

The first author h-index (h_{fa} -index): levelling the field for small and large institute medical and science scholars

Martin J. Butson · Peter K. N. Yu

Published online: 11 November 2010
© Australasian College of Physical Scientists and Engineers in Medicine 2010



Recent editorials and debates in the literature have highlighted the h-index measurement scale for researchers and how it can be used as a measure of their contributions to the medical and scientific community [1–5]. Indeed, in many University Institutions, the h-index (or h-factor) is being employed for assessment of regrading applications and for individual academics impact. So like it or not, it is here to stay and play. Whilst the debate will continue, it is

M. J. Butson · P. K. N. Yu
Department of Physics and Materials Science, City University
of Hong Kong, Kowloon Tong, Hong Kong

M. J. Butson (✉)
Department of Medical Physics, Crown St, Illawarra Cancer
Care Centre, Wollongong, NSW 2500, Australia
e-mail: martin.butson@sesiahs.health.nsw.gov.au

M. J. Butson
The Illawarra Health and Medical Research Institute,
and the Centre for Medical Radiation Physics, University
of Wollongong, Northfields Ave, Gwynneville, NSW, Australia

definite that there are factors which can weight the h-index value to either advantage or disadvantage the researcher. Baldock [6] quite elegantly pointed out how subtle ways of citing papers can occur to benefit one's h-index. This is inevitable. However, one area where substantial improvements could be made to the h-index may lie in the area of enhancing the h-index score by weighting first author papers or a h_{fa} -index. This may not be practical if a large proportion of journals used alphabetical listings for authors. However this practice is not common and a well established researcher would normally publish in multiple journals reducing this overall effect. Upon investigation, according to the ISI Journal Citation Reports 2009, of the top 20 journals ranked in the subsection of "Radiology, Nuclear Medicine and Medical Imaging", no journals used alphabetical name order convention.

The h-index [7, 8] of course is a measure of impact and quality of a medical or scientific researcher and is easy to calculate as the number of papers, h , that have each attracted h citations or more—the author's other papers (N_p-h) will have $<h$ citations each.

One major factor which this value does not examine is the contribution to each paper by the individual author within the paper. This would be difficult to calculate, even if there was a percentage contribution per author given in the paper details as it would have to be extracted for each paper and values weighted accordingly. As the % contribution to the work is not acknowledged by the h-index it would be easier to achieve a higher h-index value by working with a large group of scholars as compared to a small group. For example take a group of six researchers working together with an average output of two papers per year each. This group could then produce 12 papers per year. Whilst a small

group of say three researchers producing a same per person level of output would produce six papers per year. Suppose each paper (assuming each paper has the same significance and impact) is referenced three times per year. After 5 years, the large research group authors will have published 60 papers and each researcher will have a h-index of approximately 12. The smaller group of three will have published 30 papers and each have a h-index of approximately 9. With all others things being equal (i.e. quality of work, even distribution of work amongst authors), the small group researchers are disadvantaged by their ‘size’.

To minimize (not eliminate) this difference or impact on h-index, a weighting factor for the first author could be introduced so that the first author h-index (h_{fa} -index) would be:

$$h_{fa}\text{-index} = h\text{-index} \times (N_p + F_p)/N_p$$

where N_p is the total number of h-index papers and F_p is the number of first author papers of the h-index papers. As h-index is easily calculated and given by many databases such as SCOPUS or WEB OF SCIENCE, the calculation of F_p is a very simple task requiring only a minute extra by manual verification. The modified h_{fa} -index could be used as a more appropriate individual impact index.

Using the same scenario as above the large group authors would have a h_{fa} -index of $12 \times (12 + 2)/12 = 14$. (After 5 years each author will have two “first author papers which have contributed to the h-index”). Whereas the small group researcher will have a H_{fa} -index of $9 \times (9 + 4)/9 = 13$. (The authors will have four first author papers which will contribute to the h-index).

This index could also compensate a “main” first author researcher in the group by allowing a large contribution to their h_{fa} -index for their larger contribution. Again, taking the smaller group researchers, say one member is especially productive with high quality papers and they may have produced four of the six papers published each year as the first author. In that instance, their h_{fa} -index would now be $9 \times (9 + 8)/9 = 17$.

All types of individual research impact measurements have some form of anomaly or inconsistency which can benefit or disadvantage researchers. Whilst this tweak of the h-index does not totally rectify a known problem, it reduces the difference in h-index for a small group researcher or someone who has a high level of first author papers compared to a large group author who has the benefit of smaller contributions to multiple papers. A similar approach may be taken for the corresponding author. It is acknowledged that for some work, the secondary authors contribute a significant amount of effort to the published paper which may not be recognised by this h_{fa} -index. However, it would be prudent to state that normally the first author is the major contributor to the said work and they should be rewarded

Table 1 h-index and h_{fa} -index for some leading medical physics researchers in Australia

Author	Publications	(As primary author)	h-index	h_{fa} -index
A	95	16	22	27
B	102	60	18	29
C	143	34	18	25
D	83	13	17	19
E	130	28	16	22

Data from SCOPUS retrieved March 2010

somehow within the h-index system. A recent examination of the h-index for a small group of some of Australia’s leading radiotherapy medical physics researchers revealed the following statistics given in Table 1.

Using the h-index, author A would be considered the leading researcher with the other four authors on relatively equal standing. However applying the first author h-index would reveal that author B could be considered the leading researcher. This would be due to the considerably higher contribution to the h-index from their first author papers which number 60 out of 102 as opposed to 16 out of 95. The h_{fa} -index also allows for more differentiation between researchers by reflecting their contributions through first author papers like authors D (13 first author papers) and E (28 first author papers).

So whilst there will always be debate concerning factors used to assess work value, the first author h-index could provide a more level playing field for researchers and clinical staff who work in small centres and can currently be disadvantaged by the use of the h-index as an indicator of research significance.

Acknowledgments We would like to acknowledge the Research Grants Council of HKSARs (China—Project no. CityU 100509) support.

References

1. Ball P (2005) Index aims for fair ranking of scientists. *Nature* (Lond) 436:900
2. Vanclay JK (2007) On the robustness of the h-index. *J Am Soc Inf Sci Technol* 58:1547–1550
3. Glanzel W (2006) On the opportunities, limitations of the h-index. *Sci Focus* 1:10–11
4. Baldock C, Ruiman Ma MS, Orton CG (2009) The h-index is the best measure of a scientist’s research productivity. *Med Phys* 36(4):1043–1045
5. Bornmann L, Daniel H (2007) What do we know about the h-index? *J Am Soc Inf Sci Technol* 58:1381–1385
6. Baldock C (2008) The h-index and medical physics. *Australas Phys Eng Sci Med* 31:10–12
7. Hirsch JE (2005) An index to quantify an individual’s scientific research output. *Proc Natl Acad Sci USA* 102:16569–16572
8. Hirsch JE (2007) Does the h-index have predictive power? *Proc Natl Acad Sci USA* 104:19193–19198