MODULE 2

CLASSIFICATIONS IN RESEARCH

Department of Pediatrics & Preventive Dentistry

College of Dental Sciences & Research Centre,

Gujarat University, Ahmedabad

IN THIS MODULE

- Classification of Study Designs
- Classification of Data
- Classification of Hypothesis
- Classification of Sampling Strategies
- Classification of Bias

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CLASSIFICATION OF STUDY DESIGNS

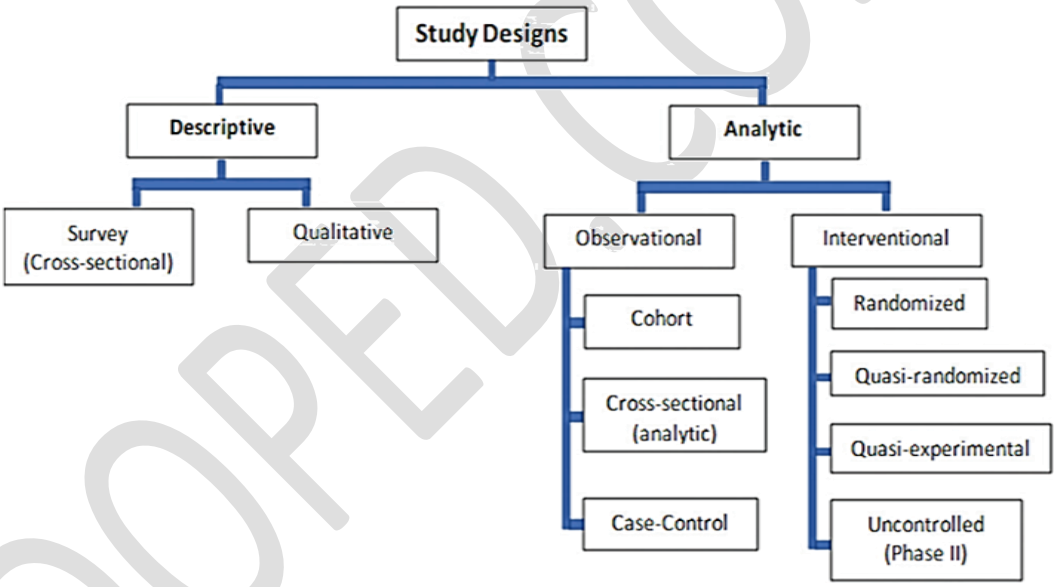

Figure 1 Source: Cancer Research, Statistics and Treatment, 2020.[1]

**Refer to the learning module "A brief overview of common research designs" to learn more*

CLASSIFICATION OF HYPOTHESIS [2]

Based on Formulation

1. NULL HYPOTHESIS: No differences between the groups being studied (e.g.: There is no difference in the amount of reduction in plaque in children who brush with manual or powered toothbrushes)
2. ALTERNATE HYPOTHESIS: There will be a difference between the groups being studied.

a. Directional Hypothesis: When the hypothesis states the extent of the difference between the two groups (e.g.: A greater reduction in plaque control is seen in children in the group brushing with a powered toothbrush than in the group brushing with a manual toothbrush)
b. Non-directional Hypothesis: When the hypothesis does not state the extent of the difference between the two groups (e.g.: The amount of plaque reduction in children brushing with manual toothbrush and powered toothbrush will be different)

Based on Derivation

1. Inductive Hypothesis: A generalized statement based on observation (e.g.: Plaque accumulation increases when I brush without a dentifrice)
2. Deductive Hypothesis: A hypothesis backed by theory (e.g.: Microstreaming forces in powered toothbrushes help in effective plaque control than manual toothbrushes)

CLASSIFICATION OF DATA

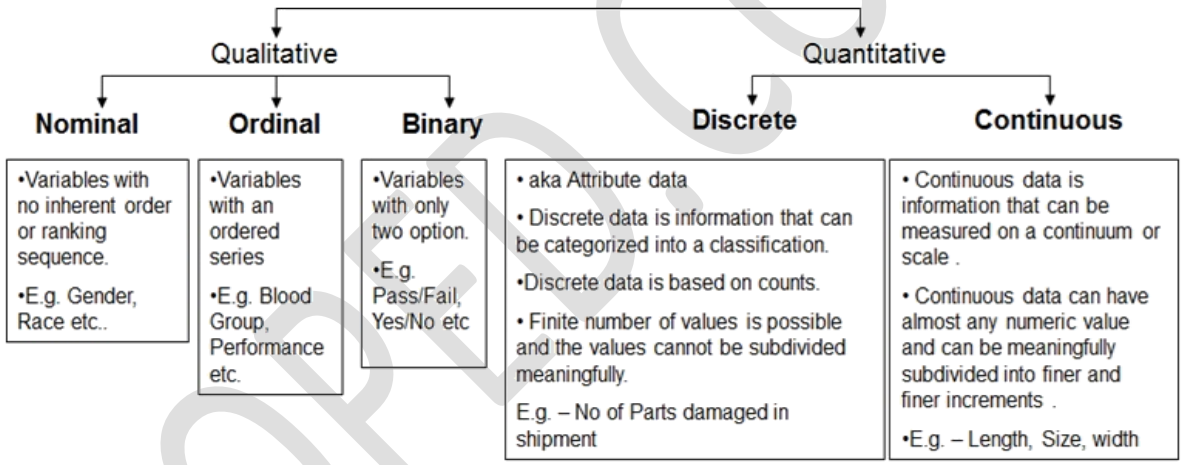

Figure 2 Source: Six Sigma Institute [3]

CLASSIFICATION OF SAMPLING STRATEGIES

Sampling strategies or techniques can be divided into two broad types within which different sampling strategies can be understood.[4]

Non-Probability Sampling

- Samples are not randomly selected
- Samples can be representative of a specific population
- Greater chance of bias and sampling error

1. Convenience Sampling: Participants chosen based on availability.
2. Snowball/Network Sampling: Participants who have already participated in a study ask others to participate in the study. This is commonly seen in survey studies.
3. Quota Sampling: Defining specific characteristics from a population and dividing them categorically. For example, in a population of children with mixed dentition, you divide the samples based on which transitional period of mixed dentition they are in.
4. Purposive Sampling: Choosing participants with specific characteristics. For example, if a researcher wants to analyse the dentition of children with autism with mutism, then only those children will be included rather than including all children with autism.

Probability Sampling/Random Sampling

- Easier to generalize the results to a larger population
- Reduced chances of sampling error
- Eliminates sampling bias
- Can be costly and time consuming

1. Simple Random Sampling: Every sample in the population has a chance to be included in the study. Participants can be picked through random assignment (into experimental and control groups) and random sampling (lottery method, number assignments, etc)
2. Systemic Sampling: Every n^{th} person in the population is picked in the study. This sampling technique is opted for when the study does not demand the characteristics of the participants to be specific.
3. Stratified Random Sampling: A population is divided into subgroups. Samples are randomly chosen from these subgroups and are included in the study. For example, in a population of children having only primary dentition, the researcher divides them into ones with Baume's mesial step primary molar relation and Baume's distal step primary molar relation. Samples from these two groups are then randomly chosen and included in the study.
4. Block Randomization: Samples are randomized into groups of equal sizes at even spaced intervals. For example, 60 participants of a specific characteristic are divided into two groups of 30 each. Each group is then divided into two subgroups of 15 each. The four groups thus made are allocated to different interventions.
5. Cluster Sampling: Groups or clusters of population are chosen and then a simple random sampling method is performed. For example, in order to compare the level of fluorosis in North Indian and South Indian population, the researcher divides the population from the two regions into clusters and then randomly picks participants from both groups till a probability sample size is reached.

CLASSIFICATION OF BIAS

Bias is the presence of a systematic error in a study. Right from inclusion of participants in the study till the dissemination of that study, bias can occur at any stage and adds to the limitations of the research work carried out. Sackett has identified 35 types of bias in research.[5] However, we shall consider only those which are frequently encountered.

SELECTION BIAS	INFORMATION BIAS
Sample	Recall
Loss to Follow-up	Interviewer
Disease Spectrum	Verification or Work-up
Referral	Follow-up or Surveillance
Participation	Response
Image-based Selection	Reviewer
Study Exam	Diagnostic Review
Self-selection	Test Review
	Incorporation
	Imperfect Standard
	Reader Order
	Measurement
	Clustering or Repeated Measurement
	Context
	Publication

Figure 3 Radiology, 2006. [6]

Wrong design bias: This occurs when the research design chosen is inappropriate, thereby leading to misleading answers

Selection Bias: This type of bias is seen during sample allocation and occurs because the researcher prioritizes his or her convenience first. It can take place in three ways:

- Despite randomization, individuals are included or excluded
- Intervention is done based on how the individuals are allocated to different groups
- Potentially eligible participants are excluded because the intervention might not provide the needed results

Intervention bias: When the intervention carried out is manipulated for every sample. An intervention bias can also take place if there are flaws in the intervention itself. For example, the effect of a drug can vary if not given for an optimum time duration in a particular dose.

Confounding Bias: This type of bias occurs when an unconsidered extraneous variable affects the intervention being carried out. For example, if a study is observing the effects of remineralizing toothpastes in children with molar-incisor hypomineralization, participants who are mouth breathers may showcase inconsistent results. In such a case, mouth breathing becomes the confounding factor.

Operator Bias: This type of bias occurs when the researcher and the data analyser are improperly blinded to the samples and their allocated groups. For example, in a pre- post-test study design, the same researcher who is carrying out the intervention is also the one evaluating the pre and post-test changes.

Selective reporting bias: When only positive outcomes of the intervention are reported and negative outcomes are ignored.

Ascertainment Bias: When the results or conclusions are distorted based on which intervention each participant is receiving.

Publication bias: This commonly seen when sponsors or big industries publish positive results in order to report the effectiveness of their product or intervention. A publication bias falls under the umbrella of "fraud bias."

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