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Critical review of a scientific publication: An insight

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Abstract

The ever-increasing number of scientific publications has made the critical review/appraisal of articles necessary to weed out the irrelevant scientific publications as well as to remain up to date. The aim of this article is to present the concepts and principles of reviewing a scientific publication and it will be helpful to researchers, authors and reviewers in writing/evaluating a scientific publication. The article provides a detailed review of all the structural head of a manuscript {title, abstract and keywords, main text (introduction, methods, results, and discussion), conclusion, references, tables and figures}. Can be the decisive factor about the merit of the article. The title should be attractive, provoke curiosity, simple, concise and easily understandable without jargon while the abstract is a concise & accurate summary of the publication.

Introduction: Is the brief description of the subject matter of the scientific publication, contains the present state of knowledge, and should progress from the general to the more specific. Rationale/justification of the investigation should be clearly laid out in this part.

Methodology: Describes what has been done, how it has been done and what does the authors looked for. It describes the various stages of planning, type of study sample, conduction of the study and the statistical part.

Results: Show “what the authors have found?” and should reveal the points raised in the methodology, results for end points, reporting of statistical significance and other observations.

Discussion: This section discusses and interprets the study findings and puts the findings in the proper perspective in the light of available literature on the study. This section compares the findings of the study with the status quo and odes the critical analysis of study limitations.

Conclusions: Include the most important relevant logically derived interpretation of the study.

Keywords: Critical analysis, evaluation, scientific publication, validity

Introduction

Publication in scientific journals is considered as a scholarly activity and merits academic credit [1, 2, 3]. Publication requires writing a report of a research study in a particular format for a scientific journal [1]. The publications should be in a readily accessible, widely read, and prestigious indexed journal [1]. Research publications esp. in medical sciences is increasing by leaps and bounds mainly due to the Medical Council of India (MCI) which has mandated two research publications in certain indexed journals for promotion of medical faculty [4-8]. Further the concept of Evidence based medicine has fuelled the researchers, scholars, students, academicians to undertake research in different fields. The ever-increasing number of scientific publications has made the critical review/appraisal of articles necessary to weed out the irrelevant scientific publications as well as to remain up to date [9]. Moreover regularly reading and reviewing research articles helps in learning how to write manuscripts. The interpretation and evaluation of a research article requires the basic understanding of medical knowledge as well as the statistical methodology [9]. The current article aims to present the concepts and principles of reviewing a scientific publication. *Scope of the article-* The article will be of help to researchers, authors and reviewers in writing/evaluating a scientific publication. The concepts presented in the articles apply to all the epidemiological studies (observational and experimental). *Initiating a review/ appraisal-* It is pertinent to mention here that before initiating any review the evaluator/reader should have basic information of the subject. The necessary information can be gathered by reading some textbooks, review article or a meta-analysis or searching it online.

Structural Make Up of a Scientific Publication: The structure of the scientific article is same for all the journals [3, 10-12]. The draft of the manuscript consists of the title, abstract and keywords, main text (introduction, methods, results, and discussion), conclusion, references, tables and figures [2, 3, 10, 13]. Apart from these headings the publication should have

acknowledgements (if any), financial statements, Conflict of Interest disclosure and ethical statement. The title and abstract of any scientific publication give the reviewer a first-hand impression of the content and standard of the article. Many a times, the title and abstract can be the decisive factor about the merit of the article. The title should be able to provide a brief idea of the article content. It should be attractive, provoke curiosity, simple, concise and easily understandable without jargon [2, 11, 14]. The abstract is a concise & accurate summary of the publication, providing in short the content of the article and has the same structural heads/ sub-heads as the main text [2, 3, 11, 14]. The abstract should succeed in summarizing the purpose and provide a conclusion of the study and needs to reflect the content of the article accurately without any disagreement with the text [3, 14].

The purpose of the introduction is to define the subject matter of the scientific publication. The introduction should contain the present state of knowledge about the subject matter, global as well as local, and should be presented with reference to the recent literature. One of the important characteristics of a good publication is that the central statements are well supported with references to the literature. The findings of the literature cited should be specific to the subject and to be quoted numerically. It is a good practice for the reviewer to consult the cited references in case of any doubt. Ideally the Introduction part should progress from the general to the more specific. Why the subject merits investigation i.e. rationale should be clearly laid out in the Introduction part. This part should clearly explain what the research question/study intends to answer and why the chosen design is appropriate.

Methodology

This is the one of the important section that describes what has been done, how it has been done and what does the authors looked for. Authors have described this section to resemble a cook book [9]. The description of procedures should provide the reviewer “recipes” that can be followed to repeat the study [1, 9]. This section provides the essential data that permits the review of validity of the study [1]. This section consists of ethical aspects (permission from ethics committee and institutional review board, consent, and assent), description of the study setting, participants, design, treatments/procedures/interventions, end points, and outcomes [2, 3, 11, 12, 20].

This section can be divided into sub-sections which may have their own headings like different laboratory procedures or measurements apart from statistical methods. The methodology section describes the various stages of planning, type of study sample, conduction of the study and the statistical part.

The reviewer should evaluate that whether the methodology of the study is:-

- Suitable to fulfill the aims and objectives of the study.
- What is the type of study design and does it addresses the aims and objectives of the study.
- The endpoint/outcome of the study precisely defined and statistical measures used to characterize the end point (Rates /ratios etc.).
- The study area, the universe, the sample unit/study subject, study period related to methodology should be described in detail.

Table 1: showing the basic requirements of methodology

The protocol was written before the study commenced	Yes/No
The investigation preceded by a pilot study	Yes/No
Study area/Location specified	Yes/No
Study period defined	Yes/No
Approval of Scientific research and ethical committee taken	Yes/No
Appropriate Study Design	Yes/No

The epidemiological investigations can be divided into experimental (interventional) studies and observational studies (Cohort, case control, cross sectional etc.) [17]. These epidemiological investigations are applied according to the purpose of the investigations [18].

Table 2: showing the various studies suitable to a particular situation

Purpose of Investigation	Type of Study Suitable
Investigation of Rare Diseases, exposure to multiple agents	Case-Control Studies
Investigation of exposure to rare environmental factors, of multiple end-points,	Cohort Study
Estimation of incidence in exposed populations	Exclusively Cohort study
Investigation of cause and effect	Experimental Study

The Study design is an important aspect of the article, if being unacceptable; the article is likely to be declined irrespective of how the data was analyzed [15]. Why the

study design was chosen should be explained clearly. Various authors have described Study Design and its implementation [15]. In experimental studies, precise description of design is of paramount importance. The validity and reliability should also be detailed. The inclusion of control group, randomization, blinding of investigators etc. increases the quality of the study. Sample size and its estimation should also be detailed, while specifically concentrating on what statements/ data was taken for sample size estimation. The CONSORT statement provides the international recommendations for the reporting of randomized controlled clinical trials [16].

An important aspect of a good quality publication is clearly defined and precise inclusion and exclusion criteria. Rates such as response rate, Rate to Loss of Follow up should also be mentioned. The selection criteria and the rates of loss to follow-up indicate whether the study sample is representative of the target population or not. Reviewer should scrutinize that the choice of controls must be described clearly to ensure the comparability and minimize the systematic discrepancies like confounding or other problems [18].

A reviewer should find that the measurements in the study were explained along with the instruments and techniques like measuring devices, lab data etc. The measurements should be standardized making them comparable for all study subjects. The reviewer must evaluate the scale of variables so that the kind of analysis possible can be ascertained. Reviewer should also consider whether the power of the study is sufficient or not. The real difference may not be detected in the small sample size. Along with above mentioned details, the statistical methods employed should be described clearly citing proper references. Each important aspect of the methodology should be described. If some important aspect has not been specified, it should not be assumed as done ^[15].

Results

The section contains the findings of the study without any interpretation and should address the aims and objectives of the study. It shows “what the authors have found?” ^[1]. The findings should be presented clearly and objectively in a well-structured, easily understandable and consistent manner. The findings should first be described in terms of sample size, measures of central tendency, measures of variation and confidence intervals and complete socio-demographic details of the study subjects. Thereafter analytical section describing the relations/associations between various variables (dependent and independent) should be described. Several authors have recommended comprehensive description of data on CI and effect sizes besides information of statistical significance (p-value) ^[19]. The tables, figures and graphs improve the clarity and should be self-explanatory. The results should reveal the points raised in the methodology, results for end points, reporting of statistical significance and other observations ^[2, 3, 11, 12]. The non-technical use of technical statistical words (random, significant etc.) should be avoided ^[1].

Discussion

This section discusses and interprets the study findings and puts the findings in the proper perspective ^[1]. In this section, findings are interpreted in the light of available literature on the study. This section states the meaning/interpretation of important findings, discusses the new and important aspects of study, compares with previous similar research, explore plausible explanations for conflicting results, practical implications and state the limitations and biases in the study ^[2, 3, 11, 12, 20]. To be more specific, this section *compares* the findings of the study with the status quo. The Reviewer should scrutinize that whether the Discussion section has added to the already available knowledge on the study topic, conclusions drawn from the resultant findings, does the study findings lead to change of professional behavior or take previously unaccounted factors into consideration, do the findings indicate further investigation, does the study opens/explores/ raises new/ unanswered questions, what are the implications of the finding on medical science and practice, are the findings in accordance with the earlier studies, if not, what could be the reasons, do the results appear plausible.

Another important aspect reviewer should do is critical analysis of the study limitations. Even a meticulously planned and executed study, errors cannot be wholly excluded. Unexpected high attrition or loss to follow up can change the composition of the group and may affect the

comparability of the study. This may cause resultant findings to change and concealing of true difference. The discussion must indicate these differences and describe the patients who are loss to follow up.

Systematic errors are very common in observational epidemiological studies for e.g. recall bias in case control studies, confounding in Cohort studies. These potential errors should be mentioned in the publication otherwise reviewer/evaluator may presume that results might be invalidated by this type of error.

Authors pay greater importance to the statistically significant findings ($p < 0.05$) of the study because they are more likely to be published. This unfortunate publication bias can compromise the scientific knowledge because “Not Significant” does not mean “No Association”. Hence findings/results that do not attain statistical significance must also be published. The inclusion of non-significant results contributes to the credibility and the study attains objectivity if the possibility of chance result is admitted. Literature has shown that when all the valid results of a planned and well executed study are published only then it is possible to draw a conclusion especially in clinical studies. The significance attached to the statistical significance, i.e. the minimization of the likelihood of a chance result, is not the same as clinical relevance. The reviewer has to appreciate the difference between statistical significance and clinical relevance in order to review the findings properly. Available literature has shown that even minute differences can become statistically significant in a large sample size, but that does not make the results of the study automatically relevant ^[18]. This is applicable to all the studies whether observational or experimental. Hence it becomes extremely important for the evaluators to take decisions carefully regarding to modify or retain the current practices. In a large community based perspective, the author must ask about the actual presence of risk factor and whether a small increase in risk justifies public health interventions. Similarly in clinical studies, it should be carefully considered whether the higher efficacy of a preparation outweighs the disadvantage of the cost component and side effects.

Conclusions

The reviewer must find out that the conclusion should include the most important relevant interpretation of the study and should be derived logically from results. The conclusion should be supported by one’s own data or findings of other studies. During the formulation of conclusion, the limitations of the study should be kept in consideration. Some journals use Level of Evidence Scale which can help the reviewer decide the extent practice/body of knowledge will be affected by the publication ^[1]. Conclusion of a study should be followed by describing the generalizability of the study findings, take home message, and possible directions for further research ^[2, 3, 12]. The reviewer should remember that every journal looks for high quality research publications with new knowledge base relevant to the scope of the journal ^[10, 13].

References

The Reviewer should observe that the references cited are in the journal's standard style. All the references whether cited in text, table or figures must be included in the list. The up-to date, orderly references indicate the new knowledge

content of the publication. The references should help the reviewer to explore the topic. Re-review of literature should be done to include the recent publications (within last 5 years) if the original review of literature was done some time ago^[10].

Tables/Figures/Graphs

The reviewer should observe that the tables and figures should be understood independently, should have a title/legend, numbered consecutively^[2, 3]. There should be no duplication of data either in the text or in tables or in figures.

Acknowledgements and Conflict of Interest Statement

The section provides the info on sponsors/financiers and any potential conflict of interest, financial or otherwise, must be stated^[2]. The reviewer must also check for plagiarism.

Box -1 Characteristics of a research article that merits publication.

- The study should be medically relevant, pose scientifically interesting questions and should be innovative.
- All the statements and data supported by literature citations.
- The study should investigate the predefined aims and goal.
- Appropriate study design to address the aims and objectives of the study.
- No major deviations from study protocol during its practical implementation.
- Adequate representative sample size and power of the study.
- Missing values should not be large enough to obstruct meaningful analysis.
- Course/implementation of the study monitored properly.
- Logical derivation of Conclusion from the data.
- No financial or ideological conflict of interest.

Checklist

Some authors have provided a checklist to assist the evaluation of medical studies^[3, 15, 16].

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