Aurobindo College of Dentistry

Indore, Madhya Pradesh

INDIA

Module plan

- Topic : Epidemiology
- Subject : Public Health Dentistry
- Target Group : Undergraduate Students
- Mode : PowerPoint Presentation
- Platform : Institutional LMS
- Presenter : Dr. Sandesh N

Learning objectives

- General Objective
  - Epidemiological methods and principles
- Specific Objective
  - Definition and aims of epidemiology
  - Principles of epidemiology
  - Methods of epidemiology
  - Uses of epidemiology

Introduction

- Since the evolution of man- combat Disease
- Hippocrates (460-375BC) – 1st known Epidemiologist

- Thomas Syndenham (1624-1689) – Founder of Epidemiology
- John Snow (1813-1858) – Father of Epidemiology
- W.H.Frost (1927) – 1st professor, Epidemiology, US
- Major Greenwood - 1st professor, Epidemiology, UK

Basic Epidemiology

- Epi = among / Upon; demos = people; logus = study
- The branch of medical sciences which treats of epidemics (Parkin 1873)
- The science of mass phenomenon of Infectious diseases (Frost 1927)
- The study of distribution and determinants of disease frequency in man (MacMahon 1960)

Definition

- The study of the distribution and determinants of health related states or events in specified population, and the application of this study to the control of health problems (John M Last 1988)

Aims of Epidemiology (IEA)

1. To describe the distribution and size of diseases in human population.
2. To identify etiological factors in the pathogenesis of disease.
3. To provide data essential to the planning, implementation and evaluation of services for the prevention, control and treatment of disease.

- Ultimate aim of epidemiology
  - To eliminate or reduce the health problem or its consequences
  - To promote the health and well being of the society as a whole.

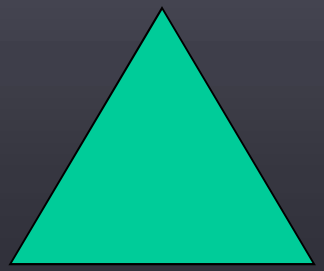
Principles of Epidemiology

- Exact Observation
- Correct interpretation
- Rational explanation
- Scientific construction

Natural history of disease

- Pre-pathogenesis phase
- Pathogenesis phase

Epidemiological triad



Agent Environment

Agent factors

- a substance, living or nonliving, or a force tangible or intangible, the presence or relative lack of which may initiate or perpetuate a disease process.
- Biological agents – viruses, rickettsiae, bacteria, fungi, protozoa & metozoa
  - Should exhibit – infectivity, pathogenicity, virulence
- Nutrient agents – proteins fats carbohydrates vitamins minerals & water
- Excess/ deficiency – PEM anemia goitre, vit deficiency etc,.

- Physical agents – excessive heat cold humidity radiation pressure etc,.
- Chemical agents
  - exogenous- allergen, metals, fumes, dust, etc,.;
  - endogenous – urea (ureamia) serum bilirubin (jaundice) ketones (ketosis)
- Mechanical agents – chronic friction, sprains, tearing, dislocation etc,.
- Absence or insufficiency or excess of factors necessary for health
- Social agents – poverty, smoking, unhealthy life style etc,.

Host factors

- Demographic – age, sex, ethnicity.
- Biological – genetic factors; biochemical levels of blood; blood groups & enzymes; immunological factors; physiological function of diff organs.
- Socioeconomic factors- education, stress etc,.
- Life style – living habits, nutrition, physical exercise etc,.

Environmental factors

- All that which is external to individual human host, living or nonliving and with which he is in constant interaction
- Physical environment – air water soil housing etc,.
- Biological environment – is the universe of living things which surrounds man including man himself
- Psychosocial environment – cultural values, customs habits morals, religion etc,.

Risk factors

- An attribute or exposure that is significantly associated with the development of disease.
- The presence of risk factor does not imply that disease will occur and in its absence disease will not

- Risk factors
  - Truly causative / merely contributory / predictive only in statistical sense.
  - Modifiable / unmodifiable

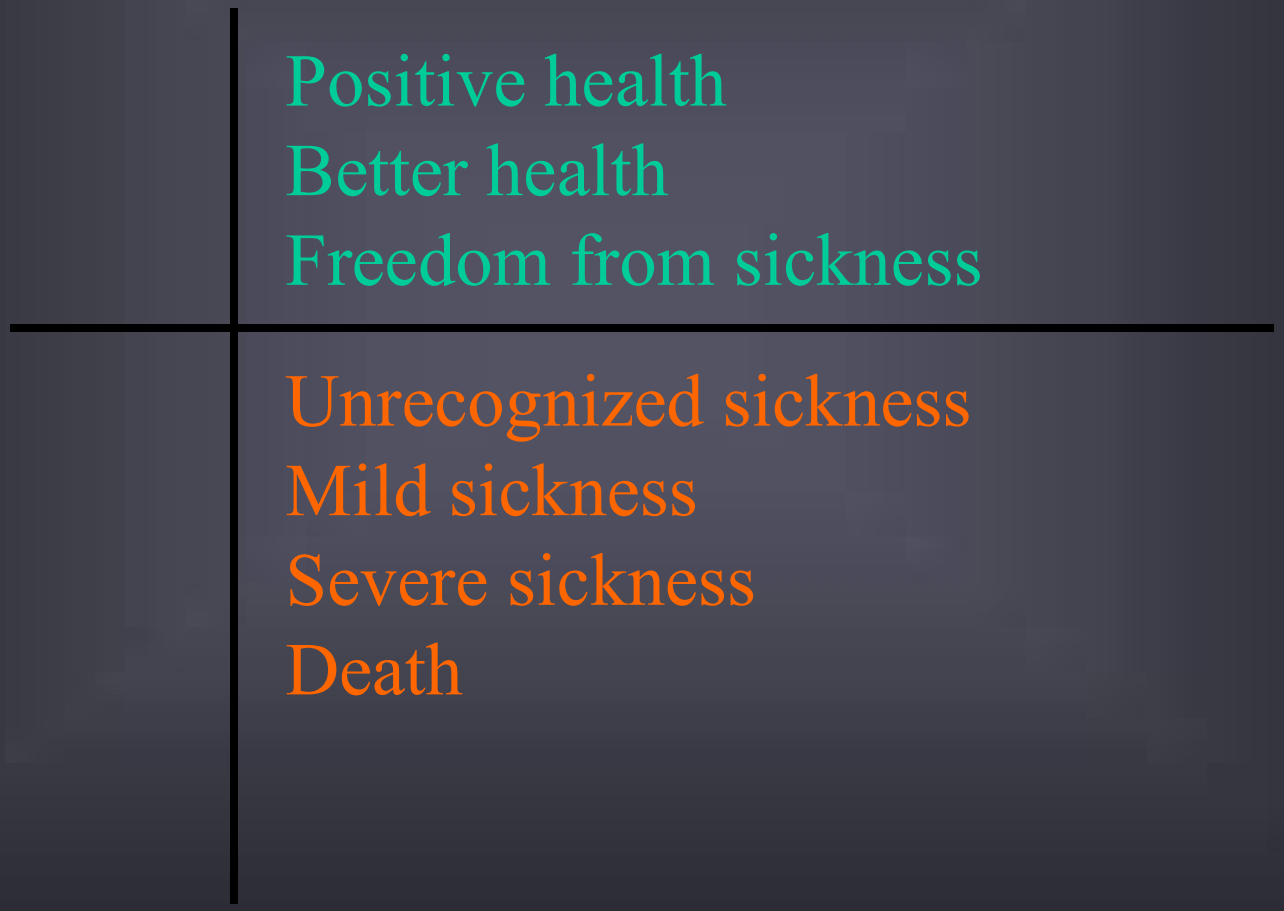
Multifactorial causation

- *Puttenkofer* of Munich (1819-1901)
- Other factors in the etiology of disease (social, economic, culture, genetic, psychological) are also equally important
- This de-emphasizes the concept of disease agent & stress on multiplicity of interaction b/n host and environment.

Web of causation

- *Mac mohan & Pugh* – Epidemiological principles and methods
- ideally suited for chronic diseases – interaction of multiple factors
- Considers all predisposing factors of any type & their complex inter relationship with each other.
- Sometimes removal or elimination of just one link or chain is sufficient to control disease, provided that link is imp in pathogenic process

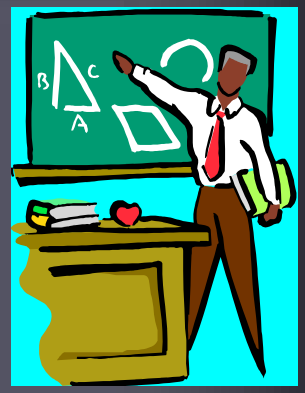
Spectrum of health



Iceberg phenomenon

- Floating tip – what physician sees in community – clinical cases
- Vast submerged portion – hidden mass of disease – latent, presymptomatic & undiagnosed or carrier cases
- Water line – demarcation b/n apparent and in apparent cases

Measurements in epidemiology



- Rate
- Ratio
- Proportion

- Rate – measures the occurrence of some particular event in a population during a period of time

$$\text{Death rate} = \frac{\text{Number of death in one year}}{\text{Mid year Population}} \times 1000$$

- Ratio – expresses a relation in size between two random quantities
  - Numerator is not a component of the denominator
  - X:Y or X / Y

- Proportion – is a ratio which indicates the relation to magnitude of a part of the whole
  - Numerator is always included in the denominator
  - Usually expressed as a percentage

$$\text{Proportion} = \frac{\text{Number of children with caries}}{\text{Total no. of children in community}} \times 100$$

Incidence

- Number of new cases occurring in a defined population during a specified period of time

$$\text{Incidence} = \frac{\text{Number of new cases of specific disease during a given period}}{\text{Population at risk during that period}} \times 1000$$

- Uses of Incidence
  - For taking action to control diseases
  - For research into etiology and pathogenesis
  - For testing efficacy of preventive and therapeutic measures

Prevalence

- Refers specifically to all current cases (old & new) existing at a given point in time, or over a period of time in a given population
  - Point prevalence
  - Period prevalence

$$\text{Point prevalence} = \frac{\text{No of all current cases (old \& new) at a given point of time}}{\text{Estimated population at the same point in time}} \times 100$$

$$\text{Period prevalence} = \frac{\text{No of all current cases (old \& new) at a given period of time}}{\text{Estimated mid-interval population at risk}} \times 100$$

$$\text{Prevalence} = I \times D$$

Incidence x Mean duration

- Uses of Prevalence
  - To estimate the magnitude of the disease problem in the community
  - Useful for administrative and planning purposes

Uses of Epidemiology

1. To study the historical rise and fall of disease in the population
2. Community diagnosis
3. Estimate the individual risk and chances of developing the disease
4. Syndrome identification
5. Planning and evaluation
6. Completing natural history of disease
7. Searching for causes and risk fators

Epidemiological methods

1. Observational studies
   - *a. Descriptive studies*
   - *b. Analytical studies*
     - i. Ecological (correlational, with populations as unit of study)
     - ii. Cross sectional (prevalence, with individuals as a units)
     - iii. Case control (case-reference, with individual as a unit)
     - iv. Cohort (follow-up, with individual as a unit)
2. Experimental studies (intervention studies)
   - *a. Randomized controlled trials* (clinical trials, with patients as a unit)
   - *b. Field trials* (community intervention, with healthy people as a unit)
   - *c. Community trials* (with communities as a unit)

Descriptive epidemiology

- Descriptive epidemiology is the observation of the distribution of disease or health – related characteristics in human population and identifying the characteristic with which the disease in question seems to be associated.

Descriptive epidemiology

Procedures

1. Defining the population to be studied
2. Defining the disease under the study
3. Describing the disease by

a. time — Short term; periodic; long term or secular;

b. place — International; national; rural-urban; local distribution

c. person — Age; sex; ethnicity; marital status; occupation; Social class; behaviour; stress; migration

4. Measurement of disease

Cross sectional

longitudinal

5. Comparing with known indices

6. Formulation of an etiological hypothesis

Hypothesis is a supposition, arrived at from observation or reflection.

It can accepted or rejected using analytical epidemiology

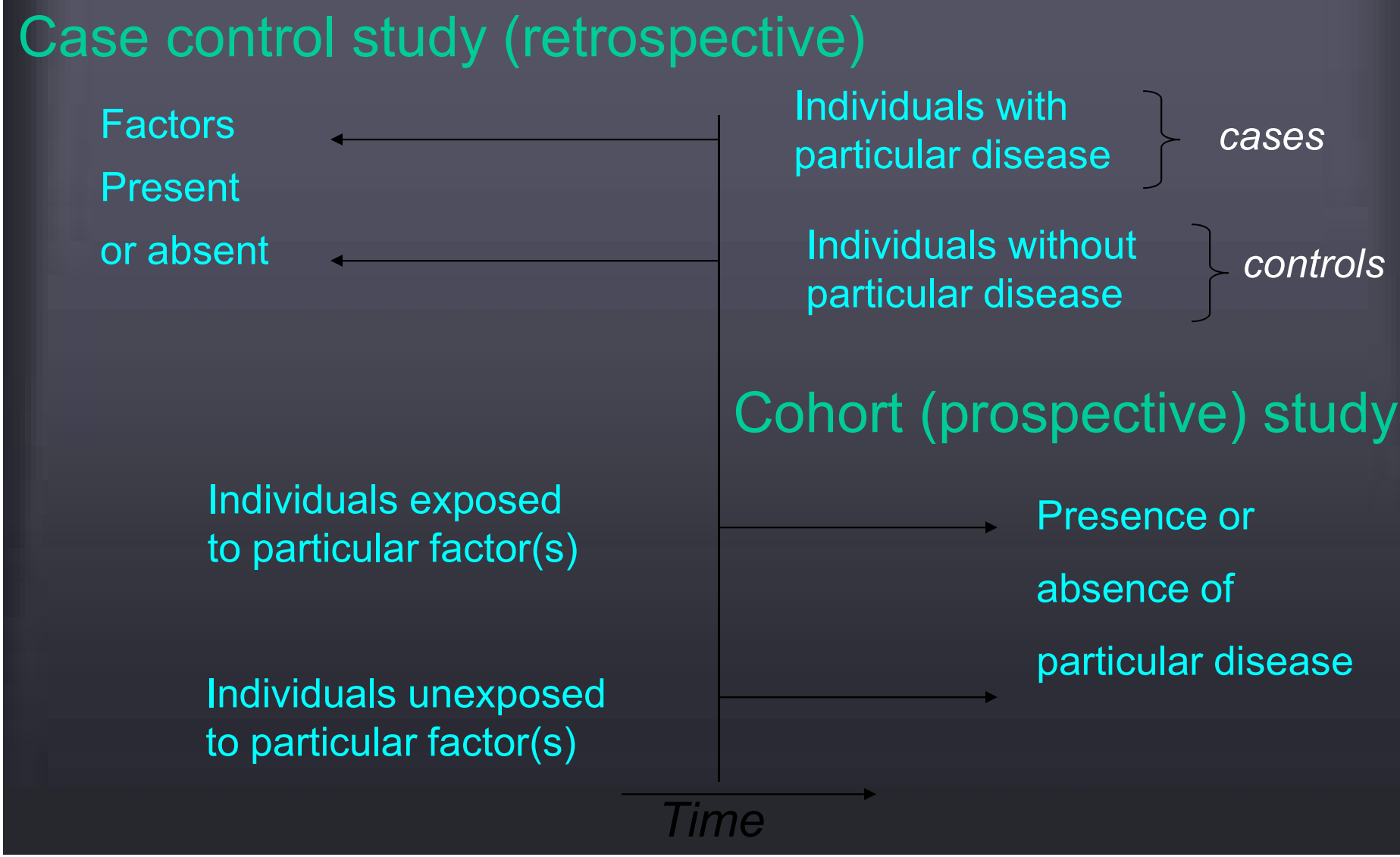
Uses of descriptive epidemiology

- Provides data regarding magnitude & types of disease problems in a community
- Provides clues to disease etiology – etiological hypothesis
- Provide background data for planning, organizing and evaluating preventive & curative services
- Contribute to research by describing variations

Analytical epidemiology

- The analytical epidemiological studies are usually conducted (to attempt) to establish that a casual relationship exists between a factor and a disease and if one exists, the strength of association.
- There are two types of analytical studies
  - Case control study
  - Cohort study

Analytical epidemiology



Case control study

- Also called retrospective study consists of three distinct features.
  - Both exposure and disease have occurred before the start of the study.
  - The study proceeds backwards from effect to cause.
  - It uses a control or comparison group to support or refute an inference.

Framework of case control study

Suspected or risk factors	Cases (disease present)	Control (disease absent)
Present	a	b
Absent	c	d
	a+c	b+d

Basic steps in case control study

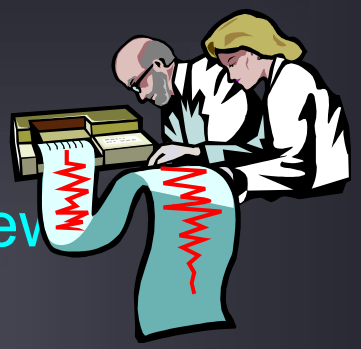
1. Selection of

- *cases* → Diagnostic criteria
  - Eligibility criteria
  - Sources – hospitals; general population
- *controls* → Sources – hospital; relatives; neighborhood; general population

2. Matching

- Group matching
- Pair matching

3. Measurement of exposure



Obtained by questionnaires or interview
or studying past records

4. Analysis & interpretation

Exposure rate

Estimation of risk

Odds ratio (cross-product ratio)

- Measures the strength of association b/n risk factor and outcome

	Diseases	
	yes	no
exposed	a	b
unexposed	c	d

Odds ratio = ad / bc

Odds ratio is a key parameter in the analysis of case control studies

Bias in case control studies

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

Cohort study

- Prospective study; longitudinal study; incidence study; forward looking study
- To obtain additional evidence to refute or support the existence of an association b/n the suspected cause and disease
- Cohort – group of people who share a common characteristic or experience with in a defined period of time

Indications of cohort study

- Good evidence of association
- When exposure is rare; but incidence is high among exposed
- Attrition is minimum , ie follow-up is easy
- Ample funds are available

Framework of cohort study

Cohort	Disease		Total
	yes	No	
Exposed to putative etiologic factor	a	b	a+b
Not Exposed to putative etiologic factor	c	d	c+d

Types of cohort studies

1. Prospective cohort studies
2. Retrospectives cohort studies
3. Combination of retrospective & prospective cohort studies

Elements of cohort study

1. Selection of study subjects
2. Obtaining data on exposure
3. Selection of comparison group

   Internal; external; general population
4. Follow up
5. analysis

   Incidence rate; estimation of risk

Relative risk

$$RR = \frac{\text{Incidence of disease among exposed}}{\text{Incidence of disease among non-exposed}}$$

Attributable risk

$$AR = \frac{\text{Incidence of disease among exposed} - \text{Incidence of disease among non-exposed}}{\text{Incidence rate among exposed}} \times 100$$

Differences

Case control	Cohort
Effect to cause	Cause to effect
Starts with the disease	Starts with people exposed to risk factors (no disease)
First approach to test the hypothesis	Reserved for testing precisely formulated hypothesis
Involves fewer number of subjects	Involves large number
Yields quick results	Long follow-up
Suitable for rare disease	Inappropriate when disease or exposure is rare

Yields only RR (odds ratio)	Yields incidence rate, RR, & AR
Cannot yield information other than the study selected	Can yield information about more than one disease
Relatively inexpensive	expensive

Experimental epidemiology

- Aims –

1. To provide scientific proof of etiological factors
2. To provide method of measuring the effectiveness & efficiency of health services, & improve the health of community

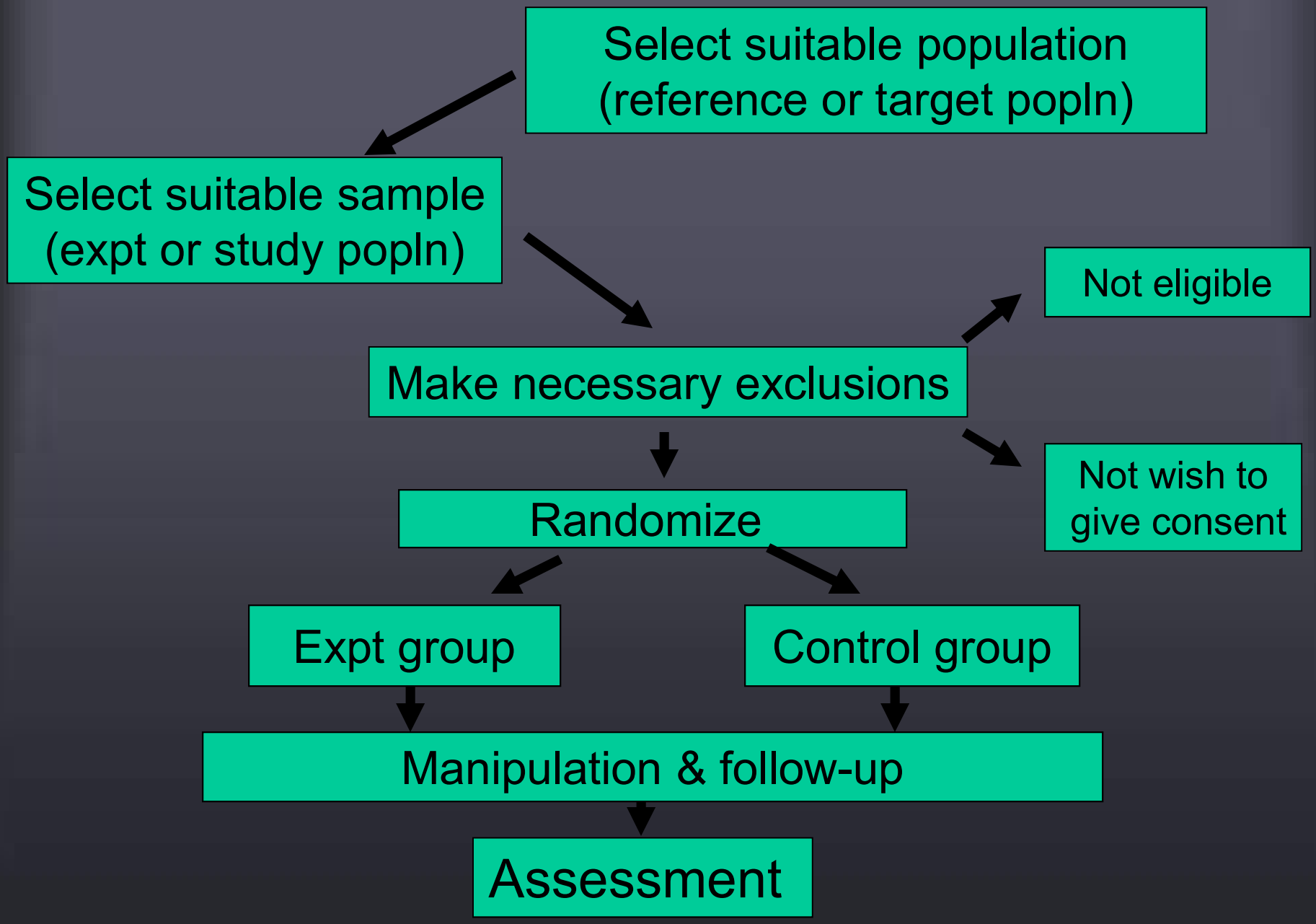
- Randomized controlled trials (RCT)
- Non – Randomized control trials

Randomized control trails (RCT)

- *Steps-*

1. Drawing up a protocol
2. Selecting a reference & experimental population
3. Randomization
4. Manipulation or intervention
5. Follow-up
6. Assessment of outcome

Design of RCT



Blinding

- Is the process of masking the identity of the cases and the control.
  - Single blind study
  - Double blind study
  - Triple blind study

Some study designs

- Concurrent parallel study design
- Cross-over type study design

Types of RCT's –

1. Clinical trials
2. Preventive trials
3. Risk factor trials
4. Cessation experiments
5. Trial of etiological agents
6. Evaluation of health services

Non-randomized trials

- Uncontrolled trials (no comparison group)
- Natural experiments
- Before & after comparison studies
  - Without control
  - With control

Association and Causation

- Association is defined as “Concurrence of two variables more often than would be expected by chance”.
  - Association does not imply causal relationship
- Correlation indicates the degree of association b/n two characteristics
  - Varies from -1 to +1

Types of association

1. Spurious association
2. Indirect association
3. Direct (causal) association
    1. One to one causal association
    2. Multifactorial causation

Additional criteria for judging association (Causality)

- Temporal association
- Strength of association
- Specificity of association
- Consistency of association
- Biological Plausibility
- Coherence of association

Bibliography

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- Community Oral Health – Cynthia M. Pine
- Dental health education theory & practice
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- Various websites on Epidemiology


Thank u