European Geriatric Medicine 6 (2015) 573–579

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Research paper

Writing a scientific article: A step-by-step guide for beginners

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ARTICLE INFO

Article history:
Received 22 June 2015
Accepted 18 August 2015
Available online 19 September 2015

Keywords:
Scientific publications
Writing
Research
Article

ABSTRACT

Many young researchers find it extremely difficult to write scientific articles, and few receive specific training in the art of presenting their research work in written format. Yet, publication is often vital for career advancement, to obtain funding, to obtain academic qualifications, or for all these reasons. We describe here the basic steps to follow in writing a scientific article. We outline the main sections that an average article should contain; the elements that should appear in these sections, and some pointers for making the overall result attractive and acceptable for publication.

1. Background

Every researcher has been face to face with a blank page at some stage of their career, wondering where to start and what to write first. Describing one's research work in a format that is comprehensible to others, and acceptable for publication is no easy task. When you invest a lot of time, energy and often money in your research, you become intimately and emotionally involved. Naturally, you are convinced of the value of your research, and of its importance for the scientific community. However, the subjectivity that goes hand in hand with deep involvement can make it difficult to take a step back, and think clearly about how best to present the research in a clear and understandable fashion, so that others – likely, non experts in your field – can also appreciate the interest of your findings.

Even today, the old adage "publish or perish" remains valid. Many young researchers find themselves under pressure to produce scientific publications, in order to enhance their career prospects, or to substantiate requests for funding, or to justify previous funding allocations, or as a requirement for university qualifications such as a Masters degree or doctoral thesis. Yet, often, young doctors do not have much training, if any, in the art of writing a scientific article. For clinicians, in particular, the clinical workload can be such that research and scientific writing are seen to be secondary activities that are not an immediate priority, and to which only small amounts of time can be devoted on an irregular basis. However, the competition is already quite fierce amongst all the good quality papers that are submitted to journals, and it is therefore of paramount importance to get the basics right, in order for your paper to have a chance of succeeding. Don't you think that your work deserves to be judged on its scientific merit, rather than be rejected for poor quality writing and messy and confusing presentation of the data?

With this in mind, we present here a step-by-step guide to writing a scientific article, which is not specific to the discipline of geriatrics/gerontology, but rather, may be applied to the vast majority of medical disciplines. We will start by outlining the main sections of the article, and will then describe in greater detail the main elements that should feature in each section. Finally, we will also give a few pointers for the abstract and the title of the article. This guide aims to help young researchers with little experience of writing to create a good quality first draft of their work, which can then be circulated to their co-authors and senior mentors for further refinement, with the ultimate aim of achieving publication in a scientific journal. It is undoubtedly not exhaustive, and many excellent resources can be found in the existing literature [1–7] and online [8].

2. Getting started: things to do before you write a word

A certain amount of preparatory work needs to be done before you ever write a word of your article. This background work should generally already have been accomplished by the time you are at the writing stage, because it also serves as background to the research project you are writing about. All the time you invest in preparing the protocol for your project is an advance on the writing

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http://dx.doi.org/10.1016/j.eurger.2015.08.005
1878-7649/

of the article that will come out of your project. Thus, you probably already performed an extensive literature review to establish the current state of knowledge on the topic, and ensure the originality of your research when developing the protocol, and this can serve for your paper. It is helpful, when you are reviewing the literature, to take notes of important points or phrases that you intend to include in your article, with the relevant references. A software program for managing references (either free versions or commercially available products) can be helpful for managing the large volume of references that you are likely to wade through before sifting out the most important points.

Usually, you will also have the final results of the statistical analysis of your data. This will form the basis of your results section. Some of the graphical representations of your results will serve as figures for the article, so it is helpful to highlight the most important findings as you read through the results so that you do not forget anything important.

Before starting to write, you should identify the target journal in which you intend to submit your research. This will have consequences for the formatting, but more importantly, for the orientation of your writing style, since the writing must be appropriate for the type of reader you are targeting. For example, are you targeting a specialist journal, where readers are expected to be experts in your field, or a general medicine journal, where readers may be experts from other disciplines? This will have implications for the amount and type of information that you must include. In addition, the editorial policy of the target journal should also be taken into account. For instance, in a given area of expertise, some journals favour papers reporting basic research, whereas other journals give precedence to more clinical work. The choice of the target journal depends on a range of factors, which are beyond the scope of this article. However, at the very least, you should check that your paper falls within the scope of the journal you have chosen.

3. What are the main sections of a scientific article?

The vast majority of scientific journals follow the so-called "IMRAD" format, i.e. introduction, methods, results and discussion. Naturally, there are some exceptions to this rule, and you should always check the instructions for authors of the journal where you plan to submit your paper to ensure that this is indeed the recommended format. For the purposes of this guide, we will only discuss the IMRAD format, as it is the most widely used.

Your article should thus contain (in this order) an introduction, a methods section, a results section and a discussion. Added to this will be the abstract, which is more or less a summary of these main sections, and of course, the title. At the end, there must be a list of bibliographic references, the tables, and the legends to any figures. Finally, there may also be some other optional sections, such as acknowledgements, conflicts of interest or authors' contributions. Below, we will discuss each of these sections in detail, outlining the main points to keep in mind when writing them.

3.1. The introduction section

The introduction is of prime importance in grabbing the reader's attention (Table 1). In particular during the review process, the introduction must get the reviewer "hooked", wanting to read more, and thinking to themselves, "How come I never thought of this?". In this section, you will thus explain why you undertook your study, what you aimed to achieve with it, and how this constitutes a useful addition to the existing body of evidence on this topic.

In concrete terms, you should start by explaining briefly, using appropriate references, what is already known about this subject. You should then narrow the field down somewhat and identify the areas where there is still some uncertainty, citing, where appropriate, any previous (and possibly conflicting) data. This will logically lead to a description of an explicit gap in the knowledge that your study hopes to fill. This is an essential element in justifying the utility of your work. Having now explained how your study is going to contribute something new and useful, you should clearly state your working hypothesis, followed by your objective(s), and very briefly, the strategy implemented to achieve these goals (Table 1).

In the background, the reasons that prompted you to undertake your research should be clear to the reader, and justified by the state of scientific knowledge with appropriate references. It is not necessary to cite every article in the literature on the topic; a careful selection of the most pertinent publications is sufficient. Similarly, it is not necessary to state universal truths that may seem over simplistic or eminently obvious. Yet you should try to achieve a suitable balance between relevant background information, and excessive detail. In this regard, you should keep in mind the target audience you are aiming for. This will depend on the profile of the readership of the journal in which you intend to submit your research, as mentioned above. If you are targeting a specialty journal, then your background can be more detailed and technical than if you are addressing an audience of non-specialists in your field.

The introduction should logically flow towards the identification of the gap in knowledge that you hope to fill. This is your opportunity to state the added value of your study, or the new information that your study will yield. Will your results change clinical practice? Will they help the scientific community at large to move towards consensus on a previously controversial topic by providing hard evidence in one direction or the other? This is your chance to make a sales pitch for your article, in the appropriate terms, of course.

As far as possible, try to avoid diverging from the subject at hand. Every sentence should serve a purpose. Many journals have a limit on the length of the introduction, with a maximum number of

Table 1
Outline of the main features of the Introduction section, with examples.

Feature	Example
Background describing what is known on the subject	Percutaneous coronary intervention is the cornerstone of therapy for acute coronary syndromes, but may be associated with procedure-related complications
What is not known? What elements are still subject to controversy? What is the exact gap in the knowledge that your study hopes to fill? Cite any existing data, especially conflicting data that indicate uncertainty	It remains unknown whether… To date, it has not been proven… No study to date has investigated the effect of… There are few data to quantify… The effect of… on… remains unclear
Objective (± working hypothesis)	We hypothesized that the administration of… would reduce/increase… in the context of…
Cite the exact parameter you plan to measure	We aimed to identify/assess/evaluate/investigate…
Cite the type of patient population or clinical context	Through a prospective, single-/multicentre, observational/interventional… study
Cite any secondary objectives	