



## How to Write a Scientific Research Paper

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### Abstract:

*Scientific experiments are demanding, exciting endeavors, but, to have an impact, results must be communicated to others. A research paper is a method of communication, an attempt to tell others about some specific data that you have gathered and what you think those data mean in the context of your research. Scientific papers must be written clearly and concisely so that readers with backgrounds similar to yours can understand easily what you have done and how you have done it should they want to repeat or extend your work. This Paper provides a proper guideline to write a scientific paper for young researchers and that allow them to prepare a well-structured and comprehensive manuscript for a publication submission.*

**Key words:** Scientific Paper; Research Paper; Manuscript Writing

### Introduction:

The dissemination of research results and findings is an integral part of the research process and the career in academia. Researchers write to keep records of their work for themselves, but more importantly for readers and peers who are expecting a standard form, language and style when reading research papers. <sup>[1]</sup>Scientific paper has a required structure and style. However, a research article is not only a technically rigid document, but also a subjective intellectual product. Therefore, it requires good skills in both structuring and phrasing. These skills are acquired through experience, and can also

be taught. <sup>[2]</sup> Ironically, most graduate programmes in medicine and health sciences do not offer hands-on training in writing and publishing in scientific journals. Therefore, most authors learn the art and science of scientific writing the hard way; though there are papers that provide step-by-step guide to writing. <sup>[3]</sup>

What constitute a good paper- worthy of publication? There are no straight answers. Some define a good paper as a clear, coherent, focussed, well-argued document that uses unambiguous language. <sup>[2]</sup>

The main objective of this paper is to serve early-stage researchers with handy introduction to the structural components of scientific papers and the processes that lead to their publication.

### Structure and Content of a Manuscript

A manuscript is typically composed of a number of sections:

- Abstract;
- Key words;
- Introduction;
- Method;
- Results;
- Discussion;
- Conclusions;
- Acknowledgement and
- References



## Title

This provides the first impression to the reader, so selecting the most appropriate title requires some thought. The title influences whether a reader is interested in reading the manuscript. It should include all essential words in the right order such that the topic of the manuscript is accurately and fully conveyed (e.g. clearly related to the purpose of the study).<sup>[4]</sup>

## Abstract

An abstract is a brief summary (of specified word limit) of the content of the manuscript. It should provide the highlights from the introduction, methods, results, discussion and conclusions (Table 1).

**Table 1: Abstract**

### Statement of:

- The question asked (present verb tense).
- What was done to answer the question (past verb tense) – research design, population studies, independent and dependent variables.
- Findings that answer the question (past verb tense) – the most important results and evidence (data) presented in a logical order.
- The answer to the question (present verb tense)
- If useful, and where word limit allows, include: One or two sentences of background information (placed at the beginning)
- An implication or a speculation based on the answer (present verb tense, placed at the end).

The abstract must also provide a clear and accurate recapitulation of the manuscript for readers who read the entire manuscript. For example, an abstract must not contain data which are not included in the results. The abstract is usually written as one or two paragraphs and it is important that the text flows and does not resemble a collection of disjointed sentences. The choice of words should be simple, jargon avoided and abbreviations omitted except for standard units of measurement and statistical terms. Citations are not usually included.<sup>[5]</sup>

## Key Words

Most journals require the author to identify three or four key words which represent the major concept of the paper and these key words are used for indexing purposes.

## Introduction

The purpose of the introduction is to stimulate the reader's interest and to provide background information which is pertinent to the study. The statement of the research question is the most important part of the introduction. The review of the literature needs to be short and concise. The content of the introduction is outlined in Table 2.


**Table 2: Introduction** <sup>[6]</sup>

<p><b>Background to the topic</b> (past verb tense)</p> <ul style="list-style-type: none"> <li>- What is known or believed about the topic.</li> <li>- What is still unknown or problematic.</li> <li>- Findings of relevant studies (past verb tense).</li> <li>- Importance of the topic</li> </ul> <p><b>Statement of the research question</b></p> <ul style="list-style-type: none"> <li>- Several ways can be used to signal the research question , e.g.,</li> <li>- “To determine whether ………”</li> <li>- “The purpose of this study was to ………”</li> <li>- This study tested the hypothesis that ………”</li> <li>- “This study was undertaken to ………”</li> </ul> <p><b>Approach taken to answer the question</b> (past verb tense)</p>
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## Methodology

This section is descriptive. The main consideration is to ensure that enough detail is provided to verify the findings and to enable replication of the study by an appropriately trained person. Information should be presented, using the past verb tense, in chronological order. Sub-headings should be used, where appropriate. Reference may be made to a published paper as an alternative to describing a lengthy procedure. Many journals require mention of relevant ethics committee(s) approval for the study and that subjects gave informed consent. Table 3 provides an outline for the content of the methods section.

**Table 3: Methodology** <sup>[7]</sup>

<p><b>Outline of the study design</b></p> <p><b>Subjects</b></p> <ul style="list-style-type: none"> <li>- Method of sampling and recruitment;</li> <li>- Number of subjects; and</li> <li>- Justification of sample size.</li> <li>- Inclusion, exclusion and withdrawal criteria;</li> <li>- Method of allocation to study groups.</li> </ul> <p><b>Variables</b></p> <ul style="list-style-type: none"> <li>- Independent, dependent, extraneous, controlled.</li> </ul> <p><b>Pilot Studies</b></p> <ul style="list-style-type: none"> <li>- Outcome of any pilot studies which led to modifications to the main study.</li> </ul> <p><b>Materials</b></p> <ul style="list-style-type: none"> <li>- Equipment, instruments or measurement tools (include model number and manufacturer).</li> </ul> <p><b>Procedures</b></p> <ul style="list-style-type: none"> <li>- Detailed description, in chronological order, of exactly what was done and by whom.</li> </ul> <p><b>Major ethical considerations</b></p> <p><b>Statistical analyses</b></p> <ul style="list-style-type: none"> <li>- Method of calculating derived variables, dealing with outlying values and missing data.</li> <li>- Methods used to summarize data (present verb tense).</li> <li>- Statistical software (name, version or release number);</li> <li>- Statistical tests (cite a reference for less commonly used tests) and what was compared;</li> </ul>
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## Results

The two functions of this section are to report the results (past verb tense) of the procedures described in the methods and to present the evidence that is the data (in the form of text, tables or figures), that supports the results. Some journals combine the



results and discussion into one section. Before sitting down to write the first draft, it is important to plan which results are important in answering the question and which can be left out. Include only results which are relevant to the question(s) posed in the introduction irrespective of whether or not the results support the hypothesis(es). After deciding which results to present, attention should turn to determining whether data are best presented within the text or as tables or figures. Tables and figures (photographs, drawings, graphs, flow diagrams) are often used to present details whereas the narrative section of the results tends to be used to present the general findings. Clear tables and figures provide a very powerful visual means of presenting data and should be used to complement the text, but at the same time must be able to be understood in isolation. Data rarely stand alone, they are facts, often numbers, which may be presented in their raw form, summarized (e.g. means) or transformed (e.g. percentages, ratios).<sup>[8]</sup>

## Discussion

The discussion should be considered as the heart of the paper and invariably requires several attempts at writing. It serves to answer the question(s) posed in the introduction, explain how the results support the answers and how the answers fit in with existing knowledge on the topic. This is the main section in which the author can express his/her interpretations and opinions, for example how important the author thinks the results are, the author's suggestions for future research. In order to make the message clear, the discussion should be kept as short as possible whilst still clearly and fully stating, supporting, explaining and defending the answers to the questions as well as discussing other important and directly relevant issues. Side issues and unnecessary issues should not be included, as these tend to obscure the message. Care must be taken to provide a

commentary and not a reiteration of the results. The recommended content of the discussion is given in Table 4.

**Table 4: Discussion<sup>[9]</sup>**

- Answers to the question(s) posed in the introduction together with any accompanying support, explanation and defense of the answers (present verb tense) with reference to published literature.
- Explanations of any results that do not support the answers.
- Indication of the originality/uniqueness of the work
- Explanations of:
  - How the findings concur with those of others
  - Any discrepancies of the results with those of others
  - Unexpected findings
  - The limitations of the study which may affect the study validity or generalizability of the study findings.
- Indication of the importance of the work e.g. clinical significance.
- Recommendations for further research.

## Conclusion<sup>[10]</sup>

This section should comprise a brief statement of the major findings and implications of the study. It is not the function of this section to summarize the study; this is the purpose of the abstract. New information must not be included in the conclusions.



## Acknowledgement

All important contributors should be acknowledged, for example persons who provided statistical or technical advice and assistance; the subjects; those who helped with recruitment and personnel who helped with the preparation of the manuscript. If the research was supported by a grant, then the name of the funding body must be included.

## References

References authenticate the scientific facts and statements. Include only the essential references. Cite most accessible reference, and the primary source rather than reviews. Eliminate archaic and irrelevant references, and references for established facts. Check the references for accuracy. Follow the referencing style suggested by the target journal.

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