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Conference Report

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

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ABSTRACT

The basic concepts of research are learned through systematic literature searches which form the basis of a research statement and research topic. Then the research question, hypothesis, aim, and objectives, as well as the experimental design, are developed. Given the context provided, the primary focus is on the importance of adequately training postgraduates and young research investigators in research methodology and project development. It is evident that there is a lack of proper training in these areas, and the rapid expansion of colleges in India exacerbates this issue. To address this, research students must receive comprehensive instruction in scientific research methodology, experimental design, statistics, scientific writing, publishing, and research ethics. Our team has been conducting workshops and symposia for more than two decades to improve the current teaching methods in these areas. Most recently, we organized a series of national and international workshops and seminars in multiple states across India to fortify the core concepts of scientific research for students and faculty members. This report highlights the key aspects of these workshops and the positive outcomes experienced by participants.

1. Glimpses of events

In the process of scientific research, it is crucial to employ creativity and critical thinking to generate innovative ideas. Originality plays a vital role in this process, as it leads to the development of new theories that have a significant impact on society. Gaining new knowledge to address existing gaps is an intellectual challenge, and understanding sequential research processes, both theoretical and practical, is essential for success in the scientific profession [1–4]. A series of national and international workshops and seminars were organized by our team at various universities and colleges across four states in India (Karnataka: Adichunchanagiri University, Dayananda Sagar University, Acharya BM Reddy College of Pharmacy and Government College of Pharmacy; Telangana: Vishnu Institute of Pharmaceutical Education and Research; Tamil Nadu: Indian Pharmacological Society's 53rd Annual Conference at SRM Institute of Science & Technology; Maharashtra: Savitribai Phule Pune University) between December 2023 and January 2024 to enhance and reinforce the fundamental concepts of scientific research and indexed publications. The faculty, encompassing a wide range of expertise from diverse disciplines, contributed to the success of the events. The didactic lectures revolved around the formulation of research problems and questions, the development of study protocols, and the comprehensive understanding of the literature search and review, study designs, statistical analysis, and data interpretation. The pinnacle of scientific research is scientific publishing, and the workshops systematically taught the fundamental elements and logistics of composing a scientific article and publication process with a focus on publication ethics.

The key points we discussed in various workshops/conferences/seminars are summarized below. Notably, due to time constraints, not all topics were covered at each location. Each meeting concluded with a session for questions and answers. The feedback from the attendees highlighted their successful acquisition of new tools and strategies for navigating their research. The post-meeting sessions comprised brainstorming group discussions, offering support to budding researchers seeking feedback on their study protocols, project designs, statistical approaches, ethics, and successful publication strategies.

The day commenced with a presentation on the fundamental principles of scientific research. Dr. G. Jagadeesh provided an insightful overview of the key aspects involved in the research process and the essential elements of the research project. A research project is a creative endeavor that begins with an innovative idea based on literature reviews, keen observation, and active engagement in academic discussions. The development of novel concepts for research problems requires creativity, critical thinking, and logical reasoning. A well-developed idea lays the foundation for a high-quality research protocol, which includes a research topic, research questions, hypotheses, and the necessary statistical information. The study's aims and objectives should be clearly articulated, and the proposal should demonstrate how the study will contribute to scientific knowledge and the benefits it offers to society [5].

One of the most fundamental steps in the research process is the

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literature search, which involves reading all peer-reviewed published sources to uncover critical scientific information related to the topic under consideration. The literature search and review serve as the foundation for the research statement, topic, and research question. Prof. Balakumar outlined methods for conducting an efficient literature search using a variety of search engines and biomedical databases (ScienceDirect, PubMed, JANE, Embase, Web of Science, SciFinder, CINAHL, The Cochrane Library, International Pharmaceutical Abstracts, Scopus, Google Scholar, BibliMed, PubChem, The Merck Index, PharmaPendium, AHFS Drug Information, DrugBank Online, Facts and Comparisons, Micromedex, Drugs@FDA, TOXNET, DSSTOX, *etc*.). Conducting a comprehensive literature search is crucial for gaining insight into the existing knowledge landscape, identifying research gaps, and avoiding duplication of efforts [4,6]. Prof. Balakumar elaborated on strategies for conducting a thorough literature search including snowball "backward reference tracking" and "forward citation tracking" strategies.

Statistics plays a crucial role in biomedical research, encompassing various stages such as study design, data collection, analysis, and result reporting. Dr. Gangaboriah emphasized the significance of defining target populations, selecting appropriate samples, determining study designs, and choosing relevant variables for measuring exposure and outcomes. The importance of a well-structured experimental design and meticulous statistical analysis for hypothesis testing were underscored. The selection of statistical tests is guided by factors such as study design, variable types and quantities, adherence to normality assumptions, and sample size, as depicted in Fig. 1.

The dissemination of findings through publication serves as a means for researchers to enrich the existing knowledge base and propel their field forward. Manuscripts should strive to narrate a compelling story that effectively communicates the study's results by integrating prior research, addressing the research question, and examining the initial hypothesis. Dr. Balakumar elucidated the process of manuscript development leading to publication. The critical stages encompass the creation of an engaging title (descriptive versus declarative), abstract (structured versus unstructured), selection of keywords (MeSH database), the inclusion of a graphical abstract, highlights, and the crafting of the introduction, methodology, results, discussion, and conclusion sections. The introduction should begin with a concise overview of the topic, emphasizing key findings from previous studies and stating the research question. It should outline gaps in existing theory, unmet research needs, and unanswered questions, cite recent literature, and conclude with the study's objectives. The methodology section can be structured using the "research onion" framework, comprising layers arranged in a hierarchical pattern [7]. Within the "methods" section, precise procedures for presenting results should be outlined, while the "results" section ought to showcase key findings in a logical sequence. The "discussion" section is pivotal in offering a comprehensive analysis of the findings, acknowledging any potential limitations, and proposing avenues for further research. Authors should adhere to either Harvard or Vancouver referencing styles as instructed by the journal of submission [6]. Before submission, authors should engage in a plagiarism check to ensure that the originality of their work surpasses 90%.

The journey from manuscript submission to publication, navigating through the peer review process, was presented by Dr. Jagadeesh. Consideration should be given to selecting a suitable journal for submission based on factors such as the type of manuscript, novelty, and significance of the study, target audience, and impact of the work. It is equally important to assess criteria such as the Science Citation Index Expanded-Clarivate Analytics journal impact factor, abstracting/indexing services, professional society journal, open access, page charge, publication frequency, and target readership. Authors are strongly advised against submitting to predatory or cloned journals. A well-crafted manuscript that aligns with the journal's guidelines should be accompanied by a well-written cover letter, emphasizing the novelty, significance, and relevance of the research. Once the manuscript meets the journal's standards, the editorial office forwards it to expert reviewers for evaluation. Peer review serves as a crucial process in which the author's work is scrutinized by knowledgeable peers in the field. The editor's responsibility for post-peer review is to assess reviewer feedback and make a decision on the manuscript. Each published paper contributes to the continuity and progression of research in the field [8].

The final session of the meeting on "Research and Publications Ethics" commenced with a presentation by Dr. Shubhada Nagarkar. Over the last two decades, the academic community has been grappling with the pervasive issue of predatory publications, posing a significant threat to the credibility of scholarly research in India [9]. The prevalent "publish or perish" culture worldwide for career progression might have

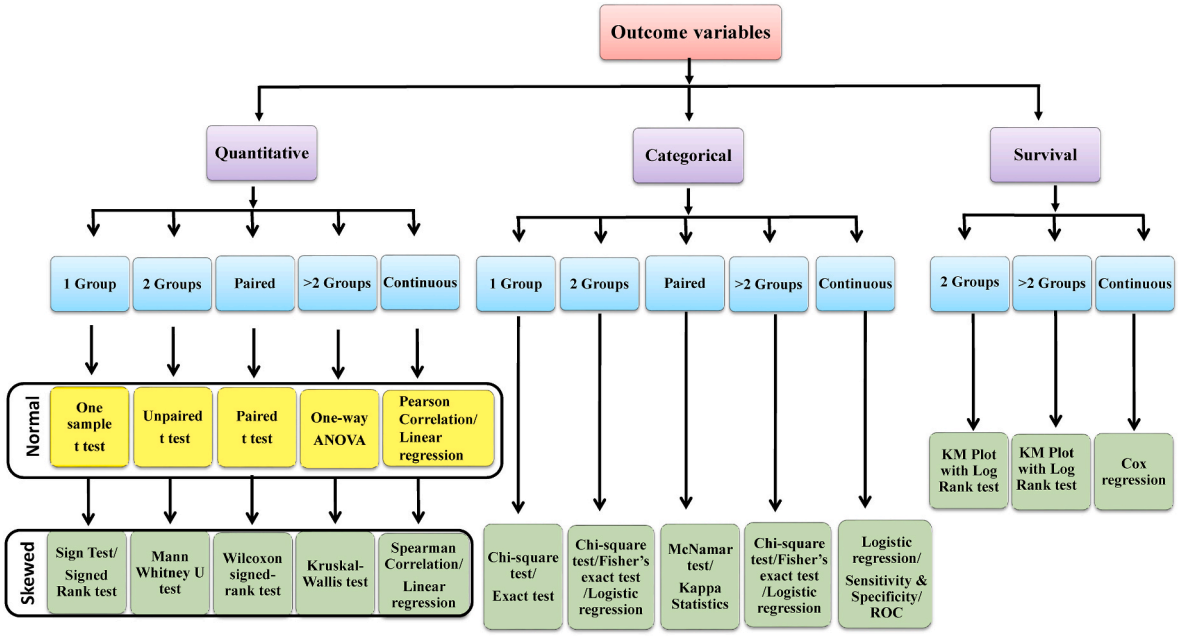

Fig. 1. Selection of appropriate statistical tests. This framework will assist in elucidating the relationships under investigation in the study, aligning the design elements that articulate a research question, and determining the suitable statistical analyses for various data formats.

the potential to harm academia. This pressure has resulted in various unethical practices such as plagiarism, image replication, data manipulation, and the proliferation of predatory journals and paper mills. The presentation also sheds light on the global efforts to combat unethical practices and predatory publications. It highlighted the contributions of individuals like Jeffrey Beall from the USA, as well as initiatives such as the Centre for Journalology at Ottawa Hospital in Canada, and commercial databases like Cabell's, "UGC-CARE: a reference list of quality journals" an initiative of the University Grants Commission, India, which has received international recognition, particularly for the inclusion of Indian language journals that have never found a place in globally recognized databases such as Web of Science and Scopus. The presentation concluded with recommendations to stay vigilant regarding current publishing trends and to follow reputable blogs such as ThinkCheckSubmit, the World Association of Medical Editors, the Committee on Publication Ethics, the Scholarly Kitchen, and the Retraction Watch.

In conclusion, the participants were provided with extensive short-term training and valuable information on various research-related subjects, including research methodology, literature search, scientific writing and publishing, experimental design and statistical analysis, and publication ethics. The attendees perceived the training program as highly beneficial for their dissertation and research endeavors. They recommended that such events be organized regularly and span over three to five days to allow for comprehensive hands-on training and a diverse array of lectures. The participants expressed their keen interest in attending similar training sessions in the future. Overall, the training program was deemed quite beneficial for students, educators, and aspiring researchers.

Conflict of interest

None.

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Author contributions

PB: Conceptualization, Writing the original draft, Editing, and Supervision; **SN**: Conceptualization, Review, and Editing; **GB**: Conceptualization, Review, and Editing; **RA**: Conceptualization, Review, and Editing; **GJ**: Conceptualization, Review, Editing, and Supervision. All authors were involved in revising and approving the final manuscript.

Declaration on the use of generative AI in scientific writing

The authors declare that no generative AI has been used in the writing process.

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