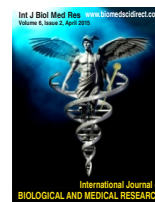




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Review article

Journal Impact Factors - Its Value and Applicability in Research arena

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ABSTRACT

The impact factor is based on citations of papers published by a scientific journal. The primary goal of impact factor analysis was to improve the management of library journal collections. The true value and implications of the journal impact factor are important to understand. It is critical to remember that journal impact factor can be used only to evaluate journals as a scientific basis is lacking for its use for assessment of the quality of individual papers, scientists and departments. It is not a perfect tool to measure the quality of articles but there is nothing better and it has the advantage of already being in existence and is, therefore, a good technique for scientific evaluation. Even though it has been subject of numerous controversies, especially due to certain biases around its calculation, the journal impact factor will likely be around for a long time. The present article is aimed to highlight its calculation, strengths, limitations and common flaws on its application in the research field.

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1. Introduction

The identification and evaluation of research studies of high scientific merit is an important but difficult task. Therefore, quantitative measurements of journal article quality, such as the journal impact factor, have become increasingly popular as a surrogate measure of scientific quality. It was originally proposed 50 years ago as a measure of the impact that individual articles have on the research community.¹ Journal Impact Factor is from Journal Citation Report (JCR), a product of Thomson ISI (Institute for Scientific Information). The ISI in Philadelphia serves as a continuous record of scientific citations. The references are rearranged to show how many times each publication has been cited within a certain period of time and by whom, and the results are published as the scientific citation index (SCI).² On the basis of the Science Citation Index and authors' publication lists, the annual citation rate of papers by a scientific author or research group can thus be calculated. Similarly, the citation rate of a scientific journal - known as the journal impact factor - can be calculated as the mean citation rate of all the articles contained in the journal. The impact factor, often abbreviated IF, is one of the quantitative tools for ranking, evaluating, categorizing, and comparing journals and is a measure reflecting the average number of citations to articles published in science and social science journals.³ It is frequently used as a proxy for the relative importance of a journal within its field, with journals with higher

impact factors deemed to be more important than those with lower ones.

The impact factor was devised by Eugene Garfield, the founder of the Institute for Scientific Information, now part of Thomson Reuters. In 1955, Garfield¹ suggested that the number of references could be used to measure the "impact" of a journal, but the term "impact factor" was introduced in 1963 by Garfield and Sher.⁴ In 1964, Garfield introduced the first science citation index in a 5-volume print edition that indexed 613 journals and included 1.4 million citations.⁵ Presently, there are more than 5,000 journals from various specialties worldwide that are published annually in the JCR of the Institute for Scientific Information (ISI) in Philadelphia, USA.⁶ The Association of the Scientific Medical Societies in Germany (AWMF) also uses its recommendations to evaluate scientific achievement on the basis of the IF.⁷ The impact factor was intended primarily as a bibliographic research tool for retrieval of overlapping research for the benefit of scientists who worked in relative isolation to contact colleagues with comparable interests. Later it also developed as a research tool for the social sciences and more recently administrators appear to have discovered the impact factor as a parameter for quality of work of (groups of) scientists. Journal impact factors, which are published annually in SCI Journal Citation Reports, are widely regarded as a quality ranking for journals and used extensively by leading journals in their advertising.

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Calculation

Impact factors are calculated yearly for those journals that are indexed in Thomson Reuter's Journal Citation Reports.⁸ It is a measure of the frequency with which the "average article" in a journal has been cited in a particular year or period. The annual impact factor is a ratio between citations and recent citable items published. It is calculated usually by dividing the number of current year citations to the source items published in that journal during the previous two years.

Example: Calculation for journal IF 2016

A= Total cites in 2016 B= 2016 cites to articles published in 2014-15 (this is a subset of A) C= No of articles published in 2014-15
D= B/C = 2016 impact factor

The 'aggregate Impact Factor' for a subject category is calculated the same way as the Impact Factor for a journal, but it takes into account the number of citations to all journals in the category and the number of articles from all journals in the category. An aggregate Impact Factor of 1.0 means that that, on average, the articles in the subject category published one or two years ago have been cited one time. The 'median Impact Factor' is the median value of all journal Impact Factors in the subject category.⁹

Uses and misuses of Impact factor

In the current scenario, IF is the main marker within the scientific community for evaluation for promotion/ tenure/ grants, or in some countries, even government funding of an institution on the basis of their publication output, to assess how actively they are engaged in research. For example, the science ministries in South Korea, China and Pakistan now offer cash rewards to their scientists if they are able to publish papers in journals with high IFs such as Nature, Science and Cell. The remuneration amount can be quite impressive, as much as US\$ 50,000 in China. In Pakistan, scientists can receive between US\$ 1,000 and US\$ 20,000 on the basis of their annual cumulative IFs.¹⁰ It is also frequently used as an evaluation source by librarians during journal cancellations or new purchases.

In market research, the impact factor provides quantitative evidence for editors and publishers for positioning their journals in relation to the competition—especially others in the same subject category.¹¹ By assigning a 'quality label' to papers in the form of the impact factor of the journal at the time of publication, in theory a much faster quality assessment could be made.¹² It eliminates some of the bias of such counts which favour large journals over small ones or frequently issued journals over less frequently issued ones and of older journals over newer ones. Particularly in the latter case such journals have a larger citable body of literature than smaller or younger journals. The impact factor can be used to provide a gross approximation of the prestige of journals in which individuals have been published.

On the other side, journal impact factors are not statistically representative of individual journal articles. The journal impact factor is directly related to the area of research: The larger the scope of the journal, the higher the journal impact factor. Usually publications in journals with a high IF, is used as the only

evaluation criterion rather than the quantification of the scientific contribution itself. Because the original idea of citation analysis was developed to protect against the uncritical citation of fraudulent and even disputed data, some have questioned the usefulness of the IF, stating that it actually represents popularity rather than prestige.¹³ Rey-Rocha et al have shown discrepancies in the IF between scientists or research groups in English and in non-English speaking countries.¹⁴ In most non-English speaking countries, research is not published in high IF journals, and sometimes, it is a source of embarrassment for the scientists working in those countries whose journals are not even listed by SCI. For example, Spanish language research publications in domestic journals are not included in SCI.¹⁵ The IF is often misused, as there are no specifically-defined principles governing its interpretation. The IF is used to measure the importance of journals, as well as a researcher's potential, a use for which it was never intended, and it is also used to make faulty comparisons among journals.

Drawbacks of IF

The IF and its method of counting and determination, according to several authors, is poorly constructed and poorly used as a measure of scientific quality. Apart from being non-representative, the journal impact factor is encumbered with several shortcomings of a technical and more fundamental nature.² A journal that includes meeting reports, interesting editorials, and a lively correspondence section can have its impact factor greatly inflated relative to journals that lack such items. Review articles generally are cited more frequently than typical research articles because they often serve as surrogates for earlier literature. It is widely believed that method articles attract more citations than other types of articles.^{16,17} The other factor influencing the value of the denominator in the formula for the impact factor is the content of the scholarly articles accepted by the JCR. Scientific journals publish many articles that consist of correspondence, letters, news stories, obituaries, editorials, and interviews but that may not contain substantive research or a review.¹⁸ Perhaps nonscientific articles should not be included in the JCR calculation of source items (which nevertheless could be cited). Also it should be noted that only a limited subset of journals are indexed. What about the scientific articles which are published in journals which are not indexed?

Editors who want to raise the impact of their journals should make frequent reference to their previous editorials, since the database makes no correction for self citations. The practice of self-citation can be considered at many levels, including author self-citation, journal self-citation, and subject category self citation. This may increase the impact factor leading to a bias. A title change affects the impact factor for two years after the change is made. Different specialties exhibit different ranges of peak impact. It does not distinguish between letters, reviews, or original research. It has inadequate and uneven international coverage. Very few publications from languages other than English are included, and very few journals from the less-developed countries. The number of citations to papers in a particular journal does not really directly measure the true quality of a journal, much less the scientific merit of the papers

within it. Furthermore, because citation rate is roughly proportional to the length of the article, journals might wish to publish long, rather than short, articles. Dynamic research fields with high activity and short publication lags, such as biochemistry and molecular biology, have a correspondingly high proportion of citations to recent publications - and hence higher journal impact factors - than, for example, ecology and mathematics.¹⁹ The number of errors in reference lists is common and this occurs in approximately a quarter of all references cited in the articles, which inevitably affect the accuracy of the IF. Lack of empiric studies on Impact factor as measure of quality is one of the major drawback of this system.

Possible modifications

No single summary measure of scientific quality can be used to assess the credibility of individual journal articles or journal quality. The impact factor could just have been based solely on the previous year's articles. This would give even greater emphasis to current research. However, despite several valid concerns, JIFs are still widely used in many countries as the primary criterion in assessing research quality. To help address such concerns, Eigenfactor (ES) and Article Influence scores (AIS) have been devised to assess scientific impact of journals. In ES, the journals are rated according to the number of incoming citations, with citations from highly-ranked journals weighted to make a larger contribution to the Eigenfactor than those from poorly-ranked journals²⁰ As a measure of importance, the ES scales with the size of a journal. All else equal, larger journals have larger ES. As such, ES are not directly comparable to impact factor scores, which are a measure of per-article prestige. To allow per-article comparisons using the Eigenfactor approach, the AIS scales Eigenfactor score by the number of articles published by the journal and thus is directly comparable to impact factor.

Other measures of a journal's worth include the Index Copernicus, citation half-life and immediacy index.²¹ The immediacy index of journal is intended to measure how often, on average, authors cite very recent articles from that particular journal, and hence how rapidly the average paper from that journal is adopted into the literature and cited half life is a measure of how long articles in a journal continue to be cited after publication.²² Some new methods have recently been developed that may help in updating or modifying the methods of evaluation of the IF in the future. For example, Hirsch has developed a new method called the h-index, which aims to evaluate the impact of individual scientists.²³ Bollen et al have introduced a new parameter called the Y-factor, in which multiplication of the Page Rank factor is done using the IF. Using these weighting methods, the status of a journal for a particular year can be re-analyzed and the rankings of the top journals re-evaluated.²⁴

Conclusion

Impact Factor is not a perfect tool to measure the quality of articles but there is nothing better and it has the advantage of already being in existence and is, therefore, a good technique for scientific evaluation. The use of IF as a measure of quality is widespread because it fits well with the opinion we have in each field of the best journals in our specialty. It should be remembered that the impact factor is not valid for the assessment of the quality

of individual scientists or a group of scientists. It can be manipulated, it does not guarantee quality of a journal's content, and a high impact factor may or may not increase the author's citability when publishing in that journal. Even though the impact factor has become the subject of wide spread controversy, it will likely be around for a long time and the key is to understand how it works. Despite its limitations, this citation metric is widely used to reflect scientific merit and standing in one's field. Although several investigators have criticized various weaknesses of the impact factor, including the 2-year window that is used in the calculations, it has not been replaced by any other means of rating the quality of journals. In addition, no data are available regarding trends in the impact factor of scientific journals as a whole that may help in relevant comparisons of journals that are partially based on the use of this index. As with all measures of quality, any interpretation of the JIF should be guided by a sound knowledge of its limitations.

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