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Research in Nursing: A Guide to Understanding Research Designs and Techniques

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ABSTRACT : Nurses like any other professionals are expected to participate in research studies since nursing is a science that is fast evolving. Research in nursing paves the way for high quality, evidence-based nursing care. Findings from research highly informs quality nursing practice. Nursing practice needs to be research based; hence, it is worth commending that all nurses understand research techniques and designs and be involved in research. However, some bedside nurses are not aware of the relationship between research and the quality of care provided to patients. Such nurses need to be aware of the importance of research in nursing and get on board. There are different types of research designs and methods, and the type of design employed for a particular study will determine the methods to be used for that study. Generally, the different types of study designs include experimental and non-experimental research designs which can be used according to the need to answer many questions in the field of nursing. Thus, this paper gives an overview of research designs and methods in order to provide novice nurses with the basics of research methodology. This istoensure that nurses have an understanding of the research process and participate in research activities. This will in turn ensure that quality care which is evidenced-based is rendered to all patients.

KEYWORDS: *Nurses, research, research methods and techniques, evidenced-based care*

I. INTRODUCTION

Research is an organized enquiry that utilizses acceptable scientific methods such as systematic observation, classification and interpretationof data to solve problems and create new knowledge that can be applied generally. Research in nursing makes way for high quality, evidence-based nursing care. However, some bedside nurses are not aware of the connection between research and the quality of care provided to patients [1]. Since findings from research highly informs nursing practice, it is worth commending that all nurses understand research techniques and designs and be involved in research. This will ensure thatquality care which is based on research evidence is rendered to all patients. Even though nurses exhibit critical thinking skillsmost of them are not knowledgeable about the steps to conduct scientific research [1]. This may hinder their ability to carry out research and may not apply research findings in providing care.A study conducted by [2] on nurses' knowledge, attitudes and opinions about clinical research revealed that only 8.6% of the respondents had participated in prior clinical research. This might be due to the low level of knowledge regarding research as many studies have reported that nurses' lack of knowledge and experience in clinical research [6,13,19]. Nurses should be able toconduct research in order to contribute to the development of the nursing knowledge [3].

Researchers have consistently found that nurses who treasured research were more likely to use research findings in practice. This suggests there is a need to get more nurse clinicians deeply involved in the development of research into best practices. This can be achieved by making nurses understand the different research methods and techniques. This will make research less intimidating to many nurses and will become a part of who nurses are and what they do. This will go a long way to enhance evidence-based practice among nurses [1].

Quantitative research looks at numerical and measurable data while qualitative data on the other hand is based on observation and interpretation of personal experiences hence, a subjective information is collected. It is mandatory that nurses acquire skills to conduct both quantitative and qualitative studies, interpret results and utilize findings appropriately in their practice.This paper aimed at describing qualitative and quantitative research designs, experimental and non-experimental research designs and techniques. The subsequent sectionslook at how to carry out quantitative and qualitative studies and the difference between the two approaches.

II. CONDUCTING QUANTITATIVE AND QUALITATIVE RESEARCH

Research is an organized enquiry that utilizes acceptable scientific methods such as systematic observation, classification and interpretationof data to solve problems and create new knowledge that can be applied generally. As stated earlier quantitative research comprises numerical and measurable data. Quantitative skills are objective, numerical and measurable. Quantitative data analytics rely on mathematical and statistical research methods and can be used to measure long-term trends [3]. Quantitative data analysis skills, gives one the ability to understand and interpret data and findings related to statistical analysis, probability and software applications among others. Qualitative data is based on observation and interpretation of personal experiences hence, a subjective information is collected. It is necessary for researchers to acquire skills to analyze both quantitative and qualitative data in order to interpret new data and make good use of them.The section briefly looks at how to carry out quantitative and qualitative research, and the difference between the two approaches.

1. Conducting a Qualitative Research

In qualitative research the data is not in numbers (empirical); qualitative researchers study things, people and groups in their natural settings, attempting to explore and interpret phenomena in ways in which people experience them (i.e. phenomenological approach)[4]. Qualitative research approach is exploratory and aims at explaining 'how' and 'why' a particular phenomenon or specific behavior exists or occurs in a particular context. This section focuses on specific qualitative designs, advanced data collection methods and analysis.

1.1. Qualitative Research Designs

The design of a qualitative study evolves during the research, and can be adjusted or changed as it progresses.
These include participatory action research, narrative research, phenomenological research, grounded theory and discourse analysis [5]among others.

1.2 Data Collection Methods and Analysis

1.2.1 Data Collection Methods

Different types of qualitative data collection methods exist among which are in-depth interviews, diary accounts, documents, case study research and ethnography which lead to findings which provide in-depth understanding of participants' perceptions of their real life situations and how they interact with their environment [6].

Unstructured interviews use open ended questions to generate qualitative data through. This allows the participants to narrate their experiences in their own words while the researcher probes accordingly. In this way the researcher explores their total understanding of a particular situation. In addition to questions, visual materials or personal experience in the form of photographs, videos, sound recordings and among others can be considered qualitative data [7]. It is worthy of note that the qualitative researcher is an essential part of the data, he/she participates actively in order to obtain the necessary data. Theory emerges from the data collected during the process of research.

1.2.2 Data Analysis

Qualitative research data can be analyzed by content analysis, thematic analysis, grounded theory or discourse analysis [8]. In qualitative analysis attention is not on numbers but rather on in-depth, observational research it focuses on gathering and deducing information to draw conclusions [4]. Effective qualitative analysis requires the researcher's ability to collect large volumes of unstructured data and convert into meaningful information by identifying and interpreting key themes.

2. Conducting a Quantitative Research

This is a structured approach to inquiry where everything about theresearch processis programmed or well determined. Quantitative research is used to test theories and eventually accept or reject them hence, it aimed at ascertaining general laws of behavior and phenomenon across a variety of contexts (Fallon, 2016)[9].

2.1 Quantitative Research Designs

These include true experiments and quasi-experiments which are a less precise form of experiments. Also, quantitative designs include applied behavioral analysis or single-subject experiments where an intervention is administered to a single individual or a small number of individuals for a particular period [6]. Furthermore, quantitative designs include non-experimental designs such as causal-comparative and correlational designs. Incausal-comparative design the investigator compares two or more groups in terms of a cause (or independent variable) while in the correlational design the researcher employ the correlational statistics to describe and measure the degree of association between two or more variables or sets of scores [9].

2.2 Data Collection Methods and Analysis

2.2.1 Data Collection Methods

Quantitative data deals with numbers and quantitative research is concerned with testing hypotheses. Quantitative data may be collected through the use of structured questionnaires with closed ended questions. Also, data may be collected through experiments and controlled observations which yield quantitative data [9].The researcher collects data on participants in a study selected through probability sampling techniques.

These methods of data collection limit the way participants can appropriately report their experiences. Hence, findings can only be a reflection of the investigator's assumptions.

2.2.2 Data Analysis

Specialized skills are required in analyzing quantitative data in order to clean and interpret data for important insight. Also, the analyst should know what types of analysis to conduct and how to perform the chosen tests. The researcher should be skilled in questioning the data output, identifying correlations and link findings[7]. With the use of statistics quantitative data is transformed into useful information which can influence decision making. In other words, statistics is used to summarize quantitative data, describe patterns and associations. Statistics may be used as inferential or descriptive. While inferential statistics are used to determine whether the difference between two groups or more of data is statistically significant, descriptive statistics is employed to summarize the data.

3. The Difference between Qualitative and Quantitative Research

Qualitative research explores and describes the experiences of individuals or groups regarding a social or human situation in the manner in which they undergo or experience the problem[6]. Data is collected in the participants' settings through the use of open ended questions. The data is analyzed thematically by identifying key terms that emerge grouping them into major themes as the researcher reads and interpret the data [8]. On the other hand, quantitative researchers deal with numbers. They collect numerical data to answer specific research questions with the aim to provide an accurate description or paint a picture of a particular phenomenon. The idea behind quantitative research is that a social situation can be quantified, measured and presented using numbers and analyzed using statistical methods [9].

3.1 Major Characteristics of Qualitative Research

Qualitative researchers study participants in their natural context; thus, they immerse themselves in the setting to inquire and bring out the lived experiences of their participants from the participants' perspectives [5]. Therefore, through qualitative research the researcher interacts with the study participants and learns about their lives and understands the experience as it is lived.

3.2 Major Characteristics of a Quantitative Research

Quantitative researchers strive to control extraneous variables and objectively carry out studies in the laboratory without bias. Control is central to a quantitative study because it allows the researcher to clearly establish the causes or sources of his or her observations since to the quantitative researcher reality is objective and can be seen by anyone. The study design is decided or established prior to the study [9]. The goal of quantitative research is to provide answers to certain questions, identify and explain why things happen under the conditions in which they occur (McLeod, 2019)[6].

EXPERIMENTAL, QUASI-EXPERIMENTAL AND NON-EXPERIMENTAL STUDY DESIGNS

The definition of research designs takes in to consideration the type of study and sub-type, research problem, hypotheses, independent and dependent variables. Also, the design of a study takes into account the methods used to collect and analyze data as well as reasons for selecting the design. Therefore, a research design can be defined as a structure composed of the methods and procedures employed to collect and analyze data regarding a particular research problem. In other words, it refers to the procedure of utilizing research methods to enlist subjects, administer interventions, collect and analyze data during a research process [10]. There are three main types of study designs and the decision to use a particular type to answer a specific research question is guided by the nature of the question, the research goal, and the accessibility of the needed resources. Thus, a researcher might decide to use either a descriptive (non-experimental design), semi-experimental (quasi), or an experimental design (true design) taking into consideration the advantages and disadvantages of each design.

When a study is well designed it allows the researcher to address the research problem appropriately and adequately, and hence, draw strong and convincing conclusions. It is important to note that the design chosen for a particular study can affect the validity of its results. For instance, the results of a study can be unacceptable if the researcher is not aware of related past studies, or the study is poorly designed and implemented among others [11]. Also, it is worthy of note that the research problem directs the design of the study as the chosen design is expected to clearly address the research problem. For the purpose of this course the different study designs are explored thus, the following sections critically examine experimental, quasi-experimental, and non-experimental study designs.

Experimental and Quasi-Experimental Study Designs

An experiment is a precise and logical study in which one or more independent factors are controlled and applied to one or more dependent variables over a period of time, then the effect(s) are recorded [12]. So basically an experiment involves two sets of variables; one is constant, known as the independent variable(s) which is employed to determine the change in the second; called the dependent variable(s). In other words, an experiment should demonstrate a remarkable cause and effect. Usually, experimentation takes place when a researcher administers an intervention on a specific group of persons with the intention to investigate the precise effect(s) of the treatment.

The treatment may be administered to the subjects by level that is, in terms of the amount or magnitude after describing clearly the specific questions to be answered. This means that with an experiment, the natural condition of the subjects is altered which can affect the validity of the experiment [13]. Hence, it is important to be very careful when planning and performing an experiment. The controlled independent variables are specific kinds of treatments which may represent different levels of a variable or treatments administered to different groups or experimental units. Also, known or expected sources of unevenness in the experimental units should be determined in order to reduce such effect.

Experiments are very quantitative studies that try to test hypothesis using concrete data and statistical methods producing the most authoritative conclusions and measurable results possible which specify whether or not a particular intervention has a noteworthy influence on the intervention group(s) [11]. Experimental designs are ideals for research and are very much appreciated by stakeholders, policy makers and researchers since they attempt to establish causal relationships among two or more variables. These designs are particularly employed to investigate social matters.Similarly, a quasi-experiment involves control group or multiple measures. Note that some authors claim that quasi-experiment is not classified under experimental designs. This is because for a design to be a true experiment, items must be randomly assigned to groups. The subsequent subsections present a synopsis of experimental and quasi- the experimental designs.

I. Experimental Study Designs

An experimental design can be defined as the process that deals with the analysis of data produced from an experiment. It is a method used to investigate an assumption which involves putting in place precise measures to find out if there is an association between variables. A "true" design allows one to properly organize experimental study in order to obtainobjective and valid results. It is worth mentioning that the validity of the results obtained from an experiment depends on the chosen design and this has an influence on the internal and external validity as well as the reliability. If an experiment is well planned the investigator is able to answer the research question(s) with a high degree of certainty since the conclusions will be supported up by tangible data [11]. It is worthy of note that the terms **e**xperimental design and design of experiments can be used interchangeably in different disciplines. The following subsections present the principles of experimental research designs, describe the types of experimental research designs and explain how to conduct an experiment.

I.1 Principles of Experimental Research Designs

As mentioned earlier, with experimental research designs attention is placed more onthe design than the results obtained hence, the followingprinciples must be observed:

First, experimental research designs are expected to explainhow the subjects are assigned toexperimental groups or units. Generally, this is done by complete randomization whereby the respondents are allocated to groups randomly [13]. Also, a randomized block technique can be employed in which the subjects are divided into homogeneous blocks for example, using particular characteristic age groups before being randomly allocated to the different groups. This helps to reduce or remove bias from the results. Second, experimental research designs shouldreduce or eradicate confusing variables that might influence the results.That is, the investigator should try as much as possible to avoid or minimize other conditions that might influence his/her results. Third, experimental research designs shouldpermit the researcher to make assumptions /conclusions about the connection between independent and dependent variables.

Again, inconsistency or differences within treatment groups should be reduced or minimized in order for the researcher to easily bring out disparities in results. Also, the researcher should plan to make changes to independent variables and the effect response variables [13]. In addition, data should be systematically collected in order to generate valid results which can be interpreted easily and are ultimate. Furthermore, the researcher should ensure the experiment is replicable by other investigators by employing the use of statistics such as standard error of the sample mean or confidence intervals. Finally, the design should manage sources of variation in the experimental results, hence, ensure blocking.

I.II. Types **of Experimental Research Designs**

Generally, experimental research designs are usually classified depending on how the researcher assigns participants to different groups and conditions [12]. Thus, there exist three types which are true experimental, quasi-experimental and pre-experimental research designs. It is worth noting that within each type of design, there are various sub-types. The following sections describe some of these designs, their subtypes and examples.

i. Pre-experiment or Pseudo-experiment Research Designs

These designs apply the principles of experimental designs, but for the fact that a control group is not included [14]. In this type, different dependent groups or a group will be observed if a change has occurred due to the effect resulting from the application of an independent variable. It is the simplest form of experimental research designs which employs a sole group pre-design versus post-design. The design displayscorrelation; however, it exhibits weak generalizability and low quality of evidence quasi-experiment. The three types of pre-experimental research design include:

One-shot Case Study Research Design: This is a posttest study which involves only one dependent group or variable. The study is conducted after some treatment which was believed to cause change. For example, investigating the level of pain among cancer patients on Opioids

One-group Pretest-posttest Research Design: This research design uses a single group on which both pretest and posttest are conducted before and after the intervention is administered [13].

Static-group Comparison: In this study, two or more groups are observed of which only one of them is subjected to some intervention while the other groups are held static [14]. A post-test is then administered to all the groups and the differences observed among them are believed to be due to the intervention.

ii. Quasi-experimental Research Designs

This type of experimental design is employed in settings where the subjects are not randomly assigned to experimental or control groups. It is commonly used in educational research where students are not randomly selected assigned to treatment conditions [14]. Pretest-posttest designs may be quasi-experimental such as time series, no equivalent control group design, and the counterbalanced design (these examples are described in section4.1.2.). As stated earlier, some schools of thought classify quasi-experiment designs under non-experimental designs because participants are not randomly assigned to conditions or orders of conditions. Still others state it does not control for confounding variables, therefore, it is usually in between correlational studies and true experiments.

iii. Randomized or true experiments

This type of design must randomly assign participants to the treatment and control groups and must contain a variable that can be manipulated by the investigated. This allows for the control of extraneous variables. Also, this design has the ability to display cause and effect and high quality of evidence [13]. It is uses statistical analysis to approve or disprove a hypothesis and is the most precise type of experimental designs. It may be conducted with or without a pretest on at least two randomly assigned reliant subjects. The different types are:

The Posttest-only Control Group Design: Here, the participants are randomly selected and assigned to the experimental and control groups, with the treatment administered only to the experimental group. Both groups are then given a post-tested after close observation, and a conclusion is made based on the differences noticed in the two groups [12].

The Pretest-posttest Control Group Design: A pretest is first of all administered after a random selection and then just like the first design, subjects are randomly assigned to the experimental and control groups. The intervention is given only to the experimental group after which, both groups are given a post-test to determine if a change has occurred and the extent.

Solomon four-group Design: This refers to the combination of the posttest-only and the pretest-posttest control groups. The participants are randomly selected and assigned to four groups. The investigator employs the posttest-only method to investigate the first two groups are, while the other two are tested using the pretest-posttest technique [13]. Presented below is the three commonly used examples of experimental designs.

Independent Measures Design: Is also known as between-groups design. It is when each participant is assigned to either the control or treatment group. In other words, separate groups are created for each treatment no participant is assigned to more than one treatment group. That is different groups are created for every treatment. For example, if the investigator wants to test two treatments he/she will have to randomly assign subjects to three groups: Group 1 (treatment 1), Group 2 (treatment 2) and Group 3 (no treatment). One of the advantages is thatit is one of the simplest types of experimental designs [12]. Also, it allows for multiple treatments and treatment levels to be tested at once. Furthermore, it can quickly be conducted; however, the process can be too cumbersome if many treatment groups are composed. Again, participants' variables (age, race, gender) may skew results and are almost impossible to control for in this experimental design and the researcher may be unable to generalize results to a larger group among others.

iv. Completely Randomized Experimental Design

In this type of experiment there is random assignment of treatments that is, each experimental unit has the same chances of being given a particular treatment. Generally, this type of experiment is conducted in the laboratory where environmental factors are easily control and when two treatments are involved, it is equivalent to a t-test. In a randomized controlled trial participants are assigned randomly to two or more groups to investigate a particular intervention or medication. Participants are assigned to either the intervention or control group which respectively receive the medication or a placebo an alternative treatment, or no treatment at all [12]. Examples

of randomization methods are simple random sampling, systematic or stratified random sampling. The advantages of this design are that there is no bias and subjects are readily recognized as members of a specific population among others. However, it is usually more expensive and needs more time, and requires a very large sample size (over 5,000 participants) among others. A completely randomized design with sub-sampling is often used when experimental units are limited.

v. Factorial Design

A factorial experimental design is used to investigate the effect of two or more independent variables on an independent variable [15].

vi. Repeated Measures

Also referred to as within groups, or within-subjects design is an experimental design where the same participants take part in each treatment of the independent variable (more than one treatment). That is, each treatment or levels of treatment is administered to the same group of participants for instance, all the participants are given both types of medication. The levels can either be ordered (like height or time) or not [12]. An example is checking the blood pressure of all subjects after watching horror and romantic movies in turn. These designs are often used in pre-test/post-test situations. As an advantage, this designrequires fewer participants than the between subjects design hence, it usually cheaper. Also, individual differences between subjects are controlled for since the subjects are measured more than once thus, each participant acts as their own control.

However, range effect could occur whereby effects from a previous treatment r intervention could influence the next. For example, an elevated blood pressure due the exposure to a scary movie could stay elevated for hours hence, affecting the blood pressure values measured later to check the effect of a romantic movie. Also, with pretest-posttest studies the subjects can display "practice effects", whereby scores may get better because they have taken the same test more than once. Furthermore, running hypothesis texts, such as ANOVA may not be possible because data is not completely independent [15].

vii. Randomized Block Design

In this design, the participants are split into identical blocks and then treatments are assigned randomly to the blocks. For example, females could be put in one block and males in the other. Randomized block design reduces unevenness in experiments for example, in investigating the efficiency of a new drug whose response can be influenced by *age.* Therefore, to exempt this confounding variable, the researcher should set up randomized blocks having equal numbers of subjects with different age groups spread across the blocks [16]. Hence, the age is controlled and removed as a probable source of variability.

viii. Matched Pairs

Here the participants that are similar in age or socioeconomic status are paired (homogeneous groups or blocks) and one participant from each pair is assigned randomly to the control group while the other to the control experimental group [17].

I.III Designing andConducting a True Experiment

As said earlier, an experiment is a type of research study in which the researcher controls the independent variable(s) in order to determine the effect on the dependent variable(s). It is usually designed such that there is always a cause and response [14]. It is worth noting that generally, the design of an experiment depends on the context, and a good experimental design must consider all the uniqueness of the study system in order to produce information that is both valid and relevant to the research question. Therefore, in conducting a good experiment the researcher needs to have a good experimental design which takes into account the necessary features summarized into the following main components:

The Research Question(s): It is important for the investigator to first of all have an understanding of the specific research question to be investigated. That, is, the experimenter should be answering questions like is the CLE Method effective in teaching children with autism? Such a question allows the investigator to determine if the treatment works or not. Next, the main variables are stated that is, the independent and dependent variables showing how they are connected as this helps to translate the research question into specific and testable hypotheses. Dependent variables are those to be controlled while independent variables are the experimental treatments administered to the dependent variables [18]. Extraneous variables, on their part are factors other than the treatment that may as well contribute to the change that might be observed after the experiment. Depending on the type of experiment the investigator may decide to include multiple independent variables (Multivariable) for instance, test scores time and skills among others.

Also, the researcher establishes how widely and finely the independent variable(s) will vary as these will influence the extent of information and the external validity of the results [14]. That is, the degree to which the results can be generalized and applied to wider group. Therefore, the investigator may decide to modify the independent variable just slightly or extensively above normal ranges or conditions. Again, he/she may decide to treat the independent variable as categorical (either as binary or as levels of a factor) or a continuous variable. This influences how much the experimenter can infer from the results obtained.

In addition, the possible confounding variables are determined and ways to control them during the experiment are sought. The variables are illustrated on a diagram (conceptual framework) showing the possible connections between them and the expected direction of the associations [14]. Furthermore, the internal validity of the experiment is determined by making the right judgments regarding randomization, control groups, and autonomous designs. It is worth noting that in any true experiment the researcher must thoroughly and precisely control the independent variable(s), accurately measure the dependent variable(s) and manage any possible confounding variables.

Sample Selection and Sample Size: Here the investigator gathers the participants for the study taking into consideration their common features (age, gender and income among others). Also, it should be noted that the manner in which the intervention/treatment is administered to the selected subjects is critical for obtaining valid and reliable results [16]. The first thing to consider is the **sample size**; noting that the larger the **sample size**, the greater the experiment's statistical power, and hence, the extent of confidence one can have in the results.

Control and Experimental Groups: Generally, any experiment involves two main groups; that is the study subjects are either assigned toanexperimental group which receives the treatment or a control group which does not receive the treatment [11]. Thecontrol group is certainly the most critical attributes of an experiment. This is because it provides a foundation for a comparison to be made between the experimental and the control groups since it paints a clear picture as to how the subjects of the experimental group would have looked like had it been they received no treatment. Hence, the control group guides the investigator in making judgment regarding the effect(s) or effectiveness of the intervention. In other words, the intervention group reveals the effect of the treatment while the control group reveals what would have happened to the experimental group if they had not received any treatment.

Random Assignment: In addition to having a control group, a true experiment should randomly assign the selected subjects to either the control or experimentalgroup**s.** This is to avoid pre-existing differences and ensures the researcher reports with certainty that the results obtained/effects on the experimental group are genuinely due to intervention and nothing else.It is worth noting that subjects in anexperiment can be randomized in two ways[11]. That is, they can be completely randomized where every subject is assigned to a treatment group at random. Also, the participants can be randomized within blocks (aka stratified random design), after being grouped with respect to a common feature (aka strata) and then randomly assigned to treatments within experimental groups. That is, grouping children with autism according to levels of severity before being randomly assigned to interventions. However, where randomization is not possible (due to ethical reasons), the researcher can employ a partially-random or even non-random design like in a quasi-experimental study.

Description of the Intervention or treatment: It is important that the treatment administered to the experimentalgroup be sufficiently described in simple and clear language in the methodology section. For instance, in a study to investigate the effect of the CLE Method on the speech of children with autism, its components**,** contents and duration of each unit, instructional methods and materials should be explained. This gives the reader a clear understanding of how the experimentalgroup was treated differently from the non-experimental group[14]. Also, it is important to state clearly if the subjects in the experimentalgroups (inthe case where there is more than one experimentalgroup were administered treatmentdifferently.That is, if thesubjects received only one of the possible levels of an experimental treatment and follows that level of treatment throughout the experiment. This is known**s** independent measures orbetween-subjects design or classic ANOVA design. A different level of the treatment is given to each group; either a normal or subnormal or high dose of Nicotine, while no treatmentfor the control group. Furthermore, the investigator may use matched pairs within the independent measures design to ensure that each experimental group has the same variety of individuals and in the same proportions.

On the other hand, all the subjects can be randomly assigned to each of the experimental treatments in turn and then the effects to each treatment are measured. This is referred to as repeated measures or within-subjects or repeated-measures ANOVA design). Here the effect emerges with time, and the individual effects are measured over time they emerge. Usually, counterbalancing which is reversing the order of treatments among subjects is used in repeated-measures design [6]. This is to make sure that the order in which the treatment was administered does not influence the results of the experiment.

Non-Contamination of Participants: This occurs when the participants of the control group are given instructions that have major aspects of the instructions for the intervention or when subjects of both groups communicate. Contamination of participants is one of the greatest threats to internal validity of a true experiment [14].

Reliability of the Instrument Used to Evaluate the Effect of the Treatment: The investigator should design or use an assessment instrument that is able to exactly measure the skills the subjects are expected to acquire after the treatment (McLeod, 2019[6]).

Data Collection and Analysis: Experimental designs usually use standardized assessment instrument to collect data before and after the treatment. Also, data can be collected midway in the intervention depending on the objectives of the study. This process should be clearly described in the methodology section and the measures taken to increase the internal validity of the study. Usually, a test of significance or a t-test is used to analyze data [14]. This method of analysis allows the researcher to compare the mean scores of the two groups and determine whether there is a statistically significant difference between the groups.
Findings: The study findings should be clearly reported in order for it to be easily disseminated and appreciated. It is important for the study to be reported sufficiently and completely as it assists exactness, precision, and reproducibility of the research [20].

I.IV Quasi-Experimental Study Designs

This design has almost the same components like a true experiment mentioned earlier, but quasi-experimental designs lacks randomization and is usually considered as untrustworthy and unscientific in the physical and biological sciences. However, some experiments must employ this design due to ethical issues and risks, or because the randomization of participants is not possible [21]. An example is conducting a study to compare the educational experience among siblings. Generally, quasi-experiments are designed to investigate theeffect(s) of a certain treatment, habit or educational intervention on a particular group of individuals. An example is investigating whether smoking during pregnancy leads to low birth weight. Here, because of ethical reasons, the investigator simply asks the mothers if they smoked during pregnancy and place them in groups depending on their responses. Also, this design can be used to investigate certain topics like the consumption of certain foods and the use of over the counter medications and supplements. Some of the types of quasi-experiments are defined below.
Nonequivalent Groups Design: This describes a between-subjects design in which participants are not assigned randomly to treatments. Hence, the resulting groups are likely to be dissimilar in some ways and as such are considered to be nonequivalent [10]
Pretest-Posttest Design: Here, a pretest is given to the participants before the treatment is instituted after which the same test (posttest) is administered to determine the effect of the treatment. If a difference occurs between the average posttest and pretest scores, then it could be concluded that the treatment must have caused the change in the dependent variable. However, the change (positive) could have been due to other factors including maturation. Therefore, inferring causality from pretest-posttest designs should be done with much caution.
Interrupted Time Series Design: Just like the pretest-posttest design, this design entails administering a test to the dependent variable before and after the intervention, but for the fact that the test is given multiple times at different points.

I.VI Non-Experimental Research Designs

In non-experimental designs, the researcher does not have to manipulate an independent variable because there are already existing groups. In other words, in this type of research there is no manipulation of an independent variable, the participants are not randomly assigned to treatments or conditions (or orders of conditions) as done in experimental designs [22]. What the researcher does is to compare and describe the existing groups based on uncontrolled variable or could as well examine connections between preexisting groups. Thus, in such studies conclusions cannot be made about causal relationships between variables. This is because non-experimental designs are usually conducted in order to provide answers to questions based on existing groups and to verify any group differences. It is important to note that in non-experimental research variables are measured as they occur naturally.
Also, worthy of note is the fact that non-experimental designs are likely to yield invalid results since it is pretty difficult to restrict potential extraneous variables (control for threats to internal validity is neglected). Even though, precautions can be taken to limit potential for bias and increase the validity of non-experimental studies; retrospective studies are often prone to bias [10] Hence, the conclusions drawn from non-experimental research are purely descriptive in nature; however, conclusions about causal associations can be drawn post hoc.

Generally, researchers employing non-experimental designs conduct observational studies and describe their results. For instance, the researcher may want to investigate, the characteristics of the elderly. Also, non-experimental studies may be designed to determine the prevalence of a disease or a particular symptom for a specific disease [10]. With such studies, the focus is on prevalence rates, and not cause. However, the research may propose some relationships but which cannot be efficiently proven. It is worthy of note that even though it is difficult to make causal conclusions with non-experimental it is equally important as experimental research.
It is worth saying that among the three main categories of research designs that is, experimental, quasi-experimental, and non-experimental designs, the non-experimental designs category is the most diverse [6]. In the main,

this class has the lowest level of scientific rigor, each sub-design within this category varies as to its own individual level of scientific force. Non-experimental research designs can be divided into three broad categories which include cross-sectional, correlational and observational research designs. The following sub-sections looks at the design of non-experimental research and highlight the different types

Designing and Conducting a Non-Experimental Study

The design of any study helps the researcher conducts the study in a systematic way in order to gather evidence to answer the research question. In other words, the study design is purposefully planned to provide organized conditions for data collection and analysis in a way that endeavors to join together connotation to the research purpose with economy of procedure [10]. It is important to note that there is a relationship between the research questions, methods used and the type of findings obtained [11]. Therefore, any planned study design ensures that the data collection procedure is such that will produce results that are relevant to the project or the argument the researcher wish to present. Also, a good design ensures the study procedure is unbiased and reliable. Furthermore, it should be able to establish causality accurately and provide findings that can be generalized to a wider population [6]. Some of the elements to be considered when designing a study include the following:

Theoretical and Epistemological Perspective

The positivism perspectives believe in the independent existence of measurable facts in the social world, and researchers who adopt this orientation will like to have a fair system of measurement [10]. On the other hand, interpretivism supposes that events are interpretedby humans and researchers who use this method will be more subjective in their approach.

The Type of Study being Carried Out

It is important for the researcher to make a decision on the type of study to be conducted. This could be an exploratory study where the aim is to obtain an initial grasp of a happening. Also, the study could be a descriptive one which provides a profile of a topic or institution. Better still the study could be explanatory that examines the causal relationship between variables and this can either include the testing of hypotheses or examination of causes. Generally, the components of a study design or a research study include the introduction, literature review, methodology, findings, and discussions [8]. The following paragraphs state and explain some of these components and what needs to be considered when designing a study.

Introduction: The introduction presents the background of the study bringing out clearly the importance of the study and justifying why it should be conducted. Also, the introduction states the purpose of the research, research problem and research questions and hypotheses. The researcher clearly defines his purpose for carrying out the research and have on mind what exactly he/she wants to investigate about, the knowledge gap, the available data the time and resources required as well as the plan on how to carry out each phase of the study.

Research Question(s) and Variables: The research question is one of the two aspects of a research design that are taking into consideration when judging the quality of a study [11]. Researchers must ensure that the design used is appropriate to the question they seek to answer. It is important to note that the research question directs the study; it mostly comprises the research hypothesis which is to be tested, it brings to light the specific objectives, determines the size, breadth and the relationship between variables, how trouble-free is it to measure variables etc. Also, the research questions should match the research approach that is, whether quantitative or qualitative. With qualitative research methods the researcher can have a relatively narrow understanding of a specific situation, and later in the course of data collection generates new questions but this is not the case with quantitative approach which requires the researcher to have all the questions identified before commencing.

The types of questions that best suite qualitative research are those that allow in- depth exploration of data from a reasonable sample size. For example, what are your views regarding the teaching of sex education to teens? Again, qualitative research type questions are used in comparative studies and to a lesser extent, in "cause-effect" studies which are fairly limited in scope [22]. On the other hand, the type of questions for a quantitative approach are precise and require a “yes” or “no” response. Whatever the approach used the question should be clear and relevant in order to guide the statistical analyses, interpretation of results, and discussion.Furthermore, the investigator needs to state the key variables to be explored in the research, and decides whether the study will investigate the relationship between them or the cause and effect. The research variables are to be clearly defined in terms of their population, types, characteristics, and behaviors [23].

Hypotheses: Generally, a quantitative research to starts from a particular hypothesis which is a presumption of what the probable result will be.It suggests whether there is a relationship between the variables and the outcome and in turn guides the design of the study.

Supporting Theories and Relevant Literature: Generally, the researcher starts the research by reviewing literature which helps in formulating research questions and the variable**s** to be considered. Reviewing relevant literature assists the researcher to identify studies related to his/her research problem, methods used and problems faced in the course of the studies. The researcher is expected to state and explain theories that are linked to the research problem and be able to figure out those that can help back up his/her findings [24]. An in-depth literature review on the topic under study directs the choice of the research methodology, sample size as well as the type of statistical analysis which all improve the significance, value, and power of the research. Also, it shows whether there is a need for a further research in any area.

Conceptual framework: A working conceptual framework which explains the nature of the research problem, questions, and designs, as well as will guide the discussion of the findings should be discovered after a thorough literature review. A conceptual framework presents a description of the problem or research question, and highlights the different variables and outcomes, and how they are related [10]. Conceptual frameworks can be derived from verified theories and models with well-organized principles as well as from documented evidence-based best practices.Conceptual frameworks help to express clearly assumptions of the relationships between variables linking the study to the literature.

The Research Methods and Methodology: Talking about the research methods, it is essential that the investigator decides whether to use qualitative and quantitative approaches or both. A study is qualitative if the research question seeks to investigate, determine, recognize, explain, or produce reasons underlying certain phenomena showing how and why things happen [25]. On the other hand, quantitative studies employ deductive reasoning, and numerical statistical quantification of the association between groups on data often gathered during experiments. Using both methods help to triangulate the research; that is making sure that any deficits in a particular methodology used are compensated.

Quantitative research methods are advantageous in that it is easy to establish thoroughness because of their objectivity and can be easily replicated in another circumstance. For example, data on the experiences of nurse educators from two different institutions can be collected with a well-constructed questionnaire [10]. Also, these methods are good at generating reliable data from a large number of sources. However, their credibility dependents on the reliability of the instrument and the data produced from quantitative methods are not in-depth. For instance, with a quantitative the researcher may be able to conclude that the participants said they had learnt a new thing after an educational intervention, but may not tell how the learning took place. Hence, most often qualitative methods compliment quantitative methods; qualitative methods can be employed to further explore in details certain issues found in a quantitative study.

Concerning research methodology,the researcher is expected to plan the study such that the methodology used must be suitable for both the research questions and the findings that result from the study [11]. The research methodology describes the research design, target population, criteria for selecting the study sample, procedures, and instruments and tests for data collection and analysis as well as ways of improving the validity of the findings.

The Target Population and Study Sample: In order to answer a particular research question, the researcher selects a particular group of individuals to which the conclusions from the study will be applied to. This group is known as thestudy population which is usually made of a specific group of persons with similar characteristics that is, age, gender, occupation, geographical location and so on. The target population is defined with respect to the purpose and practicalities of the study [25].
Usually, the entire population cannot be studied (except it is very small); hence, the investigator studies a subset of the population which is broad enough to be a representative of the population. This is referred to as the sample of the study; from where data will be collected. In order to draw up a sample, the total number of people in the target population needs to be identified first from the sampling frame [26]. This is the actual list of individuals in the target population. An example could be the University of Buea database which has all the names and contact details of every lecturer. It is important to note that where the population is very large, demographically diverse and geographically dispersed, it might be hard to select a representative sample.

Sample Size and Sampling Methods: The first thing to do in sampling is to decide on an appropriate sample size based on the objectives of the study, the available time for the study, budget, and the degree of precision. To determine how many participants will make up the sample, requires the right formula to calculate the sample size (this helps in determining how big the sample should be). Generally, the number of participants in a study depends on the size of the population, and on how accurately you want the results to represent the population as a whole.Usually, the larger the sample size, the more accurately and confidently conclusions can

be made about the whole population [24]. Also, the researcher identifies suitable sampling methods to recruit the participants into the study.

Sample Size Determination: The confidence interval and confidence level of the sample are first of all established in order to determine the appropriate sample size and the degree of accuracy to be achieved. The confidence interval (the margin of error) is usually + or - 5 which represent the range within which the likelihood of a response occurs [25]. However, it could be reduced further to a + or - 2 in order to increase the precision level of the data. The confidence level is expressed as a percentage and tells how convinced the researcher wants to be about how the responses from the selected sample reflect the responses of the entire population.

Hence, a confidence level of 95% suggests the researcher can be 95% sure. The lower the confidence level, the less confident the researcher will be. For example, if your survey question is "does small businesses pay tax?" and 65% of your sampled businesses say "yes," then using a confidence interval of +/- 5, you can state with confidence that if you had asked the question to all small businesses, between 60% (i.e. 65-5) and 70% (i.e. 65+5) would have also responded "yes." The sample size is then calculated using any accepted sample size calculator such as Survey Monkey or Raosoft taking into account the objectives of the study time and resources [24]However, precision can commonly be increased with an increased sample size if only biases are avoided or minimized; if not, the increased precision will aggravate the biases.

Sampling Techniques: A **s**ampling technique is the means by which elements of the sample are selected. This could be done either by using probability **or** non-probability sampling methods. This is a crucial research design decision, which is guided by the theoretical approach behind the study (i.e. positivist or idealist) as well as whether the study employed qualitative or quantitative approach among others [24]. However, both **probability** and **non-probability sampling methods** may be used for diverse purposes at different points in the research process. For instance, a purposive sampling and then, a random sampling could be used in the same study. P**robability** and **non-probability sampling methods are described below with some examples.**

Probability Sampling: Generally, with this technique there is an equal chance for each member of the target population to be selected. That is, the subjects are randomly selected from the sampling frame after the investigator has decided on the sample size. Simple random sampling is done using tools like random number generators or other methods that are based entirely on probability.Random sampling of participants is usually done if the researcher adopts a **positivist**perspective to research, and employs **quantitative** methodology [24]. This allows the researcher to make statistical inferences about the population. In other words, a probability sampling technique is used when the researcher want to produce results that are representative of the whole population. Other examples of probability sampling include:

Systematic sampling; similarly, with this sampling method, every member of the population is given a number, and then participants are selected at regular intervals; that is, the researcher selects every **nth element** of the population. For instance, from the list of all lecturers in the university, among the first 10 numbers the researcher randomly selects a starting point from where every tenth member is selected until the required sample size is attained. This might be problematic if there is any hidden trend in the list because the sample is likely to be skewed towards senior staff (Moffatt et al., 2006). This is because the interval might leave out the junior staff if the lecturers are listed according to their faculties and in order of seniority.

Stratified random sampling; this is the right sampling method if the population has mixed features, and the investigator wants to make sure that every feature is represented in the sample equally. The population is divided into segments or strata with respect to the stated feature. For example, in the case of a university, the population could be partitioned into academic, administrators, and support staff. Better still the population can be split based on the age range, gender and work experience among others. The number of persons to be sampled from each subgroup is calculated based on their overall proportions of the population [24]. Then a random or systematic sampling is employed to select a sample from each stratum. In a case where gender is the main characteristic, the population is divided into two subgroups base on gender. Then using random sampling participants are selected from each stratum proportionately; 30males from a segment of 300 and 70 females from a stratum of 700 giving a representative sample of 100 respondents. It is worth noting that if the number of persons per segment is too small to select participants the strata is altered and reduced into fewer strata.

Cluster; the population is partitioned into segments having similar characteristics and the entire subgroup is randomly selected. That is, each person from each cluster is included; however, where clusters are large, individuals from each cluster are sampled using random or systematic sampling methods. This is a good method for dealing with large and dispersed populations; however, it could be difficult to get a representative sample of the whole population since the chances of error in the sample are high. This is because there could be significant differences between [25]. An example is the country has ten State universities with all having the same number of employees with the same functions. If the researcher cannot go to all the universities he/she can randomly

select four universities which are the clusters. Also, the subgroups may be sampled based on a particular geographical feature that is, sampling particular areas of the country.

Non Probability Sampling: This is the non-random selection of subjects based on convenience or other criteria, which allow initial data to be collected easily, but without giving everyone a chance of being included. Though it is cheaper and easier to access the study sample, there is a higher risk of sampling participants with bias; hence, the researcher cannot draw valid statistical inferences regarding the whole population [10]. Usually, non-probability sampling techniques are suitable for exploratory and qualitative studies in which the researcher does not aim at testing a hypothesis. Such studies are often conducted to boost an original understanding of a small or under-researched population. Non-probability sampling techniques include:

Convenience/accidental; this is the selection of participants based on the researcher's convenience instead of certain features of the sample 9]. The investigator includes the most accessible persons and so one cannot determine whether the sample is representative of the population. Hence, the results obtained cannot be generalized as stated earlier.

For instance, if I am researching the views of nurses about autism in the hospital where I work and during my shifts in the mornings I administer my questionnaires. This is a convenient way and not representative of the nurses because those in the evening shifts are not considered.

Purposive; with this sampling method, the participants are selected intentionally because their views are relevant to the topic under study. In other words, the researcher uses his/her discretion to select a sample that is most useful to the purposes of the research. It is usually employed in qualitative study in which the investigator seeks to get an in-debt knowledge about a specific phenomenon [9]. For instance, the researcher wants to gain more insight into the views and experiences of diabetic patients among the staff of the university, he/she then selects confirmed cases in order to gather different views regarding their lifestyles. For purposive sampling to be considered effective it must have clear criteria and rationale for inclusion. Its weakness is its subjectivity

Snowball; this sampling technique is used when it is difficult to access the population. Thus, with this technique participants are recruited through other participants [10]. For instance, when conducting a survey among persons smoking marijuana. If the researcher approaches one person and he/she agrees to participate in study, the parson then links the researcher to the other marijuana smokers. The number of people you have access to "snowballs" as you get in contact with more people.

Quota; here, an assumption is made about the existence of pre-existing subgroups in the population, and a quota is selected to reflect these differences. The subgroups are expected to be a representative of the population; however, the researcher is cautioned about making conclusions for the whole population [9]. Since a quota sample taken in the City of Buea for example, would not be representative of the whole of Cameroon.

Voluntary response sampling; similar to a convenience sample, a voluntary response sample is mainly based on ease of access. Instead of the researcher choosing participants and directly contacting them, people volunteer themselves (e.g. by responding to a public online survey). It is a method in which the participants volunteer themselves to participate in a study by responding to a public online survey. This technique is similar to convenience sample since the voluntary response sample is mainly obtained based on ease of access. The technique yields samples that are likely to be biased, as some individuals will be more likely to be in a position to volunteer than others [27].

When a purposive sampling is used, the sample size for the study is determined by judgment, but if random sampling is used, it is calculated as a **proportion** of the sampling frame. This ensures that the sample size is a representative of the whole. For instance, 10 per cent is a good **proportion** for a large population of above a 1000, while for a small population a larger proportion is required [9]. Whatever technique(s) the researcher used should clearly explain in the methodology section how the sample was selected.

Ethical Principles: Ethics in research cannot be underestimated; therefore, when designing studies ethical issues like informed consent, confidentiality and anonymity among others must be considered. The participants are requested to willing give their written consent to participate in the study after the researcher has given them a complete explanation regarding the nature of the study [10]. Also, permission must be obtained before transcribing conversations, participants must be treated with respect, cutesy and concern.

Reliability of the Study: When designing a study the researcher takes the responsibility to ensure that the results of the research will be the same if the research is repeated by another researcher using the same instruments in a similar context. Therefore, the study should be designed in a way that the measurements of the research methods are accurate and consistent [28].

Validityof the Study: In ensuring validity, the design must ensure that the research successfully measures what it was actually designed to measure. Also, the results obtained from the study must be accurately interpreted and transferable to other situations [9]. Furthermore, the researcher does all to make sure other circumstances which can influence the results of the study are avoided.

Ensuring that the Study Findings can be Generalized: It is worth mentioning that the methodology employed indicates how much trust other researchers can have about the generalizing the research findings [11]. The study should be designed such that the findings should be applicable in other research settings and a theory developed that can be applied to other populations. Such studies will have a relatively large sample, and a survey is usually conducted.
Transferability: The design of a study should be such that the study can be applied to other situations especially when the study to be carried out is a case study.

The Response Rate: A good response rate is determined by the type of survey that is being conducted. Usually, it is advisable to include in the design the period to administer and collect the questionnaires. This is in order to follow up the response rate against the sample frame [10]. Also, it is important to note that if the questions are simple the response rate is enhanced.

Methods for Data Collection: It is important first all for the researcher to decide the type of data to collect; does it just relates to different types of categories (differences between men and women leaders) or does the data entails some kind of ranking. This decision directs the type of statistical analysis that is required. Generally, quantitative data is produced using a questionnaire. The researcher should first of all determine the questions for which answers are being sought. This is in order to avoid situations whereby the researcher will later on realize that he/she actually need responses to a question that were never included in the questionnaire [25]. Hence, the questionnaire should be developed after the researcher must have done a thorough literature review, and then formulates the questionnaire using precise and well phrased questions. Again, this motivates the respondents to complete the questionnaire. However, the response size depends on whether the researcher is investigating the effect of a variable, or changes in variables which will all require a larger response size.

Also, historical records and documents, as well as experiments and observation are used as instruments in quantitative research to collect or produce different types of data. According to Glen [29]data can be classified as follows:

- **Nominal**; which signifies specific groups, e.g. men or women.
- **Ordinal**; means ranked in a particular way, such as, in order of reaching the shopping counter.
- **Interval;** refers to ranking with respect to the interval between the data, which remains the same, e.g. temperature.
- **Ratio**; measures the variation between different types of data - for example applying a measurement.
- **Scalar**; this kind of data has gap between it, which are not quantifiable. For example, how many apples do you eat in a week?

The methods used to collect qualitative data include the following:
Ethnographic methods: This requires that the researcher embeds his/herself in the community while observing people. Most commonly these methods include:

Interviewing; refers to having discussions with some individuals either face to face or on the phone, or by email with the aim of collecting in-depth information for analysis. This can either be s**tructured** whereby the interviewer has some questions to guide the interview process [25]. Also, it can be **semi-structured** whereby the interviewer has a number of questions. But, the interview can still go off in unanticipated directions.

Focus groups; here the investigator gathers a group of person and explores their views in an orderly manner regarding the issue being investigated.

Participant observation; this means that individuals are observed by the investigator with respect to their behaviors, acts and language among others
Historical analysis: This refers to the analysis of historical documents of a particular corporation or business having a specific focus.
Grounded theory: This entails a preliminary investigation after which a theory is developed and tested. This is basically an inductive approach employed by the researcher to have an understanding of a specific phenomenon.
Action research: This method is highly participative as the researcher collaborates with those involved in a particular process, this often concerns some sort of change. The data collection process is cyclical as the researcher reflects and collects more data for analysis [27].
Narrative methods: Here the investigator listens to the narratives of certain individuals in the society and also consults related official documents.

Discourse theory-method: Here data is collected by means of a piece of text which could be written and spoken language in use. This methodology draws on a premise which allows language to have a meaning that is not set but is negotiated through social context[30].

Data Analysis: When designing a study it is very important to understand what you are going to measure. This helps to determine a suitable measure for the hypothesis and research question. In other words, in order to determine the statistical procedure to employ in analyzing data the design should take in to account what is to be measured and if the measure is suitable for the research question [20]. This will ensure the correct level of analysis, and helps in testing the hypothesis. Also, it is important to take into account the type of package to be used in analyzing the data. This could be an Excel spreadsheet, or a statistical package such as SPSS or Mintab. Depending on the type of data collected analysis can be done either quantitatively or qualitatively or both ways. Quantitative data are always analyzed using different statistical methods like a t-test, a chi test, cluster analysis and others. Qualitative research data analysis is based on interpretation and pattern recognition rather than statistical analysis [8] Since there are no standard ways of analyzing qualitative data, the measure and method of analyzing qualitative data need not be determined early on in the research process. Usually, the researcher uses the method that is suitable for the research question. However, it is prudent for the investigator to plan and allow enough time for the transcription of the large amount of recorded data often collected. After the transcription process qualitative data may be analyzed either by **content analysis,**or **grounded analysis. Respectively, these involve** identifying and grouping major themes [8].

Findings and Hypothesis Testing: These are the outcomes of the study which are presented either as statistical data using graphics and tables or in the form of information if obtained through the examination of qualitative research variables. If well interpreted and presented, it can prompt the author to discuss the study findings. The hypothesis is tested to determine whether it is accepted or rejected [27].

Discussion and Conclusion: The discussion highlights the significance of the study and its contributions to knowledge by comparing the study findings with existing literature while the conclusion states the summary of the findings.

Budget and timeline: After designing the study the researcher plans the budget and a timetable on how the study will be conducted [23]. This gives details of the research process and helps ascertain if the researcher will conduct the study to completion and on time.

4.2. 2.Classifying Non-Experimental Studies

Generally, research studies can either be categorized as an observational, longitudinal or a cross sectonal study. These types are described below:

Observational Studies: An observational study is occasionally referred to as a natural experiment or quasi-experiment. In this type of study the study participants are observed and the investigator measures variables without administering any interventions. That is, investigating the effect of a speech therapy among some children with autism undergoing the therapy already, and those on other therapies or no therapy at all. Therefore, observational studies are conducted when experimental studies are not feasible [8]Another example of an observational study is investigating the effects of lead among children whose parents were exposed to lead at work (occupational). The participants are expected to be similar in terms of age, levels of exposure and social conditions

Longitudinal Study: Longitudinal research is an observational study conducted to measure the same variables over a period of time that is, within weeks, months or even years. Usually, data is collected from the same participants more than once or very similar participants [25]. However, data could be collected once and a **retrospective** data is considered. For example, respondents could be asked about their past exercise habits right up to the time the study is being conducted. Most often, longitudinal studies compare data collected among participants and or between periods in order to record patterns of change and ascertain the course and degree of causal connections. Longitudinal designs can be classified in to three types. First, longitudinal panel design; it is the conventional type whereby the researcher collects the same data from the same respondents over a period of time. Second, total population design in which the total population is examined during each study period. Third, revolving panel design, whereby during each period new participants are selected. It is worth noting that repeated cross-sectional studies can be termed as longitudinal.

Cross Sectional Research:A cross sectional research entails collecting data at a particular period either directly from the participants, or by studying their records to find for example, a correlation between two variables. It is conducted to measure the prevalence of health outcomes or determinants of health, or both, in a population at a given point in time or over a short period. A cross sectional study is a descriptive study because variables are not

manipulated; rather the investigator describes what is found. Usually, this type of study is employed to determine how often a phenomenon occurs within a group [8]. It is not an expensive study to conduct especially when files are to be studied. However, it lacks the ability to control for confounding variables it is not often easy to find participants who are similar enough. Their age vary greatly, or they may not be born in very similar geographical areas. Cross-sectional studies are observational since they are carried out without changing the conditions of the participants.

Correlational Studies*:* These studies are mostly aimed at describing relationships among variables; however, it is believed that this design cannot prove causality. Therefore, it is sometimes classified under a fourth type of design, because it is not considered as experimental, quasi-experimental, or non-experimental. However, correlational studies are easily conducted and a large amount of data can be gathered quickly.

Case-control studies

These are retrospective studiesthat are conducted in order to bring out the comparative risk between a specific exposures for instance, tobacco smoke and an outcome that is cancer [29]. That is in case-control studies the researcher identifies patients who have developed a particular disease and then compares their past exposure to or experience with suspected aetiological factors with those of controls or referents who are not having the disease or did not experience the event. The goal is find out the connection between risk factors and disease, and estimate odds ratios of an individual developing a disease or experiencing an event [29]. An allowance is made for potential confounding factors by measuring them and appropriately make adjustments in the analysis (statistical adjustment). This is generally done by matching cases and controls for exposure to confounders, either on an individual basis or in groups. For instance, by pairing each case with a control of the same age and sex or choosing a control group with an overall age and sex distribution similar to that of the cases respectively.This is unlike in a cohort study, where matching alone does not eliminate confounding, statistical adjustment is still needed.

Since in a case control study, the groups are determined on the basis of whether the individuals have a particular disease or not, only one disease can be studied at a time[30]. However, a wide range information is provided about the exposures which may play a role in the development of the disease. Case–control studies are also known as case–referent studies. Examples are investigating how increased consumption of fruits and vegetables protects against Cervical Intraepithelial Neoplasia and investigating second hand tobacco smoke and increased risk of myocardial infarction.

Conducting a Case-control Study

This entails following the four main steps below:

1. Selection of cases

The study begins by enrolling people or cases who already have a certain disease or experience. The cases must be defined clearly and care taken in order that bias does not arise from the way in which cases are selected. A case-control study may use incident or prevalent cases. Incident casescompose of newly diagnosed cases during a defined period of time. Usually, incident cases are preferred, because the recall of past exposure(s) is likely more accurate among newly diagnosed cases. In addition, it is easier to assess the temporal sequence of exposure and disease among incident cases[31]. On the other hand, prevalent cases are made up of persons who have had the outcome under investigation for some time for a while. This may lead to recall bias as prevalent cases may not accurately report past experience(s). As a consequence, interpreting results based on prevalent case may pose problems as it may be difficult to tell if reported events relate to the period before the development of the disease or to the consequence of the disease process itself. This is because some individual may modify their exposure after developing the disease. In addition, if the effect of exposure is unknown it will be impossible to determine the degree to which a particular characteristic is connected to the outcome of a disease once it develops rather than to its cause. The cases may either be recruited from hospital, clinic, consultation registers or may be population bases. It is important to note that generally population based case control studies are more expensive and difficult to conduct.

Selection of controls

The control group should be similar in size to the case group and preferably from a population identical in every way to the case group but should not have the disease or condition being studied. Ideally, the control group is selected from the same population, which yielded the cases [32]. Control groups are not selected because of an exposure status, they are used to approximate the prevalence of exposure in the population which gave rise to the cases (Ingham-Broomfield, 2016). Therefore, the ideal control group is randomlyselected from the general

population that gave rise to the cases. Thisensures thatthe individuals selected would have the same distribution of exposure status as that of the cases in the absence of an exposure disease association. In other words, if there is no true connection between exposure and disease, the cases and controls should have the same distribution of exposure. It is important to note that the source of controls is dependent on the source of cases and controls should be selected to be a representative sample of the population which produced the cases in order to minimize bias.For example, if cases are selected from a defined population such as hospital admission similarly, controls should comprise a sample from hospital admission.

Ideally, the researcher ensures that theexposure of the controls to risk factors and confounders should be representative of that in the population "at risk" of becoming cases. That is, individualswithout the disease under investigation, but who would be included in the study as cases if they had. In addition, the exposures of controls should be measurable with similar accuracy to those of the cases. Commonly used sources of controls are controls selected from the general population[32]. That is, from general practice age-sex registersbecause their exposures are likely to be representative of those at risk of becoming cases.

Generally, it is safer to adopt a range of control diagnoses rather than a single disease groupin cases where other patients are to be used as referents.By so doing, if one of the control diseases happens to be related to a risk factor under study, the resultant bias is not too large.

Occasionally, the researcher might consider having two sets of controls with different possible sources of bias. Selecting equal numbers will make a study most efficient when cases and controls are both freely available. However, if the disease under investigation is rare, the number of cases that can be studied is often limited. As such, statistical confidence can be increased by taking more than one control per case[3]. However, it is usually not worth going beyond a ratio of four or five controls to one case because there exist the law of diminishing returns

Individuals are asked about their exposure to risk factors

This is usuallydetermined from personal recall, using either a self-administered questionnaire or an interview or from historical records. This method is usually considered more accurate than one that depends on memory if such records are reasonably complete. Rarely, long term biological markers of exposure are investigated[33]. This may be useful, if they are not altered by the subsequent disease process. For example, measuring serum cholesterol concentrations after a myocardial infarct may not accurately reflect levels before the onset of infarction.

Calculating the Odds Ratio

The odds ratio written as OR is used in case-control studies to estimate the strength of the connection between exposure and outcome[33]. That is, to figure out if a particular exposure (e.g eating processed meat) is a risk factor for a particular outcome (e.g colon cancer).

T**ypes of case-control studies**

Non-matched case-control study: This is the simplest form where individuals with the disease and those without the disease are selected and enroll in the study and then their exposure status are determined.

Matched case-control: Here, an individual with the disease is enroll in the study and matched with a control for some characteristic such as sex, age, weight[32]. This helps to eliminate or minimize confounders. However, the more characteristics being "matched", the longer the study takes.

Advantages and Disadvantages of Case-control Studies

Advantages

This is usually the best choice for conditions or diseases that are rare, takes less time and its inexpensive. Also, multiple risk factors can be studied at the same time and quickly establishes associations between risk factors and disease especially in cases of disease outbreaks, since the causes can be identified with small sample sizes[34]. The disadvantages include difficulties getting control groups and results can easily be contaminated by recall bias where people with the disease or condition are more likely to remember past details than those without the disease or condition. Also, it is weaker for establishing causation compared to a cohort study, generally can be generalized.

III. CONCLUSION

Qualitative research is an approach that studies human experiences in detail while quantitative research deals with numbers and studies the relationships between variables. A study design is a guide to conducting an excellent research; however, the design must be well conceived taking into consideration factors like the

research question, the resources available, the type of study that is experimental, quasi or non-experimental and their strength and weaknesses. This is because without a good design a good study cannot be conducted. Generally, experimental designs entail crafting a set of procedures to test a supposition and the statistical analysis of quantitative data. Experimental research randomly assigns participants to treatment conditions, manipulates independent variables and control for confounding factors which is not the case with non-experimental research. The approach adopted should be scientific enough to yield valid and reliable results which can be generalized to the wider group. Quasi-experimental designs are used when random assignment of subjects to experimental or control groups is not possible. Non-experimental studies do not manipulate independent variable(s) but existing groups are compared and described based on uncontrolled variable or as well examine associations between preexisting groups. Case-control studies are retrospective studiescarryout in order to bring out the comparative risk between a specific exposures or experience. This study is often the preferred choice for diseases that are rare.

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