

## Imperfect impact factor

A scientific journal's impact factor (IF) is derived using a simple mathematical formula and has grown tremendously to become the most influential tool in modern research/academia<sup>1</sup>. However, recently, IF has been an issue of controversy because of severe criticisms. A couple of highly critical editorials<sup>1,2</sup>, correspondences<sup>3</sup> and surveys accused IF as being unscientific, subjective and secretive in the way it is derived, and that science is currently rated by an unscientific process. Thus, considering the importance of IF for the scientific community and the recent criticisms<sup>1-5</sup>, we briefly summarize some facts as well as opinions.

IF, first described by Eugene Garfield in 1955, was used in the early 1960s to help select journals for what would evolve to become the *Science Citation Index*. Thomson Scientific, publishers of the *Journal Citation Reports (JCR)*, calculate IF. A journal's impact factor is calculated as the number of citations (source + non-source items) for the preceding two-year period divided by the total number of source items published in the same period. Items in the above equation are research or review articles. For example, journal *X*'s 2005 IF = Citations in 2005 (in journals indexed by Thomson Scientific) to all articles published by journal *X* in the years 2003 and 2004 divided by the number of articles deemed to be 'citable' by Thomson Scientific that were published in journal in years 2003 and 2004. Obviously, IF depends crucially on which article types Thomson Scientific deems as 'citable'.

Deriving IF seems to be a straightforward and simple procedure. Then, what are the criticisms levelled against IF? According to *PLoS (Public Library of Science) Medicine*<sup>2</sup>, since a journal's IF is derived from citations to all the articles in it, this number does not tell anything about the quality of work of any specific author. In other words, IF is not a statistical representative of individual journal articles and poorly correlates with actual citations of individual articles.

This point becomes particularly evident by understanding that a journal's IF can be substantially affected by the publication of only review articles that gets more citations than research articles/short publications. Further, editors of many scientific journals implement scientifically unethical strategies like: (a) encouraging and forcing authors to cite articles published in their journals, or to substantially cut down the references from other journals and (b) decreasing the number of research articles published. In support, *The Wall Street Journal's* (5 June 2006) 'expose' revealed how unscrupulous editors of scientific journals try to boost IF, either by forcing authors to cite more articles from their own journal or by writing 'best paper of the year'-type articles, in which most, if not all the citations, refer to their own journal<sup>6</sup>. One can understand that journal editors are entitled to do everything legitimately to improve their journal standards and IF. But the key argument is about self-citation rate listing. Apparently, ~80% of the journals in the TS database have a self-citation of ~20% compared to ~6% of the journals not in it. Also, coverage of the Thomson Scientific journal database is incomplete (only 3200 journals out of 126,000 listed so far) and dominated by American publications. Only 4% (~5900 out of 126,000 journals) has IF and the remaining 96% is often referred to as having no IF or never formally cited<sup>6,7</sup>. Moreover, the journals' inclusion criteria for the index are unclear<sup>7</sup>.

Another major criticism is related to Thomson Scientific itself. Thomson Scientific is the sole arbiter of the IF and a part of Thomson Corporation, a for-profit organization. Being a for-profit organization, Thomson Scientific is naturally responsible primarily to its shareholders, and it has no obligation to be accountable to any of the stakeholders, who care most about the IF. Further, (a) research fields with literature that rapidly becomes obsolete are favoured, (b) IF depends on expansion or contraction of the

research field, (c) small research fields lack journals with high impact, (d) relation between fields strongly determines IF and (e) citation rate of article determines IF of journals, but not vice versa.

Then, is IF a poor measure of overall impact? Is it time to reconsider the whole process of accurately assessing an individual paper's worth not only to scientists, but also to the wider community of readers? Obviously, any measure of IF will remain flawed in some way. However, there are some alternative suggestions to improve IF like: (a) assessing the impact of individual articles that makes more sense rather than using a journal's IF as a proxy measure, (b) IF assessing company should take more responsibilities and increase transparency, (c) user rating of articles, (d) use of long-term base rather than two years, (e) excluding letters and reviews to calculate IF and (f) patent and web-citation index. Such new measures may help in assessing the published literature in a better way.

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