Epidemiological Studies

Epidemiological studies can be classified as either observational or experimental.

Observational studies allow nature to take its course: the investigator measures but does not intervene. They include studies that can be called descriptive or analytical:

- A descriptive study is limited to a description of the occurrence of a disease in a population and is often the first step in an epidemiological investigation.
- An analytical study goes further by analyzing relationships between health status and other variables.

Experimental or intervention studies involve an active attempt to change a disease determinant – such as an exposure or a behavior – or the progress of a disease through treatment, and are similar in design to experiments in other sciences.

A- Observational Studies

Cross-sectional studies

Cross-sectional studies measure the prevalence of disease and thus are often called prevalence studies. In a cross-sectional study the measurements of exposure and effect are made at the same time. It is not easy to assess the reasons for associations shown in cross-sectional studies. The key question to be asked is whether the exposure precedes or follows the effect.

Advantages

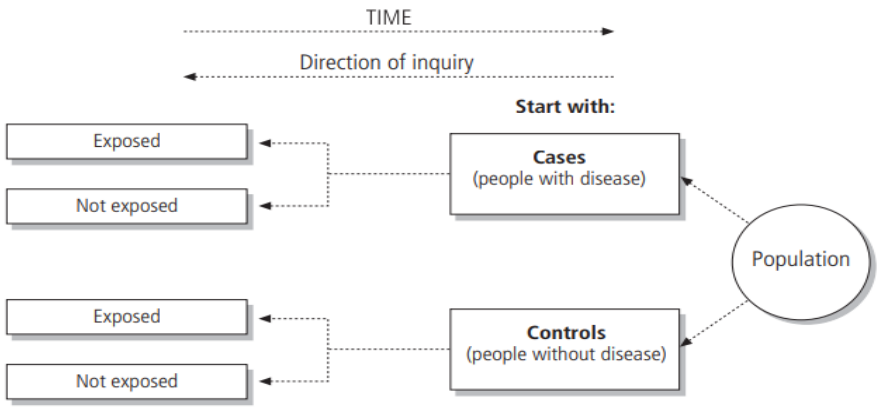
- Cross-sectional studies are relatively easy and inexpensive to conduct. useful for investigating exposures that are fixed characteristics of individuals, such as ethnicity or blood group.
- In sudden outbreaks of disease, a cross-sectional study to measure several exposures can be the most convenient first step in investigating the cause.
- Data from cross-sectional studies are helpful in assessing the health care needs of populations

Dis advantage

- No causality
- No variance control
- Doesn't look at changes over time
- Survey biases

Case-control studies

Case-control studies provide a relatively simple way to investigate causes of diseases, especially rare diseases. They include people with a disease (or other outcome variable) of interest and a suitable control (comparison or reference) group of people unaffected by the disease or outcome variable.



Advantages

- efficient for rare diseases or diseases with a long latency period between exposure and disease manifestation.
- less costly and less time-consuming
- advantageous when exposure data is expensive or hard to obtain.
- advantageous when studying dynamic populations in which follow-up is difficult.

Disadvantages

- They are subject to selection bias.
- They are inefficient for rare exposures.
- Information on exposure is subject to observation bias.
- They generally do not allow calculation of incidence (absolute risk).

Odds ratio

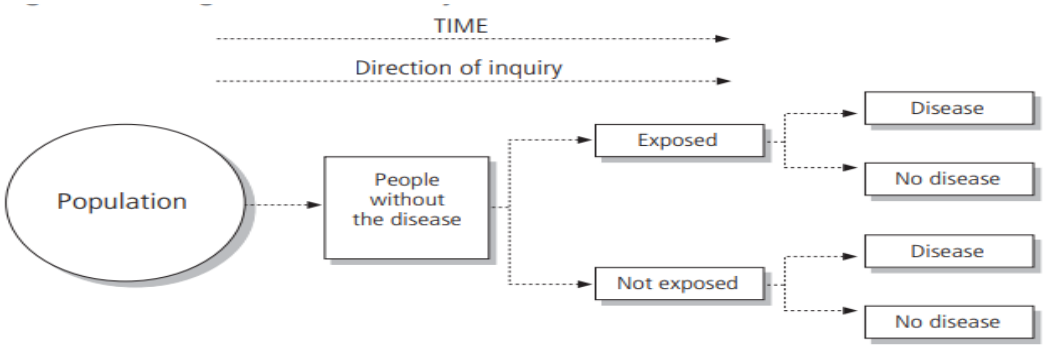
The association of an exposure and a disease (relative risk) in a case-control study is measured by calculating the odds ratio (OR), which is the ratio of the odds of exposure among the cases to the odds of exposure among the controls.

		Exposure (recent meat ingestion)		
		Yes	No	Total
Disease (enteritis necroticans)	Yes	50	11	61
	No	16	41	57
	Total	66	52	118

$$OR = (50/11) \div (16/41) = \frac{50 \times 41}{11 \times 16} = 11.6$$

Cohort studies

Cohort studies, also called follow-up or incidence studies, begin with a group of people who are free of disease, and who are classified into subgroups according to exposure to a potential cause of disease or outcome.



Advantages

- Can investigate multiple outcomes that may be associated with multiple exposures
- Can measure all variables of interest Easy to obtain large sample

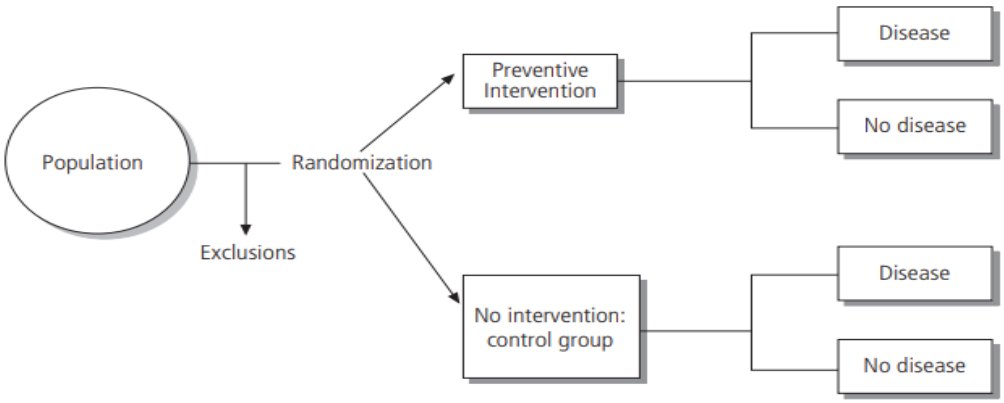
Disadvantages

- Susceptible to loss to follow-up compared with cross-sectional studies.

B- Experimental studies

Randomized controlled trials

A randomized controlled trial is an epidemiological experiment designed to study the effects of a particular intervention, usually a treatment for a specific disease (clinical trial). Subjects in the study population are randomly allocated to intervention and control groups, and the results are assessed by comparing outcomes.



Field trials

Field trials, in contrast to clinical trials, involve people who are healthy but presumed to be at risk; data collection takes place "in the field," usually among non-institutionalized people in the general population.

Community trials

In this form of experiment, the treatment groups are communities rather than individuals. This is particularly appropriate for diseases that are influenced by social conditions, and for which prevention efforts target group behavior.

Potential errors in epidemiological studies

1- Random error

Random error is when a value of the sample measurement diverges – due to chance alone – from that of the true population value. Random error causes inaccurate measures of association. There are three major sources of random error:

- individual biological variation;
- sampling error
- measurement error

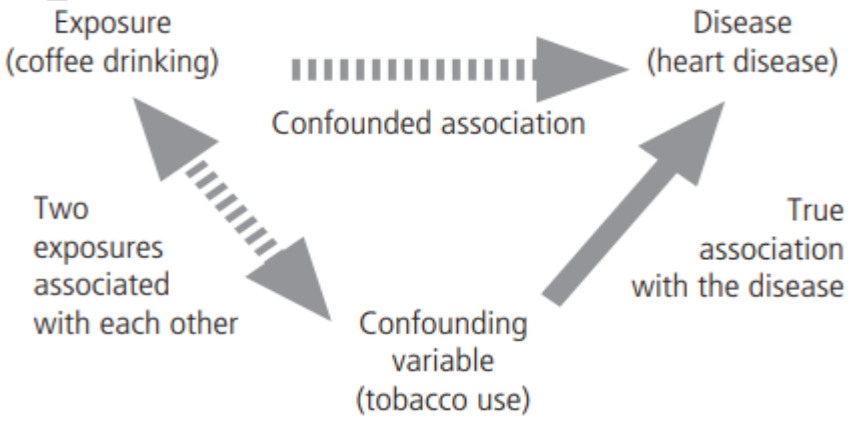
2- Systematic error

Systematic error (or bias) occurs in epidemiology when results differ in a systematic manner from the true values. A study with a small systematic error is said to have a high accuracy. Accuracy is not affected by sample size. The possible sources of systematic error in epidemiology are many and varied; over 30 specific types of bias have been identified. The principal biases are:

- **selection bias:** occurs when there is a systematic difference between the characteristics of the people selected for a study and the characteristics of those who are not.
- **measurement (or classification) bias:** occurs when the individual measurements or classifications of disease or exposure are inaccurate – that is, they do not measure correctly what they are supposed to measure.

3- Confounding

Confounding is another major issue in epidemiological studies. In a study of the association between exposure to a cause (or risk factor) and the occurrence of disease, confounding can occur when another exposure exists in the study population and is associated both with the disease and the exposure being studied.



The control of confounding

Several methods are available to control confounding, either through study design or during the analysis of results.

The methods commonly used to control confounding in the design of an epidemiological study are:

- randomization
- restriction
- matching.

At the analysis stage, confounding can be controlled by:

- stratification
- statistical modeling.