



REVIEW ARTICLE

How to Perform a Postgraduate Research and Write a Scientific Paper: The Underpinning Facts!

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Abstract

This article is a narrative review that focuses on the common shortcomings that one researcher faces. The aim of the article is to provide some key ideas to the novice researcher how to overcome those hurdles. The electronic database such as PubMed, Google Scholars, Science Direct, ProQuest are searched to find the related articles. Only the full text articles were considered. Mostly, the consensus views are presented in most of the topics. Some of the gray zones are discussed. The article will help the aspirant author to complete their research and academic writing in a presentable manner.

Keywords: Research Design, Outcome Assessment, Health Care, Sample Size, Random Allocation, Selection Bias

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Graphical Abstract

Title: How to perform a postgraduate research and write a scientific paper - the underpinning facts!
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Identify a problem :

- Formulate a research question
- Research question should be “Feasible, Interesting, Novel, Ethical, and Relevant (FINER)”

Set aims and objectives:

- Preferably one primary outcome, and 2 to 3 other outcome measures. objectives should be “SMART (Specific, Measureable, Achievable, Relevant and Time bound)”
- Title should focus primary outcome, and contain 10-12 words and shorter than 100 characters including spaces. Running title should be short containing 50 characters including spaces.

Primary outcome should be tallied with every steps.


- Title of research, hypothesis, sample size calculation, description of main finding of research in the discussion, and conclusion--all should address the primary outcome.
- Literature review should be prepared in PICO format depicting Population (subjects, operative situations and comorbidities), Intervention, Comparator(s) and Outcome measures. Literature review- a meticulous and continuous process

Correct design is the Pivot

- Consult biostatisticians early. Registration of the trial is paramount important. Sample size calculation with adequate power. Discussion should be focussed. Citation of others’ work with accuracy. Avoid plagiarism. The researcher should draw concise conclusion in a logical manner.

Conclusions

A well-planned study design and early consultation with biostatistician is the key to success. The study aims and objectives should be co-ordinated with sample size calculation, main focus of discussion and logical conclusion.

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Introduction

A thesis or dissertation is an academic document that presents the author's research findings to answer one or more research question(s) [1]. Thesis and dissertation are some commonly used terminologies in the sphere of academy and research. Although, used interchangeably, they may have different meaning and implications that varies with countries and institutes [2]. Usually they differ in academic level and regarding the scope and depth. What's in a name! Whether it is a thesis or a dissertation, both need the same seriousness. Both require

critical thinking and some basic rules such as time management, continuous literature search, improved writing, and attaining other soft skills.

Often the researcher feels pressure to complete their research works and consider the task of writing a thesis as potentially intimidating and boring [1]. However, they should follow some general principles that will make this apparently hard process enjoyable. Planning and writing the thesis in an organised manner should be the goal. Some important points to be remembered during conduct of a research (Figure 1).

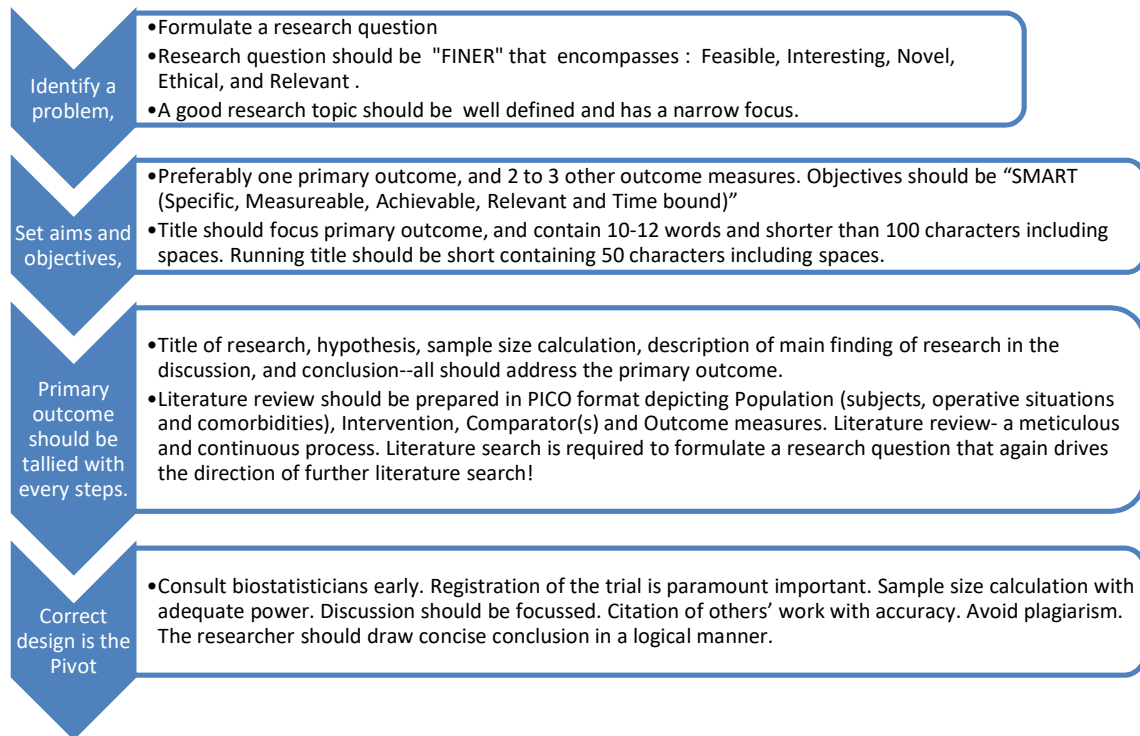


Figure 1. Important points for conducting a research.

Review

Formulating research question is the key element

After getting induction into which topic one will do the research, the candidate should consult guide(s) to formulate the research question first. The investigator should assess whether the research question is "Feasible, Interesting, Novel, Ethical, and Relevant (FINER)" before starting the research [3,4]. Although we are talking about the novelty, the research question need not to be entirely original. The researcher should do an exhaustive literature review on the related topic at first. It is helpful if a broad sheet (tabular information sheet) is prepared in PICO format depicting Population (including different operative situations and comorbid conditions of subjects) under the study, Intervention done, Comparator(s) used in that study, and Outcome of the intervention [5].

Thereafter, on careful observation of the broad sheet, the researcher will be able to detect some lacunae in the existing field of research regarding the following aspects. Investigator should try to detect any special subset of population, any variety of intervention or a different outcome that remained not studied. These are the areas where we can try some other new. Observe carefully about what outcome has already been studied and we can do study on any other aspect. This small change will make the study a bit new. It will address the lacunae in the existing literature that is an important point of adjudication of the introduction section of thesis. Overall, on careful observation of such a broad sheet the investigator will be able to prepare the justification about why this can be an interesting topic to do a research. A good research topic should be one that is well defined and has a narrow focus [6]. A properly framed research question makes

the backbone of a research [6]. Research question relates with hypothesis intimately with a subtle difference between the two. Research question indicates about the idea under study while the hypothesis framed aims to answer the research question. The research question can be converted into a hypothesis by converting it into a statement [7].

It is crucial to set the primary objective of the study based on the study hypothesis and secondary objectives based on other relevant research questions of interest [4]. The study objectives should be “SMART (Specific, Measureable, Achievable, Relevant and Time bound)” to be effective research parameters [4]. Aim of a study describes the broad areas of the research encompassing the research objectives [8].

The researcher should compose a title containing the theme of primary outcome and address all facets as per PICO format. The title appears as the ‘first detail’ or ‘face’ of a thesis or paper that one reader look upon. Hence, it should contain ‘just enough details’ to kindle the interest among the reader [9]. Lengthy titles can appear boring, clumsy, unfocused and will not transmit proper information to the readers. Initially one can go with a working title. Authors should draft the title to make it accurate, and precise. The recommended word limit of the title varies in the literature and is a gray zone. As a rule of thumb, the ideal length of a title is 10-12 words and shorter than 100 characters including spaces [10,11]. According to other literature, the word count of title should not exceed 12-16 words or the limit of 150 characters [12]. Although some authors [13] opines that title should accommodate as many words as necessary to explain the main

theme of the research without much emphasis on the length, an editor’s perspective [14] guides that a “good title should not contain more than 15 words or 100 characters”.

Correct design is the Pivot

The study design should be appropriate, rigorous, and comprehensive. The researchers should design the study correctly and for that, they must have a comprehensive knowledge on the basic structure of study designs [15]. Often, a thesis mention in the title or in the methods section that it is an observational study while later it is seen in the details of methodology that the researcher has actually assigned the participants in some way that means it is a true experimental (interventional) design indeed. In descriptive study, the investigator tries to describe the characteristics of a sample population. In analytical study, the researchers attempt to analyse and draw inferences about any relationship between the variables. The analytical study again can be experimental or observational. In clinical trials (true experimental study/interventional study), the researcher intervenes with something either to prevent a disease or to treat it. Here the researcher will actively assign the participants to receive that intervention. In contrast, the investigator makes no active intervention in observational studies; rather take a note about the patients receiving the treatment based on clinical decisions. For example, if investigator wishes to determine the prevalence of hypothyroid diseases, diabetes, ischaemic heart diseases or hypertension among the patients attending the preoperative clinic of this hospital for one year- it may be an observational study. Another example,

when the investigator wishes to find the incidence of post-dural puncture headache (PDPH) among patients receiving spinal anesthesia with different gauze needle and he is not assigning the needle gauze for any particular patients, it becomes an observational study. Here, the patients are receiving the therapy according to the preference of the conducting anesthesiologist and the investigator is just observing the incidence of the PDPH. The detailed description of study designs is out of scope for discussion in this article. Interested reader can consult the referenced resources [16,17].

Nowadays, the researchers often perform “qualitative research” to understand human experience, behavior, and perception. Qualitative research focuses into real-world problems to explore deeper insights instead of acquiring numerical data. Here, the researcher tries to organize recurring themes in the data (thematic analysis) by observation or interacting with a focused group. The researcher can use delve research hypothesis for further quantitative study. Delve is qualitative coding software that is used to analyse qualitative data. Delve provides an intuitive interface and artificial intelligence (AI)-assisted features that can be used by the researcher as assistant [18]. This simple tool ensures collaborative online qualitative analysis to find rigorous, human insights quickly. Delve provides a seamless organization and powerful analysis of qualitative data with human touch to derive proper conclusion(s). AI appears to be a powerful tool for analyzing data. However, it may not be able to construct the meaning that a human researcher can do [18].

Other areas of study include the delivery of healthcare,

prognostic/diagnostic research, medical education technique etc. A new concept gaining appreciation is the close bidirectional flow of knowledge between basic, clinical and community research and translation of this knowledge in generation of further research [19].

In case of experimental study, the researcher forms one hypothesis at the end of the introduction. The hypothesis tell clearly, what is being expected from the study. First, the researcher assumes that there is no difference in outcome with application of either of the interventions and the study result will disprove or reject that. It is termed as null hypothesis. One can formulate the alternative hypothesis that directly states what the probable outcome of the study is.

Consult biostatisticians early

It is quite important to keep required raw data what is necessary for testing and analysing the outcome. If we miss to record any important data and the study is completed, it is totally undone. No statistician can help us out. It is utmost important to keep data in a proper format and analysing them using correct statistical methods. If the necessary raw data is there, re-analysis can bring the important conclusion from that data. Hence, it is important to take the advice of the biostatistician at the very beginning about observable parameters and their format. It is better to consult a statistician at different phases of the study such as, designing the study, before and after data collection, during data analysis and logical conclusion. In the methods section, the researcher should mention details about data collection- how, when, how often, where and who collected data, how the data collector remained blind,

randomization, etc. It is important to describe how the raw data was processed and analysed. It is better to avoid simple listing of series of tests. Instead, try to mention the specific tests used to analyse each type of data. After completion of data analysis, describe the result with appropriate writing in the text form [20].

Literature review- a meticulous and continuous process

The literature review process is a paradox. Literature search is required to formulate a research question, which again drives the direction of literature search. The methodology is prepared based on research question and literature. The review and research question(s) helps the researcher to have an idea about data collection and analysis. The complexity of the research question warrants the intensity and ramification of the literature review [21]. Often a particular methodology for a study selected in such a way that it would contribute to expand the knowledge beyond what published previously in the related topic. Even for a simple research question, there is need for further search on the topic.

The researcher cannot effectively carry out a literature search without formulating the research question(s). On the other hand, the literature review can play a vital role in formulating the problem statement in to an effective research question(s). It will help constructing a summary on existing knowledge about the topic. Thus, it would throw light on the lacunae in the existing literature where the investigator would focus. It will certainly make the study novel and will contribute something new to the related field. The literature review helps to acquire a detailed understanding of the topic. It also helps to

conceptualise the research question precisely and makes it more relevant in the field of investigation [22]. The literature review is started from the beginning of the study, and should be continued till final writing of the thesis to include the latest researches in the discussion of context. At time of final submission of thesis the literature review is summarized in any of three ways – systemic (generation and comparison of evidence as per theme), semi-systemic (tracking evidence in time) or integrative (qualitative evaluation as a critique) [23].

Systematic reviews is performed when researchers have a more precise or specific research question addressing the feasibility, appropriateness, or effectiveness of a particular treatment or practice [24]. A strict search strategy is followed to select articles to be included in the review. This review is effective in synthesizing what the included studies are showing evidence on a particular question [23]. *Semi-systematic review* is conducted when there is a broad research question and the researchers wish to study a broader topic. The purpose is to overview research area and track development over time. The search strategy may or may not be as stringent as systematic. A semi-systematic review approach could be a good strategy to identify knowledge gaps within the literature and to map theoretical approaches or themes [23]. *Integrative review* can be useful when the research question requires to be a more creative collection of data. It provides a comprehensive understanding of a phenomenon from a synthesis of all forms of available evidence [25]. Here, the research question can be narrow or broad. The purpose of the review is not to cover all articles ever published on the topic.

Instead, it tries to combine perspectives to create new theoretical models. Integrative review considers diverse study designs such as experimental, non-experimental, quantitative as well as qualitative researches to reach its conclusions. Integrative reviews warrants specific skills to identify and synthesise literature [26]. A detailed insight into the most common types of review is available in the literature [27].

Materials and Methods

The methods section should be flawless and contain detail information for replication of the study successfully. Here, the investigator should mention the details of population- how they are selecting patients, inclusion and exclusion criteria, trial registration, Institutional Ethical Committee (IEC) permission and written informed consent. The investigator should mention where the work is done, the speciality of the operating room (OR), for example, general surgery, gynaecological OR, etc. instead of the specific name of that OR as given by the institute.

Registration of the trial is paramount important

Wilful concealment of results and lack of transparency in reporting of data can degrade the quality of evidences in the medical practice. It is ethical and moral responsibility of the researcher to register the clinical study protocol in the trial registry such as International Clinical Trials Registry Platform (ICTRP) or Clinical Trial Registry of India (CTRI). The WHO Registry Network is composed of Primary Registries or Partner Registries. Some registries are working with the ICTRP towards becoming Primary Registries. Researchers can access the

ICTRP search portal (<https://trialsearch.who.int>) or other registries (such as <https://clinicaltrials.gov/>), in the ICTRP Network. The researchers can try for Universal Trial Number (UTN) at <https://trialsearch.who.int/utn.aspx> that will help uniquely to identify clinical trials registered in WHO Primary Registries. They provide facilities to register trials in prospective manner. The trial registries work together as a forum to exchange information and help to establish the best practice for clinical trial registration [28].

Sample size calculation with adequate power

Researcher should mention sample size in the methods section. While writing text on sample size, the investigator should be careful about mentioning all necessary components such as power, alpha error, effect size and standard deviation or proportions of any referenced article. In most of the cases, there is mention about power and alpha error. However, the investigator should mention the effect size also. *Effect size* is the 'minimum clinically important difference' between the groups that the investigator wishes to detect [29]. This effect size should be set on the basis of *primary outcome* measure. Investigator assumes this, and thereby there is some scope of flexibility. However, this assumption should be clinically relevant and thus has some bindings as well. When evaluating a drug's effect on heart rate, an effect size of 10 beats per minute can be clinically relevant. In contrast, when we evaluate a new analgesic agent on postoperative analgesia an assumption of 10 minutes difference regarding the time to receive first rescue analgesia may not be useful clinically. The researcher should

furnish one reference against the data taken from the previous study used for sample size calculation. Besides, the researcher should furnish a reference for the formula or method used for calculation of the sample size. These are to provide the reader a scope to have an in-depth reading and understanding the matter [30]. In case where no previous data exist, the researcher should carry out a pilot study with recruitment of 10-30 subjects or 10% of sample size [31].

Randomisation and allocation concealment in Experimental study

In case of true experimental study, researcher should properly mention about randomisation, allocation concealment and blinding. *Randomisation* is a method that provides 'every subject an equal chance' to be assigned to any group. Random allocation is a process that allows choosing of participants for intervention and comparator groups entirely by chance without addressing the patients' condition, and the will or preference of researchers. This process permits mitigating the influence of all unknown as well as known factors that might influence the outcomes in both the treatment and control groups [32]. This random allocation process consists of two steps: (i) yielding a random or unpredictable sequence of intervention (*randomisation*), (ii) implementing the sequence to conceal the treatments (*allocation concealment*) until participants have been formally assigned to the respective groups.

Blinding is a technique that tries to keep the participants, the researcher or both to be unaware of the assigned intervention [32,33]. The study is single-blind when only the participants are blinded. In a double-blind study,

participants and researchers- both are blinded. In a triple-blind study, the intervention is kept hidden to not only the participants and researchers, but also to the researchers who are analysing the data. This will help reducing selection bias, implementation or performance bias and measurement bias [4]. This is to prevent bias of the investigator and team members to allocate the preferred intervention to selected participants to generate a favourable outcome of interest. The use of sequentially numbered, opaque, sealed envelopes can be one such technique [4].

The investigator should mention the details of methodology so that a reader can replicate the study with ease. There should not be any difficulty in understanding the flow of the process [34,35]. The researcher should provide the adequate definition of every measured variable. There should be adequate definition of adverse events and management. Whenever a specific score, scale or grade is being used the researcher should provide a brief description with reference.

It is important to narrow down research from a myriad of sources (Google Scholar, PubMed, Embase, Medline etc.) by using suitable search engine with appropriate keywords, Boolean operators and other search limiters as applicable so that the researcher does not lose the way [36]. However, cross-referencing of important cited articles and limitation is also important.

Results Section

The results section may begin with a short description of the study type and the time span of the study. Near the end of methods section or in the beginning of results section, the researcher should place

a flow chart that will give the reader an idea about the basic structure of the study design, number of drop out and any lost to follow up [37].

For proper analysis, the researcher should have a comprehensive knowledge about the types of data and the suitability of tests to analyse those [4,38-40]. It is important to present data in a comprehensive and palatable format. When the categorical data (e.g. ASA physical status classification, gender) are analysed by using Chi-square test it is better to use the Chi-square value and *P* value rather than the mere copy pasting of statistician's analysed data en masse which bears unnecessary numerical jugglery with individual row, column and total proportions. The latter can camouflage the necessary information and the reader face difficulties in focussing. It would be easier for the readers to grasp the essence of the presented data if the table is neat and clean by avoiding unnecessary numbers after decimal. It is practically useless to write mean and standard deviation (SD) of heart rate as 89.461 ± 10.292 and therefore can be simplified as 89.5 ± 10.3 without any harm. Although this simplified presentation of data is practical with ease of reading and appreciation in case of large sample, providing data up to second decimal would bear importance if the sample size is small. It is important to clean and cross check data and statistical analysis.

Another aspect while describing the result one should avoid writing mean and SD including the *P* values in the text. Instead of repetition of such data, the investigator should cite the table number or figure number to refer the reader to the particular table or figure and describe the essence of the displayed data what that actually indicates. However, some

researchers prefer to highlight the primary and secondary study objectives in both table and figure.

When presenting the results, one can mention the point estimate along with the 95% confidence intervals, which convey much more than just the *P* value [41]. Use of confidence intervals and interpreting it in a proper way can be more informative than mentioning the *P* values. The researchers should be well conversant with the use of confidence intervals.

In the results section, try to avoid use of simultaneous tables and figures for variables that are not any outcome measures of interest. Tables should preferably be used for furnishing detailed information with sizeable data that may be useful to compare [35,42]. In contrast, the patterns or trend are better expressed using figures [35,42]. The investigator can use both table and figure formats simultaneously to present the most important observations i.e., the findings on the primary outcome to create impact among readers [43].

During final writing of the thesis, often the researcher copies the methodology from synopsis and forgets to alter the future tense of the sentence to past tense. It is paramount important to maintain the spelling of any particular format - either United Kingdom or United States of American style.

Discussion should be focussed

In the initial phase of discussion, the researcher should depict the main observation of the study, the *primary outcome* [44]. The researcher should attempt here to answer the research question(s) with an explanation how the observed results fit with the current literature, with critical analysis and

shortcomings of the existing knowledge [35,45]. Ahmad [46] described it as the 'liveliest part' of a research. The main goal of discussion is to think critically about the work by framing a constructive debate with literature support. Agreement and disagreement with the present study findings can better be resolved if one thinks about the possible improvements under what conditions previous authors had achieved that results [46].

Researchers should avoid repetition of numerical details of data (mean \pm SD with P value). Instead, they can provide the magnitude of benefit achieved with the new intervention using plain language summary. A detailed numerical value with values many places after the decimal are useless. Rather, a rounded off value offers the benefit of easy readability owing to simpler in text appearance and serves the purpose of clinical utility.

After mentioning the main observation of the present study, furnish the findings of different studies in the related field. It would be prudent to corroborate or contrast the present study findings with others' work in the related field. The researcher should take precaution during selecting the number of *secondary outcomes* while designing the study during synopsis protocol. It is safer to keep not more than two to three secondary outcomes. It would be uncomfortable to cover the discussion on too many secondary outcome measures and to extract the essence to draw conclusion. It is important to check that the objectives of the study are identified at Introduction, followed up in review of literature, appropriately researched and analysed and finally discussed. An argument matrix is a checklist tool so that

any vital information may not be missed [47].

Often the researcher mention the result of other studies as mean \pm SD with P values with specific group names of that particular study. It would be easier for the readers to grasp the information if the researchers state the magnitude of difference achieved and avoid SD and P values as far as practicable. The researcher should state whether it is 'comparable' or there is 'considerable difference' to indicate the non-significant and significant values.

Citation of others' work with accuracy

While stating other authors' works, furnish it with appropriate reference. Avoid using copy pasting verbatim. Instead, use your own words keeping the scientific meaning unaltered. We should check all texts using plagiarism checker available online. Last but not the least, the references should be written in the proper format as per the university rules. The researcher should follow only one format- the National Library of Medicine (NLM), the American Psychological Association (APA) or any other, throughout writing of one research work. The whole file should be stored in different devices and in the clouds if feasible, to protect against loss. The files should be stored after renaming it properly (can use date) to avoid any confusion with older version. Several organizations such as 'International Committee of Medical Journals Editors (ICMJE)', 'World Association of Medical Editors (WAME)' and 'Committee on Publication Ethics (COPE)' provide publication ethics, various recommendations and guidelines to assist authors, reviewers and editors. These are helpful to prepare and disseminate

unbiased and reproducible research papers [48]. The aspirant researcher should consult those. In case of voluminous collection of references the tools such as

Zotero, Mendeley, EndNote etc. can be helpful [49]. The important steps of research are summarized in Box 1.

Box 1: Key points to be followed during research

- Identify a problem, formulate a research question
- Research question should be “Feasible, Interesting, Novel, Ethical, and Relevant (FINER)”
- Set aims and objectives, preferably one primary outcome, and 2 to 3 other outcome measures.
- Avoid selecting too many secondary outcomes. It is better not to keep more than two to three secondary outcomes otherwise discussion would be lengthier, the focus would be diluted, and there will be difficulty to extract the essence to draw conclusion.
- Objectives should be “SMART (Specific, Measureable, Achievable, Relevant and Time bound)”
- Title should focus primary outcome. Title should preferably contain 10-12 words and be shorter than 100 characters including spaces.
- Running title should be short and contain 50 characters including spaces.
- Title of research, hypothesis, sample size calculation, depicting main outcome of research in the discussion section, and drawing conclusion--all should address the primary outcome.
- Literature review should be prepared in PICO format depicting Population (subjects, operative situations and comorbidities), Intervention, Comparator(s) and Outcome measures.
- Literature review- a meticulous and continuous process. Literature search is required to formulate a research question, which again drives the direction of literature search.
- Correct design is the Pivot. Sample size calculation with adequate power. Consult biostatisticians early.
- Registration of the trial is paramount important.
- Discussion should be focused. At the outset of discussion, the researcher should depict the main observation of the study, and then try to corroborate or contrast with others' works.
- Citation of others' work with accuracy. Avoid plagiarism.
- The researcher should draw concise conclusion in a logical manner.

Limitations of the study

There should be a subsection regarding the limitations of the study at the end of discussion. Here, mention the pitfalls of the study. Do not mention or elaborate on exclusion criteria of your research. The basic idea is to look into the study retrospectively in terms of study design, resources, access to studies, population chosen, etc. and to look at scopes for improvement [50-52]. The investigator can mention a few words on future scope of the study to address these issues.

Conclusion section

The researcher should draw concise conclusion in a logical manner. The conclusion should state the inference on the primary outcome or main theme in a clear but concise manner. The conclusion should be logical that means it is drawn based only on the specific observations and their significance. The investigator should focus on the objectives and hypothesis of the study once again during drawing conclusion [53]. The conclusion must be explicit whether the observed outcome affirm or negate the research hypothesis [54]. Important findings of secondary objectives should also be mentioned in conclusion.

A final word is to organize your thesis into appropriate sections including relevant accessory materials like certificate from guide and head of institution, ethical clearance, trial registry, university registration, case record form, informed consent form, master chart, and list of tables, figures and abbreviations, plagiarism check report, Gantt chart of study timeline and acknowledgement of funding sources and conflict of interest. Various checklists are also available at the

‘EQUATOR Network (Enhancing the QUALity and Transparency Of health Research)’ available at: <https://www.equator-network.org/>. The authors should check suitable one based on their study design.

Conclusion

A well-planned study design and early consultation with biostatistician is the key to success. The study aims and objectives should be co-ordinated with sample size calculation, main focus of discussion and logical conclusion.

Declaration

An abridged version on the topic entitled “How to write the postgraduate thesis- the secrets unveiled” has been published in the souvenir of the Joint Annual Conference of Anaesthesiology, Critical Care and Pain Medicine, 2023, organized by ISA Tripura State Branch, held on 10th September at IMA House, Agartala. Subsequently, the text extended to cover other aspects. This article sufficiently distinct from the text of aforementioned souvenir is submitted to this esteemed journal for wide dissemination of current information to a greater number of readers.

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Conflict of Interest

The authors declares that they do not have conflict of interest.

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