

# CASE CONTROL STUDY

Facilitator:

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# Specific Learning Objectives

- At the end of session, the learner shall be able to describe:
  - Design of a Case-control study
  - Steps in conducting Case-control study
  - Odd's ratio
  - Bias in Case-control study
  - Advantages & Disadvantages of Case-control study

# ANALYTICAL EPIDEMIOLOGY

- Testing a hypothesis
  - Statistical association between a disease and suspected factor
  - Strength of association
- The subject of interest is individual within the population
- Inference is to the population from which individuals are selected

# Analytical Studies

Study design	Unit of study
Ecological or Correlational	Population
Cross-sectional or Prevalence	Individuals
<b>Case-control</b> or Case-reference	Individuals
<b>Cohort</b> or Follow-up	Individuals

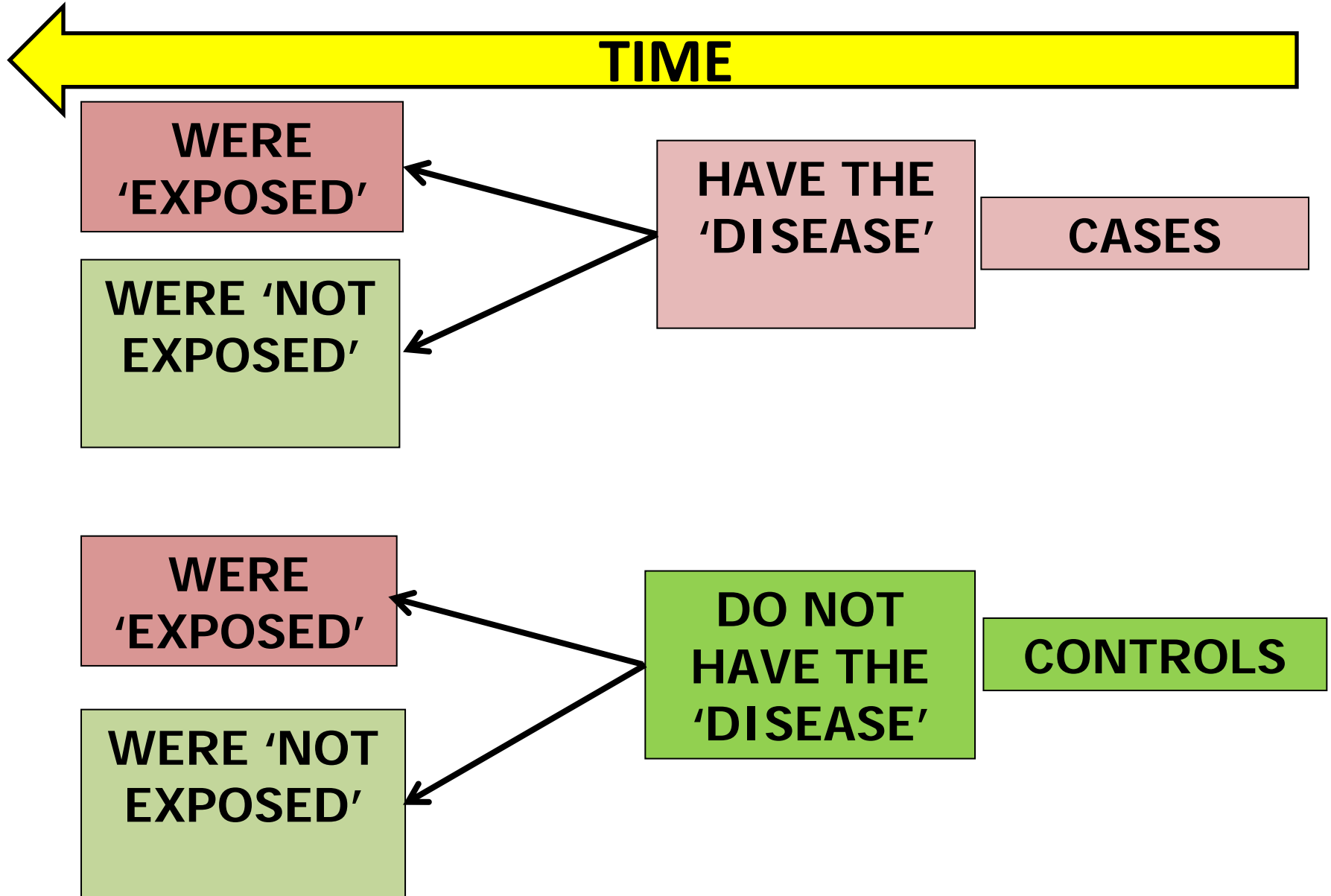
# CASE CONTROL STUDY

- Subjects are selected on the basis of whether **they do (cases)** or **do not (controls)** have a particular disease under study.
- Compared with respect to proportion having a history of an exposure or characteristic of interest.

# Distinct features

- Both **exposure and outcome (disease)** have occurred **before** the start of study
- The study **proceeds backwards** from effect to cause, and is thus called retrospective
- It uses a control or comparison group to support or refute an inference

# Design of a Case Control Study



# Basic design of Case- Control Study

Suspected/risk factors (Cigarette smoking)	<b>Cases</b> (Lung cancer present)	<b>Control</b> (Lung Cancer absent)
Present	a	b
Absent	c	d
	a+c	b+d

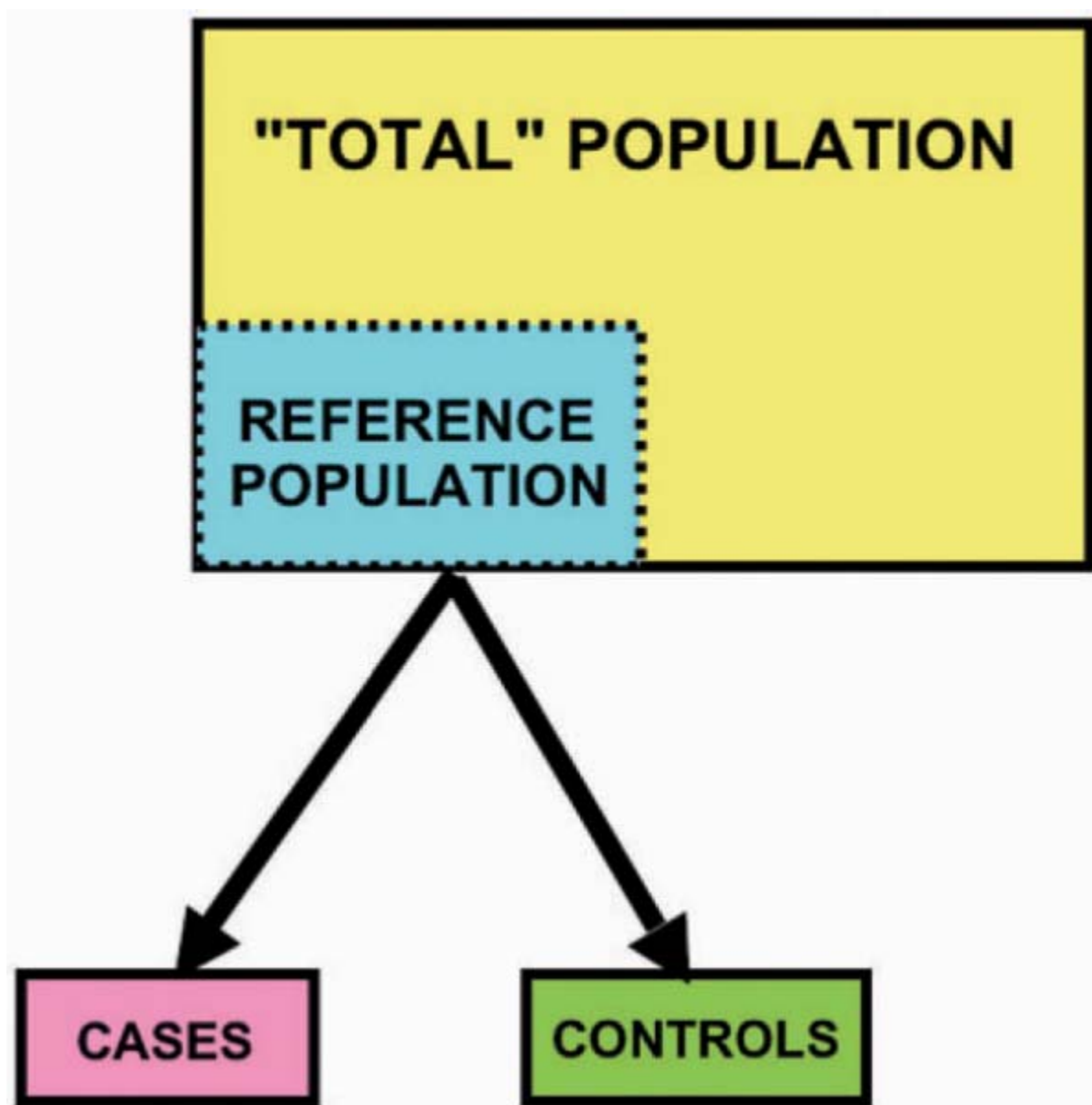


# Basic Steps in conducting a Case Control Study

- 1. Selection of cases and controls**
2. Matching
3. Measurement of exposure
4. Analysis and interpretation

# 1. Selection of Cases and Controls

- Identify a suitable group of cases and a group of controls
- Comparability of cases and controls is essential
- Major issues to be considered are:
  - selection of study groups
  - sources of information about exposures and disease



# Selection of Cases

## Definition of disease

- Diagnostic criteria
  - Once the diagnostic criteria are established, they should not be altered or changed till the study is over.
- Eligibility criteria

# Sources of Cases

- Hospital
- General Population

# Selection of Control

- Must be
  - free from disease under study
  - as similar to case as possible
- Comparison group identified before study is done

# Sources of Controls

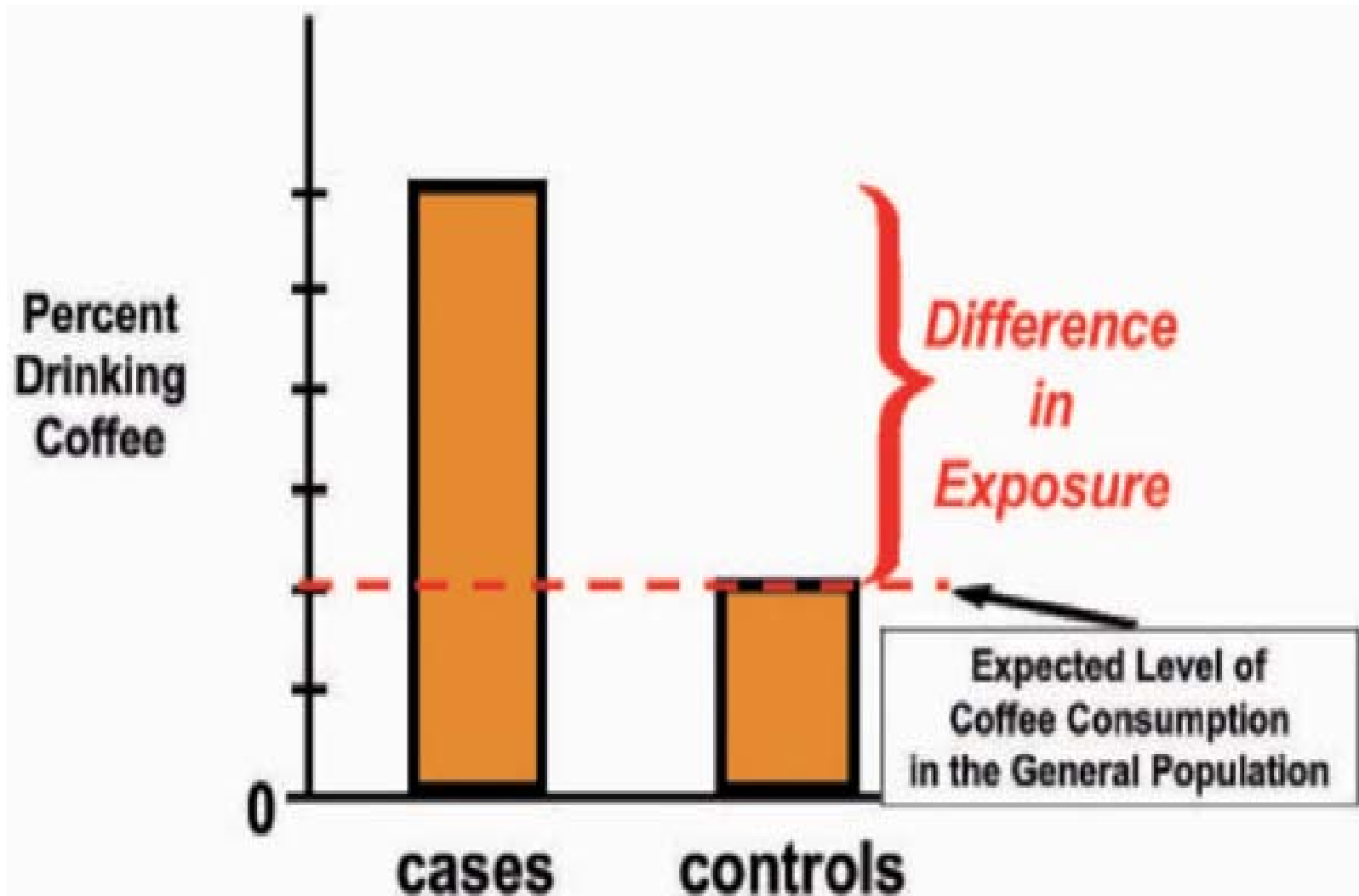
- Hospital Control
- Relatives
- Neighborhood control
- General population

# Pancreatic cancer & Coffee Consumption

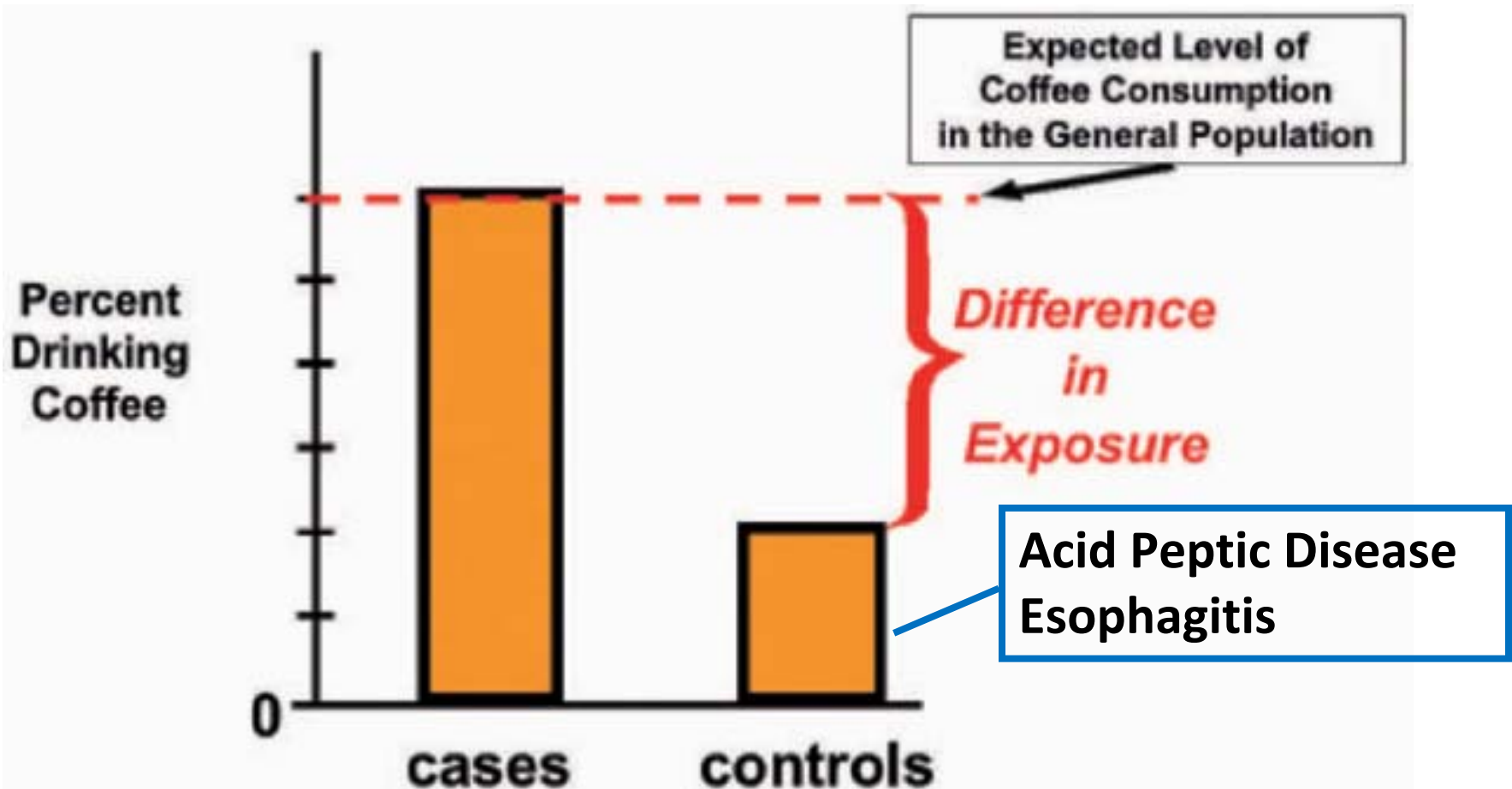




# Pancreatic cancer & Coffee Consumption



# Pancreatic cancer & Coffee Consumption



# Hospital Controls

## Advantages

- Easily identified and readily available
- More aware of antecedent exposures or events, reduce potential for recall bias
- Likely to have been subjected to the same intangible selection factor
- More likely to be willing to co-operate than healthy individuals, minimizing bias due to non-response

# Hospital Controls

## Disadvantage

- They are ill and therefore differ from healthy individuals in a number of ways
  - may be associated with illness and hospitalization in general.
- Select from various diagnostic groups
- Don't select patient with diagnosis known to be related to risk factor of interest

# Relatives

## Advantages

- Healthy and co-operative
- Offer a degree of control of important confounding factors
  - related to ethnic background, socio-economic status or environment

# Neighborhood Controls

- Controls may also be drawn from persons living in the same locality, working in same factory, attending same school as cases

# General Population

- From defined geographical areas
- **Disadvantages:**
  - more costly and time consuming
  - difficult to contact
  - quality of information may differ
  - individuals refuse to participate

# How many controls are needed?

- Ideally, 1 case : 1 control
- May be 2 – 4 controls per case depending upon:
  - size of study group
  - time
  - cost



# Basic Steps in conducting a Case Control Study

1. Selection of cases and controls
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## 2. Matching

- A major concern in conducting a case-control study is that cases and controls may differ in characteristics or exposures other than the one that has been targeted for study.
- e.g. if most of the cases are poor and most of the controls are affluent, we would not know whether the factor determining development of disease is exposure to the factor being studied or another characteristic associated with being poor.

- *Matching* is defined as the process of selecting the controls so that they are similar to the cases in certain characteristics,
  - such as age, race, sex, socioeconomic status, and occupation.
- If not adequately matched, could distort or confound the results.

# Group Matching

*Group matching (or **frequency matching**):*

- **Proportion** of controls with a certain characteristic is **identical** to the proportion of cases with the same characteristic.
  - e.g. if 25% of the cases are married, the controls will be selected so that 25% of that group is also married.

# Individual Matching

- *Individual matching* (or *matched pairs*).
- A control is selected who is **similar** to the case in terms of the **specific variable** or variables of concern.
  - e.g., if the first case enrolled in our study is a 25-year-old female, we will seek a 25-year-old female control.

# What are the problems with matching?

## ***1. Practical Problems with Matching:***

- Match according to too many characteristics, it may prove difficult or impossible to identify an appropriate control.
  - e.g., match each case for race, sex, age, marital status, number of children, zip code of residence, and occupation.

## ***2. Conceptual Problems with Matching:***

- Once we have matched controls to cases according to a given characteristic, we cannot study that characteristic.
  - For example, suppose we are interested in studying marital status as a risk factor for breast cancer.

# **Basic Steps in conducting a Case Control Study**

- 1. Selection of cases and controls**
- 2. Matching**
- 3. Measurement of exposure**
4. Analysis and interpretation

# 3. Measurement of Exposure

- Definition and criteria for exposure
- Obtain by
  - interviews,
  - questionnaire,
  - past records etc.
- Must rule out 'bias'



# **Basic Steps in conducting a Case Control Study**

- 1. Selection of cases and controls**
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# 4. Analysis

- To find out
  - Exposure rates among cases and controls
  - Estimation of disease risk associated with exposure (Odds Ratio)

# Odds ratio (Cross-product ratio)

- Assumptions:
  - a. The disease being studied must be relatively rare.
  - b. The cases must be representing of those with the disease.
  - c. The controls must be representing of those without the disease.
- The odds in the exposed group are compared with the odds in the unexposed group:  
$$\text{(Odds of disease in the exposed group)} / \text{(Odds of disease in the unexposed group)}$$

# Case Control Study Analysis

	Cases	Controls
Exposed	a	b
Not Exposed	c	d

Odds of disease in the exposed group:  $a/b$

Odds of disease in the unexposed group:  $c/d$

**Odds Ratio** =  $(a/b) / (c/d) = ad/bc$

# Bias

- Systematic error in the determination of association between the exposure and disease.
- The relative risk estimate may increase or decrease as a result of the bias.

# **Bias in Case Control Studies**

1. Bias due to confounding
2. Memory/Recall Bias
3. Selection Bias
4. Interviewer's Bias
5. Berksonian Bias

# Advantages of Case Control Studies

- Easy to carry out.
- Suitable to investigate rare diseases.
- No risk to the subjects.
- Allows study of aetiological factors.
- Risk factors can be identified.
- No attrition problems.

# Disadvantages of case Control Studies

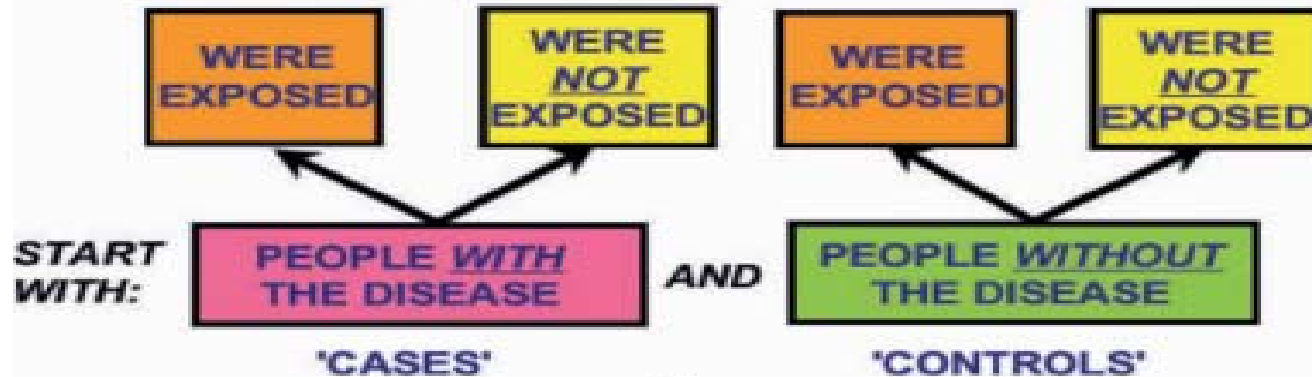
- Problems of bias relies on past records.
- Selection of control group is difficult.
- Can't measure incidence.
- Not suited to evaluation of therapy or prophylaxis of disease.





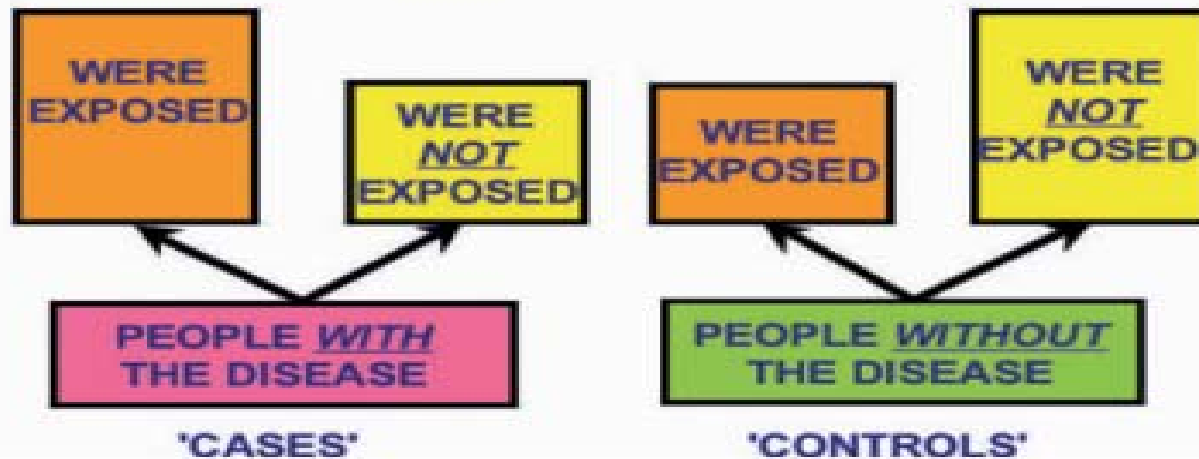
A

**THEN DETERMINE EXPOSURE HISTORY:**



B

**IF EXPOSURE IS ASSOCIATED WITH DISEASE, WE WOULD EXPECT:**



C