HOW TO WRITE A PAPER FOR A SCIENTIFIC JOURNAL

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Publication in a reputable, peer reviewed journal should be the goal of every researcher, as this provides the most effective and permanent means of disseminating information to a large audience (Cole, 1994; Portney and Watkins, 1993). When human subjects participate in research, it is on the understanding that they are assisting with the creation and dissemination of knowledge, presenting researchers with the responsibility to communicate the outcome of their research (Cole, 1994). The aim of this paper is to provide guidelines to assist with the preparation of a manuscript for a scientific journal.

Before writing a first draft, it is important to establish that the topic of the manuscript is likely to be consistent with the focus of the journal. This may be clearly stated within the journal or may be determined by examining several recent issues. Having selected a journal, it is essential to carefully read and follow the guidelines for authors published within the journal or obtained directly from the editor or publisher. These guidelines are usually very specific and include rules about word limit, organization of the manuscript, margins, line spacing, preparation of tables and figures and the method used to cite references. Failure to comply with the guidelines may result in rejection or return of the manuscript for correction, thereby delaying the process of review and publication.

Writing the Manuscript

The art of writing a manuscript improves with practice and considerable help may be gained by asking others, especially those who have published, to critique and proofread drafts. This also provides a means of a second check of accuracy and internal consistency. Getting started is often the most difficult part and for this reason it is best to begin with the easiest sections. These are usually the methods and results, followed by the discussion, conclusion, introduction, references and title, leaving the abstract until last. If possible, try and set aside some time for writing on consecutive days. Long gaps between periods of writing interrupts the continuity of thought. To avoid frustration, ensure all the necessary information, for example all data, references and any draft of tables or figures, are at hand before starting to write. The task of writing the manuscript may seem easier if each section is viewed as a separate task. Before starting to write, it may help to prepare an outline for each section which includes a number of major headings, sub-headings and paragraphs covering different points. When writing the first draft, the goal is to get something down on paper, so it does not matter if sentences are incomplete and the grammar incorrect, provided that the main points and ideas have been captures on paper. Try to write quickly, to keep the flow going. Use abbreviations and leave space for words that do not come to mind immediately. Having finished the first draft, immediately revise it and be prepared to do this several times until you feel it is not possible to improve it

further. Acceptance of a manuscript is invariably conditional on changes being made so be prepared to rewrite and revise the manuscript extensively.

Often a manuscript has more than one author and thus the writing may be shared. However, the style needs to be consistent throughout so even if sections of the early drafts are written by different authors, the first author must go through the entire manuscript before submitting, and make any necessary editorial changes.

Structure and Content of a Manuscript

A manuscript is typically composed of a number of sections:
- abstract;
- key words;
- introduction;
- methods;
- results;
- discussion;
- conclusions; and
- references

In order to maintain continuity between the key sections (introduction, methods, results and discussion) it is helpful to consider the manuscript as telling a story. The strong parts to the story-line are the introduction and the discussion so the link between thee sections must be clear. The research question which is posed as the need of the introduction must be answered at the beginning of the discussion (Zeiger, 1991).

Having invested many hours in undertaking research, the temptation is to try to tell the reader everything you read and learned in the process and to provide all the data gathered. However, in the planning stages, it is essential to remember that a word limit is usually imposed and therefore unimportant or irrelevant information must be left out. In the case of a large study, it may be necessary to write several papers which cover different research questions.

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) (Rudestam and Newton, 1992). Avoid long titles (the recommended length is 10 - 12 words) and those which begin with redundant words such as “A study of…”

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)

It must make sense when read in isolation for those who read only the abstract. This is especially important given that many computerized searchers only retrieve the abstract. The abstract must also provide a clear and accurate recapitulation of the manuscript for readers who read the entire manuscript (Zeiger, 1991). 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. Excessive detail such a long lists of variables, large amounts of data or an excessive number of probability (p) values is not acceptable. The trick to producing a clear abstract is to provide just enough detail to demonstrate that the design of the study was good and that the evidence of the answer to the question is strong.

Key Words

Most journals require the author to identify three or four key words which represent the major concept of the paper. These are used for indexing purposes and must be selected from the Index Medicus Medical Subject Headings (MeSH). For example "Physiotherapy" is not included in MeSH; the equivalent term is "Physical Therapy". In the rare event that an author does not have access to MeSH, the key words selected should be widely-accepted terms. Lack of access to MeSH should be indicated at the time of manuscript submission.

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

Background to the topic (past verb tense)

- What is known or believed about the topic
- What is still unknown or problematic
- Findings of relevant studies (past verb tense)
- Importance of the topic

Statement of the research question

- Several ways can be used to signal the research question , e.g.,
  - "To determine whether ……"
  - "The purpose of this study was to ……."
  - This study tested the hypothesis that ……"
  - "This study was undertaken to ……"

Approach taken to answer the question (past verb tense)

References are almost exclusively used in the introduction and the discussion. The references cited should be those which are the most valid and the most available. Articles in peer-reviewed journals satisfy both these criteria. Books, Master's and PhD theses and some conference proceedings, those for which papers are rigorously reviewed, are also valid sources, but usually take longer to find. Abstracts do not contain enough information to allow critical evaluation of

the work. Journal articles which have been accepted for publication are a valid source but those which have been submitted (but not yet accepted) are not, as they are unavailable. Avoid citing perusal communications and unpublished reports or observations. These are not strong evidence because they are unable to be accessed and evaluated. The number of references should be limited to the fewest number necessary by choosing the most important, the most valid and where appropriate, the most recent (Zeiger, 1991).

Methods

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: Methods

Outline of the study design

Subjects

- Method of sampling and recruitment;
- Number of subjects; and
- Justification of sample size.

- Inclusion, exclusion and withdrawal criteria;
- Method of allocation to study groups.

Variables

- Independent, dependent, extraneous, controlled.

Pilot Studies

- Outcome of any pilot studies which led to modifications to the main study.

Materials

- Equipment, instruments or measurement tools (include model number and manufacturer).

Procedures

- Detailed description, in chronological order, of exactly what was done and by whom.

Major ethical considerations

Data reduction/statistical analyses

- Method of calculating derived variables, dealing with outlying values and missing data.

- Methods used to summarise data (present verb tense).

- Statistical software (name, version or release number);
- Statistical tests (cite a reference for less commonly used tests) and what was compared;
- Critical alpha probability (p) value at which differences/relationships were considered to be statistically significant.

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. Except on rare occasions when emphasis is required data that are given in a table or figure must not be repeated within the text. Sources of help for the preparation of table and figure are Briscoe (1990), Price (in press) and Zeiger (1991).

Tables and figures must be mentioned within the text and should be placed after the related text. Photographs of subjects are often placed within the methods and should be used only if written, informed consent was obtained prior to the taking of the photograph. To preserve anonymity, facial features should be covered. If a manuscript includes a table or figure that has already been published, permission must be obtained from the copyright holder (usually the publisher) and the source acknowledged.

Confusion sometimes arises as to the difference between results and data. Results statements provide the message, that is, they interpret the data. 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) (Zeiger, 1991). For example, in a hypothetical study comparing vital capacity in supine and standing, the results statement and data respectively might be, "vital capacity was decreased in supine compared to standing" and "mean (SD) vital capacity was 2.95 (0.8) litres and 3.40 (0.6) litres ($p<0.05$) in supine and standing respectively". The two statements should be presented together with the results statement given first, i.e. "vital capacity was decreased in supine compared to standing, mean (SD) values were 2.95 (0.8) litres and 3.40 (0.6) litres respectively ($p<0.05$) in the 20 subjects". When presenting data, the sample size (n) must be given, any missing data identified and the p-values for data that have been analysed using statistical tests must be included. The significance level (critical alpha ($\forall$) probability value) should be reported but in the event that the null hypothesis (H_0) is accepted, the beta ($\exists$) probability value or statistical power should be reported. Studies in which H_0 is retained are just as important to report as those in which H_0 is rejected, providing such studies have an acceptable level of statistical power. The test statistic and the degrees of freedom, for example $t_{(12)} = 3.12$ should also be included unless only one statistical test has been used. When citing a p value, always give some idea of the magnitude of the difference (e.g. 20 per cent increase) as a p value in isolation gives no indication of the importance of the finding. It is generally accepted when reporting results that "significant" or "significantly" refer to statistical significance (Zeiger, 1991). Thus it is unnecessary to say "the decrease in pain was statistically significant".

The order of presentation of the results should be either chronological to correspond with the methods or from the most to the least important. The order of most to least important should be followed within each paragraph. For every result there must be a method in the methods. Careful planning of the tables and figures is important to ensure that the sequencing of these tells a story.

The results must not include a discussion of the findings, methods of data analyses and citations of references, except on rare occasions when a comparison is made of the raw data with the findings of a published study. This applies only when this comparison would not fit well within the discussion.

Discussion

The discussion should be considered as the heart of the paper and invariably requires several attempts at writing (Portney and Watkins, 1993). 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 (Zeiger, 1991). 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 and the clinical implications of the findings (Portney and Watkins, 1993). 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. (Zeiger, 1991)

Table 4: Discussion

- Answers to the question(s) posed in the introduction together with any accompanying support, explanation and defence 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 generalisability of the study findings.
- Indication of the importance of the work e.g. clinical significance
- Recommendations for further research

Answering the questions should be done using the same key terms and the same verbs (present tense) which were used when posing the question(s) in the introduction. The answer must be confined to the population studied, for example if the subjects were randomly selected from a population with osteoarthritis (OA) of the knee, generalize to the population with OA knee but not to a population with knee pain from other causes. If more than one question was asked in the introduction, then all questions must be answered in the discussion. All results relating to the question should be addressed, irrespective of whether or not the findings were statistically significant. Answers to the questions that were never asked must not be included.

Support the answer(s) by reference to published work whenever possible. It may be necessary to explain the answer by saying why it is acceptable and how it is consistent or fits in with published ideas on the topic. To defend the answer, explain why it is more satisfactory than other answers and why other answers are unsatisfactory. Where the findings of the study are not in agreement with those of others, this discrepancy should be explained. The sequencing of providing this information is important; discuss the results of the present study before going on to cite the work of others. In the event that unexpected findings occur, decide whether they are of little importance or may be very exciting. Demonstrating a willingness to discuss and evaluate rival explanations for the results highlights a good discussion. To discuss an unexpected finding, begin the sentence by saying it was unexpected and then go on to give the best possible explanation.

Discuss any weakness in study design, for example, extraneous variables that only became apparent during the conduct of the study. Comment on the relative importance of these limitations to the interpretation of the results and how they may affect the validity or the generalisability of the findings. When identifying the limitations, avoid using an apologetic tone and accept the study for what it is. If an author identifies fundamental limitations the reader will question why the study was undertaken (Rudestam and Newton, 1992).

A concise summary of the principal implications of the findings should be provided and regardless of statistical significance, the issue of clinical importance of the findings should be addressed. Where appropriate, make recommendations for clinical practice based on the findings. When discussing the implications, use verbs that suggest some uncertainty such as “suggest”, “imply” or “speculate”. As all research leads to further questions, give recommendations for further research but avoid the temptation to provide a long list and focus instead on one or two major recommendations. When doing so, do not offer suggestions which could have been easily addressed within the study, as this shows there has been inadequate examination and interpretation of the data.

The organisation of the content is important. The discussion should begin by stating answers to the question and supporting the answers with the results. Do not begin with a summary of the results, secondary information (place this after

the answer to the question) or indications for further research. At the need, restate the answers to the questions and indicate the importance of the research by stating applications, implications or speculations.

Conclusions

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 summarise the study; this is the purpose of the abstract. New information must not be included in the conclusions.

Acknowledgements

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.

Acknowledgements

The authors thanks Dr Diana Hopper and Dr Leon Straker for their help in reviewing this manuscript.

Reference

The above article was subtracted from:

Jenkins S 1995 How to write a paper for a scientific journal. Australian Journal of Physiotherapy 41(4): 285 - 289