Recommendations for young researchers on how to better advance their scientific career: A systematic review

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ABSTRACT

INTRODUCTION Although a number of articles offering advice for early career researchers have been published, no systematic review has summarized the available recommendations. This study aimed to enhance young researchers by reviewing the literature and providing a comprehensive set of tips and advice, applicable to a broad range of scientific fields.

METHODS The systematic review was performed in PubMed database. Relevant articles published from 1 January 1990 to 31 December 2020 were located according to a comprehensive search algorithm. Inclusion criteria were English language, articles containing clearly formed recommendations, and articles including recommendations that could be utilized by researchers working in a broad range of disciplines. The search algorithm provided 62 articles. From those, 18 fulfilled the chosen criteria and were included in the review. One further publication was added that did not emerge from the search algorithm but came up according to the snowballing approach.

RESULTS In total, 208 advice suggestions ('tips') emerged from the studied articles. Upon classification they were categorized into five broad thematic groups: 'Funding and research proposal writing' (26 tips), 'Mentorship, networking and collaboration (25 tips), 'Enhancing visibility as a researcher' (28 tips), 'Writing and publishing a journal article' (43 tips), and 'Personal and professional development' (86 tips).

CONCLUSIONS This is the first systematic review summarizing useful recommendations for young researchers with regard to initiating, conducting and promoting their scientific work and career. The provided guidelines form a valuable and easy to read tool that can inspire and encourage young researchers in building a successful scientific career while avoiding common pitfalls.

INTRODUCTION

Academia is a highly competitive world on its own with many hidden rules that can be confusing for young researchers[1]. Beyond formal training and the skills learnt in the course of their education, young researchers could benefit from further guidance on how to enhance their way to success. Indeed, literature supports that the majority of young researchers start a career in science with limited knowledge on how to confront the expectations and challenges awaiting them[2]. Apart from the core requirements such as specific knowledge and research skills, several other factors are important to boost a successful research career.

A study about life in academia revealed that among the main challenges that postdoctoral researchers faced were: work–life balance, securing grant funding, and a competitive job market[3]. Considering that young researchers are particularly vulnerable for developing mental illnesses[4-6] due to the nature of their occupation and their reduced ability to cope, the provision of advice/suggestions based on the collective experience of other senior and junior researchers with practical knowledge in the field could serve as a valuable tool. Especially young medical researchers,

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worldwide, often face several challenges in the early stages of their career, as formal acquisition of research skills in academic settings do not always offer sufficient guidance to tackle these obstacles[2]. In particular, a study among young medical researchers stressed the high levels of burnout, anxiety and depression in this vulnerable population[4], due to lack of funds, short deadlines, competitive work environment and career challenges[2,4].

Like many aspects of a person's life, research can also be enhanced by heeding the advice of others. Although some suggestions may seem obvious to senior scientists, for young researchers – especially those with limited access to good mentors – it is unknown territory[1]. The summarized guidelines can accelerate young researchers' performance to achieve the maximum of their potential while at the same time help them with their work-related anxiety and stress.

An appraisal of the current literature revealed that little guidance has been provided for novice researchers. To the best of our knowledge this is the first systematic review that has endeavored to synthesize career recommendations for junior researchers resulting in a comprehensive set of tips, applicable to a broad range of scientific fields. The main aim of this article is to enhance the efforts of young researchers by providing valuable recommendations on how to develop a successful scientific career and avoid some common, but not obvious, pitfalls during their early research steps.

METHODS

Literature search

A systematic literature review was performed in the PubMed database. Auto-alerts in Medline were also run during the course of the review, while reference lists of relevant articles were also checked. Two independent reviewers screened all articles, first by title, then by abstract and lastly full-text articles according to relevance. Disagreement was resolved by discussion, and where no agreement was reached, a third independent party acted as an arbiter. A core body algorithm and additional sub-algorithms (using alternatives and additional key words) were applied and critically appraised as described below.

Search algorithm

The core algorithm used (Supplementary file Table 1) in the study was: {(tips[Title] OR tip[Title] OR advice[Title] OR help[Title] OR guiding[Title] OR guidelines[Title] OR guideline[Title] OR assisting[Title] OR recommendations[Title] OR recommendation[Title] OR suggestions[Title] OR suggestion[Title] OR lessons[Title]

Table 1. Data synthesis

Author(s)	Title	Journal	Year	Relevance	Type of evidence/ recommended by
Antoline-Wang	How to get published: Two top journal editors offer tips and tricks for young researchers	Annals of Neurology	2013	Advice on how to get research published along with specific 'tips for success' for building a career	Opinion-based /senior
Brannan et al.	A research primer: basic guidelines for the novice researcher	Journal of the American Osteopathic Association	2013	Discusses steps of the research process and offers additional tips for the novice researcher	Opinion-based/ seniors
Case-Smith	Developing a research career: advice from occupational therapy researchers	American Journal of Occupational Therapy	1999	Qualitative study that provides advice (find mentor, networking, etc.) for developing a research career	Evidence-based/seniors
Chapman	Reflections on a 38-year career in public health advocacy: 10 pieces of advice to early career researchers and advocates	Public Health Research and Practice	2015	A set of advice derived from public health advocacy that could also be adapted in other research fields	Opinion-based/ senior
Cherry et al.	Advice for junior researchers: lessons learned from the 2011 Y-EACH Junior Investigators workshop	Patient Education and Counseling	2012	Summary of lessons learned during a workshop aiming to provide advice for young researchers	Empirical and opinion-based/ seniors and juniors
Collins et al.	Research dissemination: guiding the novice researcher on the publication path	Journal of the American Osteopathic Association	2015	Provides a digestible guide to the publication process (advice on ethics, journal selection, etc.)	Opinion-based/ seniors

Continued

Table 1. Continued

Author(s)	Title	Journal	Year	Relevance	Type of evidence/ recommended by
Elston	Planning better research projects: advice for young researchers	Journal of the American Academy of Dermatology	2019	Key items to consider when planning a research project	Opinion-based/ senior
Glover et al.	A pragmatic approach to getting published: 35 tips for early career researchers	Frontiers in Plant Science	2016	Advice for collaboration, journal selection and tips to achieve paper acceptance	Evidence and opinion-based/ seniors and juniors
Hershko	Science as an adventure: lessons for the young scientist	Rambam Maimonides Medical Journal	2010	Presents a synoptic table with lessons from author's life in science	Opinion-based/ senior
Lawrence	Getting involved in research: lessons learned from a novice researcher	Association of Women's Health, Obstetric and Neonatal Nurses Lifelines Journal	2006	Author describes the important lessons she has learned as a novice researcher	Opinion-based/ junior
Malone	Getting your study funded: tips for new researchers	Journal of Emergency Nursing	1996	Practical tips on obtaining a research grant along with 'Eleven Commandments for Getting Funding'	Opinion-based/ junior
Mbuagbaw et al.	Tips for charting the course of a successful health research career	Journal of Multidisciplinary Healthcare	2013	Based on the collective experiences of researchers, provides tips and offers some useful resources	Opinion-based/ seniors and juniors
Morrow	What does a fellow need to know to build a successful academic clinical research career?	Journal of Oncology Practice	2005	A set of advice that can be implanted in other research areas too, rather than clinical research only	Opinion-based/ senior
O'Carroll et al.	Top tips for interprofessional education and collaborative practice research: a guide for students and early career researchers	Journal of Interprofessional Care	2020	Guide that shares tips and considerations to assist early career researchers and students through their interprofessional research journey	Empirical and opinion-based/ seniors and juniors
Peters	How to become a successful researcher: tips for early career researchers	Scandinavian Journal of Work, Environment & Health	2014	Overview of tips (mentorship, networking, etc.) given by senior scientists during a conference	Empirical-based/seniors
Quigley	What does science tell us about resilience: lessons for early career scientists	Physiologist	2016	Tips on health habits that enhance resilience and reduce distress to face professional adversity	Opinion-based/ senior
Thompson	Advice to a young researcher: with reminiscences of a life in science	Philosophical Transactions of the Royal Society A: Mathematical, Physical & Engineering Sciences	2013	An informal guide with useful snippets of advice to young researchers drawn from author's career	Opinion-based/ senior

Continued

Table 1. Continued

Author(s)	Title	Journal	Year	Relevance	Type of evidence/ recommended by
Wilcox and Brown	What challenges do new researchers face when applying for funding? Doctoral candidate offers advice for overcoming barriers	ONS Connect	2007	Offers advice regarding obtaining funding drawn by authors' experience as doctoral candidates	Opinion-based/ junior
Zijlstra	Launching an academic research career	Disease Models & Mechanisms	2009	Addresses the choice to become an academic scientist and how to prepare for the job search	Opinion-based/ seniors

OR mentoring[Title])} AND {(new researchers[Title] OR (new[All Fields] AND researcher[Title]) OR early career researchers[Title] OR early career researcher[Title] OR young researchers[Title] OR young researcher[Title] OR junior researchers[Title] OR junior researcher[Title] OR research career[Title] OR novice researchers[Title] OR novice researcher[Title] OR new scientists[Title] OR (new[All Fields]} AND {scientist[Title]) OR early career scientists[Title] OR early career scientist[Title] OR young scientists[Title] OR young scientist[Title] OR junior scientists[Title] OR junior scientist[Title] OR scientific career[Title] OR novice scientists[Title] OR novice scientist[Title])}.

Inclusion and exclusion criteria

Three inclusion and exclusion criteria were adopted, as noted in Supplementary file Table 2. All articles written in English language, irrespective of the type, and that clearly provided advice that could be easily derived from the text, were included. Biographical articles that described authors own experiences/lessons learnt without giving specific advice, and articles with tips on very specific areas of a scientific field or regarding particular sectors (e.g. job search, award writing) that could not be generalized, were excluded from the analysis.

Data extraction and synthesis

The study selection process is outlined in the Preferred Reporting Items for Systematic Reviews (PRISMA) flow diagram (Figure 1). In total, 62 published articles emerged from the search algorithm in PubMed. Furthermore, 1 article was added according to the snowballing approach. Overall, 63 articles were screened. Initially, 1 article was excluded due to duplication. A total of 13 studies were excluded

Table 2. Funding and research proposal writing

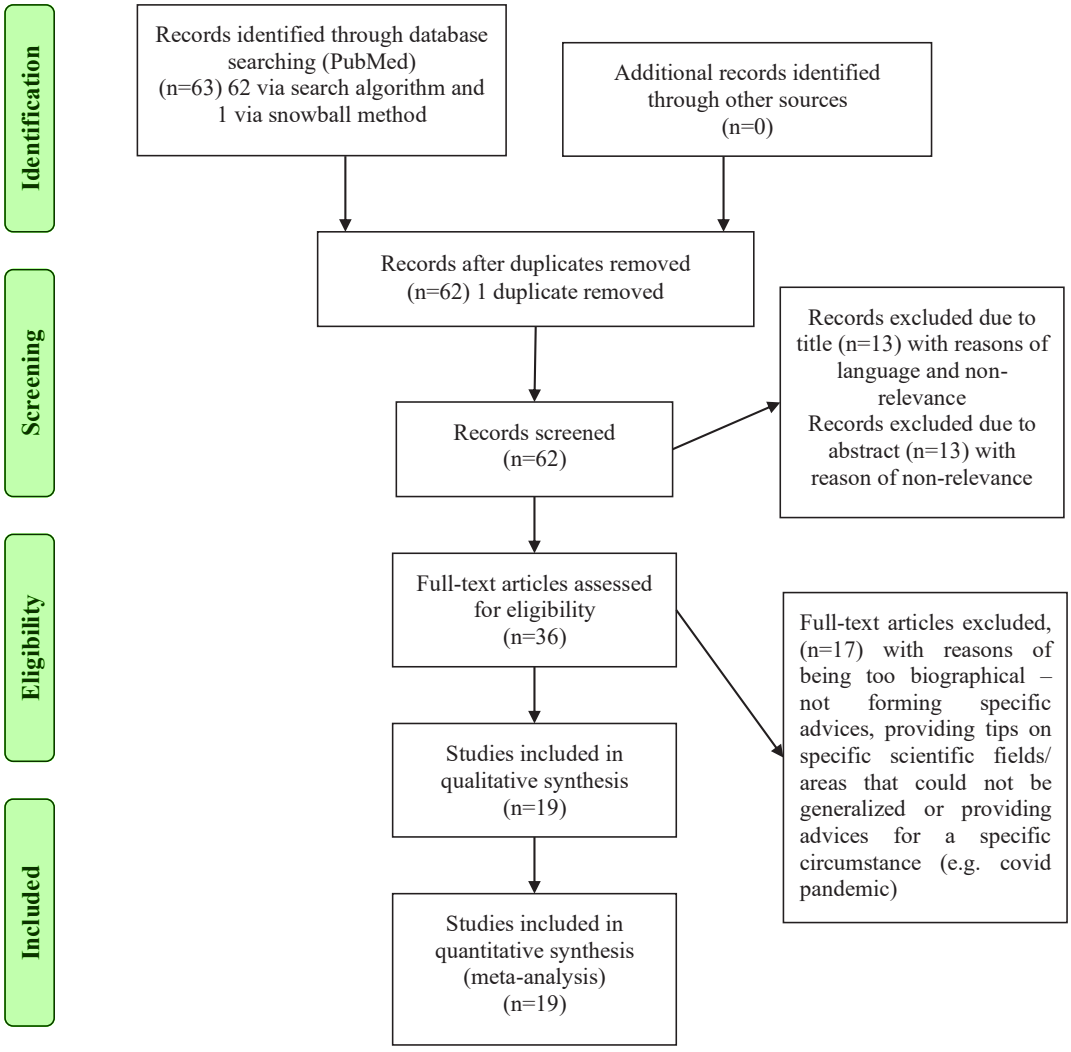
	Mentioned by
Funding	
Identify sources of funding. Having tangible funds can maximize the potential of your research.	O'Carroll et al. 2020
Secure funding. Some research requires little or no funding while for more complex projects, financial support may be necessary.	Brannan et al. 2013
Find a place with funding. The choice might be a matter of hunting around to find a university that will support you financially to work in a specific research field.	Malone 1996
Use networks to seek funding opportunities. Subscribe to mailing lists.	Mbuagbaw et al. 2013
Research proposal writing	
Develop a proposal which is the blueprint or guide of your research and is the basis for addressing the Institutional Review Board (IRB).	Brannan et al. 2013
Find the right theory to inform the research. Theory can help focus the research question and design or analyze and discuss the findings.	O'Carroll et al. 2020
Link the proposed research with the literature. Identify research gaps and flaws in previous studies. Show clearly why your approach is innovative and what your research could add to the existing body of knowledge.	Elston 2019 O'Carroll et al. 2020 Malone 1996

Continued

Table 2. Continued

	Mentioned by
Form a clear research question, aim, and study objectives to help guide the direction of your research design and methodological approach.	O'Carroll et al. 2020
Choose research methods wisely, depending on what you want to achieve in relation to your research question. Thinking through different options, reading other approaches, and using tried-and-tested techniques often lead to stronger research.	O'Carroll et al. 2020
Power the study adequately to answer the question and use statistical methods appropriate to the data.	Elston 2019
Data analysis processes should be rigorous and trustworthy. Use an identified analytical framework, appropriate to the methodology.	O'Carroll et al. 2020
Read carefully the Request for Applications (RFA). Familiarize yourself with all its details (words chosen, references cited, eligibility/review criteria, application procedures, etc.).	Malone 1996
If your RFA says that inquiries are encouraged (or possibly even if not), call the contact person listed. Discuss your concerns and ask for guidance in preparing your application. Without 'being a pest', familiarize yourself with the contact person.	Malone 1996
Ethical approval may be required. This process can be time consuming but think ahead by allowing time for ethics approvals in your project timeline.	O'Carroll et al. 2020
Engage with IRBs early for advice and guidance. If possible, have a completed human subjects' approval. The preparation of materials for your IRB will facilitate this portion of your grant application.	Malone 1996
Study design must be economically feasible and you should be able to complete the project in the specified time frame.	Elston 2019
Target your reviewers and put yourself in their place. Imagine the questions and concerns they might have and address them as specifically as possible.	Brannan et al. 2013
Give your reviewers every possible reason to like your proposal. Be clear and consistent with the terminology used.	O'Carroll et al. 2020
Make meticulous organization a priority. 1. Make sure your proposal is not only articulate, but organized and consistent throughout. 2. Specifically define the study aims and how these will be achieved. Using numbers to set them apart may help the reviewer focus. 3. Do not try to cram in too much: your reviewers may become frustrated and irritated. 4. Use headings as recommended and leave some blank space to make it easier to read.	Malone 1996
Utilize your contacts. 1. If you know someone whose research has been funded by this agency, ask for advice or to review your proposal. 2. Get letters of recommendation from people with impeccable qualifications. Ask them to serve as consultants or collaborators; if they agree, list them in your proposal as such. 3. Ask several people of diverse background to review your proposal.	Malone 1996
Rewrite, rework, revise. 1. Say exactly what you want to say. If something seems not quite 'it', work until it is right. 2. If needed, ask help for writing or editing your proposal. 3. Reread everything you write several times and imagine that you are someone who has never heard it before. Does it make sense? Do the ideas link smoothly together?	Malone 1996
Allow time for institutional process. Talk to your department's contact person about the time needed for departmental/research office processing so you do not miss a deadline.	Malone 1996
Believe passionately in your project. Understand why this project is so important and why you are the one who should do it.	Malone 1996
Envision yourself as a successful, funded researcher and you will be more likely to prepare an application that reflects that vision to others.	Malone 1996
Find the best people you can in order to form a multidisciplinary team that will help you to develop your proposal.	Wilcox and Brown 2007
Carefully follow the application or reapplication process. If your application is rejected, use the received critique to realistically reevaluate your proposal. Turn your failures into opportunities; rework, rewrite, and resubmit it.	Wilcox and Brown 2007 Malone 1996

Figure 1. PRISMA flow-diagram of the study selection process



from the title (4 due to not being written in English and 9 not being relevant). Additionally, 13 studies were excluded upon reading the abstract as they were not relevant; 36 articles were fully read upon reviewing the title and abstract of which 17 were rejected as they did not directly meet the criteria of the investigation. In total, 19 articles were included and utilized for the main findings of the study. The numerous valuable tips that emerged from the included articles (n=208) were then categorized into five broad thematic groups.

RESULTS

Nineteen articles were included in the analysis. Only two articles were published before 2000, one in 1996[7] and one in 1999[8], while another five studies were published between 2000 and 2010[9-13]. Eight studies included in the review were published between 2011 and 2015[1,2,14-19]. The last 4 articles were published between 2016 and 2020[20-23]. Table 1 summarizes the data synthesis of each article, including, publication information, its main focus, type of evidence (opinion-based, empirical, evidence-based) and authors' research career level (senior or junior researcher). Recommendations in Table 2 aimed to enhance grant proposal writing skills and guide new researchers on how to successfully obtain funds to carry out their research.

Table 3 focuses on tips regarding the 'human element' including how to facilitate collaborations, build professional networks and choose the right mentor. Advice in Table 4 is intended to help young researchers make themselves more visible in the scientific world by starting early to practice their writing skills and encouraging them to present their study findings by any means possible. Table 5 recommendations aim to help young researchers with writing and publishing articles by providing advice in several crucial areas such as which journal to target, how to prepare the manuscript and what ethical requirements need to be addressed. Finally, Table 6 gives a broader spectrum of useful

Table 3. Mentorship, networking and collaboration

	Mentioned by
Mentorship	
A great mentor is invaluable. Novice researchers should seek the guidance of a mentor when engaging in research.	Antoline-Wang 2013 Hershko 2010 Lawrence 2006 Case-Smith 1999 Collins et al. 2015 Morrow 2005 Zijlstra 2009
Find a mentor by joining mentorship programs and actively seeking mentorship.	Mbuagbaw et al. 2013
Look around for experienced people who have a career path that you would like to follow. Think about their career route. Ask them how they got a particular project or group up and running. Find your own path eventually: 'Observe, mix and do!'	Antoline-Wang 2013 Peters 2014
Choose a mentor who can guide you through the academic maze. Check what has happened to his/her previous students. Are they moving on to fulfilling careers?	Peters 2014
Choose a mentor with whom you click. You will be working closely and intimately together and a good relationship is undoubtedly needed.	Thompson 2013
A good mentor can help you: submit your work to the right places, get startup grants, develop your skills and experience, get in touch with other researchers, give you more responsibility and independence as your career progresses.	Morrow 2005 Peters 2014
Remain critical of your mentor's achievements and choose the different elements from your mentors carefully. Someday you will become an independent researcher yourself.	Peters 2014
Become a mentor; participate in mentorship programs or help junior colleagues.	Mbuagbaw et al. 2013
Networking	
Recognize the importance of networking. A network will help you in the development of new collaboration opportunities.	Cherry et al. 2012 Peters 2014
Start networking; use on-line networking forums and attend research meetings. Make contact with potential collaborators at conferences and re-approach them via email.	Mbuagbaw et al. 2013 Glover et al. 2016
Link with colleagues/investigators who have similar research interests and attend their seminars to identify potential areas for collaboration. Networks help in developing new collaboration opportunities, which may lead to new papers.	Case-Smith 1999 Morrow 2005 Peters 2014
Relocating and travelling can help building up an international network.	Peters 2014
Study media and use social media systematically. If you avoid them, you and your research are less likely to be influential.	Chapman 2015
Collaboration	
Research is fun and collaborative and requires teamwork. Start by being open to collaboration by seeking and offering help.	Lawrence 2006 Mbuagbaw et al. 2013
Be transparent with your colleagues about your career goals.	Zijlstra 2009
Build a research group. The deliberate start-up of a research group requires a core of talented researchers and a good supply of funds to attract more staff and students.	Thompson 2013
Commitment and enthusiasm are needed from everyone, while good communication between all parties at all stages is crucial.	Glover et al. 2016
Foster a team mentality that respects and supports one another's ideas and productivity. A cooperative environment is vital for individual and team success.	Quigley 2016
Discuss your ideas; other people may see possibilities that you didn't and you will be a colleague who others want in their team. Take care though to not reveal your best ideas.	Peters 2014
Be open-minded to partners' ideas/views. Treat collaborators equally and with respect.	Glover et al. 2016
At the beginning of a project: identify a leader, set clear goals and expectations for each collaborator, distribute tasks and responsibilities equitably, set dates for periodic reviews, and commit to identifying and solving problems in a timely manner.	Brannan et al. 2013

Continued

Table 3. Continued

	Mentioned by
Set the rules of the collaboration. Agree on: ethical standards, plan of action, outcomes, journals for publication, data ownership - authorship.	Glover et al. 2016
Collaborating with 'big names' can be good, as long as it is within ethical guidelines.	Glover et al. 2016
Collaboration between industry and academia is a win-win process (e.g. networking, recruitment possibilities, financial support, access to novel techniques/concepts, etc.).	Glover et al. 2016
International collaborations may lead to misunderstandings due to language barriers, especially in electronic format. Periodical face-to-face meetings can be very beneficial.	Glover et al. 2016

Table 4. Enhancing visibility as a researcher

	Mentioned by
Invest in scientific writing	
Start early manuscript writing. Good writing is part of research and an important research tool. You don't understand a result until you can present it well.	Mbuagbaw et al. 2013 Antoline-Wang 2013 Thompson 2013
Use scientific writing resources.	Mbuagbaw et al. 2013
Learn to write clearly. A good paper, like a story, has a clear beginning, middle and end.	Thompson 2013
Start and end strongly; remember that you know the area deeper than most readers.	Antoline-Wang 2013
To be a good writer, you need to invest in your writing skills. Keep up the habit of writing. Additionally, reading widely will help you become a better writer.	Peters 2014
Practice writing skills, they can be developed! Observe others and develop a style that is interesting to read and listen to. Ask others to review your drafts.	Antoline-Wang 2013
Publications in progress improve with age, provided you continue to revise them.	Thompson 2013
Worry not only about the value and correctness of your work. Be concerned also with its presentation, the writing, the drawings, the plots.	Thompson 2013
Original data are the key to papers. Find a project/position that enables access to data.	Peters 2014
Do not spread yourself too thinly by having too many projects in which you are a middle-author. Try to use the collaboration to gain experience, and next time, become a leader.	Glover et al. 2016
Put yourself out there. Do publicity for your publications to make you and your research visible to the scientific community.	Glover et al. 2016
Although social media and online platforms are increasingly being used as a quick way of sharing work, presenting research at conferences or via journal publication are common ways to disseminate findings.	O'Carroll et al. 2020
Convey the outcomes. Negative studies or unexpected results can be important.	Elston 2019
Offer to serve as a journal referee/reviewer.	Antoline-Wang 2013
Attend conferences	
Attend lectures and conferences. Conferences are a good place to present incomplete work; journals are not.	Brannan et al. 2013 Thompson 2013
Novice researchers should exhibit their findings as posters or oral presentations at conferences.	Thompson 2013
To ensure a targeted reception of your intended audience, consider in advance which conferences fit with your research goals.	O'Carroll et al. 2020
Planning for a conference presentation can be a tremendous spur to organize your material and is a good precursor to write a paper on the same topic.	Thompson 2013
Presenting your research can provide the assurance that your work really matters and can be a valuable stepping-stone to publication.	O'Carroll et al. 2020
When speaking at meetings the aim is to inform your audience by presenting your work in a clear and simple way. Simplicity will impress, unnecessary complexity will not.	Thompson 2013

Continued

Table 4. Continued

	Mentioned by
Feedback from the audience can be of great benefit.	Thompson 2013
Attend seminars. These are wonderful occasions to meet current and future colleagues.	Thompson 2013
Be an active member of conferences. This is where you get to know everybody who works in your area and where you join an informal 'international college' of researchers.	Thompson 2013
Discuss your ideas. Many young researchers have the illusion that everyone else is eager to steal their ideas. Carefully discussing your ideas in a big international conference with published proceedings is recommended; otherwise, it could be a bit risky.	Thompson 2013
Books	
Be skeptical of offers to write reviews and chapters.	Antoline-Wang 2013
A series of papers can often evolve into a book. This structure helps writers to organize their material, and put it into good, preserved, order.	Thompson 2013
It is important writing a book when there has been a great explosion or breakthrough of research in a field. This is needed to clarify, codify and record the achievement.	Thompson 2013

Table 5. Writing and publishing a journal article

Writing and publishing a journal article	Mentioned by
Apart from informing others, publishing papers benefits in building a good curriculum vitae. In addition, seeing your work in print is a very rewarding experience, and your head of department will be delighted to have an extra paper for the next research assessment.	Thompson 2013
Get into the habit of writing papers as soon as you have accumulated enough material; it is easier to publish a short, concise paper than a long and grand magnum opus.	Thompson 2013
While writing a paper, carefully check the materials. Write it up in a precise and readable way and generally try to become very familiar with it.	Thompson 2013
Make sure your article is well-written. Read the author guidelines to ensure that style and format meet the journal's requirements.	Glover et al. 2016 Collins et al. 2015
Be accurate. You are not only reporting what you did but also teaching your readers how to do it. This may be too much to ask of young researchers, but it's worth a try.	Thompson 2013
Define your aim and research questions clearly. Confirm the feasibility of the idea by considering the FINER acronym: Is it 'Feasible, Interesting, Novel, Ethical, and Relevant'?	Cherry et al. 2012 Brannan et al. 2013
Review the literature; identify a literature gap that the research will address and establish a framework and justification for a proposed study.	Brannan et al. 2013
Set the objectives and hypotheses. The objective can be one or multiple statements and can be in the form of an overall objective, specific objectives, or both.	Brannan et al. 2013
Use the research questions to inform study design. Construct a detailed description of how the research will be implemented including: study population, setting, sample size, research design, variables, data collection procedure, statistical tests, and statistical analysis. Methods of data collection must be standardized.	Cherry et al. 2012 Brannan et al. 2013
When presenting a very new method give a detailed bulleted prescription in a later section or in an appendix where the steps are summarized one by one.	Thompson 2013
Take a step back to see your research clearly.	Cherry et al. 2012
Hardly anyone will read a paper from the beginning to the end. A normal busy scientist will look at the abstract, possibly the introduction, and then the conclusions; and is likely to look the figures. This must influence the way you write and organize your material.	Thompson 2013
Have a comprehensive caption for each figure in which all the symbols/abbreviations are given their full name and the meaning of the graphs and diagrams is clearly explained. Do not introduce new notation just to be different.	Thompson 2013

Continued

Table 5. Continued

Writing and publishing a journal article	Mentioned by
Draw good figures - get as much information as possible onto the screen. This may mean sacrificing artistic elegance by packing things together fairly tightly.	Thompson 2013
Many journals require that IRB approval is received before the research is conducted.	Brannan et al. 2013
If you use someone else's results in your paper, always cite them fully and unambiguously, making clear what parts of your paper are taken from theirs.	Thompson 2013
Ethical research conduct is of utmost importance to science. Plagiarism is a serious ethical misconduct. Another unethical practice is using ghostwriters and honorary authors.	Collins et al. 2015 Brannan et al. 2013
Understand how a contribution to a study is ranked. Author order is determined by how much each author contributed to the study.	Brannan et al. 2013
Besides writing your own papers as a first author, publications can be achieved by getting others on board as co-authors. Primary publications and co-authorships need to be balanced: young researchers need to show that are productive and can write papers.	Peters 2014
Don't publish repetitive work or publish your work piecemeal to get more publications. Nevertheless, putting too many topics in one long paper can make it opaque.	Thompson 2013
If you wish your work to be remembered, publish it in a reputable journal.	Thompson 2013
Researchers are strongly encouraged to submit to peer-reviewed journals. In some disciplines, high impact factor journals have high rejection rates. Even if an article is rejected, a novice researcher may benefit from the external reviewers' comments.	Brannan et al. 2013 Glover et al. 2016
Studies published in journals with too low impact factor may not be considered 'good' and could lead to lower evaluations by job search committees or funding agencies.	Glover et al. 2016
To identify a target journal, consult its website to review the following considerations: aim and scope, target audience, authorship requirements, impact factor, cost.	Collins et al. 2015
Online journal selection tools can be valuable to use for an automated assessment of what potential journals fit your work.	O'Carroll et al. 2020
Make sure that the scope of the potential journal matches your paper.	Glover et al. 2016
One helpful technique for choosing the right journal: check in which journals your cited references have been published in.	Glover et al. 2016
Consider the decision time of target journals, especially if you are under time pressure. Take journals information on decision and publication speed with a grain of salt. Consult your peers to get a more realistic estimate of start to finish (see also https://www.scirev.sc). Refer also to https://www.journalguide.com for decision and publication speeds.	Glover et al. 2016
Preprints are scientific articles that are not yet peer reviewed, but published online. Preprints get your work out to the scientific community as soon as possible. Furthermore, you can often first preprint, then publish in a traditional journal.	Glover et al. 2016
Many journals offer Open Access (OA) options. Take advantage of OA benefits while at the same time publishing in a highly-regarded journal. OA journals potentially accrue more citations due to their wider availability, which will ultimately increase your H-index.	Glover et al. 2016
OA journals are establishing themselves as high-quality research outlets and their reputations have significantly improved in recent years. If you've dismissed them in the past, it may be time to reconsider them.	Glover et al. 2016
OA journals acceptance rate is generally higher. Be aware though of OA publishing outlets with no adequate peer review system for quality control.	Glover et al. 2016
Suggestions and questions by reviewers, once addressed, should increase the value of your work. Systematically address each of the reviewer concerns in a polite manner.	Glover et al. 2016
Put yourself in the position of the editor/reviewer. Re-read your work and objectively. Generally, an effective strategy is to go point-by-point through the reviewer comments and either make the suggested changes or politely explain and clarify your disagreement.	Glover et al. 2016
Be prepared for discrepancies between reviewers' opinions and for diverging suggestions for manuscript improvement.	Glover et al. 2016

Continued

Table 5. Continued

Writing and publishing a journal article	Mentioned by
When you have spent plenty of time creating something it is extremely difficult not to take criticism personally. Keep in mind that the function of peer review is not only to correct possible mistakes but to improve the quality of your work. Reviewers help authors.	Glover et al. 2016
Do not be overly angered by unfavorable reviews. Examine the review carefully to decide whether the reviewer was unequipped or your presentation wasn't clear enough. It is better to rewrite your article than to argue with the reviewer.	Thompson 2013
Realize that the editor has always the final word. If you feel like the reviewers were unjust or misunderstood your work, make your case to the editor.	Glover et al. 2016
As the first contact between you and the editor, a thought-out cover letter is crucial.	Glover et al. 2016
Be realistic with the quality of your research. Lean toward modesty but it is critical to highlight its novelty and importance in the article and cover letter to get published.	Glover et al. 2016
Review process can be unusually long. If the decision is delayed longer than promised at submission, do not hesitate to send a friendly inquiry email to the managing editor.	Glover et al. 2016
Do not forget the random component. Due to unforeseen/subjective factors, you still might need a bit of luck to get accepted.	Glover et al. 2016
If you publish a grievous error, don't try to cover it up or persist in it out of pride. Publish an erratum or give notice of the error and correct it in a succeeding publication.	Thompson 2013

Table 6. Personal and professional development

Personal and professional development	Mentioned by
Follow your dreams and remember that research ideas can come from the strangest places (driving, walks, music). Accidental observations may be the most important ones.	Peters 2014 Thompson 2013 Hershko 2010
Form ties with a local company or a government facility; ideas can rise from their needs.	Thompson 2013
The most important research is often about raising questions, not finding answers.	Thompson 2013
Maintain your drive and determination, even when things are not going so well.	Peters 2014
If you are stuck in your research, give yourself a mental jolt; it can work wonders. Gain insight by getting away from your environment.	Thompson 2013 Cherry et al. 2012
Move out of your training institute; work in another environment to extend knowledge.	Peters 2014
Choose an institution that values research and has research infrastructure. Become familiar with your institutional review board, their requirements and submission policies.	Morrow 2005
Don't let impractical research become your dominant research theme. Choose a research area that complements what your mentor does and is mostly unexplored.	Thompson 2013 Peters 2014
Have real depth at least in one area, although it may take a long time to develop.	Thompson 2013
Develop an area of expertise that will get you reputation and on which people will want to collaborate with you, especially if it is some type of methodological expertise.	Peters 2014
Make 'bricks'; modules of secure knowledge and technique. A major 'brick' is writing a short paper.	Thompson 2013
Values are everything. Strive to maintain intellectual integrity regardless of financial and administrative pressures.	Chapman 2015 Peters 2014
Navigate relationships with industry and potential conflicts of interest carefully.	Antoline-Wang 2013
When in doubt, do the right thing. If we seek the truth, we must be truthful ourselves.	Thompson 2013
Don't chase whatever seems to be 'hot' at the moment. Nevertheless, sometimes you may have to research 'hot topics', as this is where the funding is.	Peters 2014
Keep attuned to new developments in your field, also those occurring outside academia.	Peters 2014
Always respect evidence, and if the evidence changes, so should you.	Chapman 2015

Continued

Table 6. Continued

Personal and professional development	Mentioned by
Be clear and concrete about what you want to change or support.	Chapman 2015
Use 'killer facts'. Once they're inside your head, it is difficult to get them out.	Chapman 2015
Learn to touch-type now while you are young and your brain is receptive.	Thompson 2013
Have the adequate equipment (good PC/laptop, efficient printer, fast and reliable Web and some form of electronic back-up). A quiet room and a desk will also help.	Thompson 2013
General-purpose computer programs are needed, but take care when using them.	Thompson 2013
Harness each opportunity. In a dynamic and limited job market such as academic research, you need to be ready to engage your resources whenever a job prospect presents itself.	Zijlstra 2009
When opportunity knocks, don't blow it! Keep your eyes open for awards, grants, funding, job opportunities.	Morrow 2005 Antoline-Wang 2013
Identify your strengths, weaknesses and research interests. Matching them to a job position increases the potential of your application.	Zijlstra 2009
Develop an adequate set of interpersonal and personal skills; can be gained via mentoring and by seeking resources for specific skills like time management and resilience.	Mbuagbaw et al. 2013
Develop good organizational skills early in your career so you can meet deadlines easily.	Morrow 2005
Invest in developing research methods training (formal education, free resources, etc.).	Mbuagbaw et al. 2013
Ensure a supportive social network, both in your workplace and outside of it.	Quigley 2016
Find and maintain balance of work with personal life. Focus on time management; ensure that you have adequate time for yourself.	Mbuagbaw et al. 2013 Antoline-Wang 2013
If you feel depressed during a dry period, occupy yourself with other tasks. Activities which lead to desirable results stimulate you and create endorphins to beat depression.	Thompson 2013
Being a researcher requires creativity.	Lawrence 2006
Be active. Sedentarity is an important issue among scientists. Also, eat a healthy diet.	Quigley 2016
To keep pace with goals in your 'career race', you need to keep up good sleep habits.	
Take risks, prioritize, manage time, and learn about the systems that support research.	Case-Smith 1999
Learn the rules of the road at your institution (tracks, tenure, graduate programs, etc.).	Antoline-Wang 2013
Take advice with caution. Advice is based on the giver's personal experience and prejudices and cannot anticipate all situations. Some things one must simply learn for oneself.	Thompson 2013
Avoid mistakes by having good intuition; develop intuition by making mistakes.	Thompson 2013
Be unreasonable sometimes! Sometimes ethics forces us to go out on a limb, and our quest for truth forces us to explore territory that others would rather avoid.	Thompson 2013
Read, but do not always believe. There is a fair amount of bad, erroneous material published, so be on your guard and develop your own critical faculties.	Thompson 2013
Read, but not too much. It becomes a substitute for thinking things out for yourself; you get mesmerized by the accepted view; you can feel overwhelmed by the work of 'giants' and feel inadequate or just give up altogether.	Thompson 2013
While it is good to study just to acquire knowledge, keep in mind that there is no limit to the amount of knowledge one can acquire on a topic.	Thompson 2013
Don't wait to have complete knowledge of a topic before you develop your own ideas.	Thompson 2013
Develop ideas; enlist mentors as collaborators and reach researchers in other disciplines.	Brannan et al. 2013
Do not allow your interests to become too narrowly focused: read and think broadly.	Peters 2014
Avoid being a perfectionist who can't finish anything.	Antoline-Wang 2013
Persistence and hard work can compensate for lack of genius.	Thompson 2013
Complete a doctoral education.	Case-Smith 1999

Continued

Table 6. Continued

Personal and professional development	Mentioned by
Ask yourself: 'What are the requirements for that fellowship, grant or job?' and 'What steps do I need to take to get me from here to there?'.	Peters 2014
Find out what will make you stand out from colleagues in the future and focus on that.	Peters 2014
Have a lot of excitement and fun in science; this is how discoveries are made!	Hershko 2010
Do work that you love, interests and excites you; you will spend long hours doing it.	Quigley 2016
Be happy in your work! Research should be a source of joy, exhilaration, and an act of love. If it isn't, it may be difficult to endure the hardships that research entails.	Thompson 2013
Get institutional affiliation by maintaining contact with previous educational institutions, offering volunteer work or formally requesting affiliation.	Mbuagbaw et al. 2013
Optimize your professional environment. Avoid isolation, but seek out 'the untraveled path'. Tackle the challenging issue of independence.	Antoline-Wang 2013
A wise person can learn from anyone. Listen carefully to others, especially to the questions of people struggling to understand your work.	Thompson 2013
Talk about your research to anyone who is prepared to listen; a casual reply can often trigger a sudden new understanding by the alert researcher.	Thompson 2013
Find an important subject that is not yet interesting to others.	Hershko 2010
Identify research interest and seek ways to contribute to a field and enhance your skills.	Mbuagbaw et al. 2013
Research is most satisfying when it serves some immediate practical purpose.	Thompson 2013
Do not be afraid to examine a topic because a colleague thinks such work is silly or that the problem is settled. On the other hand, if you discover nothing important, move on.	Thompson 2013
Use whatever experimental approach is needed for your objective; it may not necessarily be the most fashionable ('state-of-the-art') technology.	Hershko 2010
If it is your first experience with research, join an existing project, conduct a simple survey, or use secondary data to ensure that you will finish within a specified time frame.	Brannan et al. 2013
For trainees, research is a very engaging process and should be done with careful planning so it does not interfere with their education.	Brannan et al. 2013
Apply project management techniques and balance your time commitments.	Peters 2014
Careful planning is important, especially when you have to leave a piece of your work to go over to something else for a while. It is vital to leave your current work in good order.	Thompson 2013
Be flexible with your research plan.	Cherry et al. 2012
Design your research so that it can be completed within a manageable time frame.	Brannan et al. 2013
Besides practice time management, set specific achievable objectives.	Mbuagbaw et al. 2013
Periodically assess your progress, trajectory, and focus.	Antoline-Wang 2013
It is difficult to obtain jobs and funding in science. To compensate, work in a smarter manner; focus your efforts and do not fear failure. Mistakes are a great way to learn.	Zijlstra 2009
The sky will not fall if you make a mistake. Life and work require constant adjustment.	Thompson 2013
Seize the day. Do not procrastinate in your work, especially when it comes to working independently. You must take the initiative in doing independent research.	Thompson 2013
Keep it simple. Simple things are often the hardest to find. Above all, avoid making a career out of publishing endless variations of your dissertation or some other research work.	Thompson 2013
Do not be influenced by the kind of person who favors simplicity over correctness.	Thompson 2013
Every work can't be a breakthrough, but should be useful. If not of immediate practical use, it should improve understanding or provide an intermediate step to something useful.	Thompson 2013
No one said that research would be easy. Don't give up too easily on a problem, and don't work on an unyielding problem for too long without doing other things as well.	Thompson 2013

Continued

Table 6. Continued

Personal and professional development	Mentioned by
You may not always be rewarded as you deserve. Colleagues may try to damage you or take credit for your work. To work hard and do good work is often the best we can do.	Thompson 2013
Never leave bench-work, and you shall continue to get a lot of excitement and fun.	Hershko 2010
To a mature, well-educated scientist a discrepancy means an opportunity. Acknowledge that most discrepancies point to an error. Do not ignore/hide them; learn to use them!	Thompson 2013
Drawings are also fraught with dangers, since it is often very difficult to interpret signs correctly from drawings. The misinterpretations can sometimes be very subtle.	Thompson 2013
Never trust a published formula; rederive it yourself. If an article is not well written, there may be communication problems in the results as well. Always save your notes.	Thompson 2013
Attention to details! Items of no obvious consequence can lead to important research.	Thompson 2013
Check your work! This doesn't mean only finding errors. If you are able, derive your result in more than one way. Check any properties your results should have.	Thompson 2013
You will need to communicate your skills to your potential employer; know your value and how you would fit into an organization and keep updated your curriculum vitae.	Zijlstra 2009
Research cannot all be part of the business. Some of it must be joyous personal activity. If we forget this, we risk making research just a job.	Thompson 2013

tips for young researchers to flourish both personally and professionally.

DISCUSSION

Numerous articles in the literature have highlighted the various obstacles and difficulties that young scientists face while pursuing a research career, either within academia or outside it[1-3,12,24]. Among them, applying for fellowships and grants[1-3,7,11], publishing and disseminating research results[8,18,20,25], complying with research ethical requirements[18,24,26], and developing successful interpersonal relationships both inside and outside the work environment[1,20,27], are frequently mentioned. The above issues, along with many other aspects of launching a research career, were multifacetedly approached in this review by a number of recommendations drawn from several publications in order to secure a comprehensive and holistic approach on each theme.

Funding and research proposal writing

Among the biggest thresholds that young researchers have to face is obtaining sufficient funds to carry out their research. This is a real struggle as competition for grants is becoming more difficult, especially during the last decade, as many countries around the world face financial and economic crises. Limited budgets have resulted in more than just restricted research; they are damaging morale by making scientists afraid to take risks, when it is more important than ever to invest in innovative research[28]. It is obvious that learning how to apply for funds is one of the researcher's most important skills, but it is also not well-addressed in university formal educational programs[7]. This review offers a number of practical tips regarding how to successfully write a research proposal in order to obtain research grants that could help young researchers kick-start their first funded project and advance their career.

Mentorship, networking and collaboration

It goes without saying that research is a collective effort that requires teamwork and collaboration. A researcher's productivity has been strongly linked to both collaboration strategy and the number of collaborators[20]. Studies have shown that researchers who act collaboratively present enhanced number of published peer-reviewed journal articles[29] and that collaborative studies result in more highly cited publications[30]. Furthermore, the importance of a great mentor must not be neglected. A good mentor can be very helpful in many aspects of a young researcher's career development[1]. Therefore, building collaboration networks and forming strong partnerships along with the ability to recognize and choose a great mentor, have been included amongst the advice presented in this review directed to young researchers.

Enhancing visibility as a researcher

Successful publication is essential for scientists in order to disseminate their research findings and communicate insights to a broad audience[20]. This can be usually achieved through writing a journal article or presenting a study at a scientific conference. Especially for young researchers, publishing is important because it is the fundamental metric of career progress evaluation[31]. Nevertheless, literature

has identified a number of commonly mentioned obstacles to publishing (e.g. lack of time and/or support, limited knowledge of the publication process, or fear of rejection and criticism)[8]. The relevant advice summarized, aim to advance young researchers' publication rate and dissemination by encouraging them to invest in their writing skills and to boost their confidence with regard to making themselves and their research visible to the scientific community. Besides, the research process is considered lacking without dissemination of findings to peers' audience[18].

Writing and publishing a journal article

The ultimate aim of almost every research is to publish its findings, ideally in a peer-reviewed journal. Nevertheless, for many people switching from research to writing may be difficult[18]. It is essential for new researchers to familiarize themselves with journal manuscript requirements while at the same time exploring the publishing landscape and becoming accustomed to the ethical requirements. Insufficiency in scientific writing skills may lead to rejections that can have an adverse impact on the pursuit of an academic career or a position promotion[25]. Also, submitting research to an unsuitable journal can result in a lot of time wasted and unnecessary effort[20], a fact that many young researchers ignore or choose to neglect in their first steps. In addition, young researchers often unknowingly violate research ethics such as proper publication process[26]. This review provides young researchers with a set of recommendations on how to select the appropriate journal for publishing their research, how to best handle ethical issues to prevent publication misconduct and which common pitfalls to avoid while preparing their manuscript to increase their chances of achieving publication acceptance.

Personal and professional development

Apart from doing great science, it is important for early career scientists to pay attention to some recommendations about their career and life[21]. Science will always be important for a devoted researcher but many other aspects of life such as personal development can also be rewarding. Evolving into a successful researcher requires being proactive; development of technical skills and specialization within a field are core aspects along with the right education, preparation and initiative[12]. In addition, personal components such as one's energy, ability to preserve and critically analyze/reason along with the ability to respect the truth are important attributes that can lead to a successful scientific career[27]. In this section, a broad range of tips for both personal and professional growth are presented addressing multiple aspects of a young researcher's life to enhance personal and professional development.

Finally, we would like to stress that science, like life, is evolving. That is also what the recent pandemic has taught us. A publication[32] that emerged from the search algorithm but was excluded due to the focus of the recommendations on a particular circumstance (the COVID-19 pandemic) has some interesting insights to offer to early career researchers who may not have secure academic positions or funding. Key recommendations related to research (e.g. methodological considerations, ethical implications) in the context of the COVID-19 pandemic are provided. Some are:

- Mobilize new web-based/digital data collection tools and techniques that accommodate the constraints of the pandemic and ensure that digital data collection methods uphold high levels of personal data protection; and
- During the pandemic, build new skills or shift focus to other areas of research projects (e.g. writing articles, reviewing manuscripts)[32].

Briefly, it is of high importance to support young researchers in the development of their career to facilitate their transition to being highly effective and independent scientists[33]. The valuable knowledge and experience of senior and junior researchers in the form of recommendations that were presented in this review can serve as a valuable guide to all young scientists pursuing a research career, independent of field of expertise. If followed, these strategic steps could increase productivity and enhance motivation of young researchers. The necessity of this collective knowledge emerged both from the gap of such a brief synoptic overview in the literature, along with the authors' personal interest as young researchers in seeking expert advice to advance their careers.

Strengths and limitations

Among the major strengths of this study is the novelty of the idea, as to the best of our knowledge this is the first systematic review to summarize existing recommendations for young researchers. In addition, a comprehensive search strategy was developed utilizing a robust and versatile algorithm, while two independent reviewers were involved at each stage of the review process. Furthermore, the provided tables are a valuable and easy to read tool that can serve as a quick guide for many young researchers working in a broad range of scientific fields.

Nevertheless, the limitations of this systematic review should also be acknowledged. Its main disadvantage is that it was performed in one database (PubMed). In addition, restricting studies that were published only in English may have excluded relevant studies published in other languages.

CONCLUSIONS

Young researchers are confronted by numerous challenges in the pursuit of their scientific career that can be personally draining. It is essential for young scientists to be aware that building a successful career path in research requires a number of strategic steps and careful planning along the way. The present systematic review offers a useful tool to encourage and support young people entering the field of research by summarizing valuable recommendations, published in the last 30 years, based on the collective

experiences of other senior and junior researchers. The readers will need to select the recommendations that are most appropriate for advancing their own research career.

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