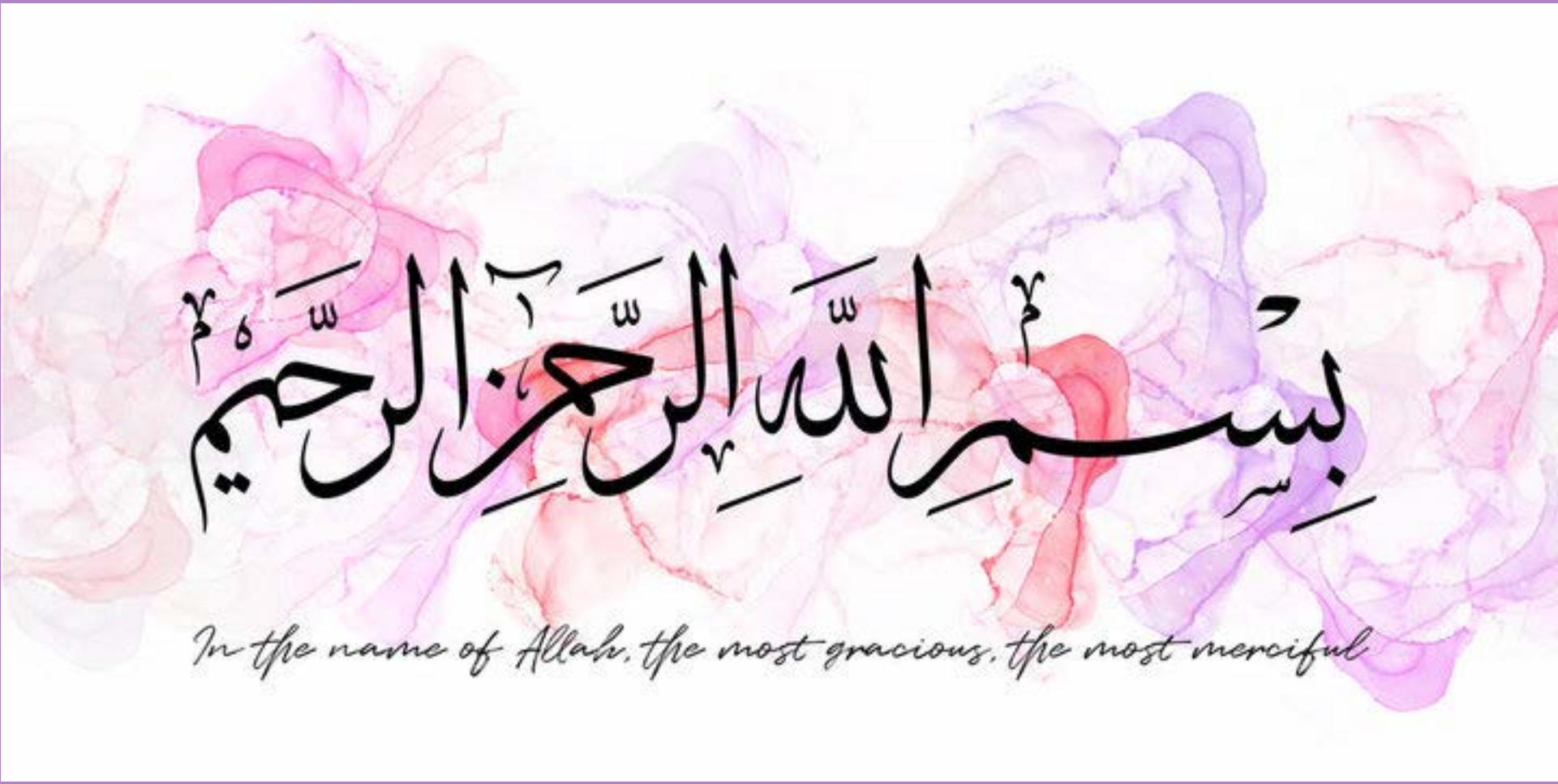




بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

*In the name of Allah, the most gracious, the most merciful*

# QUANTITATIVE STUDY DESIGN

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Dr. Hira Anjum

# LEARNING OBJECTIVES

By the end of this session, students will be able to:

- Define quantitative research.
- Identify key features of this study design.
- Apply this knowledge to dental research scenarios



### **Question 1**

A researcher wants to determine the **average DMFT score** of 200 BDS students.

### **Question 2**

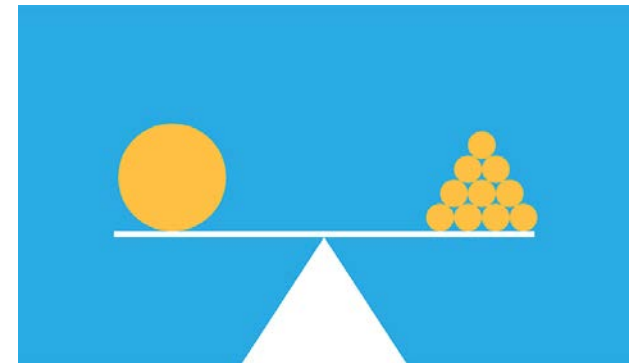
A researcher interviews 20 patients to understand **why they are afraid of root canal treatment**.

### **Question 3**

A researcher measures the **postoperative pain score** of patients after endodontic treatment.

# QUANTITATIVE RESEARCH

- **Quantitative research** is the process of collecting and analyzing numerical data.
- It can be used to find patterns and averages, make predictions, test causal relationships, and generalize results to wider populations.
- **Examples:** measuring the prevalence of dental caries (cavities) in a population, comparing the effectiveness of different toothpastes in reducing plaque



Quantitative research involves:

- Collecting **numerical data**
- Measuring variables
- Using structured methods
- Analyzing data statistically
- Testing relationships, differences, or effects

# KEY FEATURES

- **Objective:** To measure and analyze variables numerically
- **Data Type:** Numerical (e.g., scores, percentages, frequencies)
- **Approach:** Structured and controlled
- **Sample Size:** Large, statistically representative
- **Instruments:** Surveys, questionnaires, structured observations
- **Analysis:** Statistical (e.g., t-tests, regression, ANOVA)
- **Outcome:** Generalizable results, patterns, correlations



A quantitative study generally involves:

**Research question**



**Variables**



**Participants/sample**



**Measurement**



**Numerical data**



**Statistical analysis**



**Results/conclusion**

## **Quantitative = Data in numbers**

Examples in dentistry:

- DMFT score
- Plaque index
- Gingival index
- Pocket depth in mm
- Number of carious teeth
- Pain score
- Salivary pH
- Success rate of RCT
- Patient satisfaction score

# Components of Quantitative Study Design

- Title of the study
- Research problem/topic
- Research question
- Study objectives
- Study design
- Study population
- Study setting
- Study duration/time period
- Sample size
- Sampling method
- Inclusion criteria
- Exclusion criteria
- Variables
- Data collection method
- Data collection instrument/measurement tool
- Type of data collected
- Data analysis/statistical methods
- Ethical considerations

# Research Question

- The research question tells us **What do we want to find out**
- **Example:**
- “What is the prevalence of dental caries among 2nd-year BDS students?”
- This determines what information we need to collect.

# Study Objectives

Objectives state **what the researcher intends to accomplish.**

## **Example**

### **General objective:**

- To determine the prevalence of dental caries among BDS students.

### **Specific objectives:**

- To determine the proportion of students with dental caries.
- To compare caries prevalence between male and female students.
- To determine the association between caries and frequency of tooth brushing.

# Study Design

- Definition
- **Study design is the overall plan or framework used to conduct a research study.**
- It describes:
- **How the researcher will collect, measure and analyze data to answer the research question.**

# STUDY DESIGN / TYPE

- Different research questions require different designs.
- **Common quantitative study designs**
- **Observational**
- Cross-sectional
- Case-control
- Cohort
- **Experimental**
- Randomized controlled trial
- Clinical trial

# Cross-Sectional Study

Data are collected at **one point in time**.

- **Example:**
- Determine the prevalence of dental caries among 2nd-year BDS students in 2026.
- We assess:
- **Students → Caries → Same time**
- **Best for:**
- Prevalence
- Frequency
- Describing a population



# Cohort Study

Participants are followed over time.

- **Example:**
- Follow patients with and without high sugar intake for 3 years and compare development of dental caries.
- **Exposure → Follow-up → Outcome**

# Case-Control Study

- **"START WITH THE OUTCOME"**
- Researchers start with:
- **Cases → Disease/outcome present**
- **Controls → Disease/outcome absent**
- Then look backward for exposure.
- **Dental example**
- Compare:
- **Patients with oral cancer**
- vs
- **Patients without oral cancer**
- and investigate previous tobacco exposure.

# Experimental Study

- **“INTERVENE → MEASURE EFFECT”**
- The researcher actively introduces an intervention.
- **Example:**
- Compare postoperative sensitivity after using two different restorative materials.
- **Group A → Material A**
- **Group B → Material B**
- Measure sensitivity
- Compare results

# STUDY POPULATION

- The **entire group of people** to whom the researcher wants the findings to apply.
- **Example**
- Research topic:
- Dental caries among BDS students in Lahore.
- **Target population:**  
All BDS students in Lahore.
- **Study population:**  
BDS students available in selected dental colleges.

- We usually cannot study everyone.
- Therefore:
- **TARGET POPULATION**
- ↓
- **STUDY POPULATION**
- ↓
- **SAMPLE**
- **Example**
- All BDS students in Lahore
  - ↓
  - Students in 3 selected dental colleges
    - ↓
    - 300 students selected for the study

# Study Setting

- The **place/location where the research is conducted.**
- Dental outpatient department
- Operative Dentistry clinic
- Orthodontic clinic
- Dental hospital
- Community dental camp
- University
- Laboratory
- **Example**
- Study conducted in the Operative Dentistry Department of a dental hospital in Lahore.

# STUDY DURATION

- Time is an important component.
- **Examples:**
- **Cross-sectional:**
- Data collected once.
- **Longitudinal:**
- Participants followed over time.
- **Example**
- Postoperative sensitivity:
- Baseline
- 24 hours
- 7 days
- 30 days
- This is a **longitudinal approach**.

# SAMPLE & SAMPLING

## Sample

- A **smaller group selected from the study population** for participation in the research.
- Example:
  - Study population = 2,000 students
  - Sample = 300 students
- **Why use a sample?**
- Saves time
- Reduces cost
- More practical
- Allows research on large populations



# Sampling Method

- Common methods include:
- **Probability sampling**
- Simple random sampling
- Systematic sampling
- Stratified sampling
- Cluster sampling
- **Non-probability sampling**
- Convenience sampling
- Purposive sampling
- Consecutive sampling

# VARIABLES

A **variable** is a characteristic that can take different values.

**Dental examples:**

- Age
- Gender
- DMFT score
- Dental anxiety score
- Plaque score
- Salivary pH
- Type of restoration
- Postoperative sensitivity

# Types of Variables

## **Independent variable**

- The factor that is expected to influence another variable.

## **Dependent variable**

- The outcome being measured.

## **Example:**

- **Effect of restoration material on postoperative sensitivity**
- **Independent variable:**  
Type of restorative material
- **Dependent variable:**  
Postoperative sensitivity

# DATA COLLECTION

- Common methods:
- Questionnaire
- Clinical examination
- Patient records
- Interviews
- Laboratory measurements
- Radiographs
- Electronic databases

# MEASUREMENT TOOLS

A quantitative study requires appropriate tools to measure variables.

| Variable        | Measurement         |
|-----------------|---------------------|
| Dental caries   | DMFT/DMFS           |
| Plaque          | Plaque index        |
| Gingival health | Gingival index      |
| Anxiety         | Anxiety scale       |
| Pain            | Visual Analog Scale |
| Salivary pH     | pH meter            |

The measurement tool should be:

- Valid
- Reliable
- Appropriate for the variable

# DATA ANALYSIS

- After data collection:
- **Raw data → Statistical analysis → Results**
- Examples:
- **Descriptive statistics**
- Frequency
- Percentage
- Mean
- Median
- Standard deviation

- **Inferential statistics**

- Chi-square

- t-test

- ANOVA

- Correlation

- Regression

# ETHICAL CONSIDERATIONS

- Research involving human participants should consider:
- Informed consent
- Confidentiality
- Privacy
- Protection from harm
- Voluntary participation
- Right to withdraw
- Ethical approval



# What is the prevalence of dental caries among 2nd-year BDS students?

Component

Example

Study design

Cross-sectional

Population

2nd-year BDS students

Sample

200 students

Sampling

Simple random sampling

Setting

Dental college

Variable

Dental caries

Measurement

DMFT index

Data

Numerical

Time

One point in time

Analysis

Frequencies, percentages

Ethics

Consent + confidentiality



QUESTIONS



Thank  
you

A square graphic with a light gray background and a faint, larger-scale leaf pattern. The words "Thank" and "you" are written in a purple, cursive script. The word "Thank" is on the top line, and "you" is on the bottom line. A small, stylized leaf is positioned to the upper right of "Thank", and another is to the lower left of "you". The word "you" has a long, sweeping tail that extends to the right.

# ASSIGNMENT

## **Assignment: Identify the Components of a Quantitative Study Design**

Read the following research article:

**“Correlation of Oral Hygiene Knowledge and Practice among Undergraduate Dental Students.”**

Identify the components of quantitative study design discussed in class. For each component, write the relevant information exactly as reported or paraphrased from the article. If a component is not explicitly mentioned, write “Not stated.”

Enlist at least 12 components of study design.