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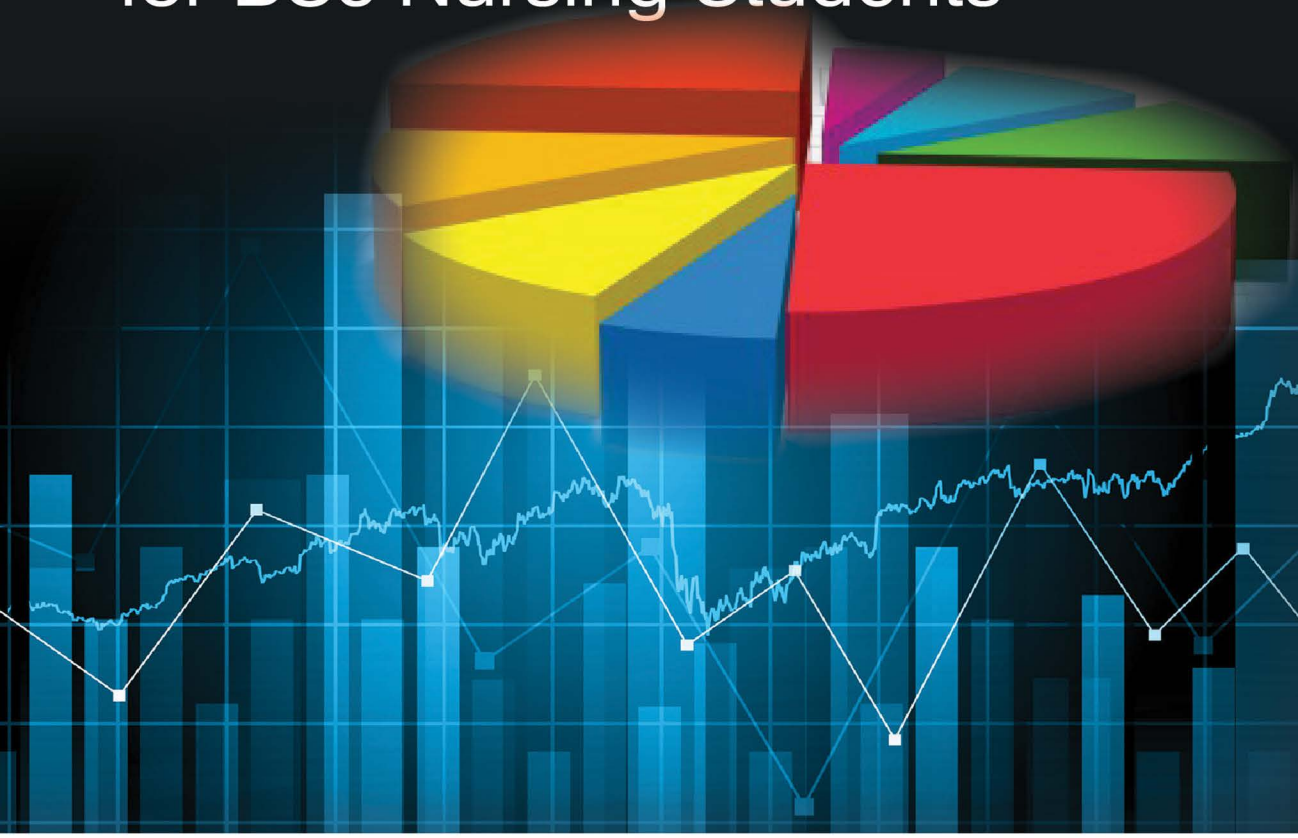
Textbook of NURSING Research & Statistic for BSc Nursing Students



Pity Koul

Foreword
AV Raman



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CHAPTER

2

Research Problem, Objectives, and Hypotheses

Learning Objectives

After reading this chapter, the students will be able to:

- Identify the problem area for research
- List the criteria of a good research problem
- Write objectives for research
- State hypothesis
- Describe characteristics of research hypothesis
- List steps in formulating hypothesis
- Explain the meaning, types and characteristics of variables
- Formulate the problem statement
- Critique the research problem, objectives and hypothesis

INTRODUCTION

Every research study begins with a problem which the researcher would like to solve. As you have studied in chapter 1, Identification and formulation of research problem is always the first and most important step of research process **(Table 2.1)**. The problem statement is further clarified by using aims or goals of the study which are derived from the problem area of the study.

Research problem is paramount to the success of a research effort. The heart of every research lies in the research problem. The research problem is an area of concern in which there is a gap in the knowledge needed for nursing practice. The research purpose is generated from the problem and identifies the specific goal or aim of the study. The research problem is about identifying and defining destination prior to beginning a journey. It determines that what a researcher will do, how he will do it, and what he will achieve. The research problem further guides the relationship between variables through hypothesis which can further be tested using statistical tests.

Table 2.1: Steps of research process.

Sl. No.	*Steps of research process*
1.	Formulating the research problem
2.	Extensive literature review
3.	Developing the objectives
4.	Preparing the research design
5.	Collecting the data
6.	Analysis of data
7.	Generalization and interpretation
8.	Preparation of the report

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A research problem can begin with simple to very complex, depending on the nature of the research theme. Formulating a well-defined clear research problem results in clearer research output and progress. The research problems consist of following requisites as given below **(Fig. 2.1)**:

- Areas of concern
- Difficulties to be eliminated
- Conditions to be improved
- Questions seeking answers

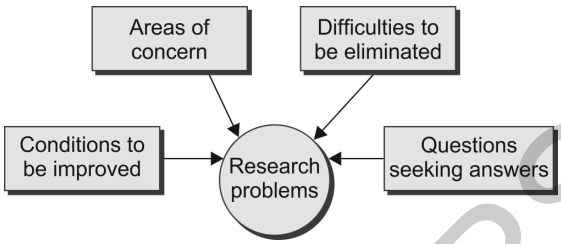

Fig. 2.1: Requisites of research problem.

DEFINITION OF RESEARCH PROBLEM

According to Powers, Meenaghan, and Twoomey (1985), research problem is a situation or circumstance that requires a solution to be described, explained, or predicted. A research problem helps to address the queries in research questions in a systematic method. It depicts the overall goal of study, identifies key concepts and the population.

Factors for Consideration in Selecting a Research Problem

The factors for selecting research problems are mentioned in **Table 2.2**.

Table 2.2: Factors for selecting research problem.

Sl. No.	*Considering factor*	*Description*
1.	Interest of researcher	It is the most important criterion in selecting a research problem. The whole research process is time consuming and needs a lot of hard work. If research topic is not according to area of interest, it becomes difficult to continue the process and draw conclusion
2.	Expertise	Before selecting a research problem, researcher should ensure to meet certain level of expertise in the proposed area. That means researcher should have appropriate knowledge, skills, and experience to address the research problem. Example: Training of the post-CABG patients about cardiac rehabilitation
3.	Data availability	If your research title needs collection of information (journal, reports) before finalizing the title, you need to make sure that you have these materials available and in the relevant format
4.	Relevance	Research problems selected should be significant to the field of nursing. The researcher should think whether current study will contribute in advancement of knowledge of nursing practice. Also, it is important to think that what benefit the study will have on the nurses or healthcare community
5.	Ethics	In formulating the research problem, ethical issues should be considered in advance. Sometimes, during the research period, the study population might be adversely affected by some sensitive questions. In order to safeguard rights, health, and welfare of participants, the researcher must comply with the scientific, legal, and ethical requirements of study protocol. So, it is important for the researcher to obtain consent from participants, protect them from harm, and maintain anonymity and confidentiality while carrying out research. It is equally important that researcher must be familiar with ethical guidelines of the professional organization or institution when research is to be undertaken

Contd...

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Sl. No.	*Considering factor*	*Description*
6.	Feasibility	The feasibility, in terms of resources, time, money, availability of sample, and cooperation from others, is an important factor to be considered. So, it is important for researcher to consider the above when determining the feasibility of study. Because researcher needs time, resources, facilities, equipment, money for material supplies, equipment, printing, etc., availability of participants, and cooperation from colleagues, organization, and others to avoid hurdles in carrying out research
7.	Originality	It is important to focus on identifying an innovative, new and unique research problem, so as to contribute to the growth of existing knowledge
8.	Researchable	Lastly, it is important to select a problem that is researchable, so that it can be investigated through collection and analyzing empirical data

Sources to Generate Research Problem

The sources are given in **Table 2.3**.

Table 2.3: Sources of research problem.

Three sources usually contribute to problem identification	Researchers **own experience** or the experience of others may be a source of problem
	Review of literature: Review helps to understand certain findings and notice that a certain field has not been covered. This can lead to a identification of research problem
	Theories can be a third source. Nursing theories must be tested through the formulation of research problem and hypothesis. Shortcomings in theories can be researched
Other sources	**Databases:** Various databases can also become source of research problem. A number of good electronic database contain references to journal, articles or books and are available in libraries also. Some of the databases related to nursing include CINAHL, MEDLINE, etc. **Social issues:** Social issues can also be a source of research. You are aware that there are so many societal problems which need to be studied, such as child abuse, substance abuse, domestic violence, etc. **Brainstorming sessions:** In the brainstorming sessions, intensive discussions are held between interest groups and progress to generate new ideas to formulate a good research problem **Folklores:** Common beliefs or practices among public can be studied to identify whether these could be right or wrong **Consulting with experts:** Experts can suggest a significant problem to be studied because they have a sound expertise in their field of study. The expert can help the researcher to identify current issues and problems in a specific discipline, which need solution and these can solve as basis for formulation of research problem

Characteristics of Research Problem

The important characteristics of good research problem are as follows:

- It should identify the key variables in the study.
- Research problem should be clear and specific.
- It should refer to the problem or phenomenon.
- It should reflect the intervention in experimental research.
- It should note the target group of participants.
- It should express a relationship between two or more variables.
- It should specify the study population and setting.
- It should imply the type of the research.

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Components of Research Problem

A well-written problem statement for a quantitative study should follow PICOT format in an interventional study which includes following:
P: Population of the study
I: Intervention
C: Comparison of interest
O: The outcome desired
T: Timeframe involved
It can also be framed using five components for noninterventional study as given below:

1. Problems to be solved (issues, situations, and needs)
2. Variables to be studied
3. People/population (individuals, organizations, groups, or communities)
4. Phenomena (cause-and-effect relationship)
5. Setting

Example: A study to assess the effectiveness of infection control program in controlling catheter-associated infections among ICU patients.
Problem: ICU infection
Variables: Infection control program
People/population: ICU patients
Phenomena: Controlling catheter-associated infections
Setting: ICU

Steps in Defining Research Problems

The different steps in formulating research problem are given below **(Fig. 2.2)**.
Step 1: Identify a broad field or subject area of interest: It is the first and foremost step in problem statement. One should think of the broad areas or issues of concern that means what is the problem one has to solve. Consult textbooks, journals or experts, etc.
Step 2: Problem definition and identification: Once a research topic has been specified, narrow it down to develop a research problem. One should pick one topic or select problem based on interest and relevance, magnitude of work involved, level of expertise, contribution the research would offer, and finally choose the most suitable one which is feasible.

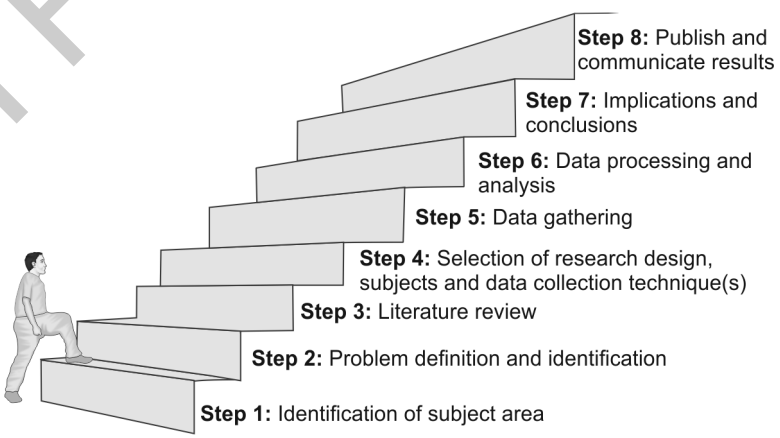

Fig. 2.2: Steps in formulating research problem.

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Step 3: Literature review: Review of literature should be done for theoretical framework, methodology, data collection methods, tools, techniques, sampling method, etc.
Step 4: Selection of research design, subjects, and data collection techniques: The next step is to select and plan the research design, identify/select study subjects as well as identify data collection techniques. Research design is crucial as it provides overall structure for the research procedure, the data that a researcher collects and the data analysis that the researcher conducts.
Step 5: Data collection: This can be done using existing instrument or developing a software-based network analyzer and administering it to a sample of network clusters.
Step 6: Data processing and analysis: The data collected need to be analyzed and computed to provide inferences and interpretation on the problem. If the research question involves quantitative approach, statistical methods are used to analyze the data. The analyzed data will be presented in tables and graphs. A researcher interprets the data in relation to the research questions based on the analysis performed. For the qualitative approach, information is coded, justified, and presented with valid reasoning.
Step 7: Implications and conclusions: These are important justifications that take note as part of the research process. The novelty of the work and contribution of new knowledge are seen in the implications and conclusion part of the entire research. Recommendations normally highlight a few potential research questions derived at the end of the research process and foster new research continuation based on the findings.
Step 8: Publish and communicate results: Once the findings of the research are obtained, it is important for you to communicate with other fellow researchers and practitioners. The results should be published in journals and conference proceedings as these are platforms for interested parties to communicate and discuss the findings.

Points to Remember while Drafting Research Problem

- One should avoid a subject that has been overdone.
- Controversial subjects should be avoided.
- Subjects whose scope is too narrow or vague should be avoided.
- The subject should be familiar and feasible, so that the related research material or sources of research are within one's reach.
- Know the limitations of your experience, ability, and capacity.
- The problem should be stated clearly and unambiguously.
- The problem should express a relationship between two or more variables or at least between dependent and independent variable, implying empirical testability.
- The problem should specify the nature of the population being studied.
- The problem must have significance and relevance to nursing.
- The researcher should have interest in study.
- It should be manageable in time available.
- Ethical issues should be considered.

Critique of Research Problem

- Is there a statement of the problem?
- Is the problem "researchable"? That is, can it be investigated through the collection and analysis of data?
- Is background information on the problem presented?
- Is the educational significance of the problem discussed?
- Does the problem statement indicate the variables of interest and the specific relationship between those variables which are investigated? Are the variables directly or operationally defined?

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RESEARCH OBJECTIVES (FIG. 2.3)

Introduction

Research objectives are the results sought by researcher at the end of research process. The research objectives should be closely related to statement of problem. The objectives help the researcher to stay focused on study variables only.

Definition

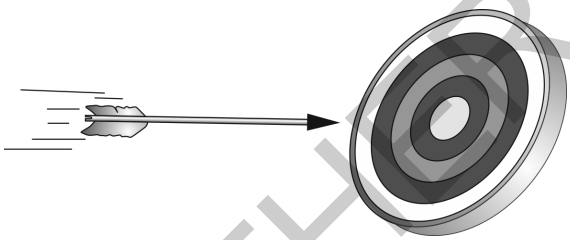

Fig. 2.3: Setting a target in research objectives.

According to Gilbert, **objectives** are the foundation upon which you can build lessons and assessments that you can prove to meet your overall course or lesson goals. An **objective** is a statement describing an instructional outcome rather than an instructional process or procedure. It describes **intended results** rather than the means of achieving those results. Objectives are the goals that are set out to attain in the study. They inform a reader what researcher wants to attain through the study.

- Objectives are specific, observable, and measurable learning outcomes.
- In contrast, goals are general and nonspecific. Goals are appropriate for an entire course or a curriculum of study, while objectives are written for individual units of study. Specific objectives determine what the researcher will do in the study, where and for what purpose.

Types of Objectives

- **General objectives (aim/goal):** General objectives/goals are broad and generalized statements about what is to be achieved. The general objective of a study states what researchers expect to achieve by the study in general terms. The main objective is an overall statement of the thrust of the study.
- **Specific objectives:** Specific objectives are written to state what the researchers are expected to achieve after conducting the study.

Methods of Stating Objectives

- The objectives should be stated briefly and concisely.
- They should cover the different aspect of a problem and its contributing factors in a coherent and logical sequence.
- The objectives should be clearly phrased in operational terms.
- Use action verbs that can be evaluated (action verbs: To identify, to determine, to calculate, to analyze, to describe, to establish, etc.).
- They are realistic considering local conditions.

Characteristics of an Objective

Objectives should be:

- Complete
- Specific: Very specific to the topic concerned
- Identify main variables to be correlated
- Identify the direction of relationship between variables
- Clear: It should be clearly stated not in ambiguous form.

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Benefits/Importance of Writing Research Objectives

- Objectives emphasize major points and reduce non-essential material.
- It assists researcher in organizing the study and development of research methodology.
- It focuses on the study (narrowing it down to essentials).
- Helps to avoid the collection of data which are not strictly necessary for understanding and solving the problem.
- Facilitate the researchers to orient them to collection, analysis, interpretation and utilization of data.
- Organize the study in clearly defined parts.
- They guide the researcher to what is expected of the study and help them to review relevant literature.

Critical Questions

1. Identify the four key components (A, B, C, and D) of specific objective in following research problem. **"Effectiveness of basic life support program on improving knowledge regarding CPR and skill from baseline to 30% among critical care nurses in tertiary care hospital."**
2. Based upon the verbs mentioned in the exercise, formulate one objective each from cognitive domain, psychomotor domain, and affective domain.
3. **On skill station, the learner observes the chest compression by CPR trainer, and later he is instructed by trainer to perform the same skill.**
   Which type of objective will cover this behavior shown by learner?

RESEARCH HYPOTHESIS

Development of a hypothesis is an integral part of the scientific method and research. A hypothesis is a statement of the researcher's expectations about relationships between study variables. It is a possible answer to a research question. Hypotheses are predictions of expected outcomes. Most quantitative studies are designed to test hypotheses through statistical analyses.

Based on background research and prior knowledge, the hypothesis predicts the outcome of a study. The hypothesis can be tested and supported but never proven or confirmed. The hypothesis is only a rough sketch of outcome of a study.

In quantitative studies, researchers use hypothesis as a step toward doing research; while in qualitative studies, researchers conduct their studies and allow hypothesis to emerge from results.

Definition

According to Sarantakos, 1998—"**a hypothesis** is an assumption about status of an event or relationship between variables. It is explanation of research problem, possible outcome of research, or an educated guess about a research outcome".

The American Heritage Dictionary defines a **hypothesis** as—"a tentative explanation for an observation, phenomenon, or scientific problem that can be tested by further investigation".

Need of Formulating Hypothesis

- Hypothesis provides a shape and mould to the study.
- It determines the kinds of questions to be asked and the measurement scales for the data to be collected.
- It determines the kinds of analysis which will be necessary.

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Characteristics of Research Hypothesis

The characteristics are as follows:

- **Conceptual clarity:** It should be clear and precise.
- **Specificity:** It should be specific and limited in scope.
- **Consistency:** It should be consistent with the objectives of research.
- **Testability:** It should be capable of being tested.
- **Expectancy:** It should state the expected relationships between variables.
- **Simplicity:** It should be stated as far as possible in simple terms.
- **Objectivity:** It should not include value judgments, relative terms, or any moral preaching.
- **Theoretical relevance:** It should be consistent with a substantial body of established or known facts or existing theory.
- **Relevant:** The hypothesis should have to be relevant to the study.
- **Availability of techniques:** Statistical methods should be available for testing the proposed hypothesis.

Sources of Research Hypothesis

The different sources of hypothesis are as follows:

- Examination of data and records for possible trends
- Review of similar studies
- Exploratory investigation/observation
- Logical deduction from the existing theory
- Continuity of research
- Intuition and personal experience

Components of Research Hypothesis

To complete the hypothesis, it must include three components:

1. The variables
2. The population
3. The relationship between the variables

Example: The infants born to heroin-addicted mothers have lower birth weight than infants of nonaddicted mothers.
Variables: Birth weight, addiction
Population: Delivering mothers
Relationship: Infants of heroin-addicted mothers have lower birth weight than infants of nonaddicted mothers.

Instructions to Formulate Hypothesis

- Identify what result researcher is looking from study
- Group similar outcomes together
- Generate research questions
- Define variables
- State the null hypothesis (H0)
- Identify hypothesis statement (H1)

Steps in Formulating Hypothesis

- Develop your research problem.
- Think about two events, objects, or subjects and see how they may be related.
- Come up with a general hypothesis after observation, review of literature, experiences, etc.

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- Make your general hypothesis more specific.
- Identify independent variable and the dependent variable.
- Re-read hypothesis and ensure it is a testable statement.
- Conduct an experiment to test your hypothesis.
- Analyze data.
- Draw conclusions.
- Communicate results.

Types of Hypothesis

Research hypothesis: It is the hypothesis constructed from research problem when the predicted relationship among the variables is to be tested by scientific methods. It guides the researcher in collection and analysis of data.
Example: Physicians spend less time in explaining treatment plans to patients than nurse practitioners.

Statistical hypothesis: When there is use of statistical test to reject or accept the hypothesis. It is expressed as null or alternate hypothesis.
Null hypothesis: It predicts no relationship between independent variable (IV) and dependent variable (DV). It is used when statistical testing procedures are applied to the data. It is usually represented as H_0. It states that all the differences between identified samples are by chance or all the samples are from same population and their means are equal.
Example: There is no relationship between maternal smoking and newborn's birth weight.

Alternative hypothesis: It predicts a relationship between the IV and DV or it is the opposite of null hypothesis. It is represented as HA or H1. The alternative hypothesis makes a formal statement of expected difference among variables.
Example: There is relationship between maternal smoking and newborn's birth weight.

Simple hypothesis: It predicts the relationship between one independent variable and one dependent variable.
Example: Newborns of smoking mothers (IV) have lower birth weight (DV) than those of nonsmoking mothers.

Complex hypothesis: It predicts the relationship between 2 or more IV and 2 or more DV.
Example: Structured **preoperative support (IV)** is more effective in reducing surgical patient's **perception of pain (DV)** and request of **analgesics (DV)** than structured **postoperative support (IV)**.

Directional hypothesis: It predicts not only existence, but also direction of relationship between variables. It states the relationship like positive, negative, or no relationship.
Example: There is positive relationship between low hemoglobin and postpartum infections.

Nondirectional hypothesis: It reflects the relationship between two or more variable, but it does not specify anticipated direction and nature of relationship.
Example: Smoking affects the birth weight of infant delivered from mother who takes more than 4 packs a day.

Importance of Research Hypothesis

- *Clarity:* Hypothesis brings clarity to research.
- Formulation of research hypothesis gives a focus to your research.
- *Direction:* Hypothesis sets a direction of research in formulating the objectives, research design, methodology, and mode of analysis.

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- *Objectivity:* Every research requires objectivity which is possible with research hypothesis.
- Identifies the variables to be manipulated and/or measured.
- Hypothesis helps to guess the solution of the problem.
- It describes, in concrete terms, what you expect to happen in the study.
- Hypothesis reflects the population of the study.
- It delimits the area of research and keeps the researcher on the right track.

Function of Research Hypothesis

- Hypothesis provides the focus to a study through highlighting specific aspects.
- A hypothesis tells what data to collect and what not to collect.
- It enhances objectivity in a study.
- A hypothesis adds to the formulation of a theory.
- It enables to conclude what is true or what is false.

Hypothesis Testing

Research hypothesis testing shows that any relationship observed in the data is real. A statistical test assesses the probability of obtaining a given sample or samples of scores, assuming the null hypothesis is correct.

Testing null hypothesis: If the probability is low enough (e.g., $p < 0.05$) then the null hypothesis is rejected. If the probability is not sufficiently low (e.g., $p > 0.05$) then the null hypothesis is not rejected but retained and the independent variable is deemed to have no effect (i.e., the observed changes are due to chance).

Type I and Type II Errors

No hypothesis test is 100% certain. Because the test is based on probabilities, there is always a chance of drawing an incorrect conclusion. When we conduct a hypothesis test there are possibility of two types of errors (**type I and type II errors**), which, by design, cannot be avoided and the researcher must be aware that these errors exist. The risks of these two errors are inversely related and determined by the level of significance and the power for the test. Therefore, it is very important to determine which error has more severe consequences in a respective study.

How to distinguish between Type I and Type II error?

- Type I errors happen when we reject a true null hypothesis.
- Type II errors happen when we fail to reject a false null hypothesis.

Type I error

The first kind of error, that is possible, involves the rejection of a null hypothesis that is actually true. This kind of error is called a **type I error**. **Type I** errors are equivalent to false positives.

For example, if null hypothesis states that the training session has no influence in increasing skill of participants. Now after hypothesis testing (using statistical test in analysis), if it is rejected that means training session has increased the skill of participants, but in actual, the null hypothesis is true, which means the session did not enhance the skill. The intervention was falsely claimed to have a positive effect.

Type I errors can be controlled. The value of alpha, which is related to the level of significance, has a direct bearing on type I errors. Alpha is the maximum probability for type I error. For a 95% confidence level, the value of alpha is 0.05. This means that there is a 5% probability that we will reject a true null hypothesis.

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Type II error

The other kind of error, that is possible, occurs when we do not reject a null hypothesis that is actually false. This sort of error is called a type II error. Type II errors are equivalent to false negatives.

The same example if null hypothesis states that the training session has no influence in increasing skill of participants. Now after hypothesis testing (using statistical test in analysis), if it is accepted that means training session has not increased the skill of participants, but in actual, the null hypothesis is false, which means the session actually enhanced the skill. The intervention was falsely claimed to have a negative effect.

The probability of a type II error is given by the Greek letter beta (β). This number is related to the power (sample size) or sensitivity of the hypothesis test.

How to avoid type II errors?

Although the errors cannot be completely eliminated, we can minimize type II error by increasing power of the study.

Typically when we try to decrease the probability of one type of errors, the probability for the other type increases. We can decrease the value of alpha from 0.05 to 0.01, corresponding to a 99% level of confidence. However, if everything else remains the same then the probability of a type II error will nearly always increase.

Points to Remember in Research Hypothesis

- Start with a broad and general hypothesis
- The hypothesis must go along with the researcher's background information.

CRITIQUING THE HYPOTHESIS

1. Are specific questions to be answered listed or are specific hypotheses to be tested stated?
2. Do the research questions and hypotheses naturally flow from the research problem and theoretical framework?
3. Are the research questions or hypotheses worded clearly and objectively?
4. Does each hypothesis state an expected relationship or difference?
5. Does each research question or hypothesis contain at least two variables?
6. Is each hypothesis testable?

VARIABLE

The quantitative phenomenon under the study is called a variable. A variable can be classified as either discrete or continuous.

- **Discrete variable:** A variable, which can take up only exact values and not any fractional value, is known as discrete variable. For example, number of workmen in a factory, members of a family, students in a class, number of births in a certain year, number of telephone calls in a month, etc. are examples of discrete variable.
- **Continuous variable:** A variable, which can take up any numerical value (integral/fractional) within a certain range, is called a "continuous" variable. Height, weight, rainfall, time, temperature, etc. are examples of continuous variables. Age of students in a school is a continuous variable as it can be measured to the nearest fraction of time, i.e., years, months, days, etc.

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SUMMARY

The knowledge of research problem, objectives, variables, and hypothesis is the basic requirement for the nurse researcher to conduct the research, which is relevant and significant to contribute to the scientific body of knowledge to nursing profession.

REVIEW QUESTIONS

1. Enlist the steps in formulating research problem on—"infection control practices in ICU".
2. Identify the four key components of research problem for a problem scenario; "compliance to infection control practices by ICU nurses in reducing urinary tract infections from baseline to 50% in 6-month duration".
3. Identify the different sources for framing research problem in above-mentioned scenario.
4. State one research hypothesis and one statistical hypothesis for the following research problem. Effectiveness of video-assisted program in improving knowledge and skills for neonatal resuscitation among final year BSc nursing students.
5. Formulate one null hypothesis and one alternate hypothesis for problem—"effect of sedentary lifestyle on incidence of coronary artery diseases among urban population".

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Pity Koul PhD MSc (Nursing) MD (Public Administration) PGDDE is Director, School of Health Sciences, Indira Gandhi National Open University (IGNOU), New Delhi, India. She is a researcher, planner, curriculum designer, educator and administrator. She has guided about more than a dozen of research scholars who have been awarded degree and many more are being guided at present.

She has 38 years of teaching experience including conventional and open and distance learning. She is member and chairperson of various statutory bodies within and outside university.

She has many awards and honours to her credit including National Florence Nightingale award (Presidential award). She has published a large numbers of research papers in national and international journals and chapters in various books. She has written and edited large number of courses in IGNOU and developed audio video material.

She has presented papers in national and international forums and chaired large number of scientific sessions. She has been part of many committees in government. She is member, founder member and office bearer of many professional organizations. She has worked in many projects and is Project Director/Coordinator of training for community health officers.

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