GMR Genetics and Molecular Research
Online Journal
ISSN:1676-5680

Opinion

Relative h-index to compare the scientific performance of researchers

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Genet. Mol. Res. 11 (2): 1738-1740 (2012)
Received March 13, 2012
Accepted June 5, 2012
Published June 29, 2012
DOI http://dx.doi.org/10.4238/2012.June.29.6

ABSTRACT. I propose the *Relative h-index* of a scientist, which is based on his or her Hirsch's *h-index* divided by the total number of published papers recorded in the database. The *Relative index h* allows for a comparison of the scientific output among researchers and can be very useful for research support institutions, universities, and institutes to rank researchers for the purposes of recruitment, promotions, awards, and grant funding for projects.

Key words: Hirsch's *h-index*; Number of citations; Number of papers; Comparison of the scientific output among researchers

INTRODUCTION

The impact and relevance of scientist's publications are well quantified by the individual *h-index*. According to Hirsch (2005), a scientist has *index h* if *h* of his or her papers have at least *h* citations each. The *h-index* has been widely accepted by the scientific community and is used in databases such as the Web of Knowledge (http://apps.webofknowledge.com) and Scopus (http://www.scopus.com). For a scientist, the number of citations is a measure of success (Campbell, 2008). Hirsch claims that the *h-index* that he proposed is advantageous and preferable to many other evaluation criteria of a scientific researcher, and lists its advantages and disadvantages:

i. Total number of papers. Advantage: measures productivity. Disadvantage: does not measure importance or impact of papers.

ii. Total number of citations. Advantage: measures total impact. Disadvantage: hard to find and may be inflated by a small number of "big hits", which may not be representative of the individual if he or she is a coauthor with many others on those papers. Another disadvantage is that the total gives undue weight to highly cited review articles versus original research contributions.

iii. Citations per paper (i.e., ratio of the total number of citations to total number of papers). Advantage: allows comparison of scientists of different ages. Disadvantage: hard to find, rewards low productivity, and penalizes high productivity.

iv. Number of "significant papers", defined as the number of papers with > y citations (for example, y = 50). Advantage: eliminates the disadvantages of criteria i, ii, and iii and gives an idea of broad and sustained impact. Disadvantage: y is arbitrary and will randomly favor or disfavor individuals, and y needs to be adjusted for different levels of seniority.

v. Number of citations to each of the q most cited papers (for example, q = 5). Advantage: overcomes many of the disadvantages of the criteria above. Disadvantage: It is not a single number, making it more difficult to obtain and compare. Further, q is arbitrary and will randomly favor and disfavor individuals.

While fundamental to quantify the scientific output of an individual researcher, the *h-index* fails when it comes to comparing the scientific production of 2 or more researchers. However, in disagreement with Hirsch (2005), any 2 researchers (A and B, for example) of the same area and with the same *h-index* cannot be compared directly, unless the number of published papers is equal and cited in the same database. If, for example, both researchers published 10 papers and both were cited at least 5 times, based on at least 5 of their articles, then the *h-index* of both is 5, and they are perfectly comparable.

Suppose now that researcher B has published twice as many papers, inserted in the same database, as researcher A, i.e., 20 papers. The comparison between these researchers is unsubstantiated, as the *h-index* of both remains 5.

Relative h-index

Herein, I propose the use of the *Relative h-index* to compare the performance of 2 or more researchers, by the following equation:

$$Relative\ h\text{-}index = \frac{h}{N}$$

where *h* is Hirsch's *h-index* and *N* is the total number of papers published by the researcher

and entered into the database. Thus, each researcher will have a *Relative h-index* that allows comparisons of a single scientist's publication record with that of others, preferably within the same area of research. Returning to the above example, the scientific production of researcher A was more widely discussed and had a greater impact than that of B. In this case, the correct way of comparing the research output of researchers A and B is the use of the *Relative h-index*, as follows:

Relative h-index of A = 5/10 = 0.50
Relative h-index of B = 5/20 = 0.25

The *Relative h-index* can be very useful for research support institutions, universities, and institutes to rank researchers for the purposes of recruitment, promotions, awards, and grant funding for projects. Moreover, this scientometric indicator can be easily calculated from information that is available in databases such as the Web of Knowledge (Thomson Reuters) and Scopus or it could even be implemented and made available by these databases to complement the bibliometric data. Another important feature from the point of view of Campbell (2008) is that any index should rate the merit of a paper, rather than of the journal it was published, which applies to the *Relative h-index*.

ACKNOWLEDGMENTS

Research supported by FAPEMIG (Fundação de Amparo à Pesquisa do Estado de Minas Gerais), CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico), and CAPES (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior).

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