

Research Planning, Statistical Analysis, Ethics, and Successful Publishing

Pitchai Balakumar^{1,2}, Renukha Sellappan², Shubhada Nagarkar³, Avijit Hazra⁴, Gowraganahalli Jagadeesh^{5,6,*}

¹The Office of Research & Development, Periyar Maniammai Institute of Science and Technology (Deemed to be University), Thanjavur, Tamil Nadu, INDIA.

²School of Pharmacy, Faculty of Health and Medical Sciences, Taylor's University, Subang Jaya, Selangor, MALAYSIA.

³Department of Library and Information Science & Centre for Publication Ethics, Savitribai Phule Pune University, Pune, Maharashtra, INDIA.

⁴Department of Pharmacology, Institute of Post Graduate Medical Education & Research, Kolkata, West Bengal, INDIA.

⁵Formerly, Office of Cardiology, Hematology, Endocrinology, and Nephrology, Center for Drug Evaluation and Research, US Food and Drug Administration, MD, USA.

⁶College of Pharmaceutical Sciences, Dayananda Sagar University, Bengaluru, Karnataka, INDIA.

ABSTRACT

Novice researchers are frequently inexperienced with basic concepts of research and successful scientific publishing. To strengthen their fundamental knowledge of scientific research, we recently conducted a brainstorming symposium at the 73rd Indian Pharmaceutical Congress held in Hyderabad, India in July 2024. This report highlights the symposium's key components as well as the benefits that attendees experienced. The symposium was intended to equip faculty and postgraduate and doctorate students with the skills they need to succeed in scientific research and publishing. It sought to dispel the mystery around the research process, from conception to publication, highlighting the significance of a well-conceived, reliable, reproducible, and ethically sound experimental design. Participants acquired knowledge about developing research questions and hypotheses, crafting thorough research protocols, and using statistical techniques to increase the acceptability of their findings. Our team clarified the subtleties of data interpretation, making sure that participants advanced their research aptitude. The symposium also emphasized the significance of good communication for scientists, providing delegates with guidance on how to craft papers that concisely and compellingly convey their findings, thereby increasing the likelihood of their submissions being accepted by high-impact indexed journals. The presentations also covered the ethical aspects of academic publication, emphasizing the perils of predatory journals that jeopardize the credibility of scientific communication. This symposium was not only an educational event but also a crucial step in nurturing a new generation of scientists equipped with advanced research skills and driving innovation ethically and responsibly.

Keywords: Research methodology, Scientific writing, Statistics, Journal submission, Peer review, Scientific integrity.

Correspondence:

Dr. Gowraganahalli Jagadeesh, Ph.D
Distinguished Visiting Professor, College of Pharmaceutical Sciences, Dayananda Sagar University, Bengaluru, Karnataka, INDIA.

Email: jagadeesh-sps@dsu.edu.in;
GJagadeesh2000@gmail.com

Received: 15-08-2024;

Revised: 20-09-2024;

Accepted: 30-10-2024.

INTRODUCTION

Our team has been organizing symposia and workshops in India for more than two decades, enhancing the concepts of research methodologies used by academic researchers across numerous fields.¹⁻⁶ We recently conducted a brainstorming symposium at the 73rd Indian Pharmaceutical Congress held in Hyderabad, India, on July 6, 2024. The target audience included postgraduates, pre- and postdoctoral fellows, researchers, and faculty members from pharmacy, medical, nursing, and allied

health sciences, and delegates from the pharmaceutical and biotech industries. This symposium aimed to provide scientific researchers with the knowledge and tools needed to excel in research and successful publishing. Through this event, the process of research was demystified, emphasizing the importance of strong and reproducible experimental designs that are ethically sound. Researchers learned how to formulate research questions, create detailed protocols, and employ statistical methods to enhance the validity of their findings.^{7,8}

The team also guided participants in lucid manuscript submissions for high-impact journals, underscoring the significance of excellent communication in research. We also discussed the ethical dimensions of academic publishing, highlighting the risks associated with predatory journals that compromise the integrity of scientific communication.⁹



DOI: 10.5530/ijper.58.4s.111

Copyright Information :

Copyright Author (s) 2024 Distributed under
Creative Commons CC-BY 4.0

Publishing Partner : Manuscript Technomedia. [www.mstechnomedia.com]

EMBARKING ON RESEARCH: CRAFTING A RESEARCH PROTOCOL OR PROPOSAL

As the first speaker, Professor G. Jagadeesh outlined how a study protocol is structured and planned for postgraduate and doctoral students. Theoretical or innate knowledge is a foundation for empirical knowledge (derived from experience, observation, and experiments). The depth of the literature review and the strength of the subject are determinants in identifying research gaps and generating innovative ideas. By including more variables (dependent or independent), a new concept or theory can be developed to form a reasonably original research problem. Creativity and critical thinking are needed for both the research statement and the research topic. Successful research requires several thinking paradigms: creative thinking, critical thinking, divergent thinking, and convergent thinking.

The topic is articulated as a research question. For the study to be successful, the question must be right, since it is the starting point, sets the framework, and will guide the rest of the experimental design. The research question is then expressed as a hypothesis, the central component of the research process. To answer the research question, we need to think about what comparisons will be necessary, and we will need to establish a format for interpreting the results using statistical tests. What you are attempting to accomplish is a "gateway" to a study. This is achieved by listing the study's "aims and objectives."

Aims are general statements that provide direction and/or identify an intention to act in writing a research/grant proposal. It can be broken down into various objectives that help achieve the aim. The researcher must be ready to discuss the study's relevance (need) or why this particular research issue is important. A written purpose statement or rationale for the study should be included in the protocol. A statement on the specific goal of the study should be comprehended from the topic. The researcher should bear in mind that the research proposal, whether for acquiring a degree (M.Pharm./Ph.D./M.D.) or obtaining a grant, is evaluated based on whether it is interesting, original (first-tier ideas), well-designed, feasible, and impactful. The proposed study should be a noteworthy step forward and will contribute to the body of knowledge and the discipline as a whole. Thus, developing a research question, planning a study, writing an optimal study protocol/proposal, and initiating and then completing the study are daunting tasks. Research endeavors, experiments, and publications cannot occur without a carefully thought-out study strategy.^{7,8} Figure 1 illustrates the overlap between the components of a research protocol using a stacked Venn diagram.

PRINCIPLES OF DESCRIPTIVE AND INFERENCE STATISTICS

Next, Professor Avijit Hazra explained the concepts of descriptive and inferential statistics for the analysis of biological data.⁸ Nowadays, biostatistics is an integral part of medical research, and its knowledge is also essential for understanding most of the medical literature. The values of the variables are indicated by the term data. It is important to understand the types of data and their mutual interconversion. The raw data for statistical analyses come from experiments or observations which can be either numerical or categorical. Numerical variables might be continuous or discrete. Categorical data are described in terms of frequencies, proportions, or percentages. Three types of statistical applications are used in the medical sciences: descriptive statistics, inferential statistics, and statistical modeling. Descriptive statistics involve summarizing a collection of data from a population. The observations within a sample tend to cluster around a central location, with more extreme observations being less frequent. Measures of central tendency summarize the extent of clustering, while measures of dispersion describe the extent of spread. The measurement of central tendency includes mean, median, and mode, while the measurement of dispersion includes the range, standard deviation, interquartile range, and others. The population mean, median, standard deviation, *etc.*, are known as the parameters, while the sample mean, median, standard deviation, *etc.*, are known as statistics. We can seldom know the true values of the parameters. However, we can obtain a reasonable point estimate of a parameter and define an interval in which the true population value is likely to lie within a certain confidence level. This range is known as the Confidence Interval (CI). Conventionally, a 95% CI is used for most analyses.

Understanding patterns in data sets and the distribution of the corresponding population are important components of descriptive statistics. The most common distribution is the normal distribution, which is depicted as the well-known symmetrical bell-shaped Gaussian curve. Various graphs and plots have been devised to summarize data and trends visually. Some plots, such as box-and-whiskers plots and stem-and-leaf plots are less familiar but provide useful summaries in select situations.

The central maxim of inferential statistics is a generalization from the sample to the population. It focuses on drawing inferences about the population by analyzing sample data. To do this, it resorts largely to the hypothesis testing approach, whose goal is to reject the null hypothesis. The result is usually returned as a *p*-value that denotes the maximum probability of obtaining the observed result, assuming that the null hypothesis is true. Many hypothesis tests are available, and the one to be applied depends upon the research question, the nature of the variables of interest, and the number of groups that are to be compared. Student's *t*-test is commonly used for comparing the

Stacked Venn showing overlapping relationships in a research protocol

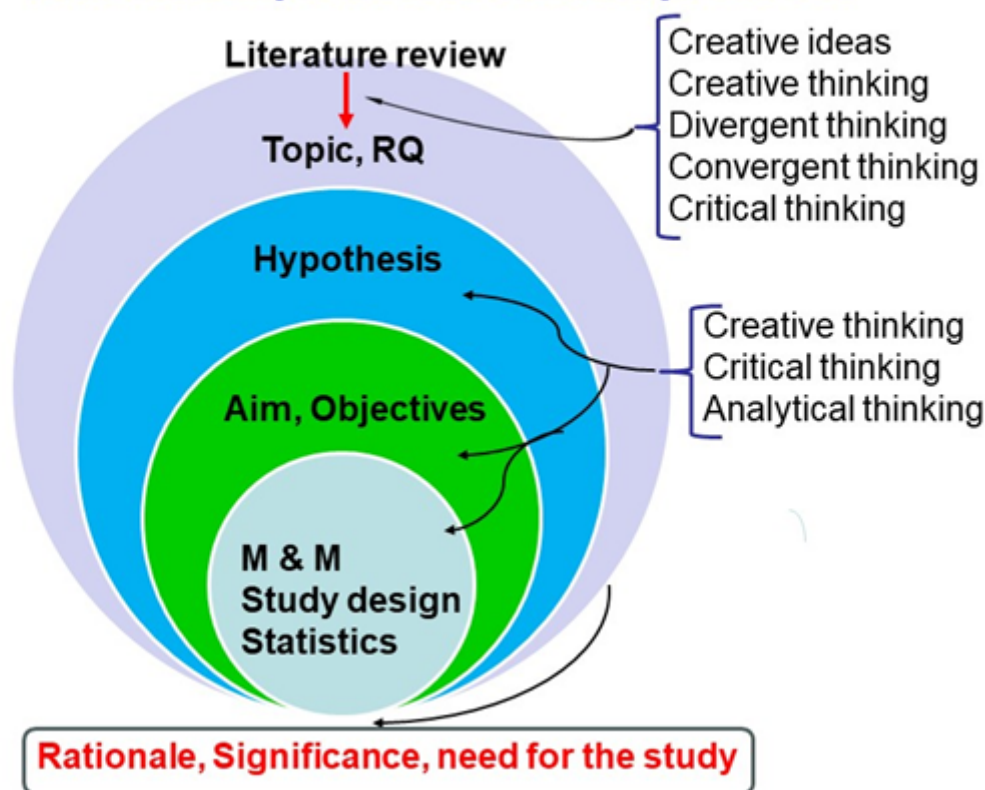


Figure 1: A stacked Venn diagram illustrating the overlapping relationships between the components of a research protocol. Every research proposal/protocol starts with an innovative idea. This must be developed into a research topic, testable research question, and hypothesis. All biomedical research is hypothesis-driven. The next step should be to define the aims and objectives of the study. A proposal should also explain how the proposed research will improve scientific knowledge and innovation (need for the study). A research protocol comprises all five elements, which are interconnected. [Abbreviations: RQ = research question, M&M = materials and methods].

means of two independent or paired data sets that are normally distributed. One-way Analysis of Variance (ANOVA) and its counterpart in repeated measures extends the comparison of means to more than two populations. There are non-parametric counterparts of each of these tests that compare the medians of skewed data sets. Categorical variables can be compared between independent groups by Pearson's chi-square test or Fisher's exact test, while McNemar's chi-square test and Cochran's Q test are used for paired proportions. The strength of the linear association between two numerical variables is quantified by a correlation coefficient, such as Pearson's correlation coefficient r or Spearman's rank-correlation coefficient ρ . The relative risk and odds ratio are used to quantify the association between two binary categorical variables.

The tediousness of statistical computing is no longer present due to the growing accessibility and ease of use of statistical software, allowing researchers to focus on correctly applying methodologies rather than doing computations.

CRUCIAL ELEMENTS TO STRUCTURE A TOP-NOTCH MANUSCRIPT FOR A SUCCESSFUL PUBLICATION

In the lecture that followed, Professor Balakumar Pitchai discussed how to put together different components of a research paper. A framework of well-written top-notch manuscripts can successfully navigate the publishing process by addressing significant aspects of the study.⁸ The following is a brief instruction on how to structure a manuscript: (I) TITLE: Journal article titles can be divided into three primary categories: (a) Declarative: outlines the article's primary findings or conclusions; (b) Descriptive: outlines the topic of the piece but leaves out the conclusions or results; (c) Interrogative: outlines the topic of the article as a question. (II) ABSTRACT: This section includes the problem statement, methodology, results, and conclusions of your study. Meet the abstract word limit set by the journal, which is normally between 150 and 250 words. Include relevant keywords at the end of the abstract by selecting four to six terms that are directly linked to the subject of your

study. Combining general and specific keywords can improve searchability. (III) INTRODUCTION: This is the first component of the IMRaD (Introduction, Methods, Results, and Discussion) style manuscript. The section on introduction should contain (a): *Background information and context*: Describe the background and establish the setting for your research; (b) *Problem statement*: Clearly identify the problem that your study attempts to address; (c) *Significance of research*: Provide a succinct explanation of the importance, rationale and possible implications of your study; (d) *Review of literature*: Prior research should be briefly reviewed to identify any gaps (niche areas) that your study aims to fill. You should also critically evaluate earlier research to support the necessity of your study. (e) *Objectives*: Describe the hypothesis and the major aim and objectives of the investigation. (IV) METHODS: It must be systematic and reproducible, outlining techniques in detail to enable others to do a similar study. This section may have *Subsections*. Divide methodology into subsections according to the subjects, materials, procedure, and data analysis. *Ethical considerations*: Address carefully any ethical recommendations or considerations. Finally, Saunder's research onion model can be used for designing research methodology as it consists of a set of beliefs and philosophical presumptions that influence how the research questions are understood and guide the selection of research techniques. (V) RESULTS: The finding should be rational and understandable, and should be presented clearly and logically. Use figures and tables to help illustrate your data, and make sure the text correctly identifies and references them. Include a thorough statistical analysis as well. (VI) DISCUSSION: The following items should be included in this section: (a) *Interpretation*: Consider your research questions and hypotheses while interpreting your findings; (b) *Comparison*: Discuss any discrepancies you discover between your findings and previous research. (c) *Implications*: Explain how your findings may impact future studies, theory, and practice; (d) *Limitations*: Recognize the constraints of your study and suggest key areas for more research. (VII) CONCLUDING REMARKS: Provide an overview of your study's key findings, restate the importance of your work, and suggest possible directions for future research. (VIII) ACKNOWLEDGMENT AND OTHER MINOR SECTIONS: Express gratitude for the individuals or any financial support from organizations. The authors also declare conflicts of interest and CRediT author statements. (IX) SUPPLEMENTARY MATERIALS: Include any additional material that supports your research but is not essential to include raw data and calculations. (X) REFERENCES: Provide accurate and complete information. When referencing sources for your research, make sure they are complete, formatted following the journal's specifications, and include a diverse range of indexed references (SCIE/SSCI/AHCI/PubMed/Scopus, etc.) to support your research. (XI) FIGURE

AND TABLE LEGENDS: Include the legends for figures and tables and upload them online separately.

As a final note, ensure that your manuscript adheres to the target journal's formatting requirements and follows a consistent presentation and citation style. Carefully edit the manuscript to eliminate typographical, grammatical, and syntax errors. Use plagiarism detection tools to ensure that the content is at least 90% unique. Use clear and precise language to convey your ideas. Use the active voice to write in a clearer, more interesting manner. Before submitting the manuscript, get input from peers to improve it. By adhering to these suggestions, you may enhance the quality and impact of your paper, which will raise the possibility that it will be accepted into a journal that is indexed by SCIE/SSCI/AHCI/PubMed-Medline/Scopus.

THE PROCESS OF MANUSCRIPT SUBMISSION AND PEER REVIEW

The next lecture was delivered by Dr. Renukha Sellappan, outlining the key stages and considerations, from selecting the right journal to navigating the peer review process. The journey of manuscript submission and peer review is a critical aspect of academic publishing.

Selecting the right journal is the first crucial step. Authors should consider potential journals' scope, impact factor, audience, and open access policies. Journal selection sites, such as Journal Finder and Manuscript Matcher, can assist in identifying suitable options based on the manuscript's content and focus. Before submission, it is essential to seek feedback and consent from all co-authors, ensuring that they agree with the content and the choice of a journal. This collaborative step promotes transparency and collective responsibility.

Each journal has specific instructions for authors, which must be meticulously studied. These guidelines typically cover formatting, structure, ethical considerations, and submission procedures. Adhering to these instructions enhances the likelihood of acceptance. The article submission should include the manuscript, cover letter, and any supplementary materials such as data sets or multimedia files. The cover letter should succinctly introduce the paper, highlight its significance, and explain why it fits the journal well.

The peer review process is a cornerstone of scholarly publishing, ensuring the quality and credibility of published research. The editorial office manages the initial screening and assigns the manuscript to an editor. The editor selects reviewers with relevant expertise to evaluate the manuscript's originality, methodology, and contribution to the field. One common type of peer review is single-blind peer review, where authors are unaware of the reviewers' identities, but reviewers know the authors' identities.

Conversely, in a double-blind peer review, neither reviewers nor authors are aware of each other's identities. Triple-blind peer review is a variant of the double-blind process, where the identities of the managing editors and authors are concealed from the reviewers, and reviewers' identities are kept secret from the authors. More recently, open peer review has been practiced. This involves openly sharing the peer review report with all readers online, rather than only with the authors. Additionally, the complete peer review history, including editors' suggestions and authors' responses, may also be published.

Authors play a crucial role in responding to reviewers' comments. This often involves revising the paper and providing a detailed response to each comment, demonstrating how comments were addressed. Constructive engagement with reviewers' feedback can significantly improve the manuscript. After acceptance, authors can expect further steps such as copyediting, typesetting, and proofing. Additionally, they should be prepared for post-publication responsibilities, including promoting their work and responding to any post-publication inquiries. Understanding the manuscript submission and peer review process helps authors navigate this complex landscape, ultimately contributing to the advancement of knowledge in their respective fields.

RESEARCH AND PUBLICATION ETHICS

Dr. Shubhada Nagarkar presented the last lecture on research and publication ethics. In recent decades, researchers have faced unrelenting pressure to publish their work for career advancement and other academic purposes. This leads to unethical research practices including Falsification, Fabrication, and Plagiarism (FFP). Predatory publishing becomes a thriving industry over time, abusing the situation. These publishers hijack titles, ISSN, the names of publishers, and the names of editorial board members of credible journals. There are several other issues, such as fear of job loss, being unable to publish in credible journals, rejection of papers, and competing with colleagues to publish as many articles as possible. Due to a lack of proper training, many students and young faculty members fall victim to these publications. Research integrity is at risk since so many publications have been made in such a short period. Moreover, several ethical concerns have been brought up by the usage of chatbots powered by artificial intelligence to create research papers.¹⁰

Dr. Nagarkar presentation focused on unethical research and publication practices, including FFP, image manipulation, unfair authorship, salami publications, selective reporting, undisclosed conflicts of interest, retraction of papers, unethical practices in the informed consent form, citation misconduct, paper mills, retraction of papers, and predatory publications. The discussion also included characteristics of predatory publications, identification techniques, different types of predatory journals,

dubious indexing databases, and false impact factors. It further explains the consequences of predatory publishing, such as corruption in science and other disciplines, effects on human health, damage to the careers of researchers, institutions, and countries, loss of money, waste of time and efforts, *etc.* (COPE: <https://publicationethics.org/resources/elearning/why-should-you-be-concerned-0>). The method of identifying predatory publications was also discussed. The speaker finally explained the worldwide initiatives to battle against unethical research and publication practices. The presentation briefly covered initiatives like ThinkCheckSubmit, blogs like Retraction Watch and Scholarly Kitchen, *etc.* It also highlighted the UGC-CARE initiative of the University Grants Commission of India.¹¹

CONCLUDING REMARKS

Doctorate and postgraduate students who have had little to no formal instruction at their institutions in scientific methods of research and communication had the chance to learn from "how to create a study protocol, which is a road map for discovery" to "successful publishing." In academic research, a literature review, statistical analysis of data, and interpretation guide the process from conception to the writing of a research article. Publication is the ultimate aim of scientific research. The talks focused on the dangers of predatory publications that jeopardize the integrity of scientific communication and addressed the ethical aspects of academic publishing. This symposium was an important step in developing a new generation of scientists who can advance knowledge and spur innovation in an ethical and significant way, in addition to being an educational event.

ACKNOWLEDGEMENT

We gratefully thank the Organizing Committee of the 73rd Annual Conference of the Indian Pharmaceutical Congress Association-2024 held in Hyderabad, India for having organized and supported the symposium.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

REFERENCES

1. Balakumar P, Srikumar BN, Ramesh B, Jagadeesh G. The critical phases of effective research planning, scientific writing, and communication. *Phcog Mag* 2022;18:1-3.
2. Balakumar P, Jagadeesh G. The basic concepts of scientific research and scientific communication. *J Pharmacol Pharmacother* 2012;3:178-82.
3. Balakumar P, Jagadeesh G. The critical steps for successful research: The research proposal and scientific writing. *J Pharmacol Pharmacother* 2013;4:130-8.
4. Balakumar P, Murthy, S and Jagadeesh, G. The Basic Concepts of Scientific Research and Communication. *Ind J Pharmacol* 2007;39:303-6.
5. Balakumar P, Sellappans R, Thangiah M, Shanmugam K, Srividhya PK, Jagadeesh G. Demystifying the intricacies of research methodology, scientific publishing and patenting. *Indian Journal of Pharmaceutical Education and Research*. 2024;58(2):1-10.
6. Balakumar P, Nagarkar S, Bilagumba G, Alluri R, Jagadeesh G. The art and science of research methodology, biostatistics, manuscript writing, and publication ethics: An

- invigorating training for improving research aptitudes in southern Indian biomedical institutions. *J Ayurveda Integr Med.* 2024;15(4):100996.
7. Jagadeesh G, Murthy S, Gupta YK, Prakash A. (Editors). *Biomedical Research - From Ideation to Publication*. Philadelphia: Wolters Kluwer Health-Lippincott Williams and Wilkins; 2010.
 8. Jagadeesh G., Balakumar, P, Senatore, F. (Editors). *The Quintessence of Basic and Clinical Research and Scientific Publishing*. ISBN 978-981-99-1283-4; ISBN 978-981-99-1284-1. <https://doi.org/10.1007/978-981-99-1284-1>. Springer Nature, Singapore Pte Ltd. 2023.
 9. Balakumar P, Jagadeesh G. India: neutralizing temptation by predatory journals. *Nature.* 2023;621(7979):474.
 10. Patwardhan, B. Why India is striking back against predatory journals. *Nature,* 2019;571(7763):7-8.
 11. Patwardhan, B., & Nagarkar, S. (2021). The UGC-CARE initiative: Indian academia's quest for research and publishing integrity. *First Monday*. DOI: <https://doi.org/10.5210/fm.v26i10.10349>. <https://firstmonday.org/ojs/index.php/fm/article/view/10349>.

Cite this article: Balakumar P, Sellappan R, Nagarkar S, Hazra A, Jagadeesh G. Research Planning, Statistical Analysis, Ethics, and Successful Publishing. *Indian J of Pharmaceutical Education and Research.* 2024;58(4s):s1102-s1107.