

I performed experiments and I have results. Wow, and now?

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Summary

Writing a scientific article is not an easy task, but it is definitely a great satisfaction to be able to conclude and publish it. Indeed, each publication is a service we make to the entire scientific community and to the advancement of science even before our personal career. There is and there will not be a final book/article for writing a scientific paper. Therefore, some knowledge is a decisive factor to increase the chances of our work being accepted by a specialized scientific journal. The purpose of this editorial is to trace an ideal path, based on our personal experience, useful to properly structure a scientific article, from bibliographic research to cover letter. Articles should not be written in a polished way to gratify one's own ego, but they must be written for anyone who can read and understand them.

Level of evidence: V.

KEY WORDS: academic writing, publication, publishing, scientific criteria.

The fascination of writing a scientific article

If you are reading these lines, you are writing for the first time, or you have already tried to write a scientific article, and wish to improve your chances of getting it published.

Whether one or the other, this is not going to be the usual technical note on how to write a scientific article. Dozens such publications are available on the web, and this is a quick reference guide on how the Editorial team at Muscles, Ligaments and Tendons Journal would like its Authors to try writing well and in a way understandable to its readers.

Scientists are a very small part of the whole world population: the Thomson-Reuters report "The World's Most Influential Scientific Minds, 2015"¹ estimated that the active scientists in the world are about 9 million, and produce about 2 million scientific articles a year.

In addition, the requirements of modern scientific endeavours make each scientist usually hyper-specialized in a narrow field of research²: therefore, we naturally tend to write scientific articles using a hyper-specialist tone³ rather than a popular one⁴.

Also, given the *publish or perish* culture prevalent in academic circles, there is a risk of writing just sufficient articles, poorly discussed and methodologically misleading, probably not really worthy of being published or published in relatively low level scientific journals.

Anne Louise Germaine de Staël – better known as Madame de Staël (1766-1817) – wrote: "*The pursuit of truth is the noblest occupation of man; its publication is a must*".

In addition to the nobility of Madame de Staël's statement, the reasons which press us to publish are multiple, in addition to communicate something new: modifying existing practice, promoting debate or reflection on a specific theme, teaching, doing a career, and so on.

Where to start from

Let us say that we had what we believe is a great

idea. The first thing to absolutely do is a search on PubMed, where we can verify whether somebody else has already had our great idea, and has published it. PubMed is the most famous search engine for scientific publications, which, by the way, has among its articles a tutorial for its use⁵. As mentioned above, about 2 million scientific articles are published every year, an average of 5,500 articles per day. Obviously, such quantities are unmanageable by a human being, and the intelligent and correct use of PubMed is a real life-saver. However, in our experience as mentors and supervisors, we have realized how students, even those considering to embark in higher doctorates, do not use properly this precious tool.

PubMed allows us to ascertain whether our research hypothesis has already been thought out and published by someone else. In this case, the good news is that it was probably a good idea; the bad thing is that we will not be able to publish something already written.

However, we may take it as a starting point for further in depth, widening, critical analysis or new research ideas.

Before you start combing the science world through the tools available on PubMed, it is important to use common sense. When we search for a given topic, we can get tens of thousands of results, and it is unthinkable to be able to read everything that has been published about that given topic.

Even restricting the search may still produce an unacceptably high amount of scientific publications. For this reason, a good criterion is to focus our search on the title of the work.

It is possible that a research group has focused on a topic over a long period. In this instance, it may be useful to read one of the last articles published by the group.

It is helpful to compare and contrast the results by different research groups from different geographic locations, dealing with similar topics and publishing more or less at the same time.

Clicking on the site <https://www.ncbi.nlm.nih.gov/pubmed> you will find a page with a search bar at the top, as in Figure 1.

Let us suppose that we are interested in the hip. We will then write "Hip", and we will click on "Search". However, such search will produce a lot of results (Fig. 2). This search does not discriminate a fundamental thing: where 'hip' as a term appears in the manuscript. Such a search asks the search engine to select all the articles that have been published so far which have the word "hip" anywhere in the manu-

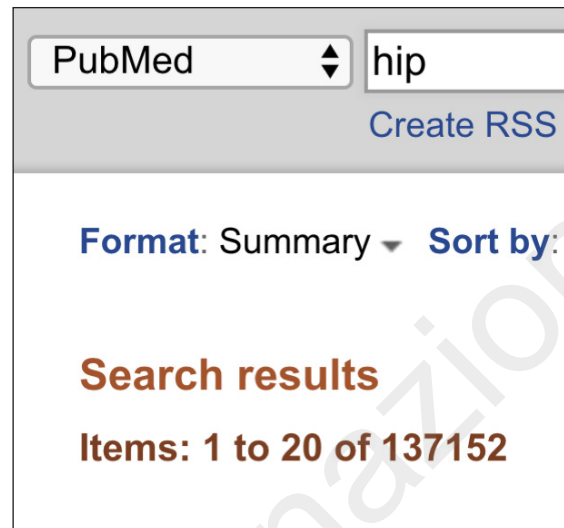


Figure 2. Looking for Hip and clicking on Search will result in 137.152 scientific articles.

script (i.e., title, abstract, extended article, thanks etc.). The first article that appears with hip written somewhere in the article dates back to 1827, by Edward Stanley⁶.

To improve our search we will need to use Boolean operators (must be written in upper case letters):

- AND - it allows us to select all the items having two terms present at the same time. For example, writing hip AND surgery you will find, to date, 67.805 items instead of 137.152;
- OR - it allows us to select all the items having two terms that may not be present at the same time. For example, writing hip OR surgery you will find, to date, 4.188.032 items instead of 137.152;
- NOT - it allows us to select all the items having a given term, but not the next one to NOT. For example, writing hip NOT surgery you will find, to date, 69.347 articles instead of 137.152.

There are other extremely useful commands that must be written in square brackets after a given term and in lower case letters. The main ones are:

- [ti] - it allows us to search all the scientific articles with that term in the title. For example, hip [ti] will provide, to date, 56.094 results;
- [tiab] - it allows us to search all scientific articles with that term in both title and abstract. For example, hip [tiab] will provide, to date, 116.814 results;
- [au] - it allows us to search for all the scientific articles published by a given Author, in this case,



Figure 1. PubMed search bar where to insert keywords and Boolean operators.

besides his/her surname, it is useful to know the initial of the name. For example, Trentacosta N [au] AND hip [ti] will provide only 1 result.

As it can be seen in the last example, the clever combination of commands in brackets and Boolean operators provides the best result in reducing the number of scientific articles to be consulted.

How to proceed?

We have thought of a research project, we have completed it, and now we have outcomes that we want, or, as Madame de Staël would say, must communicate to the scientific community.

This step follows another, which we do not tackle in this article, namely the quality of experimental design, the comparison with ethical committees, the use of animal or human subjects; these topics are described in depth in one of our previous articles⁷.

No stylistic virtuosity, no particularly sophisticated or hyper-specialist writing will save us from a poorly set up and conducted research. So before, we set up on a research project, we need to try and answer some fundamental questions:

- Is the research original?
- Are the tools, including questionnaires, I chose to use validated, and have they already been used in other research works?
- Does the research design test in clearly and complete fashion the basic hypothesis?
- Are all subjects participating in the study, whether they are human beings or animals, in a statistically relevant and representative number?
- Does the research project follow accepted ethics standards?

Assuming that our research project is a good one, now we need to ask ourselves honestly how these results are innovative and important to the progress of science, and whether they are interesting enough to pursue our purpose of wanting to publish. It can be argued that every new result is a progress, a mosaic tile in the knowledge of the world, but there are important, less important, and unfortunately, irrelevant discoveries. Returning to the mosaic metaphor, there are central and peripheral tiles.

Once established that our results can be influential, even in light of what it has already been published, the following questions arise: “*What type of article do I write?*”; “*Where do I start writing it?*”; “*Which journal do I send it to?*”

Answering these questions for a senior researcher is an automatic mental routine, but this is not the case for researchers at the beginning of their career. Communicating well and in the right scientific journal is essential for the work to reach its maximum possible visibility. So, before writing down the article, it may be useful to have a new and brief checklist:

- Is the content of the research significant?
- Is the research really original?
- Have the tools used met the criteria of reliability and validity?^{8,9}

- Are the measurements of the results well correlated with the variables set in the study?
- Does the research design test clearly and completely the basic hypothesis?

Once all these conditions have been met, we can start thinking about which journal will receive our manuscript.

Type of articles

A very special thing about modern scientific articles is their brevity. Indeed, several years of research need to be condensed into a remarkably few pages. Those not involved in such ruthless brutal synthesis may not understand the effort behind it all. Classically, the types of article that can be written are basically four:

- Reviews
- Letters to the Editors
- Clinical cases/Case reports
- Original articles.

Review articles

These types of articles^{10,11} have a very important function. Let us imagine a young researcher wanting to know more on knee injuries: he goes to PubMed and type Knee injury [tiab]. He can find out 2.279 articles to date. However, he can select on the left, under the Article Types, the Review section (Fig. 3), and he will realize how the number of articles have dropped to 199.

Still many articles, and it may be necessary to further refine the search. The researcher is interested in soccer knee injury, and he will type on PubMed Knee injury [tiab] AND soccer [ti] by finding 34 articles, of which only 4 reviews. The functions of Review articles can be summarized in these three points:

- Summarize the previous studies by making a sort of snap-shot of present literature;
- Identify relationships, contradictions, lacks in literature about a given topic;
- Define, clarify and suggest a further step forward with regard to a given scientific problem.

Review articles have evolved. Only a few years ago the most common ones were narrative reviews. These have been largely superseded by systematic reviews and meta-analyses. Both systematic reviews and meta-analyses test a clearly formulated hypothesis, and offer a quantitative synthesis to the issue at hand. They may require sophisticated statistics, and may inform, and at times change, practice.

Letter to the Editor

This is a brief communication to the Editor, which usually does not exceed 500 or 600 words, normally commenting on another paper published on the same journal¹². This type of article is useful to criticize, support, correct or ask further information/explanations about results presented by other scientists¹³⁻²⁶.

Clinical cases/Case reports

They are considered the most basic and ancient form

The screenshot shows the PubMed.gov interface. At the top left is the PubMed logo and the text 'US National Library of Medicine National Institutes of Health'. A search bar contains 'knee injury [tiab]'. Below the search bar, there are options for 'Article types' (with 'clear' next to it), 'Format: Summary', and 'Sort by: Most Recent'. The 'Article types' dropdown is open, showing 'Clinical Trial', 'Review' (which is checked with a blue checkmark), and 'Customize ...'. Below this, there is a section for 'Text availability' with 'Abstract' selected. The main search results area displays 'Search results' in a large orange font, followed by 'Items: 1 to 20 of 199'.

Figure 3. Article types section on <https://www.ncbi.nlm.nih.gov/pubmed> where refine the search to Review articles.

of communication in medicine. These articles are centered on the description of clinical cases of scientific interest for diagnosis, treatment, care, etc. of a given problem²⁷ or to describe particular diseases, observations or conditions²⁸.

Specifically, cases are usually first observations and are discussed in an original way. They are able to give rise to debate in the scientific community. The popularity of case reports as a publication is waning. Many scientific journals, including *Muscles Ligaments and Tendons Journal*, statutorily do not publish case reports. This is not because they cannot be interesting, or of didactic value. Unfortunately, they are of little academic value, and, given their nature, carry little chance of citation. Also, many appointment committees disregard them wholly for the purposes of career advancement.

Original articles

Original articles are the standard of scientific research, and can concern laboratory, field, animal research²⁹⁻³⁴ or human research³⁵. They are structured so that other scientists can replicate that specific experiment.

The structure of this type of article is very formulaic, and follows a fairly standard mode: title, abstract, introduction, materials and methods, results, discussion/conclusions, reference; sometimes are present acknowledgements. Furthermore, they can be structured in the form of guidelines³⁶ or perspective³⁷.

Most of the published articles report only positive results. However, publication of negative results should be encouraged to allow other researchers not to pursue avenue which are unproductive, saving time, money and resources. As long as a result is valid, and has been produced in a scientifically sound fashion, it deserves publication. At present, to our knowledge, only two journals (<http://www.negative->

[results.org/](https://www.negative-results.org/) and <https://jnrbm.biomedcentral.com/>) are totally dedicated to the publication of negative results.

How to write an Original Article

Whereas in the case of reviews, case report, letter to the editor articles we can use more or less a free form (always taking into account logical criteria, even in a case report it makes sense to write the description first and then the case discussion) in the original article, the drafting of the final article provides, as we have aforementioned, a rigid order.

However, when we write down the article we will not follow a rigid order because it is easier to structure the manuscript in a different way. Let us now see some suggestions step-by-step for creating an original article which obviously in its final form will have to be written as follows: Title, Abstract, Introduction, Materials and methods, Results, Discussion, Conclusions, References. Furthermore, it is possible to write also Limitation of the study and Acknowledgements.

Materials and methods

We have finished the experiment, done the statistical analysis and we have had good results.

We would like to write result and discussion paragraphs at once but the material and methods section is more important at this stage. It is the first part to write down, in some ways the most simple and complex section in the same time³⁸. The simplest because we describe what we did, tools, resources, samples, etc. we worked with³⁹. It is very descriptive but also very complex, because there is the risk of being synthetical taking for granted much information. Sometimes we omit to write what it seems to be a de-

tail, but this section allows Dr. Vattelapesca, belonging to Pincopallino University on the other side of the world, to read our article and replicate the experiment. Science is distinguished from pseudoscience precisely because of this: for the repeatability of the result.

Therefore, we must enable Dr. Vattelapesca to reproduce the experiment with the same peculiarities, thus achieving the same results. Let us make two examples: I) Use the same metering tool but produced by different companies can lead to different results; II) If we did some experiments outdoors and all of them were done while raining, this does not represent a detail to be omitted because reproducing the experimental procedure on the other side of the world, when it is sunny, can lead to different results. On the contrary we might repeat the experiment outdoor changing the climate conditions and see if data measurements and results change.

When we write materials and methods it is therefore decisive to put ourselves in the reader's shoes who knows nothing about that experiment and has to follow a recipe. In other words, using a culinary language, I cannot just write "bake the cake" rather what type of oven (microwave? standard oven? wood oven?), at what temperature and for how long. Materials and methods are the most exposed part of possible criticisms of the scientific community though and that is why it is essential to write them immediately so as to try to be as consistent as possible throughout the article.

Results

Unlike materials and methods, this part of the article should be essential. The mistake that many researchers have at the beginning of their career is to write in this section part of the discussion. In other words, they start commenting here the results.

In addition to being synthetic, Result section has to present all statistical aspects so that the reader has clear the impact of the experiment (i.e., standard deviation, means, p-values, etc.). Moreover, it must not be redundant. For example, if we write the statistical results in the main-text, it makes no sense re-write them in tables and/or in captions belonging to images/charts. However, they can be summarized in tables. Those who read, first of all the reviewers, want this part to be clear (i.e., results are unequivocally highlighted) and concise. Finally, it is important that the measurement values are the same through the whole article (e.g., if we use minutes we will always use minutes, not hours or seconds).

Introduction

This part of the article is often underestimated and thought as annoying, but it is an essential part because it describes: I) The current state of the scientific literature about the topic we will face; II) A given problem but not still solved; III) Our contribution to enriching the previous two points.

When we write down the introduction we have constantly to keep in mind: "Why am I writing another study on this topic?".

Going back to our culinary language if there is a problem for properly baking an apple pie and we are going to write a new apple pie recipe made with an innovative oven that improve the quality of result, it is pointless talking about pears and fridge in the introduction. We will rather describe how an apple pie has been made so far, what kind of apples, oven, etc. Moreover, the results of the mentioned papers in introduction must not be discussed here, we could just mention consistency or contradictions among scientific articles about the same topic. Finally, the introduction should always end with an affirmation that defines the purpose or purposes of the study, for example: "[...] therefore, the purpose of this study ...".

Discussion, Conclusions, Limitation of the study

It is the final section of our coveted article and is undoubtedly the most important and delicate part.

At this point we have to discuss our results by comparing them to publications already existing in the reference scientific field without unnecessary emphasis and with due objectivity.

In this section we have to say to the scientific community the reasons why our research is useful to the science progress. It is important to quote many articles that have already discussed the issue we have addressed and explain whether we are in line with these ones and why or whether we disagree explaining convincingly the reasons, especially if much of the literature is not consistent with our results. At this point we can describe which perspectives are able to open our research, by looking at the future, always aware that science in general is by definition in progress. For this reason almost all scientific works tend to close with such phrases "Further studies are necessary to better understand...".

Some scientists prefer to add a paragraph "Limitation of the study" but, where not expressly required by the scientific journal or reviewers, it seems to be a way to support ourselves that the research is good but not enough. Perhaps it may be useful when we know that our materials and methods are weak, but regardless writing this paragraph seems to be objectively useless.

The references

The aim of citations and references is to support the statements we made along the manuscript. Sentences such as "It has been known" or "It has been previously demonstrated that" must be expressly supported by a bibliographic entry (this is a common mistake made by students when writing their graduate thesis, where they go into continuous statements without promptly saying who and where a certain thing has been said). It is true though that some statements are commonly accepted so as to make it pointless specifying the bibliography (e.g., the earth planet is spherical), but basically each statement must be supported by a bibliography. Before pro-

ceeding to the entire writing of the manuscript, and after choosing the journal to send it to, it is very important to read the guide for the Authors which reports the style of formatting the citations and references that, unfortunately, changes according to the different journals. The risk consists in making a huge work and then have to change it.

The title

The title must be captivating, not trivial, and directly describing the main outcome(s). The title should be considered as a bait with which to attract the reader so as he reads the abstract. Moreover it is the first criteria when we have to choose and open a link, an online article or choose whether to read an article in a scientific journal. For example, a bad title may be: *"The use of mindfulness to reduce stress in the healthcare environment"*. A good title may be: *"Mindfulness as a tool useful to reduce stress in all healthcare professionals"*.

The abstract

Once we have found an attractive title for our research it is important to write a good abstract, which will be the "business card" of our article. This section is readable to anyone in the world and therefore we have to create a good collage of the whole manuscript. Those who click on the title of our article on PubMed will do that for reading the abstract and choose whether to venture into reading our last effort. There are two mistakes to avoid in the most absolute way.

The first is not to follow the journal guidelines (i.e., some journals require a subdivided abstract, for example into Background, Methods, Results, Conclusion, Keywords, Abbreviations). The second is to write an abstract with a long winded background and few lines with respect to results and conclusions. A good abstract must have the opposite principle: very few lines on the background and many more on results, conclusions and, if possible, future perspectives. In an abstract of 10 lines, 2-3 should be devoted to the background, the rest to the results and conclusions.

Keywords

Many journals use keywords. These are useful for us because they allow our article to appear more likely in PubMed filtered searches and therefore allow us to use terms that we have not been able to put into the title or that can be sought alternately (e.g., kinesiophobia vs fear of movement; mindfulness vs awareness).

The Authors and their position

This is a most thorny decision. A good rule is to establish from the beginning the order in which the Authors' names will appear. The International Committee of Medical Journals Editors (ICMJE)⁴⁰ has established four essential criteria according to which the Authorship can be credited:

- substantial contributions to conception or design

of the study; or the acquisition, analysis, or interpretation of data for the study;

- drafting the article or revising it critically for important intellectual content;
- finally approving the version of the article to be submitted;
- agreement to be accountable for all aspects of the study in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

There should be no deviation from these four principles, and probably anything else it should be considered a violation from the ethics of scientific publishing. Once the names are chosen, it will be necessary to list them in order, taking into account that the first and the last Author are regarded as the most important. Generally, the first Author should be the one who has conceived the experimental design and/or has written most of the work. The last Author should be the one who has revised the entire manuscript and has, hopefully, improved it. The central Authors, on the other hand, from the third onwards, are those who have materially conducted most of the experiments. The second Author, in our opinion, should be the one who contributed more to the success and writing of the manuscript by supporting the work of the first Author.

What is the best journal for my paper?

Our work cannot bounce from journal to journal without even undergoing peer review: it is therefore necessary to decide which journal to submit it to. First of all, it is important to read the aims and scope section of a journal. This obviously should be done before the manuscript has been finalised. Most journals implement a pre-peer review process in which they perform a formal consistency check between what is required in the Author's guide and what is written in our files (e.g., if we removed the Authors from the main manuscript to make the article blinded, if we used the right formatting for citations and references, etc.). Is the manuscript fulfils the formal requirements of the journal, the editor will give a first reading to the manuscript, and decide whether it is consistent with the aims and scopes of the journal. If so, the editor will appoint two or more reviewers. If not, the Authors will have their manuscript returned to them, telling them to look for another journal more in tune with the work.

This is a non-exhaustive checklist to help us decide whether our work can suit a particular journal:

- Aims and scope: take into account that the journal we chose for our article may easily be among those we quoted in our references;
- Sample size and significance of results: if we know that our results will not revolutionize science, the journal which we will aim for is unlikely to have a high impact factor. The impact factor is a good index to understand how prestigious the scientific journal is. The more we assume our results are important, the more we can think about a scientific journal with a high impact factor.

- Indexing: it is important to choose journals indexed in the most well-known databases (e.g., Scopus and Web of Science), and verify whether the journal is listed in PubMed;
- Article types: journals do not accept all types of articles. For example, there are journals which only publish review articles, and do not accept original articles.

Finally, avoid the “predatory journals”, scientific journals that ask for money to publish and which do not meet scholarly publishing standards¹⁹. These journals are often not indexed in the major databases and in PubMed, they often disappear into nothingness, have no impact factor, and therefore do not contribute to our curriculum.

Cover letter

Once a suitable journal has been chosen, it is recommended that we write a brief letter presenting our article without being verbose, and outlining two issues: I) Why we want to publish in that specific journal; II) Briefly describe why our research is innovative. The cover letter is important to give an idea about what the editor will read. We must not write backgrounds, materials and methods, conclusions, etc., but only focus on scientific results and progress.

Conclusions

There is no a definitive guide to writing a scientific article. There is no substitute for actually performing the research, and writing the manuscript.

Writing an article is a service to the whole scientific community, and not a selfish exercise in style. Reviewers and readers will read the article with their own eyes and knowledge, and it is therefore important to write a manuscript aimed at the whole scientific populace.

Conflicts of interest

The Authors declare no conflicts of interest.

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