

# How to Write an Original Research Article: A Guide for Undergraduate Students

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## Abstract

You have selected a study topic, approached a supervisor, drafted the proposal and questionnaire for ethical approval, collected the data and analysed the results. What next? Writing a manuscript for publication is the last stage; however this is a step which many students find to be a daunting task which therefore leads to many delays before it gets published. This paper attempts to give a general outline, which undergraduate students can refer to, and cites a few checklists and official guidelines, which can help in structuring a manuscript.

**Keywords:** Medical writing, medical manuscript, biomedical research writing

(ASH & KMDC 21(1):48;2016).

## Before starting the paper

Before starting to write a paper, one should undertake the following tasks to allow easy and smooth writing process and therefore avoid any potential sources of road blocks that may come in the way.

Literature search should have already been done prior to the study at the time of designing the proposal. Next step is to review the research and to note any important updates which may have taken place. The entire literature review should not be cited. Selected literature, which focuses on the specific area of your research, should be included.

The next important step is to search for the author guidelines or instructions of the journal where submission is likely. Although the general outline would be the same, it is smarter to follow

and adhere to the journal's specific guidelines as that might reduce the amount of revisions required.

The National Knowledge Service of the United Kingdom (UK) National Health Service (NHS) provided the initial funds to set up the EQUATOR Network (Enhancing the Quality and Transparency of Health Research)<sup>1</sup>, which is an online collection of guidelines the authors can follow when reporting their research of each particular design<sup>2</sup>. For example, observational studies in epidemiology including cohort, case-control, and cross-sectional studies, one can refer to the STROBE guideline<sup>3</sup> and for meta-analysis of observational studies, the MOOSE guidelines can be referred to<sup>4</sup>. Checklists such as these can be easily downloaded and can be used as checkpoints throughout the writing process. Another general guideline to follow is the Recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly Work in Medical Journals released by the International Committee of Medical Journal Editors (ICMJE)<sup>5</sup>.

It is a good idea to make a general outline or brainstorm the manuscript before attempting to write one. This would ensure one does not miss any important aspect, and in addition can help out when

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**Date of Submission:** 17<sup>th</sup> January 2016  
**Date of Acceptance:** 28<sup>th</sup> February 2016

one is stuck on a particular point. This would also be a good stepping stone for discussing the paper with colleagues or supervisor, and would help in dividing the tasks of writing between the authors if that is the plan. Refer to Fig.1 for a general outline.

This paper attempts to outline the structure of the manuscript, starting from the abstract till the references, using the IMRAD (introduction, methodology, results and discussion) format<sup>5</sup>. Each component of a written manuscript is discussed below which includes abstract, introduction, methods, results, discussion, conclusion, acknowledgement and conflict of interest.

### **Abstract**

Abstracts should be balanced and informative<sup>6</sup>. After the title, most readers will only get a chance to read the abstract. This is true when it comes to electronic databases like PubMed, when readers peruse a journal<sup>7</sup>, abstract is the only portion of the paper that can hold interest for the longest period of time. For these reasons and more, it is important to keep the abstract organised and present as many salient features as possible in the shortest possible word count.

Abstracts of original articles, systemic reviews and meta-analyses should be in a structured format<sup>5</sup>. Sub-headings should be used when writing such summaries. These can include an introduction, objective and/or background, methodology, results and/or conclusion. It is always better to adhere to the journal's guidelines when designing the summary. In an unstructured abstract, sub-headings are not used even though a logical sequence is followed.

The background should be restricted. In the methods section, one should not forget to mention the research design, duration and setting of the study, sample size and the research instruments used<sup>7</sup>. Present the main findings as results, with frequency and percentages along with statistical significance if required. The conclusion should have the take-home message stated in a precise and honest way<sup>7</sup>.

### **Introduction**

After the abstract, the introduction is next in line for readers. The introduction is just as important as an abstract in attracting the attention of the readers. Therefore, it is important to do justice to your paper and give it a proper beginning. Introduce the topic with succinct facts and figures. Explain to the readers the importance of the work, or why it may be a novelty. State the hypothesis or objective<sup>5</sup>.

It is important to keep the introduction brief, around 250 to 600 words<sup>8</sup>. This may seem a difficult task at first, but realise that the introduction is not a discussion, so no comparisons or contrasts are required here. It may be helpful to write the introduction after penning down the methodology and results because it will give a clear idea as to the study. Ideally, one should be confident regarding this beforehand, but having it penned down in an organised manner would help.

### **Subjects and Methods**

This is the section where how the study was conducted is discussed, so that anyone who reads the article is able to replicate the research. One of the most important reasons of research articles is not just to disperse knowledge, but to provide opportunity to other scientists to replicate your experiment so to approve or disapprove your theory.

If this the first time in writing a manuscript, many students would find it useful to start with this section. All the details are already accessible, and no comparisons or analyses need to be done when stating the methodology. Note down as much information as possible in the first draft before sorting and formatting this section. As most students work on a cross-sectional study design, the STROBE checklist gives a helpful list of items to note<sup>6</sup>. Give the study design. Describe the settings in detail; include the locations, for example hospitals, schools, state how many were included, and specify whether they were public or private institutes. State the dates, in months or years, for the duration of data collection.

State clearly whether prior ethical approval was taken by ethical review committee, or exempted by the same<sup>5</sup>. If no ethics committee is available, ensure that you have gone through the principles of the Declaration of Helsinki<sup>9</sup> and state that you have adhered to them.

Give details regarding the participants. This refers to inclusion and exclusion criteria and details regarding the selection of the participants. Note that demographic information should be the part of the results, unless such information is a part of the selection criteria of the participants. You may have to provide the rationale for choosing such populations.

Explain how the sample size was arrived at. Many online sample size calculators are available<sup>10-12</sup> and it is easy to input the population or prevalence numbers into their formulas to extract the sample size. There is no need to give the entire formula, however the population size and the prevalence number should be cited with their source.

Describe the statistical methods used in detail. Specify the software used along with its version. Cite references for methods which have been previously published. Give details regarding any drugs, chemicals or materials used. Many students conduct questionnaire-based studies, so ensure that you have detailed the components of the form clearly.

## **Results**

The results section should summarise the data gained from the study. Make sure to use a logical sequence. The STROBE checklist gives a useful outline for the results using the following items: participants, descriptive data, outcome data, main results, and other analysis<sup>6</sup>. State the number of participants, and explain any missing data or non-participation. Give pertinent demographic information. State the frequencies along with the percentages. Describe numeric and categorical variables and give the output as results. If required, one can always refer to a biostatistician for help, especially when there are statistical analyses other than descriptive frequencies and percentages, and

multiple comparisons. Do not forget to acknowledge their help in the manuscript.

It is helpful to use figures, tables and charts with appropriate captions to represent data in a more reader-friendly manner. On an equally important note, one should not be compelled to use unnecessary tables and figures just for the sake of using them. Note that many journals restrict the amount of tables and figures that can be; refer to the journal guidelines. Do not repeat all the details of the figures and tables in the text and vice versa.

Do not get confused with the content of the results, methods and discussion section. Work done prior to the outcome goes in the methods section while the meaning of the results goes in the discussion.

Writing this section is an art. Avoid wordiness, write results appropriate to the objectives and keep the language comprehensible. The results are the output of hard work, so give it its due importance.

## **Discussion**

Although many students find the discussion section to be the most intimidating, this is where the authors have the most freedom. Begin by briefly summarising main findings; however do not repeat the details given in the results section<sup>5</sup>. Explain what results or data mean and answer the objective stated earlier in the manuscript. Continue by comparing and contrasting the work with other studies. The literature review done earlier would come in handy here. One should not cite each and every article which was searched during the earlier review; focus on the pertinent ones, using relevant literature close to the objectives. It should be remembered, that this is an original article, and not a review manuscript.

Note down any limitations or weaknesses of the study and ideally state what implications the study might have, or possibilities for future researches. It is important not to repeat in detail the information given previously under the introduction and results section.

A common challenge that might appear to students is keeping the structure of the discussion organised. Before writing the first draft, jot down the questions and important points needing discussion<sup>10</sup>. Organise these before moving on to writing the main text.

It is important not to sacrifice the clarity of this section by using complicated statements and results. Again, try to explain results and comparisons with other studies using clear and simple language which should be easy to understand for the readers.

### **Conclusion**

The conclusion should be kept brief and clear. Link the goals and objectives stated earlier with the conclusion. Do not over generalise the results<sup>13</sup>, that is, do not go beyond the limits of the study conducted.

### **Acknowledgement, disclaimers, conflicts of interests and funding sources**

ICMJE recommendations state four criteria for authorship. If there are any contributors who do not meet these four criteria, they should be acknowledged. Examples of individuals which should be acknowledged include those who helped in reviewing the work, those who provided technical or language assistance or those who provided general supervising or administrative support<sup>5</sup>. The acknowledgement statement usually appears at the end of the text; however always refer to the journal guidelines for the correct formatting.

In addition, if there are any conflicts of interest, funding support or prior presentation of an abstract in a conference or published in an abstract booklet, declare these appropriately. Again, refer to the journal guidelines regarding the correct formatting of such statements.

### **References**

References are an important aspect of the paper and credit should be given where it is due to authors whose work is being cited.

Many referencing styles are used to cite literature including Chicago<sup>14</sup>, Modern Language Association (MLA)<sup>15</sup>, American Psychological Association (APA)<sup>16</sup> and Vancouver<sup>17</sup>. The Vancouver style is the one most commonly used for health and physical sciences<sup>18</sup>.

Read the guidelines provided by the journal where one intends to send the manuscript and note their preferred choice of citation style. Although citation manager software are available to note and format the references, not all of them are free. However, internet is again a useful tool as many clear guidelines are available to help in this endeavour. Some important points regarding Vancouver style include:

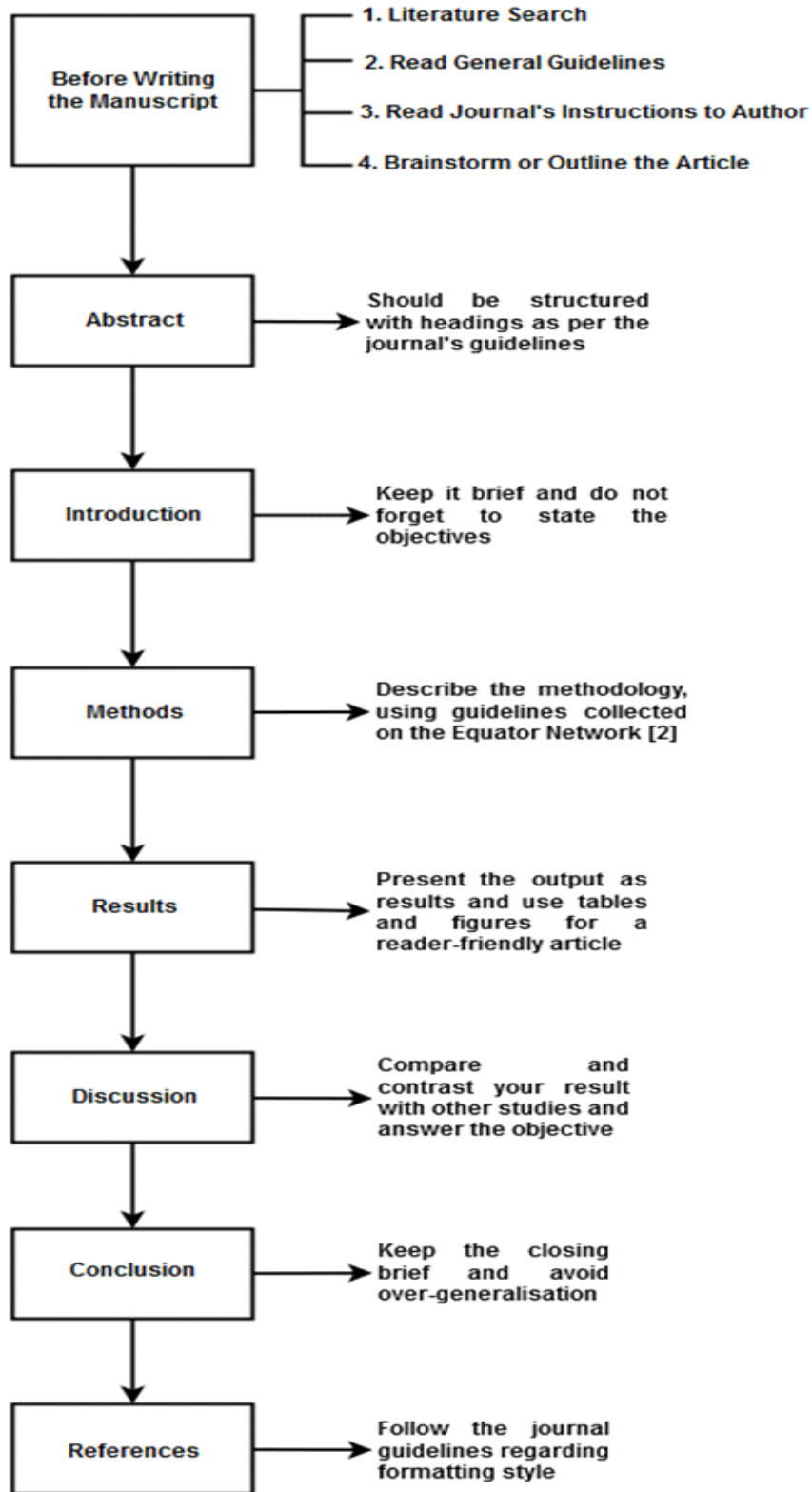
- References should be cited in Arabic numerical and should be arranged consecutively in the text<sup>5</sup>.
- If there are more than six authors, use et al after noting the sixth author's name instead of listing all of them<sup>17</sup>.
- Use journal title abbreviations according to MEDLINE<sup>19</sup>.
- Do not forget to note the citation date when online sources are referenced<sup>17</sup>.

### **Final Tips**

Revise and re-revise the paper after the first draft has been written. By this time, one should have gained enough confidence to read through it. It is advisable to read not only to correct the grammar and punctuation but also the content, organization and flow<sup>20</sup>.

Even though journals do check for similarity it is a good idea to put the manuscript through a scan using online plagiarism tools for similarity check after writing the manuscript. Many such options are available online for free. Another good practice is to get the manuscript reviewed by the supervisor, a teacher or consultant at the institute or a senior colleague who may have written original articles before. The fresh critique can offer very use-

Fig. 1. A general outline and guide for original manuscripts



ful tips and aid in improving the quality of the paper.

## Conclusion

Try to enjoy oneself throughout the research study, including writing process. In the rush to increase the publications list on the Curriculum Vitae (C.V), many students have forgotten that the actual purpose of research is the quest for knowledge. Try not to become a part of the rat race. Take each writing opportunity as a learning opportunity and do not get discouraged when others offer unkind criticisms, journals send the manuscript back for multiple revisions or the article gets rejected. This is all the part of the process and one can always learn from mistakes.

## Conflict of interest

Authors have no conflict of interests and no grant/ funding from any organization.

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