Non  
Smokers

# Control



Smokers

Non  
Smokers

# Design of case control study

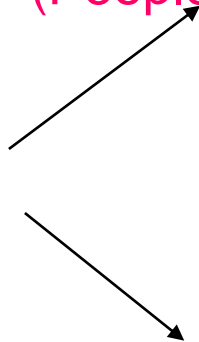
Case

(People with disease)

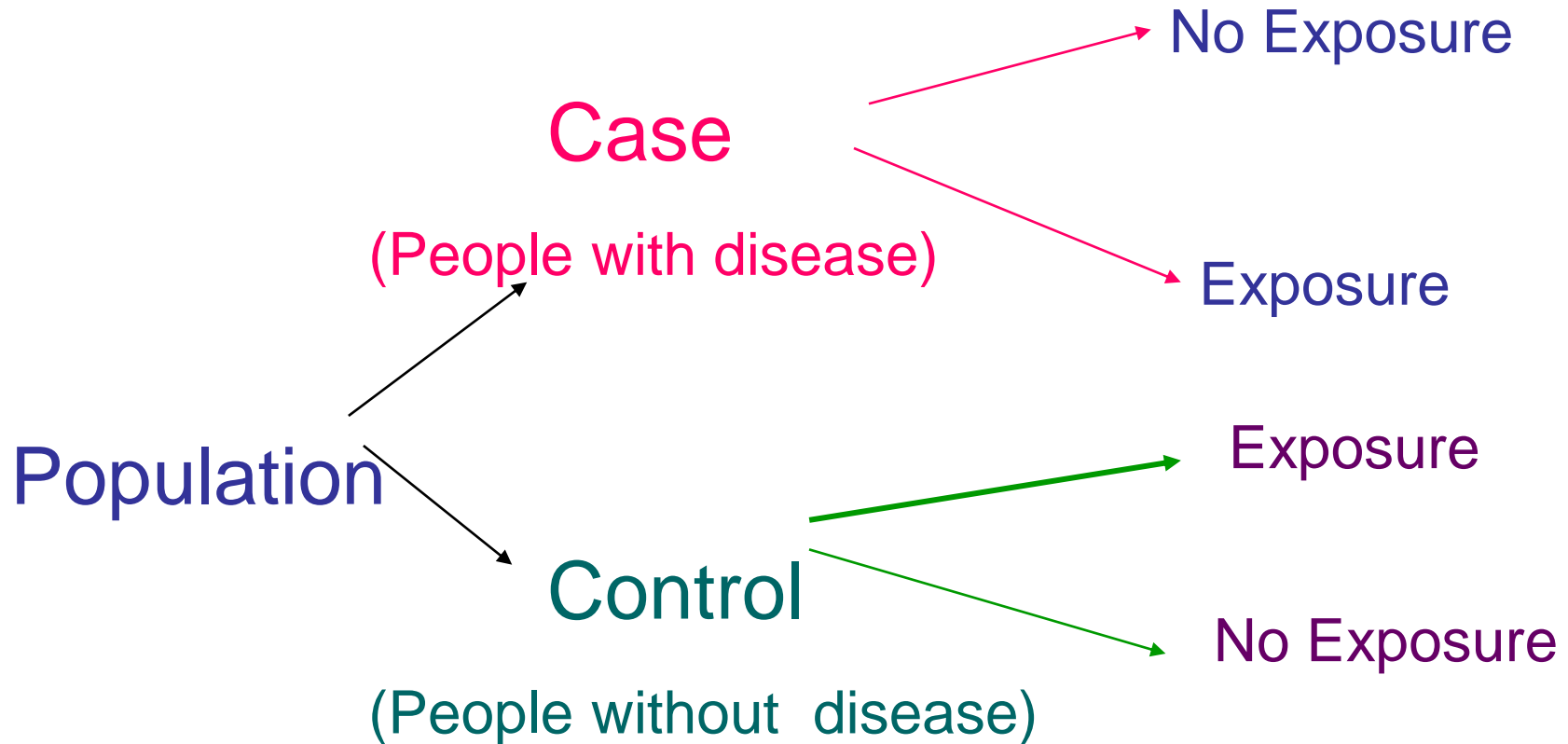
Population

Control

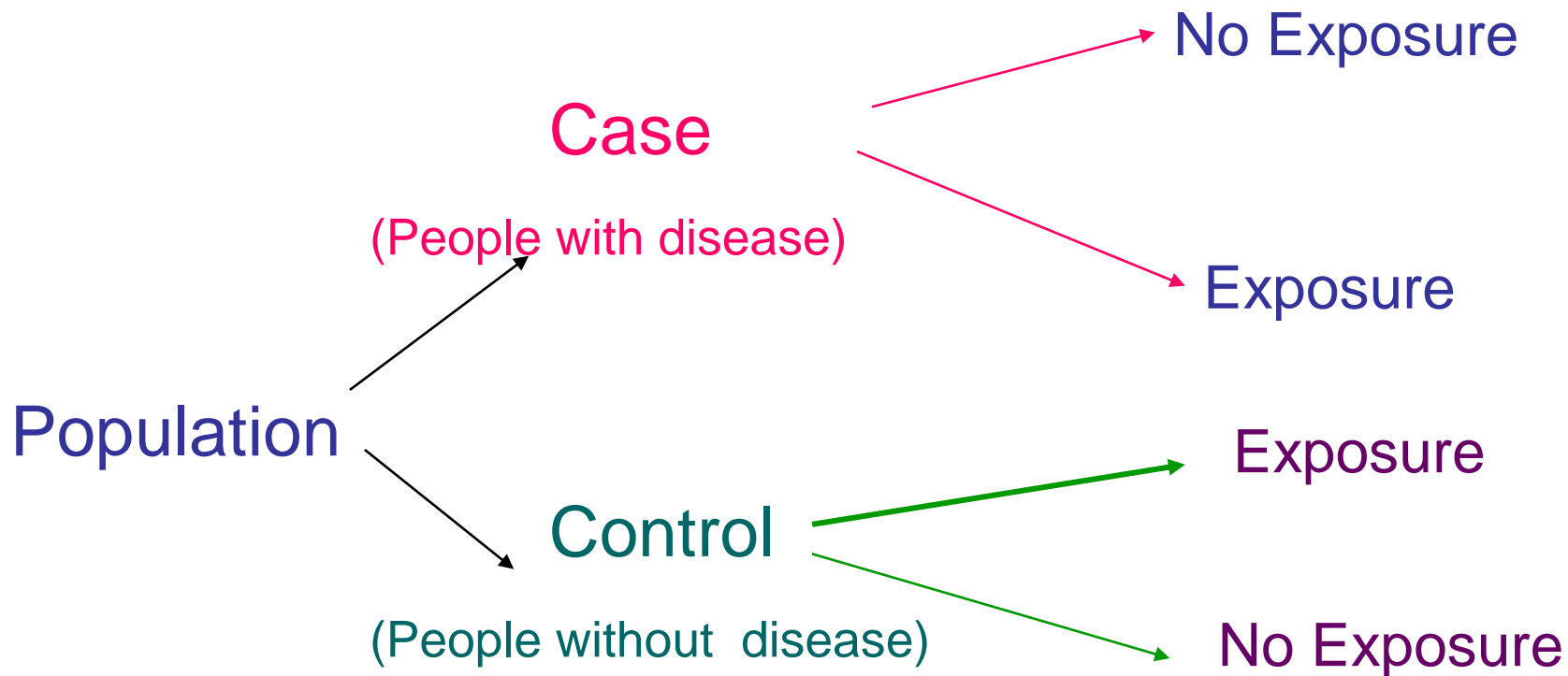
(People without disease)



# Design of case control study



# Design of case control study

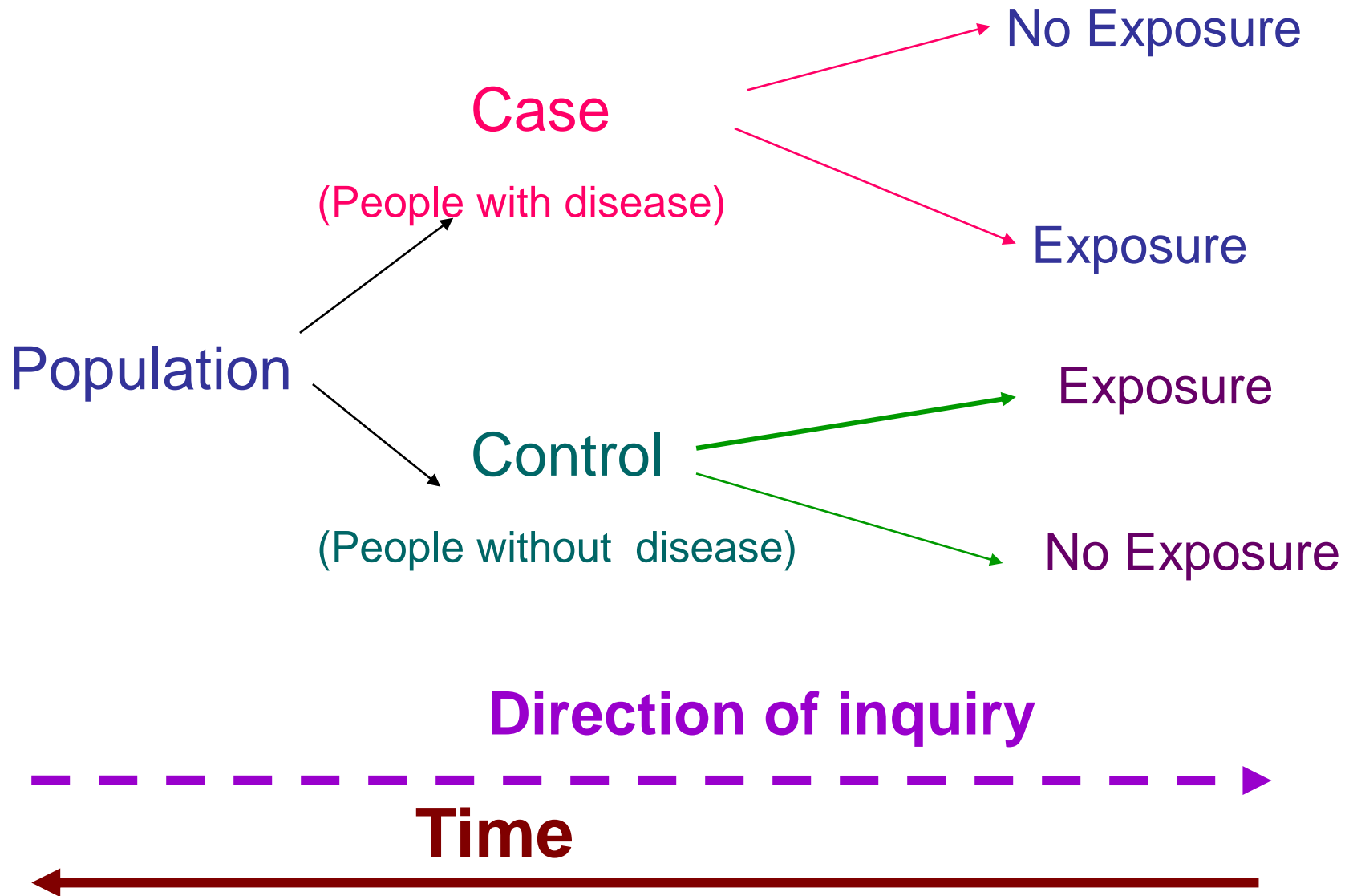


**Direction of inquiry**





# Design of case control study



# Framework

Case control	Disease yes	Disease no	Total
Exposure	a	b	a+b
No exposure	c	d	c+d
Total	a+c	b+d	a+b+c+d

# Process

- People with disease (cases) are selected from amongst the population
- People without the disease (controls) are selected from comparable population and they must be free from disease
- Data are collected
- Occurrence of possible cause is compared between cases and controls
- Analysis of data to find out association between the suspected cause and the effect

# Applications

- Suitable for rare diseases
- Suitable for chronic diseases
- Common first approach to test the hypothesis

# Basic steps

- **Selection of cases and controls**
- **Matching**
- **Measurement of exposure**
- **Analysis**

# Selection of cases and controls

- Case selection - easy
  - Define case
  - Define diagnostic criteria
  - Define eligibility criteria ( Incident case/  
Prevalent case)
  - Source of cases (Hospital / Population )

# Selection of cases and controls

e.g.- DM

- **Define case-** at what bd. sugar level\ urine sugar
- **Define diagnostic criteria-** RBs\fasting\GTT
- Define eligibility criteria ( Incident case/  
Prevalent case)
- Source of cases (Hospital / Population )

# Selection of cases and controls

## Control selection- Difficult

- Hospital controls
- Relatives
- Neighborhood (Residence/ Workplace)
- General population
- Control from more than one source



# How many controls

- At least 1: 1
- If few cases- more than one control study
- “Choice of controls and cases must not be influenced by exposure status”

# Basic steps

- Selection of cases and controls
- **Matching**
- Measurement of exposure
- Analysis

# Asbestos-→CA lung

## Case

- Mean age- 50 years
- 80% males
- 60% -smokers

## Control group

- Mean age- 30 years
- 50% males
- 10% -smokers

# Matching

Process by which we select controls in such a way that they are similar to cases with regard to variables which are known to influence the outcome of disease and subsequently confound the results

# Confounding factor

- One which is associated both with exposure and disease and is distributed unequally in study and control group
- One that, although associated with exposure under investigation, is itself independently a risk factor for disease
- E.g.- Age\Sex\ Marital status.....

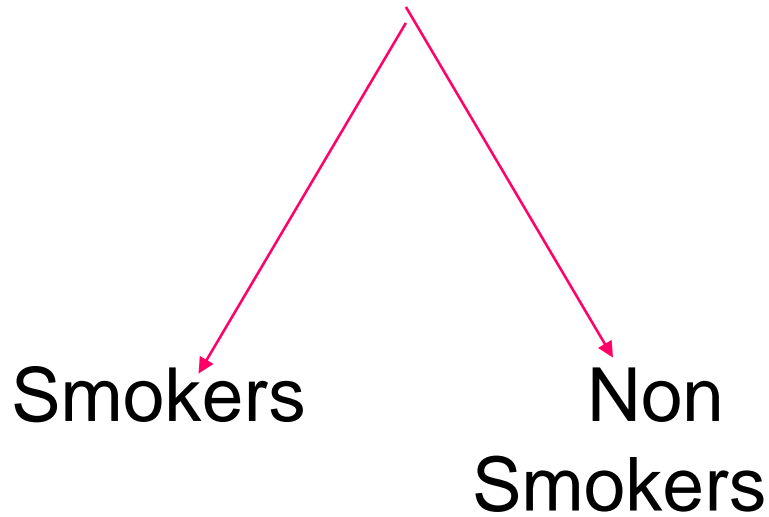
# Matching procedure

- Group matching
- Pairs

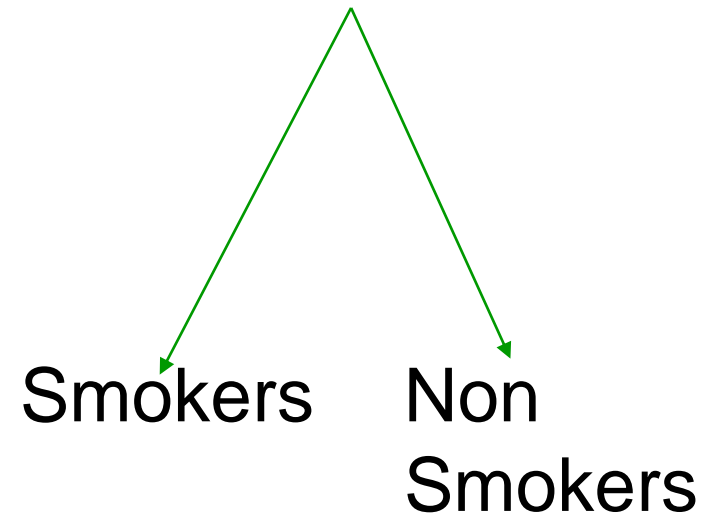
# Basic steps

- Selection of cases and controls
- Matching
- **Measurement of exposure**
- Analysis

## Case



## Control



- % of smokers in case vs. control gp
- Average duration of smoking
- Average- no. of cigarette/ day.....



# Measurement of exposure

- Occurred or not occurred
- Duration, severity and frequency
- Measured in same manner in both cases and controls
- Rule out any possible bias

# Basic steps

- Selection of cases and controls
- Matching
- Measurement of exposure
- **Analysis**

# Analysis

- Exposure rate
- Estimation of exposure risk
- To ascertain the association- Test of significance SE of proportions and means
- Association does not imply causation

# Framework

Case control	Disease yes	Disease no	Total
Exposure	a	b	a+b
No exposure	c	d	c+d
Total	a+c (Diseased)	b+d (Healthy)	a+b+c+d

# Framework

Case control	Disease yes	Disease no	Total
Exposure	a	b	a+b
No exposure	c	d	c+d
Total	a+c (Diseased)	b+d (Healthy)	a+b+c+d

Exposure rate amongst cases =  $a/a+c$

Exposure rate amongst controls =  $b/b+d$

# Odds ratio

## (Risk Ratio/ Cross Product ratio)

- Measure of strength of association and closely related to RR
- **OR =  $ad / bc$  (Key parameter in case control study)**

# Framework

Case control	Disease yes	Disease no	Total
Exposure	a	b	a+b
No exposure	c	d	c+d
Total	a+c (Diseased)	b+d (Healthy)	a+b+c+d

$$\text{OR} = ad / bc$$

**(Key parameter in case control study)**

- Out of 300 study subjects-
- Cases- 100, -- 50 are smokers
- Controls- 200 --- 10 are smokers



# Framework

Case control	Disease yes	Disease no	Total
Smoker	50	10	60
Non smoker	50	90	140
Total	100	200	300

# Framework

Case control	Disease yes	Disease no	Total
Smoker	50	10	60
Non smoker	50	90	140
Total	100	200	300

$$\begin{aligned} \text{OR} &= \text{ad/bc} \\ &= \frac{50 \times 90}{50 \times 10} \end{aligned}$$

- $OR = ad/bc$   
 $= \frac{50 \times 90}{50 \times 10}$   
 $= 9$

- **Smokers are at 9 times higher risk of getting lung cancer than non smoker.**

- Disease being investigated is relatively rare
- Case must be representative of those who have the disease
- Controls must be representative of those who do not have the disease

# Types of bias

- Bias due to confounding
- Memory or recall bias
- Selection bias
- Berksonian bias
- Interviewer's bias

# Advantages

- Easy, inexpensive, relatively quick
- Fewer subjects
- Suitable for rare diseases
- No risk for subjects
- Simultaneous study of multiple etiological factors
- Risk factor can be identified
- No attrition problem
- Ethical problems are minimum
- Easy analysis

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- Easy, inexpensive, relatively quick
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# Disadvantages

- Problem of bias specially recall bias
- Selection of controls is difficult
- Incidence can not be calculated
- Only estimate of RR
- Only disease under study is studied
- Only association is measured
- Not suitable for evaluation of therapy or prophylaxis



**THANK YOU**