Review Article

A roadmap for scientific publications – Part I

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ABSTRACT

Scientific publications are the foundation for all research activities in their respective fields. They help in sharing original research work with others and to review the research work done. They become the most important factor for the evolution of modern day science where one researcher builds his work based on others research thereby creating scope for further improvement. There are many scientific publications carried out constantly in different journals and print media. But only few articles give the details necessary to be looked into before publication, and they are also specific for any particular topic or subtopic, Hardly any article is there which gives the complete detail which a researcher needs to know before publishing his/her article. This article gives the details to be looked into before, during and after for publication of the study. It helps in making the researchers life easy by compiling all the details in a nut shell there by paving a road map for easy and hastle free publication of the articles.

For convenience sake these are published in two parts. In this first part details of various types of Scientific research, studies, sampling methods and calculations, graphical representation of results and the various analytical tests are described.

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1. Introduction

The scientific community is filled with a plethora of opportunities for a new researcher.

Research begins with the library dissertation and the main dissertation submissions for the completion of post graduate program in India.

Some start research work from their under graduate program itself. Conducting such research studies is the backbone for the evolution of knowledge in the scientific field. The information assimilated would be of no use if it doesn't see the light of the day or be useful for other researchers to dwell upon and grow. One easy and fast way of contributing to the scientific world is through publishing the work as articles in available journals.

Articles publishing scientific data and research aim to encourage more comprehensive awareness of data sharing, reuse and recognise those who share their research and are open to submissions from a wide range of areas including descriptions and analysis of big and small data, from significant resources and individuals.[1]

This article describes the intricate details and contents to look for while publishing an article under the following headings.

Part I : Describes the following

1. Types of articles/Scientific Research
2. Types of studies
3. Sample calculation and sampling methods
4. Graphic representations of results – types and indications
5. Statistical analysis – tests and indications

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These will be discussed in Part II

1. Indexing
2. Impact factor
3. DCI / RGUHS points for publication
4. Journals at a glance
5. Plagiarism

2. Types of Articles/ Scientific Research

Any scientific research can be categorised into.[2]

1. Original Research
2. Review Articles
3. Case reports and case series
4. Methodologies
5. Book reviews
6. Short reports or Letters
7. Perspective, opinions, commentaries.

It is important to understand under which category the research work can be published and follow the respective guidelines mentioned in this section. There can be small variations in the journal guidelines. It is mandatory to decide the type of article and which journal the research work is planned to be published and subsequently to prepare the manuscript accordingly.[3]

2.1. Original research

These studies are designated as primary literature because they are complete reports of original research. This is the most popular sort of journal manuscript for publishing full research findings. Depending on the journal, it may be referred to as an Original Article, Research article, or simply article. It comprises of complete introduction, methods and methodology, results, discussion and conclusion sections. E.g.: Manuscript of a Thesis. For many, this could be their first publication.

2.2. Review articles

These are referred to as secondary literature as they usually do not provide any new data from the author's experimental work. There are three different types of review articles: literature reviews, systematic reviews, and meta-analyses.

Review articles provide a complete overview of research on a specific area and assess the field's current state and prospects. These type of articles are frequently read and cited. Review articles also give suggestive directions for future research. e.g: Library dissertation.

2.3. Case study/Reports and case series

A case report details the diagnosis, treatment plan and treatment for a particular clinical scenario. The same kind of treatments are given for many cases and reported as case series. If more than three cases need to be reported, it becomes a systematic investigation and has to be approved by the institutional review board. The demographics of the patient should always accompany case reports and case series. Hence, it is also necessary to get an authorization letter from the patient or their legal guardian for publishing their information.

Lots of learning happens through these reports and it forms a foundation for others to use / modify for the patients benefit.

2.4. Methodologies or methods

These publications propose a new experimental technique, test or procedure. The approach mentioned could be entirely new or an improved version of an existing method. The article should describe a demonstrable improvement over present technology.

2.5. Book review

The majority of scholarly journals provide book reviews. A book review's purpose is to provide information and opinions on recently published academic books. They are also quick reads. Book reviews are an excellent publication choice for early career researchers since they keep up with new research in their field.

2.6. Short reports or letters

These are concise summaries of data from original research that the editors believe will interest many scholars and will likely lead to more research in the field. The format is excellent for scientists with time- critical results because it is relatively brief.

This format frequently has restrictions in length and certain experimental details may be withheld until the authors complete a full original research report. Brief communication is another name for these publications.

2.7. Perspective, opinion and commentary

2.7.1. Perspective

Perspective articles are written by authors on research done but only with preliminary data, which is not strong enough to convey the entire message. These topics are significant to a broad audience through the described innovations that are yet to be implemented. The perspective pieces may also be about an already published paper or a cluster of documents. The author gives their viewpoint, which could be challenging the concepts in the article. They are usually 2000-4000 words including abstract of 50 words, main text, references and 1 or 2 figure legends.

2.7.2. Opinion

The author gives their opinion or viewpoint on a particular hypothesis or a scientific theory. These could be constructive criticisms and always on some published data. They are brief, about 2000-2500 words with an abstract of 150 words, five references and one or two figures or tables.

2.7.3. Commentaries

Are short essays of 1000-1,500 words in length that call attention to or give a criticism of a previously published article, book or report, explaining why it piqued their interest and how it might be helpful to readers.

3. Types of Studies

The following information will give an idea of types of studies that a researcher can take up and top down hierarchy of the various studies is depicted in fig-1.

3.1. Invivo and invitro studies – differences

Invivo studies are done within the living being, on living organisms or cells, like animals including humans and plants, as opposed by in vitro studies which are done within the glass, outside of a living organism like on tissue extracts, dead organism or in a controlled environment as in a laboratory.[4] The comparison of the two is shown in Table 1.

Table 1: Comparison of invivo and invitro studies

Factors	Invivo	Invitro
Ethical approval	✓	X
Sample size	✓	✓
Inclusion factor	✓	✓ / X
Exclusion factor	✓	✓ / X

3.2. Systematic reviews and meta-analysis

A systematic review is a very high-level overview done on a very focused question. Answers are sought for the question from the already existing literature from various standard search engines. The search systematically identifies, selects, evaluates and synthesizes all high quality existing research work. These studies give visibility and accessibility of the available evidence to decision-makers. The PRISMA[5] (preferred reporting items for systematic reviews and meta-analysis) guidelines and PROSPERO registration are followed in a systematic review. PROSPERO is an international database of prospectively registered systematic reviews in health and social care. A statistical method to summarize all the data collected through systematic review is called meta-analysis. A meta-analysis of the meta-analysis is also done and this is called as metameta-analysis. A review of this is called as the Cochrane review and is held highest among the academicians.

3.3. Experimental studies

Researcher manipulates the exposure, that is in allocating subjects to the intervention or exposure group. They are of two types Randomised Controlled Trials (RCT) and Non-randomised Control Trials.

3.3.1. Randomised controlled trials (RCT)

These are interventional, prospective and experimental studies. In these studies, subjects are randomly assigned (usually by system software) into the experimental, control or comparison group. The experimental group is subjected to a practical intervention, whereas the control group is subjected to conventional or placebo intervention. The results are then analyzed to understand the effect of the intervention. Randomization is the key and is supposed to reduce bias.[6]

3.3.2. Non-randomised control trials

These are interventional and experimental studies where the researcher controls subjects allocation, which is not done randomly. Controlled before-and-after trials are defined by pre- and post-intervention outcome assessment.

3.4. Analytical studies

The researcher measures just the exposure or treatments of the groups. They are of three types Cohort study, Case control study and Cross-sectional study.[7]

3.4.1. Cohort/ longitudinal study

This is also an observational study in which a cohort or a group of individuals sharing similar characteristics is followed up over time. The outcomes observed are measured or collected at one or more points. As these are done for a long time, they are also called longitudinal studies.[8] These are time-consuming and hence susceptible to recall bias or information bias.

Types:

1. Prospective
2. Retrospective
3. Combined

3.4.2. Case control study

In these types of studies, two groups are required. One is the case group, and the other is the control group. Both groups should have the same matching factors (inclusion and exclusion criteria) for selection but different outcomes. These studies analyse the reason for the different outcomes. As the present situation is in the past, these are also categorized as retrospective studies.[8]

3.4.3. Cross-sectional study

They are also called cross-sectional analysis, transverse study, or prevalence study.

This is observational research done to collect and analyze the data across a sample population. This research is only an observation of the variables without influencing them.[9] These studies are done using survey formats to understand what is existing or prevailing across a population set. The study population is usually well-defined.
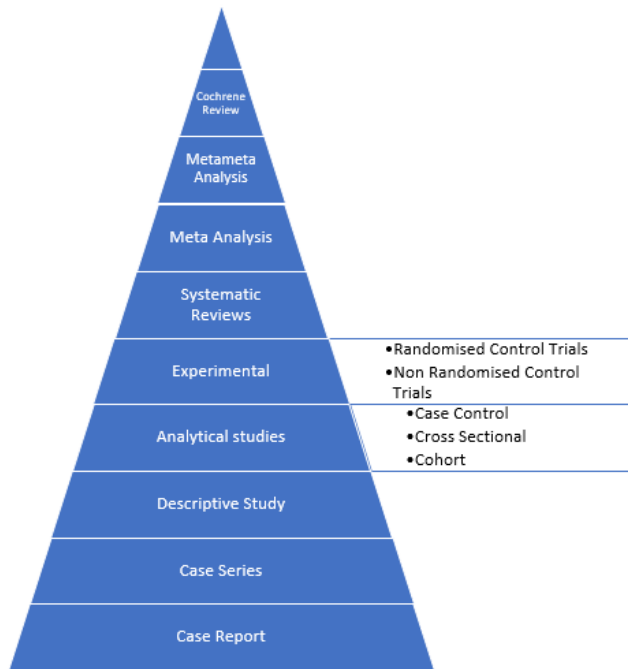

Fig. 1: Types of studies based on hierarchy

4. Sample Size Calculation and Sampling Methods

Sampling is a method to select an appropriate and manageable size for a study.

Sampling is a statistical analysis tool that measures the sample size to be tested/studied, representing the entirety.[10,11] Sample size calculation can be challenging even for a statistician. A key article is always required for sample size calculation. Using parameters from the key article like the total size, confidence interval, confidence level, margin of error, standard deviation and the Z-score found in the preformed table, the sample size is calculated by the statistical formula.

Sample Size $n = (Z\text{-score})^2 \times \text{Std Dev} \times (1\text{-StdDev}) / (\text{margin of error})^2$

In the absence of a key article, a pilot study has to be done to assess the sample size for the main research. There are many sample size calculators and statistical guides available to help calculate the sample size. A book called "Sample size: a rough guide " by Ronan Conroy is helpful.

4.1. Sampling methods

After identifying the subjects and determining the sample size, choosing the sample from the population is decided.[10,11] The various sampling methods are depicted in the self-explanatory Figure 2.
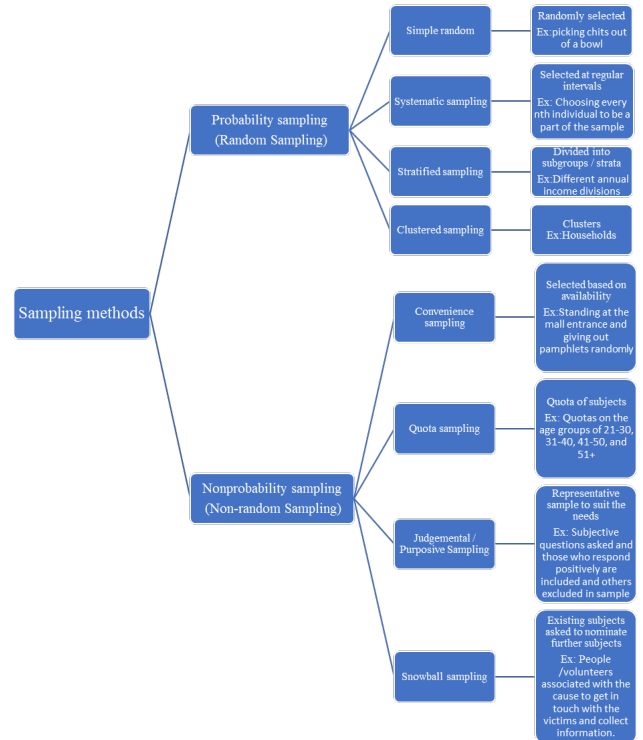

Fig. 2: Sampling methods

5. Graphical Representation of Data [12,13]

Graphical representation is the way to analyze and represent the numerical data

The different types of graphical representations are:

1. Line graph
2. Bar graph
3. Histogram
4. Line plot
5. Frequency table
6. Circle graph
7. Stem and leaf plot
8. Box and whisker plot
9. Scatter diagram

5.1. Line graph

Line graphs can be used to show information that changes over time. It is a simple, straightforward graphic representation of the relation between two variables. It can

also be used to compare many variables with one. They can also be interactive line graphs. These graphs are used to display continuous data. Ex: Comparison of cricket scores (Figure 3)
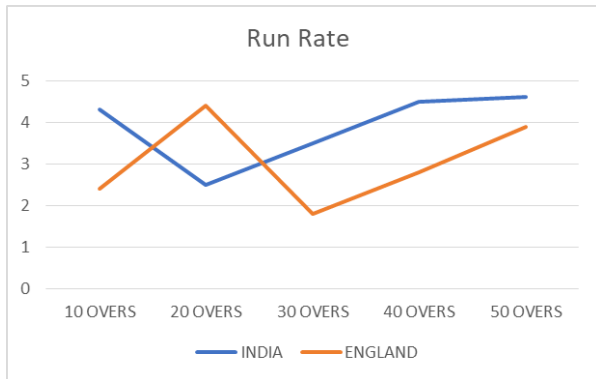

Fig. 3: Line graph

5.2. Bar graph

A bar chart or graph presents data with rectangular bars with heights or lengths proportional to the values that they represent. The bars can be vertical or horizontal. There are four types of bar graphs- a vertical bar chart (column chart), horizontal bar graph, stacked bar graph and grouped bar graph. All the rectangular bars should be of equal width and should have similar space between them. It is an excellent tool to represent data that are independent of one another. Ex: Comparison of number of people in lakhs speaking different languages. (Figure 4)
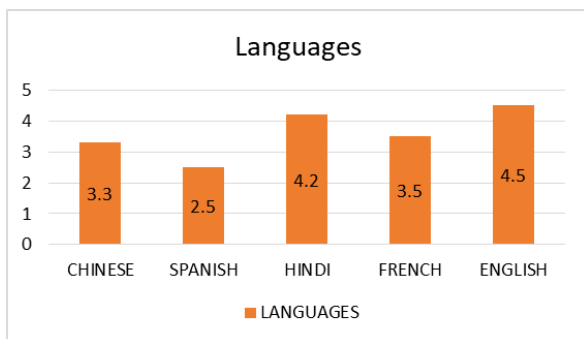

Fig. 4: Bar graph

5.3. Histogram

The histogram is a bar chart used when dealing with large data sets (greater than 100 observations). A histogram displays the frequency of numerical data, whereas a bar graph is a graphical representation of data that uses bars to compare different categories of data. Ex: The average GDP for every five years is depicted in the histogram. (Figure 5)
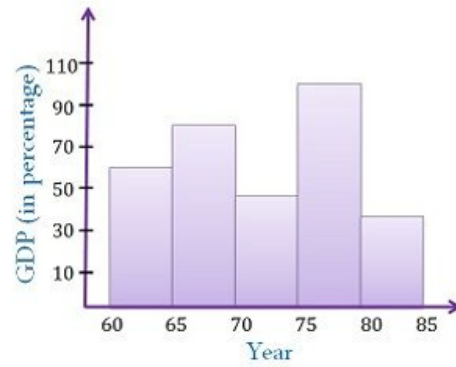

Fig. 5: Histogram

5.4. Line plot

A line plot is a graph that shows the frequency of data along a number line. It is best to use a line plot when comparing fewer than 25 numbers. It is a simple and fast way for data organizing. These graphs are used to display data using a number line. Ex: The 4 stars above 1 means that 4 persons exercised on first day (Figure 6).

Fig. 6: Line plot

5.5. Stem and leaf plot

Each data value is split into the stem and a leaf in these plots. The "stem" values are listed left, and the "leaf" values on the right. The stem represents a group of scores and each leaf represents the individual scores within each group. Ex: Stem-and-leaf plots are usually used to display public transportation timetables, with the hours along the "stem" and the minutes as the "leaves." Like bus schedules (Figure 7).

5.6. Frequency table

This table is used to display the frequency of various outcomes in a sample. A frequency table is a table that keeps a tally of how often certain events occur. A tally is simply a running total. Ex:Number of patients per day (Figure 8)

BUS TIMINGS

AM		PM	
5	:05:15:30:45	12	:10:25:45
6	:05:20:40:55	1	:10:20:35:55
7	:05:15:30	3.	:20:40:55
8	:05:20:40:55	4	:10:25:45:55
9	:05:15:30	5	:10:25:45:55
10	:05:20:40:55	6	:25:35:45:55
11	:20:36:48	7	:20:40:55
		8	:10:25:45:58
		9	:10:20:30:40
		10	:15:30:45
		11	:15:30:45

Fig. 7: Stem and Leaf plot

Day	Number of Patients	Frequency
Sunday	𝟙𝟙𝟙 𝟙𝟙𝟙 𝟙𝟙𝟙 𝟙𝟙𝟙 I	21
Monday	𝟙𝟙𝟙 𝟙𝟙𝟙 𝟙𝟙𝟙 𝟙𝟙𝟙	20
Tuesdsay	𝟙𝟙𝟙 𝟙𝟙𝟙 II	12
Wednesday	𝟙𝟙𝟙 𝟙𝟙𝟙 𝟙𝟙𝟙 𝟙𝟙𝟙	20
Thursday	𝟙𝟙𝟙 𝟙𝟙𝟙 IIII	14
Friday	𝟙𝟙𝟙 𝟙𝟙𝟙 III	13
Saturday	𝟙𝟙𝟙 𝟙𝟙𝟙 𝟙𝟙𝟙 𝟙𝟙𝟙 IIII	24

Fig. 8: Frequency table

5.7. Circle graph or pie graph

These are used to represent categorical data,[12] the relationship of the entire component. Ex: Election results of different parties(Figure 9)
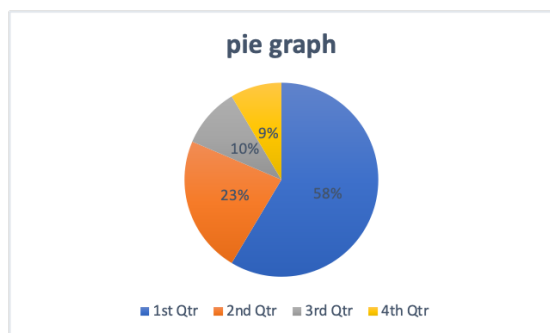
pie graph

9%
10%
23%
58%

■ 1st Qtr ■ 2nd Qtr ■ 3rd Qtr ■ 4th Qtr

Fig. 9: Pie graph

5.8. Box and whisker plot

It is used when multiple data sets from different sources are to be compared.

The data display is through quartile distribution. The box plot shows a five-number summary of a set of data which is the minimum, second quartile, median, third quartile and maximum. Whiskers depict variability outside the upper and lower quartiles representing parallel lines extending from the boxes. These graphs are used to display variation in a set of data. Ex : Comparison of multiple data sets- MCQ marks (with negative marking), years, dental schools. (Figure 10)
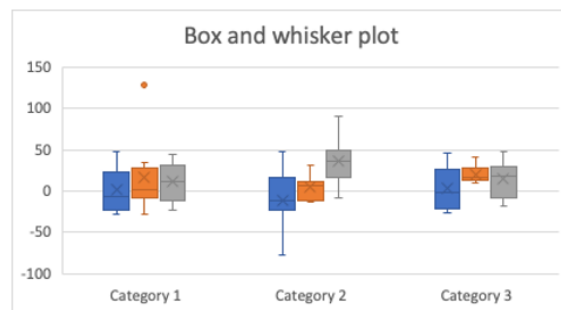
Box and whisker plot

Category 1   Category 2   Category 3

Fig. 10: Box and whisker plot

5.9. Scatter diagram

It is a diagram that shows the relationship between two variables.[12] If the dots cluster around a straight line, it offers a linear relationship. Ex: Ice cream sales Vs Temperature.(Figure 11)
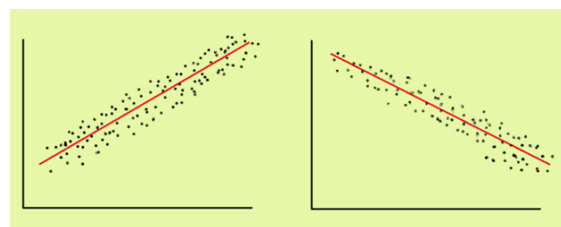
Fig. 11: Scatter diagram

The commonly used graphical representations in research articles are bar graphs, histograms and circle graphs. Graphical plotting of data should always precede the statistical analysis.

6. Statistical Analysis - Types and Tests

It is the process of collecting, reviewing and presenting large amounts of data to identify underlying patterns and trends. Statistical analysis imparts meaning to the collected data. The collected data can be either quantitative or qualitative type[14] as depicted in Figure 12.

All the collected data is uploaded to the SPSS.[15] (Statistical Product and Service Solutions) software for analysis to understand the normalcy of the data. The first version of SPSS was released in1968 developed by Norman
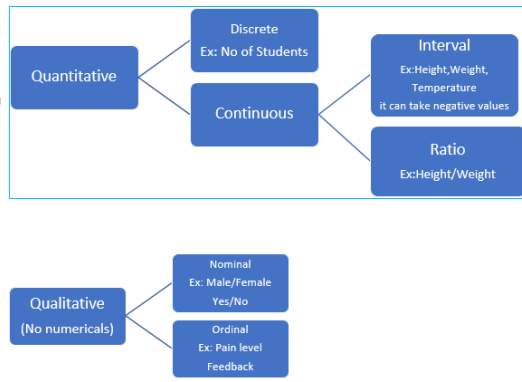
Fig. 12: Qualitative and quantitative data

H Nie et al. In 2009, SPSS Inc announced that it was being acquired by IBM and it became SPSS: an IBM company. The recent 2021 IBM SPSS is version 28, copy righted software and is not available for free. The free open source of SPSS is available as PSPP and is a free alternative. Statistical tests are applied depending on the distribution of the collected data obtained from the analysis by the SPSS / PSPP software.[10] The normal distribution of data can also be determined by the graphic representation ex. by a Histogram. In its absence, the skewness and kurtosis of the distribution can be checked using software like excel (skewness in excel 2013 and kurtosis in excel 2013).

6.1. Statistical tests

For normal distribution of data values with a "bell –shaped curve" (also called as Gaussian distribution) or interval scales or ratio scales, parametric tests are used.

For a skewed distribution of data or nominal scales (yes/ no ; male / female type of data) or ordinal scales which have some order but not meaningful (like pain levels, pain can be mild, moderate or severe ; feedback type of data), non-parametric tests are used. Non-parametric tests generally are less powerful than their parametric analogues.

The comparision of the two tests is presented in Tables 2 and 3.

Table 2: Comparison of parametric andnon-parametric test

Parametric test	Non parametric test
Quantitative data	Qualitative data
More powerful	Less powerful
Normal distribution	Skewed distribution /if normality in doubt
Mean	Median
Interval or ratio level measurements	Nominal or ordinal

For each of the parametric tests, there is a corresponding non-parametric analog:[16–18]

Table 3: Corelation of parametric and non-parametric tests

Parametric Test (Quantitative)	Non Parametric Test (Qualitative)	Criteria	Significance test applied
Paired-samples T-test	Chi square test / Wilcoxon signed rank test	Only one group (Paired group)	
Unpaired-samples T-test /Student T-test/ Independent T-test/ T-test 18	Wilcoxon Rank sum Test / Mann Whitney U test	Two groups (Unpaired groups)	
One way ANOVA	Kruskal Wallis ANOVA test	More than two groups (Unpaired group)	Post hoc (Tukeys -less than 30 samples) (Duncans-more than 30 samples)
Repeated measure ANOVA	Friedmans test	Two or more groups with data at different intervals of time (paired group)	
Pearsons correlation test	Spearmans correlation test	Relation between two variables	Correlation
Multiple linear Regression	Multiple Logistic Regression	To understand the effect of variables in descending order.	Strength of association.
MANOVA- multivariant test	Nill	Many independant variables for one dependant effect	

First we need to corelate and then apply the regression analysis to know the strength of association.

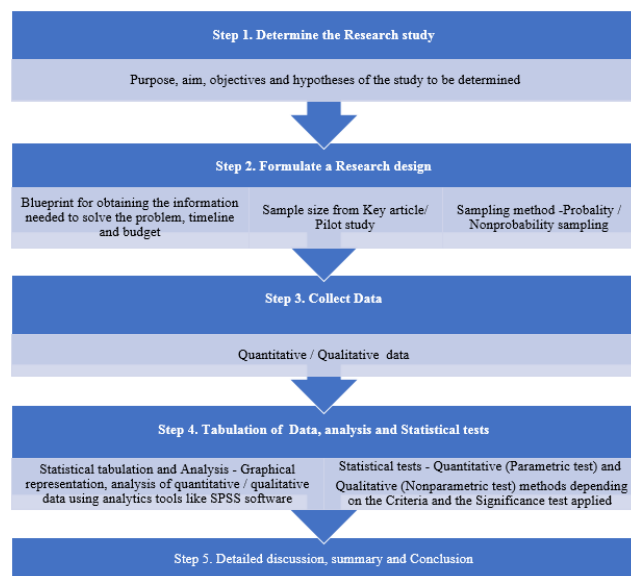**Birds eye view of the roadmap** (Figure 13)

Fig. 13: The roadmap for scientific publications

7. Conclusion

The scientific research, including its contents and practical contributions, are made available to others through publications in any particular field. This helps academicians, practitioners and scientific researchers with similar interests become aware of new expertise in their field, and it helps advance the knowledge and its usage.

8. Source of Funding

None.

9. Conflict of Interest

None.

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