

Writing a Research Article

Authors

Mahika Shah, Dheeraj Shah

Affiliations: Department of Psychology, Lady Shriram College for Women, University of Delhi, New Delhi, India.
National Institute of Health and Family Welfare, New Delhi, India.

Corresponding Author : Prof (Dr) Dheeraj Shah, Director, National Institute of Health and Family Welfare, Baba Gangnath Marg, New Delhi 110067, India; and Director-Professor, Department of Pediatrics, University College of Medical Sciences (University of Delhi) and GTB hospital, New Delhi, India.

Writing a research article can be a daunting task, but it is also a rewarding one. Publishing a good original research article in a reputed journal not only enhances the reputation and academic profile of the researchers but also helps to advance the knowledge in relevant field and has a potential to make a real impact. To start, it is important to understand the purpose of a research article. A research article is a formal piece of writing that presents a detailed account of an original research study. It is typically written for other researchers in the same field, and it should be clear and well-organized. Research articles are typically published in peer-reviewed journals, which means that they are reviewed by other experts in the field before they are published. This ensures that the research is of reasonably high quality and has a potential to make a significant contribution to the knowledge, practices and policy.

Research articles are usually structured into distinct sections, namely **Introduction**, **Methods**, **Results**, and **Discussion**, collectively referred to as the **IMRaD** format¹. The Introduction section provides background information on the research topic and states the research question or hypothesis, and objectives of the study. The methods section describes how the research was conducted, including the participants, materials, and procedures used. The results section presents the findings of the research, including in the form of tables, graphs, and figures. The discussion section interprets the findings, discusses the

limitations, and suggests implications for future research. Within these sections, the use of subheadings aids in further categorizing and organizing the content.

Standard reporting guidelines have been recommended for various study types. Examples include CONSORT for randomized trials, STROBE for observational studies, PRISMA for systematic reviews and meta-analyses, and STARD for diagnostic accuracy studies (Fig. 1)². Following these guidelines is important as they help authors to describe their study comprehensively. This enables editors, reviewers, readers, and fellow researchers to thoroughly evaluate the research. Resources like the EQUATOR Network and the NLM's Research Reporting Guidelines and Initiatives offer valuable guidance on adhering to these guidelines³. Adhering to reporting guidelines enhances the transparency and accuracy of research reporting, promoting a deeper understanding and scrutiny of research findings.

Main Sections of a Research Article: The IMRaD Format

Introduction

The introduction in a research article sets the tone for the study, familiarizing readers with the research hypothesis, and motivating them to engage with the paper⁴. It guides readers from the 'why' of the research to the 'how,' directing them towards the methods section.

In essence, an introduction comprises three key elements⁵. First, it provides a background on what is already known about the research topic, establishing the foundation for the study. Second, it justifies the research by explaining if it builds upon prior work, explores a new aspect, or aims to enhance previous ambiguous results. Lastly, it states the research objectives and, preferably, presents a well-defined hypothesis.

When writing the introduction, it is important to maintain a concise and focused approach. The structure often follows a funnel approach, beginning with a broad overview of the topic and progressively narrowing down to the research problem and hypothesis. The opening paragraph introduces and contextualizes the research topic, emphasizing the need for the study. The following paragraph identifies gaps or challenges in existing research, ultimately leading to the research question. The third paragraph outlines research objectives and presents the hypothesis, offering a tentative prediction of the relationship between variables⁵. A well-crafted introduction, alongside a strong title and abstract, lays a solid foundation for the research paper.

Methods

The Methods section of a research paper is vital for describing how and why a study was conducted in a specific manner. Clarity is the key in this section; researchers must provide enough detail for others to replicate the study's results based on the available information¹. If an external organization assisted in the research process (e.g., data collection), this collaboration should be explicitly stated in this section. It is important to state that the research obtained approval from an independent local, regional, or national review body, such as an ethics committee or institutional review board⁶.

Study Setting, Duration and Design

Begin by clearly describing the study location and duration, including the source of participants or data. Specify if it is an institute/hospital-based or community-based study. Outline the study design, differentiating between primary (basic medical, clinical, epidemiological) and secondary (systematic reviews, meta-analyses) research⁷. Adhere to specific reporting guidelines endorsed by journals for precise, transparent, and standardized reporting, to facilitate accurate research evaluation.

PICO Details

Most research papers can be described by using the PICO (Participants, Intervention, Control, Outcomes) or PECO (Participants, Exposure, Control, Outcomes) format.

Participants: This entails a clear description of how participants for the study were selected, whether they were healthy individuals, patients, or controls. It should include criteria for inclusion and exclusion, as well as a description of the source population. Inclusion of a diverse and representative population is encouraged across all study types, with descriptive data on relevant demographic variables like age, sex, or ethnicity. If the study was conducted with a particular exclusive group, authors should justify this focus, except in cases where the research question directly pertains to that group⁸. The accurate use of the terms “sex” (when reporting biological factors) and “gender” (reporting identity, psychosocial or cultural factors) is important. Unless inappropriate, report the sex (or gender) of participants, animals or cells, and how it was determined¹. Precise terminology should be used to describe participants, avoiding any language that may stigmatize them (e.g. Children with epilepsy NOT epileptics, Patients with diabetes NOT diabetics, Persons with disability NOT handicapped or challenged)

Intervention/Exposure: In experimental/interventional studies, the details of intervention (drug, nutritional substance, educational intervention) should be clearly described. Any drugs, chemicals, scientific names, or gene names used should be clearly identified. Dose(s), route of administration, frequency of administration and duration must be stated. In observational studies, 'exposure' replaces 'intervention.' The details when an exposure (e.g. smoking) is considered to have happened must be clearly described.

Control/Comparison: In controlled and comparative studies, the procedure for selecting controls (e.g. randomization in interventional study, matching in observational studies) should also be described in detail. All details as outlined for intervention/exposure should be described for controls as well.

Outcomes: Outcomes for a research article are the pre-specified end-points of the study (e.g. hemoglobin after 12 weeks and percentage of children with anemia after 12 weeks in a study evaluating two different iron formulations for treatment of iron deficiency anemia). The study's primary and secondary outcomes should be specified. Primary outcome of the study is the one which is based on the hypothesis of the study, is the main thrust of the study, and is used for calculation of sample size. All other outcomes of interest are classified as Secondary outcomes. The methods, equipment, and procedures for evaluating these outcomes must be detailed enough for others to replicate the study. Established methods should be referenced, and modifications or new methods should be thoroughly explained, including their limitations.

Statistical Analysis and Sample Size

Statistical methods should be described in sufficient detail to enable a knowledgeable reader to assess their appropriateness and verify reported results using the original data. Findings should

be quantified and presented with appropriate indicators of measurement error or uncertainty, such as confidence intervals. Beyond relying solely on statistical hypothesis testing, additional information about effect size and estimate precision should be conveyed. It is important to define statistical terms, abbreviations, and symbols and specify the statistical software package(s) and versions used. Distinguish between planned and exploratory analyses, including subgroup analyses¹.

The research article should also mention a pre-specified sample size and the basis for its calculation, with reference to other research papers from where data have been used for calculation of sample size.

Results

The Results section is a critical component of any scientific paper. It provides a clear presentation of the study's findings. Maintaining a fluent and uncluttered writing style is essential. Utilize the past tense to describe results, as the events being reported have occurred in the past⁹.

Starting with the Results Section

Begin by presenting key details regarding the study participants, outlining the number of participants screened and recruited for the study. Provide information about exclusions, randomizations, and lost-to-follow-up cases, possibly using flow diagrams for clarity. Afterwards, outline their demographics and clinical features, preferably in the narrative text. Note the count of participants with missing data for each variable and include information on exposures and potential confounding factors¹⁰.

Addressing Objectives

Start by addressing the results from primary study objective, answering the key question using appropriate statistical tests as outlined in the

methodology. Subsequently, present secondary outcomes, following the methodological order and complexity (from simple to more complicated results)¹⁰.

Reporting Guidelines

Adhere to specific reporting guidelines based on the type of study, such as STROBE for observational studies and CONSORT for randomized control trials. These guidelines dictate the inclusion of study flow diagrams, recruitment and follow-up period dates, reasons for premature trial stops, and reporting adverse events.

Important Considerations¹⁰

Precision in numerical representation: Round-off numerical results to appropriate decimal points consistent with the precision of the measuring instrument or assay, as per journal requirements.

Clear presentation of P Values: Clearly state the actual P values instead of using generic indicators like $P < 0.05$. Never state a P value as 0.000; instead, use $P < 0.001$ for more accurate representation.

Mindful choice of words: Use 'significant' judiciously, strictly denoting statistical significance (usually $P < 0.05$). Avoid the term when the difference is not statistically significant.

Addressing potential confounding factors: Clearly indicate adjusted estimates to account for confounders, specifying which were adjusted for and explaining the rationale.

Acknowledging negative findings: Report negative findings, as they hold equal importance and contribute to the credibility of the study.

Balancing text and tables: Ensure that the text, tables and figures complement each other; avoid repetition, and provide clarity.

Using Tables and Figures

Tables are effective for presenting complex data in a structured manner. They should convey key messages concisely without redundancy. Link the text to tables by sequential referencing. Tables can be placed sequentially at the end or within the results section as per journal guidelines. Limit the number of tables, typically 2-4, and include remaining data as supplementary material. A well-constructed table should be self-explanatory with a clear heading, row/column headers, and footnotes containing essential information and abbreviations.

Figures visually convey important information, and should complement the text and tables. Select data that is best presented visually, such as trends, patterns or key insights. Legends and labels in figures should be informative, and figures should be cited and numbered in order of reference in the text. Images should be of high quality and maintain proportions. Choose the appropriate chart type based on data type and comparison needs, such as pie charts, bar charts, histograms, scatter plots, line plots, or box plots.

Reviewing

Ensure meticulous review of your data to eliminate discrepancies or inaccuracies in reporting. Inaccuracies within the results reflect poorly on the study's credibility, potentially affecting the review process. Seeking a colleague's neutral perspective for reviewing your results or the entire paper before submission can help discover unnoticed flaws.

Discussion

The 'Discussion' section explains meaning of results, validates their importance, and proposes implications and future suggestions. It shows how the research questions or hypotheses posed in the introduction have been addressed by the

results and how they contribute to understanding the research problem.

Summarising Main Findings

The discussion can be imagined as an inverted funnel, starting from precise points and broadening the scope¹¹. The opening paragraph should briefly summarise the main findings, and how they answer the research questions. It should not reiterate background information or results. The significance and uniqueness of the study should be apparent.

Balanced Presentation

Both strengths and limitations should be presented. Possible alternative explanations for the study results should be considered without bias towards the proposed hypothesis. Authors should address concerns about study design, methods, sample size, and their implications on result validity¹². Counter-arguments or strengths may also be presented.

Relating to the Literature

The discussion should be focussed on the main outcome(s) and connect the research to existing knowledge by comparing and contrasting it with similar studies. Cite previous work that supports the findings and credit other researchers appropriately. Conflicting results should be acknowledged transparently¹³, and differences in design, methods, or population should be analyzed.

Implications and Future Suggestions

Practical and clinical implications should be discussed wherever applicable. Recommendations for changes in practice or policy may be proposed only when the study is of sufficient magnitude to be generalizable to the population for which the recommendations are being proposed. The discussion should also suggest specific research

avenues that could enhance understanding in the field.

Conclusion

Concluding the discussion, a clear and concise statement should summarize the study without introducing new information. The conclusions must be based on the results from the present research, and also may reiterate recommendations for practice or further research. It should align with the manuscript's tone and content¹².

Other Facets of a Research Article

Title Page

The title page for submission of a research article to a scientific journal contains essential details about the article and its authors, including the article title, author information, disclaimers, sources of support, word count, and the number of tables and figures¹. Author information includes the authors' highest degrees and affiliations. Contact details like email addresses and phone numbers of corresponding authors are usually required. Providing the Open Researcher and Contributor Identification (ORCID) is encouraged. Authors might include a disclaimer stating that the opinions expressed in the article are their own and not representing their institution. Support sources lists grants, equipment, drugs, or other support that aided the research described in the article. The number of words in the main body of the paper (excluding abstract, acknowledgments, tables, figure legends, and references) helps editors and reviewers evaluate the appropriateness of the paper's length, and adherence to word limit. Indicating the quantity of figures and tables helps the editorial team and reviewers verify the completeness of the submission and assess space usage. The ICMJE offers a standard disclosure form for conflict of interest; however, editors may request COI on the title page for convenience.

Article Title

The title should give a quick idea of what the article is about. It plays a vital role in search engine visibility. An effective title should be “SPICED,” representing Setting, Population, Intervention, Condition, End-point, and Design¹⁴. Setting describes where the research occurs, specifying if results are setting-specific. Population includes the target group and relevant characteristics. Intervention indicates the therapeutic or preventive action studied. Condition refers to the clinical state of subjects. Endpoint rarely appears in the title; it denotes the change due to intervention. Design, usually placed after a colon, clarifies the study type. For instance, “Effect of Parental Education on Vaccination Uptake: A School-based Intervention in Underprivileged Communities”. Many journals often require a brief “running title” as a condensed version of the main title, placed in the header of published pages. It is typically limited to 50 characters, including spaces.

Abstract

An abstract is a concise summary of your paper, often the first thing editors and reviewers read. The abstract should provide a condensed view of your research, outlining its background, objectives, methods, results, conclusions, and recommendations. Critique of the research is excluded. It usually spans around 300 words or about 10% of the manuscript length. Attributes of a well-written abstract are summarized in **Box1**.

Abstracts can be unstructured (running text) or structured with subheadings. The structured approach could be a 4-point or an 8-point format. The 4-point abstract comprises Background, Methods, Results, and Conclusions, while the 8-point one includes Objectives, Design, Setting, Participant Details, Methods/Interventions, Outcome Measures, Results, and Conclusions.

BOX 1: Attributes of a Well-Written Abstract

Completeness: The abstract should stand alone, offering a holistic view of the research, its major components, and novelty.

Conciseness: Be precise and avoid unnecessary wordiness or redundant information.

Clarity: Keep it readable, well-structured, and devoid of jargon. Write in past tense, active voice, and steer clear of clichés or unnecessary background.

Cohesiveness: Ensure a smooth transition between sections, maintaining a chronological order as in your main paper.

Structuring the Abstract

Background and Objectives: Briefly introduce the research’s existing knowledge and state the study’s objectives.

Methods: Describe the study design, setting, participant details, interventions, outcome measures, and assessment methods. In 8-point structured abstract (mainly for experimental/interventional studies), this section is further divided into various headings like Design, Setting, Participants, Intervention and Outcomes.

Results: Mention the number of participants including drop-outs. Present key findings with words, as well as numerical data, focusing on primary and secondary objectives.

Conclusion: Summarize the ‘take home message’ and significant findings. Relate conclusions to the research question and hypothesis. Express your perspective if applicable.

References

In medical writing, two main styles are commonly used for citing sources: the Harvard style and the Vancouver style. The Vancouver style is widely followed in medical journals..

Vancouver Style

The Vancouver style employs two main components for citation: in-text citation and a reference list.

In-text citation: Each reference is cited and numbered in order of appearance in the text. When a reference is cited in a table or figure, the citation number should follow the order in the preceding text. The numbers are typically placed in brackets or as superscripts, following the journal's policy. They appear after punctuation marks like full-stops, commas, colons, and semicolons. When citing two or more sources simultaneously, the numbers should follow the chronological order of publication, separated by commas¹⁵.

Reference list: The purpose of the reference list is to provide comprehensive information for accessing the cited sources. The list is arranged in sequential order based on how the sources are cited in the text. The authors' last names are

written first, followed by their initials. If there are more than six authors, the first three or six are listed as per journal recommendations, followed by 'et al.' When citing sources, capitalize the first letter of each author's last name and initials without any intervening periods. The same rule applies to the first letter of the publication title, place name, and publisher¹⁶.

Avoid using conference abstracts as formal references. Instead, cite them within the text using parentheses. References to papers accepted but not yet published should be marked as "in press" or "forthcoming." Manuscripts submitted but not accepted should be referred to as "unpublished observations" with appropriate permissions. Ensure references are accurate and do not cite retracted articles, except when referring to the retraction itself¹. Use authentic sources like PubMed to verify references and check for retractions.

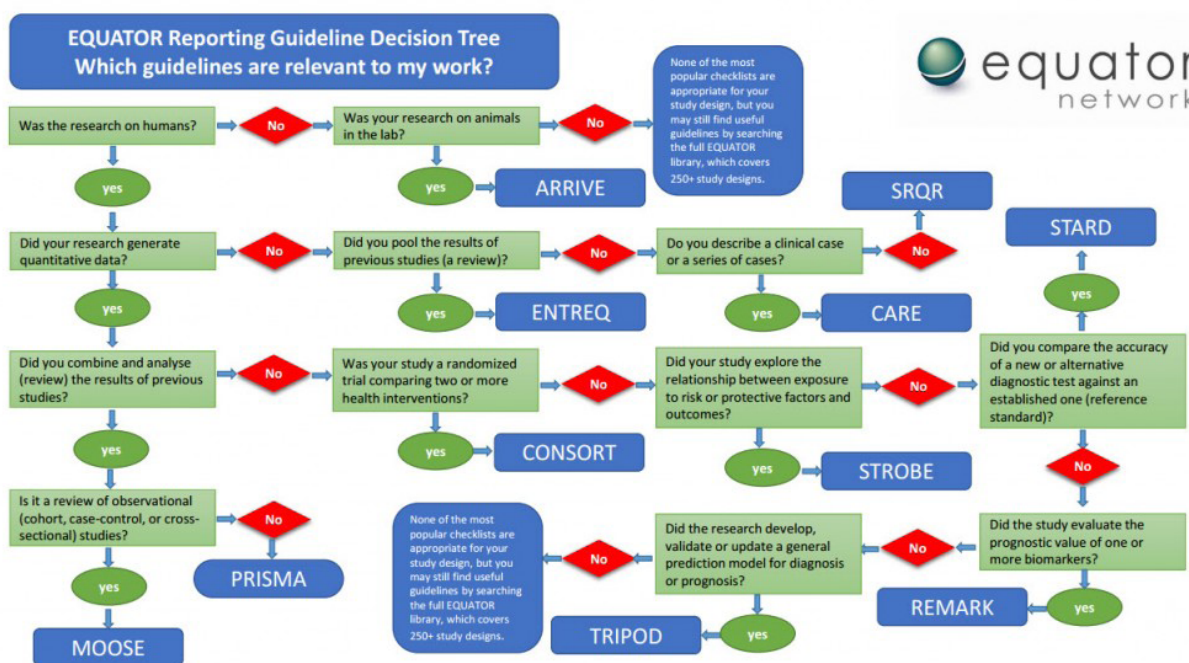


Fig. 1: Guidelines for Reporting Research (Source: <https://www.equator-network.org/toolkits/selecting-the-appropriate-reporting-guideline/>)

References

1. ICMJE. Recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly Work in Medical Journals (Updated May 2023). Available from: <https://www.icmje.org/icmje-recommendations.pdf> (Accessed October 01, 2023).
2. The EQUATOR Network. Selecting the appropriate reporting guideline for your article. Available from: <https://www.equator-network.org/toolkits/selecting-the-appropriate-reporting-guideline> (Accessed October 02, 2023).
3. National Library of Medicine. Research Reporting Guidelines and Initiatives: by Organization. Available from: https://www.nlm.nih.gov/services/research_report_guide.html (Accessed October 02, 2023).
4. Peh WC, Ng KH. Writing the introduction. Singapore Med J. 2008; 49: 756–7; quiz 758.
5. Dewan P, Gupta P. Writing the title, abstract and introduction: looks matter! Indian Pediatr. 2016; 53:235–41.
6. World Medical Association. World Medical Association Declaration of Helsinki: Ethical principles for medical research involving human subjects. JAMA. 2013;310:2191–4.
7. Röhrig B, du Prel JB, Wachtlin D, Blettner M. Types of study in medical research. DtschArztebl Int. 2009;106: 262–8.
8. Arora SK, Shah D. Writing Methods: How to write what you did? Indian Pediatr. 2016;53: 335–40.
9. Kallestinova ED. How to write your first research paper. Yale J Biol Med. 2011;84:181–90.
10. Mukherjee A, Lodha R. Writing the results. Indian Pediatr. 2016;53:409–15.
11. Annesley TM. The discussion section: your closing argument. Clin Chem. 2010;56:1671–4.
12. Bagga A. Discussion: The heart of the paper. Indian Pediatrics. 2016;53:901–4.
13. Hess DR. How to write an effective discussion. Respir Care. 2004;49:1238–41.
14. Gupta P. Framing a suitable title. In: Gupta P, Singh N (Eds). How to Write the Thesis and Thesis Protocol. A Primer for Medical, Dental and Nursing Courses. First Edition. New Delhi: Jaypee Brothers Medical Publishers; 2014. p. 45–9.
15. Todd P. Subject guides: Citing and referencing: In-text citations. Monash University. Available from: <https://guides.lib.monash.edu/citing-referencing/vancouver2022-in-text-citations> (Accessed October 12, 2023).
16. Monash University. Todd P. Subject guides: Citing and referencing: Reference list guidelines. Available from: <https://guides.lib.monash.edu/citing-referencing/vancouver2022-reference-list> (Accessed October 12, 2023).