

Impact Factor: Myths and Realities

L F Rogers,*^{MD}

Abstract

The Impact Factor was originally devised as an index of the quality of scientific journals and has since obtained mythical proportions. Authors select journals to which they submit their work on the basis of that journal's Impact Factor. Medical school deans and administrators have adopted the Impact Factor as a means of judging the quality of the academic efforts of individual faculty, as well as the aggregate academic productivity of medical school departments. Departmental budgets have been based on the Impact Factor. There are serious questions as to the validity of using the Impact Factor for these purposes.

Ann Acad Med Singapore 2003; 32:429-32

Key words: Faculty assessment, Faculty publications, Impact factor

Introduction

The need for medical school deans, chancellors and administrators to assess the work of their faculty is readily understandable, for it is the faculty's cumulative academic productivity that establishes and maintains the reputation of an institution. Assessment of academic productivity is essential in the appointment, promotion and determination of appropriate faculty salaries. Measures of academic productivity are also used in selecting the most effective uses of the financial resources of an institution. Faculty efforts that must be evaluated are basic and clinical research, publications in scientific journals, teaching of medical students and post-graduate trainees, clinical care of patients and participation in the administrative affairs of the institution.

The assessment of teaching, administrative participation and performance of clinical care are readily observed and graded. Basic research effort can be assessed, in great measure, by a tabulation of the funded research grants the individual has received. However, assessment of authorship and publications is more problematic. Ideally, a knowledgeable individual or group of peers would review the articles that a faculty member had authored and pass judgment on their quality. This requires special knowledge of the field addressed by these publications and would likely be a prolonged and expensive process. Furthermore,

in this day of specialisation in medicine, such knowledge is not readily available except to the faculty member in question or their fellow faculty members in the same specialty. This would raise the suspicion of conflict of interest and bias.

How, then, do academic institutions avoid these potential difficulties in evaluating the merit of the scientific publications of their faculty? Many institutions have adopted the Impact Factor for this purpose, in the belief that it represents objective evidence of the quality and importance of their faculty's publications. Is that true?

The adoption of the Impact Factor has had a profound impact on all academic physicians. And it can also be stated, with equal certainty, that the Impact Factor is highly controversial and held by many to be biased¹ and unscientific.²⁻⁵ Nonetheless, outside the United States, particularly in Europe and Asia, the Impact Factor has become a serious consideration in the selection of the scientific journals to which medical and surgical researchers and authors send manuscripts. The higher the Impact Factor, the more desirable the journal becomes in the eyes of many, even if that journal is not published in the author's native country, or even in the same region of the world, in which the author resides. By publishing in a journal with a high Impact Factor, even though that journal is published in a foreign country and in other than the author's native

* Editor-in-Chief

American Journal of Roentgenology

I. Meschan Distinguished Professor of Radiology

Wake Forest University School of Medicine, USA

Address for Reprints: Dr Lee F Rogers, Editor-in-Chief, American Journal of Roentgenology, 101 South Stratford Road, Suite 303, Winston-Salem, NC 27104, USA.

Email: lrogers@ajroffice.org

language, academicians are quite likely to receive more academic credit than they would for publishing the same work in their own national medical or surgical journals. How, and why, did the Impact Factor come to assume such a position of importance? And should it?

Definition

The Impact Factor is derived from the frequency of citations in the scientific literature referring to articles published in the last 2 years in a specific journal compared to the number of articles published in that same journal in the same time period, as identified in the institute's database. The more citations in that 2-year period and the fewer the articles published in the preceding year, the higher the Impact Factor. On the surface, this might seem reasonable. However, closer scrutiny raises several questions regarding the validity of the Impact Factor, to say nothing of the fact that it can be, and is, subjected to various forms of manipulation by editors.

History⁶⁻⁸

The Impact Factor was devised and termed as such by the Institute of Scientific Information (ISI) of Philadelphia, Pennsylvania, USA, a non-governmental, private company that had been originally formed to create a database of the world's scientific literature. The ISI is a completely independent organisation. It has no official governmental, scientific or academic status. Those who founded the company originally created the database for the purpose of selling subscriptions to scientists who desired information concerning scientific developments in their area of interest the world over. Other uses have since been found for the database, including production of the Impact Factor.

The Impact Factor was devised and used by ISI to determine whether or not a particular journal should be included in their database. ISI wished to include the highest quality journals in their database, those with the most frequently cited articles. In particular, ISI was interested in including smaller journals with fewer articles, and larger journals that published a greater number of articles. ISI recognised that if they simply counted the number of citations to articles published in a given journal, then the larger journals with the greater number of published articles would have an advantage in this regard. The average rate of citations was considered a measure of the quality of the journal; the greater the average, the higher the quality of the journal. By using the average rate of citations of articles as a measure of quality (the so-called Impact Factor), ISI was able to include smaller journals with fewer publications in their database. Garfield,⁶ one of the originators of the Impact Factor, maintains that the preceding was the sole purpose for which the Impact Factor was intended, and that many of the other uses to which it has been applied are

inappropriate. In particular, Garfield⁶ states, in no uncertain terms, that the Impact Factor should not be used to assess of the quality of the publications of an individual author or researcher.

Uses of Impact Factor

The Impact Factor is used principally to rank scientific journals; the higher the Impact Factor, the "better" the journal. Medical school deans and administrators have seized upon the Impact Factor as objective evidence of the quality and importance of their faculty's publications. The Impact Factor has been used for this purpose to a greater extent in Europe than Asia, but has much less status in the United States. It is the practice of medical schools to use the cumulative Impact Factor of a faculty member as a determinant of faculty rank, promotion and salary. It is even alleged that the aggregate Impact Factor of a departmental faculty has even been used to determine departmental budgets.

As expected, researchers subjected to such surveillance seek out and publish in those journals with the highest Impact Factor, for which they will receive the most academic credit. Departmental chairmen encourage their faculty to submit research to journals for the same reason. English language journals, such as the *American Journal of Roentgenology*, are the beneficiary of this practice. Non-English publications are at a decided disadvantage in this regard.

The importance placed on the Impact Factor has distorted scientific authors' approach to publication. The selection of a journal to which to submit one's work now invariably includes at least some concern for the relative Impact Factor to which an article is to be submitted. There is also more oversight and concern expressed by departmental and medical school administrators in this choice because they now have some stake in the authors' choices.

Problems Inherent in the Misapplication of the Impact Factor

In general, articles published in English are easier to access and, therefore, more likely to be cited. The National Library of Medicine database, Medline (PubMed), is more than likely to be used by authors for literature searches related to their research. This favours English language publications. Not all of the world's medical journals qualify for inclusion in Medline. Scientific journals published in languages other than English are at a decided disadvantage in this regard. Many non-English language journals now publish abstracts in English to increase the opportunity for citations.

According to ISI, the top 25 journals, those with the highest impact factors, include many readily acknowledged

elite publications, such as *Nature*, *New England Journal of Medicine*, *Science* and *Lancet*. But, curiously enough, 60% of the supposed top 25 journals publish only reviews and summaries of past research.^{4,8} That is to say, they publish no new knowledge and no fresh research results. How can you truly have impact if you do not publish new research? This is certainly a significant distortion of scientific value.

The ISI database actually covers only approximately 4000 of the estimated 126,000 scientific journals published worldwide, and this coverage varies considerably among research fields.² Obviously, because there is a significant variation in coverage between fields, those fields with a lower percentage of inclusion in the database are at a decided disadvantage when counting citations. Also, it is important to recognise that citations in books are not counted.

ISI's arbitrary choice of counting citations to articles in a 2-year period following publication gives a decided temporal bias to the Impact Factor. The full impact of articles can be understated. Some fields are more dynamic than others. In rapidly changing fields, such as molecular biology, this poses no problem; the majority of actual references to articles may occur in the 2 years following publication. However, in fields that change more slowly, such as my own field of radiology, citations are likely to accumulate over a longer time. In the case of the *British Journal of Radiology* (BJR), the citation rate for the first 2 years is low, but the citations continue to accrue for a long period.⁷ For instance, only 12% of the citations to BJR in 1999 were from papers BJR published in the previous 2 years. It was estimated that the eventual number of citations for the BJR would be approximately 6 times greater than the number of citations from the 2-year period used to calculate the Impact Factor. Similarly, only 15% of all citations to the BJR in 1994 were to articles published in the preceding 2 years of 1992 and 1993.⁴

It should not be assumed that any or all articles published in a given journal would, *a priori*, have the same rate or number of citations. There is considerable variation in the number of citations per article in any given journal. In fact, you are unable to predict the number of citations that an article will receive on the basis of the Impact Factor of the journal in which the paper is published. Publication of an article with a high Impact Factor does not guarantee that an article will automatically receive a large number of citations; that is to say, publication in a journal with a higher Impact Factor will not assure that the article has a great impact and receive a greater number of citations. It has been found that, for biochemistry journals, the top 15% of articles in number of citations account for 50% of all citations for that journal, and the top 50% of articles account for fully 90% of all citations to that journal.² For radiology journals, Chew⁹ has

calculated that 10% of articles account for 50% of all citations.

The adoption of the Impact Factor by academic institutions has created great difficulties for non-English language national medical journals. It decreases the submission of research articles to their publication by native academicians because authors are reluctant to submit their articles to journals with a low Impact Factor. This has reduced the status and importance of such publications.

Unfortunately, this problem may encourage duplicate publications, that is, publication of the same article in both an English and non-English language journals, to support the continued publication of various national journals.

Manipulation of Impact Factor

The Impact Factor is subject to deliberate manipulation by editors. Certain types of articles, particularly review-type articles, are more likely to be cited than others, such as case reports. To increase a journal's Impact Factor, editors can eliminate case reports and increase the number of review articles.

Editors could allow a greater number of references to be listed for all articles in the belief that their journal would benefit from a greater number of citations. Editors might even suggest or require that a certain number of citations be made to articles previously published in their journal to artificially elevate the Impact Factor of that journal.^{10,11}

Summary

The Impact Factor has acquired mythical proportions and, for better or worse, it has quietly become ingrained in the ethos of an academic environment. To the extent that the Impact Factor provides a quantitative and qualitative measure of the contributions of the faculty, it is a positive development in the evaluation of scientific publications. But to the extent that it may distort and misrepresent the quality of the contributions and also discourage original papers, it is undesirable, especially for non-English language journals.

What is regrettable is that, in their eagerness for an easier, cheaper means of objectively evaluating faculty, certain medical schools and universities have adopted the Impact Factor as a promotion criterion without apparent investigation of its validity and suitability as a quality tool. Garfield, the originator of the Impact Factor, states categorically that it should not be used to measure the quality of an individual publication or researcher.^{4,12}

Instead of accepting the Impact Factor *carte blanche* as a measure of the quality of a publication and cumulatively for assessment of the standing of a department or institution, deans, administrators and others in authority should familiarise themselves with the merits and demerits of the

Impact Factor. The current perception and “myth” regarding the Impact Factor as an instrument for measuring academic excellence should be tempered by the “realities” that it has inherent defects and deficiencies.

REFERENCES

1. Grange R I. National bias in citations in urology journals: parochialism or availability? *BJU Int* 1999; 84:601-3.
2. Seglen P O. Why the impact factor of journals should not be used for evaluating research. *BMJ* 1997; 314:498-502.
3. Smith R. Unscientific practice flourishes in science. *BMJ* 1998; 316:1036.
4. Hecht F, Hecht B K, Sandberg A A. The journal “impact factor”: a misnamed, misleading, misused measure. *Cancer Genet Cytogenet* 1998; 104:77-81.
5. Opthof T. Sense and nonsense about the impact factor. *Cardiovasc Res* 1997; 33:1-7.
6. Garfield E. How can impact factors be improved? *BMJ* 1996; 313: 411-3.
7. Whitehouse G H. Citation rates and impact factors: should they matter? *Br J Radiol* 2001; 74:1-3.
8. Rogers L F. Impact factor: the numbers game. *AJR Am J Roentgenol* 2002; 178:541-2.
9. Chew F S. The scientific literature in diagnostic radiology for American readers: a survey and analysis of journals, papers, and authors. *AJR Am J Roentgenol* 1986; 147:1055-61.
10. Smith R. Journal accused of manipulating impact factor. *BMJ* 1997; 314:461.
11. Hemmingsson A, Mygind T, Skjennald A, Edgren J. Manipulation of impact factors by editors of scientific journals [letter]. *AJR Am J Roentgenol* 2002; 178:767.
12. Garfield E. How to use citation analysis for faculty evaluations, and when is it relevant? Parts 1 and 2. In: *Essays of an Information Scientist*. Philadelphia: ISI Press, 1984:354-72.