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Title: Research designs – A literary review

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ABSTRACT

“A research design is a conceptual framework for doing research. It serves as the guideline for the gathering, measuring, and analysis of data. As a result, the design contains a description of the researcher's process, from developing the hypothesis to final data analysis. Several classifications are possible based on what strategy used. So, to simplify this knowledge, literary review was conducted which includes authentic search engines and literature. The study purpose is compile the data available from various sources at one place and for ease of researchers.”

Keywords: Cross-sectional, Longitudinal, Case-control, Cohort, Experimental

INTRODUCTION

It is necessary to plan ahead for research design in order to apply the appropriate procedures for data collection and analysis while keeping in mind the goal of the study and the time and financial resources.^[1]

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The use of a research design guides for collection, analysis, and interpretation of observations.

It is a logical approach that directs the researcher through several phases of study.

Good research should be^[1]:

1. Flexible
2. Appropriate
3. Efficient
4. Economical
5. Minimum Bias
6. Maximum reliability of the data collected and analysed

METHODOLOGY

A web based search was conducted using the reliable databases such as Google Scholar , Science Direct, Pubmed for research designs and homoeopathic researches done using these research designs. Further Literature search was also done to find out the relevant information. The results obtained are discussed for further reference.

DISCUSSION

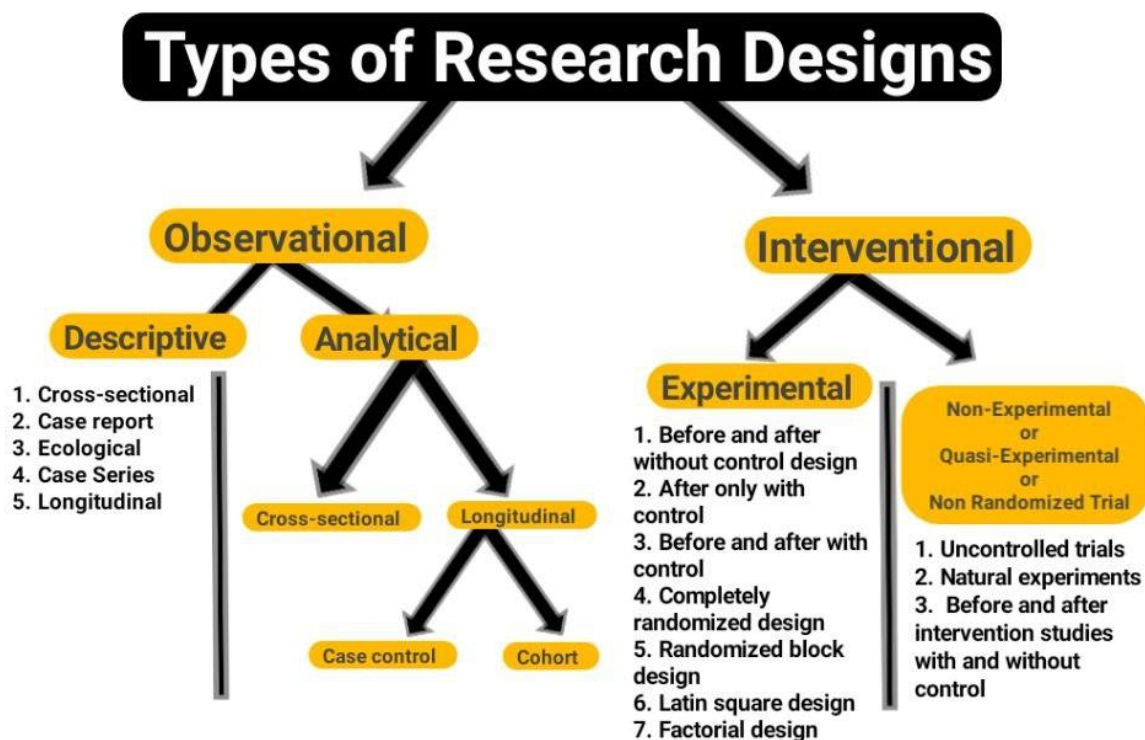


Figure 1-Research Designs-Types

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Several classifications of study types are possible, depending on what strategies are used.

1. **Non-intervention (Observational) studies** – In this researcher just observes and analyses researchable objects or situations but does not intervene.^[2]
2. **Intervention studies in which researcher manipulates objects or situations and measures the outcome of his manipulations.**^[2]

1. **Observational** – In this no intervention of human is involved in assigning study groups, simply we have to observe the relationship between disease and exposure.

- a) **Descriptive** – This is concerned with describing the characteristics of particular individual or of group.^[1]

Types of Descriptive Studies

- i. Case Report/Case Series^[2]
- ii. **Ecological Studies** – When the data taken from entire population is used to compare disease frequencies between different groups during same period of time or in same population at different time period.^[2]
- iii. **Cross Sectional Study** – This study provides information about a situation at a certain point of time. They are prospective in nature.^[2]

Example: An online cross-sectional survey on knowledge, attitudes, practices and perspectives of homoeopathic practitioners towards COVID-19^[4], Observational and cross-sectional study on the use of homoeopathy in a paediatric emergency care service^[7]

- iv. **Longitudinal** – This study provides incidence or progress of certain attribute under study. Data is collected from each subject more than once. It can be prospective or retrospective.^[3]

- b) **Analytical** – Involves control group

- i. **Cohort Studies** – In this study group is identified by exposure status prior to the ascertainment of their disease status and both exposed and unexposed groups followed in identical manner until they develop disease under study.^[2] They can be both either prospective or retrospective in nature.

Example: Outcome and costs of homoeopathic and conventional treatment strategies: a comparative cohort study in patients with chronic disorders^[6]

- ii. **Case Control Studies** – This type of study is generally done to identify the probable aetiological factors that may cause a specific disease condition. Comparison between two groups; one with the diseased condition called cases and a similar group without the condition but are otherwise similar called controls are compared.^[2] To simplify these are the events that happened prior to the onset of research.^[3] This type of study is retrospective in nature.

Explanation - A researcher conducted a case control study to determine if there is any relationship between high fat diet and Acute Kidney Failure . Here two groups are made one has subjects suffering from acute kidney failure (cases) and other is a similar group but not suffering from the diseased

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condition (controls). Now comparison is done among the two groups in relation to the consumption of the high fat diet in both the groups.

- iii. **Cross-sectional-** Prevalence of disease and exposure is noted in both groups at one point of time.^[3]

2) **Interventional** –

In interventional studies researcher manipulates a situation and measures effect of this manipulation. Usually two groups are compared, one in which intervention takes place or treatment given and another is control group in which no treatment is given.^[2]

- a. **Experimental** – It gives most reliable proof of causation. Individuals are randomly allocated to at least two groups (One control and other experimental). Outcome or treatment effect is assessed by comparing the results of two groups after intervention in experimental group.^[2]

Experimental studies follow these principles which are mentioned below:

- i. **Principle of replication**^[1] – The experiment should be repeated more than once. Thus each treatment is applied in many experimental units instead of one. For example we have to test the effects of two varieties of wheat, for this we must first divide the field in several parts (not two), then we will grow one variety in one part and another variety in other. This will lead to more reliable results.

- ii. **Principle of Randomization**^[1] – To understand this principle, first we must know what are extraneous factors or variables. Extraneous variables are those independent variables that are not related to the purpose of study can affect the dependent variable. But when the dependent variable is not free from the effect of this extraneous variable, this relationship is said to be confounded relationship.

So, the principle of randomization provides protection against this extraneous factor. This principle states that we should design the experiment in such a way that the variations caused by the extraneous factors can be reduced. For example if we divide the field into two parts and if we grow the one variety of wheat in one part and another variety in other part. In this example this could be possible that the fertility of soil will affect the yield. So, in order to reduce the effect of this extraneous factor which is fertility of soil in this example we must use principle of randomization. So, after applying it we may assign the variety of wheat to be grown in different parts of the field on the basis of this randomization principle.

- iii. **Principle of Local Control**^[1] – In this we must divide the field into blocks and each is further divided into number of parts that are equal to the number of treatment. Now, the treatment is randomly assigned to the parts of the block by applying randomization principle.

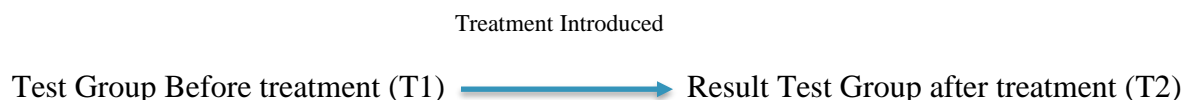
Blocking is simply dividing the field into several homogenous parts known as blocks and the blocks are the levels at which we hold the extraneous factor or variable fixed. So, principle of local control eliminate the extraneous factor variability.

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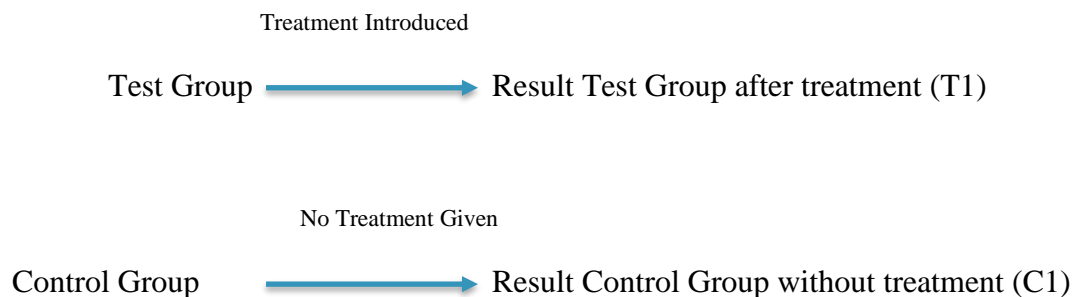
Types of Experimental Research Designs

- i. **Before and after without control design**^[1] – In this single test group or area is selected and dependent variable is measured before and after introduction of treatment. The effect of treatment will be equal to level of phenomenon after treatment minus before treatment.



Before and after without control

- ii. **After only with control design (Control Trials)**^[1] – In this two groups or areas (one is test and other is control) are selected and treatment is introduced in test area only. Dependent variable is measured in both the areas or groups after treatment induction in test one. Treatment impact is assessed by subtracting the value of dependent value in control area from its value in test area.

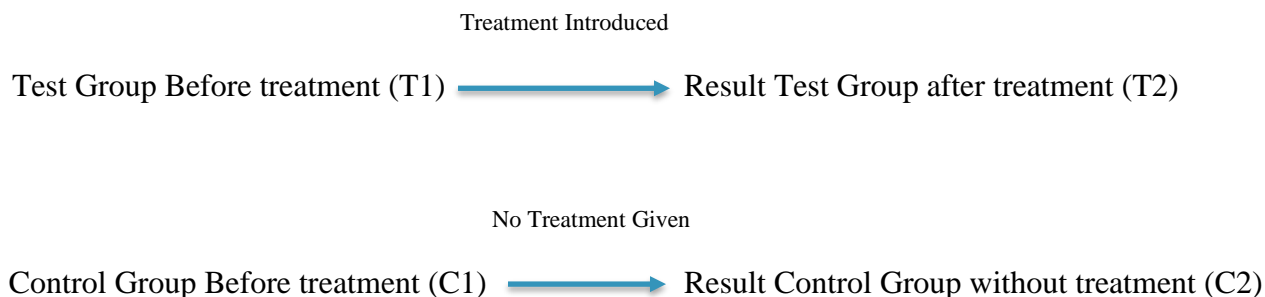


After only with control design (Control Trials)

- iii. **Before and after with control design (Control Trials)**^[1] – In this two areas are selected and dependent variable is measured in both the areas before induction of treatment and after induction of treatment in test area. Treatment impact is assessed by subtracting the change in dependent variable in control area from the change in dependent variable in test area.

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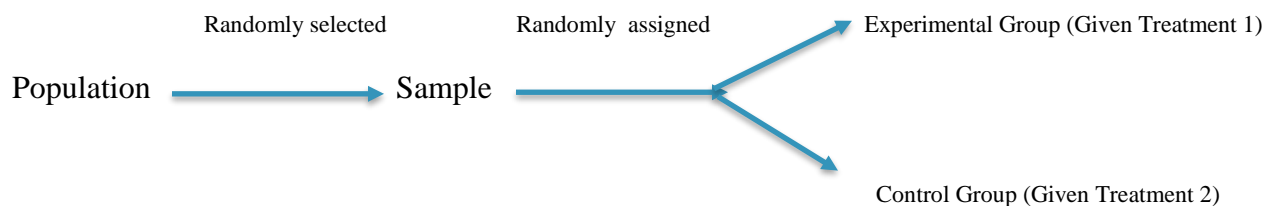
$$\text{Treatment Effect} = (T2-T1) - (C2-C1)$$

Before and after with control design (Control Trials)

iv. Completely randomized design^[1] –

In this sample is selected randomly from the population predefined, and the sample is randomly assigned to experimental and control group and different treatments are given to these two groups.

Example: Effects of individualised homoeopathic intervention in Stage I essential hypertension: A single-blind, randomised, placebo-controlled trial^[5]

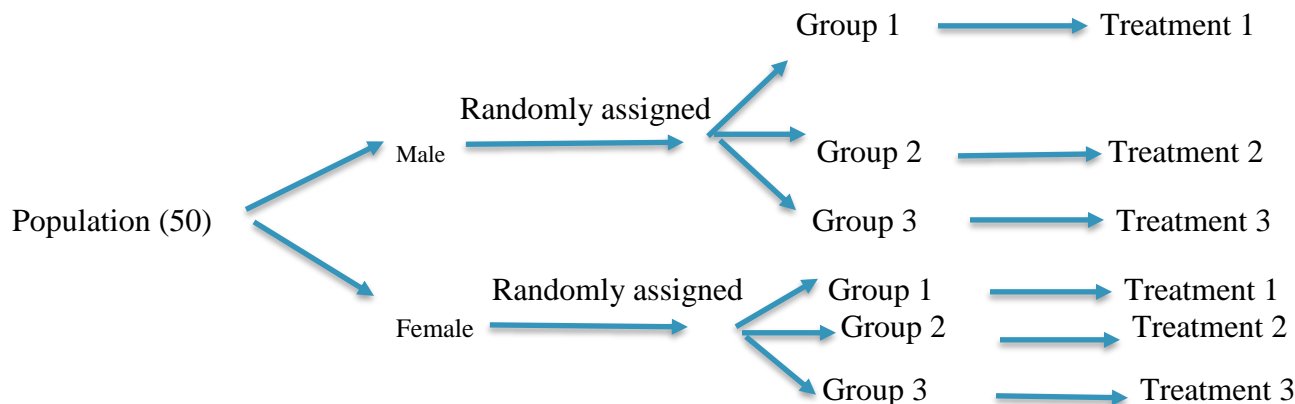


Two group simple randomized experimental design

v. **Randomized Block Design (R.B. Design)**^[1] – In this we first assigned the people in block based on characteristic that can influence the response to treatments. For example we have 50 university students in which gender can be variable, so we first divide the students into male and female and we randomly assign them groups and gave them treatment and at last we are going to compare the results.

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Randomized Block Design (R.B. Design)

- vi. **Latin Square Design (L.S. Square)**^[1] – In this design, in this each experiment will get all treatment but in square fashion. There is no repetition of treatment in row and column. It is used when there are two extraneous factor such as varying soil fertility and varying seeds.

Group	Treatment	Treatment
A	1	2
B	2	1

In this both groups got both treatments in square fashion and there is no repetition of treatment in any of row and column.

vii. Factorial Designs^[1]

- i. **Simple factorial design** – In this we consider the effects of two factors (independent variables) on dependent variable.
- ii. **Complex factorial design** – A design which consider three or more independent variables simultaneously is called complex factorial design.

Example: **Factorial design for the formulation of polymeric nanocarriers:** A 3² factorial design was performed to study about two factors.^[9]

b. Non experimental research designs / Quasi experimental or Non randomized trial^[3].

Quasi-Experimental – In this one characteristic of experiment is missing, either randomization or the use of separate control group.^[2]

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The independent variable is manipulated, participants are not randomly assigned to conditions.^[8]

Uncontrolled trials – Findings can be compared with existing data

Before and after intervention studies with and without control – Similar to randomized trial but only difference is that the subjects are not randomly allocated into intervention and study groups.

CONCLUSION

This article compiles the research design from the various sources available with the examples of homoeopathic researches done. The aim behind writing this article is to summarize the knowledge about research designs which is available in scattered way along with addition of homoeopathic examples of researches done which are published in various journals whose database is available online. So, this can be concluded from this article that it will provide all the basic knowledge which the researcher needs to understand this topic. Finally, this article is going to be very fruitful for all the researchers and students of both non medical and medical field.

CONFLICTS OF INTEREST - NIL

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