

Scientometric Dilemma: Is H-index Adequate for Scientific Validity of Academic's Work?

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ABSTRACT

H-index is an index that attempts to measure the productivity and impact of published work of scientists. H-index has several advantages – it combines productivity with echo, is not sensitive to extreme values in terms of articles without citation or to articles with above-average number of citations and directly enables the identification of the most relevant articles with regard to the number of citations received. H-index has great potential in the academic community, but it still has not realistic indicator of the quality of work of one author. Authors described most used indices for scientific assessment.

Key words. scientific publications, scientific validity, H-index.

1. INTRODUCTION

Evaluation of a scientific article refers to the finding quantitative indicators (index) of the scientific research success (1-10). The science that deals with this is called scientometrics (11-15). So far has not been found a completely satisfactory evaluation criterion of scientific work and scientists because each offered criterion has more or less its flaws, however, it is considered that more criteria is used the evaluation is more objective (16, 17, 18).

2. H-INDEX AND OTHER INDICES AS SCIENTIFIC INDICATORS

In August 2005, Jorge Hirsch introduced a new indicator for quantifying the research output of scientists (1, 2). Hirsch's so-called H index was proposed as an alternative to other bibliometric indicators - such as the number of publications, the average number of citations and the sum of all citations (3) - "a scientist has index h if h of his or her N_p papers have at least h citations each and the other (N_p-h) papers have $\leq h$ citations each" (3, 5). "H5-index is the h-index for articles published in the last 5 complete years", and finally "h5-median for a publication is the median number of citations for the articles that make up its h5 index" (5). A h-index of 5 means that a scientist has

published five papers that each have at least five citations (4). In practice this means that if the author has an h-index of 10, then it published 10 or more articles, while its 10 articles received at least 10 citations, while his other articles are quoted less than ten times (total number of citations in this case may be at least 100). There are in use another two indices: "G-index is given a set of articles ranked in decreasing order of the number of citations that they received, and the g-index is the (unique) largest number such that the top G articles received (together) at least G^2 citations". This index may be greatly influenced by very successful paper (Masic's g-index=22 means the top 22 articles have, together, at least $22^2=484$ citations). The i-10 index, proposed by Google Scholar in 2004 is defined as "the number of publications with at least 10 citations" (5, 19, 20).

H-index is an index that attempts to measure the productivity and impact of published work of scientists (the index is based on the basis of the most cited papers and the number of citations that papers received in other publications) (5). H-index as a scientometric indicator, in the basis is used for comparison of scientists in the same area and approximately of the same experience and the same argument applies to journals (two scientists with similar

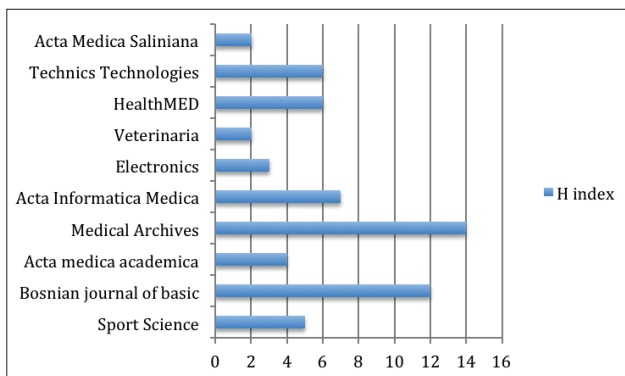


Figure 1. SCImago analysis of H-index of Bosnian and Herzegovinian journals (for 2015.)

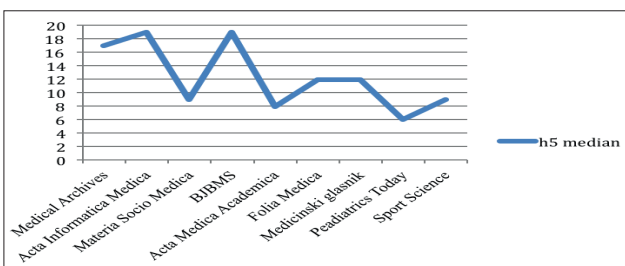


Figure 2. Google Scholar h5 median for Bosnian and Herzegovinian journals

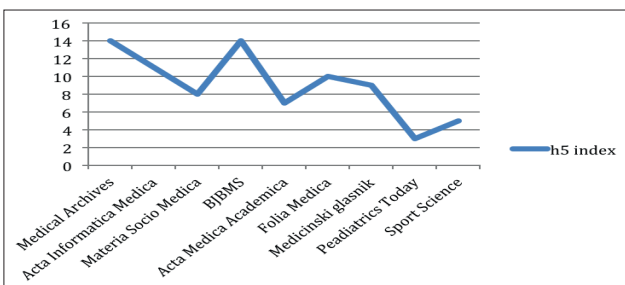


Figure 3. Google Scholar h5 index for Bosnian and Herzegovinian journals

h-indices are comparable in terms of their overall scientific productivity and echoes, even if their total number of papers and citations is very different; comparing the two scientists (with approximately same experience) with a similar number of publications and/or similar total number of citations, but different h-indices, argues in favor of greater “visibility” of scientists with a higher h-index) (19–23). According to the opinion of Brown and associates the h-index combines in the specific and balanced way effects of the “quantity” (number of publications) and “quality” (number of citations) (23).

3. ADVANTAGES AND DISADVANTAGES OF MEASURING SCIENTIFIC VALIDITY BY H-INDEX

H-index has several advantages - it combines productivity with echo, is not sensitive to extreme values in terms of articles without citation or to articles with above-average number of citations and directly enables the identification of the most relevant articles with regard to the number of citations received (6). Not rare is situation that a scientist publishes several important articles and that these articles have extremely a lot of quotes, but the h-index is not particularly high. It is often case that the scientists with a high h-index

working as a team and publish articles with a large number of authors (more than 50) and mutually quote each other, as is the case for example, in the field of high-energy physics. Batista and van Raan, warned that in case of h-index it is important to explore the impact of the number of authors in the total number of citations. These authors have shown that as the greater the number of authors is, the greater is the number of self-citations, which can directly increase the h-index, if they do not exclude self-citations. On the other hand, it is important to keep in mind that for a narrow scientific fields, for example, which is still in development, self-citation is logical and expected phenomenon. When all of the above is taken into account, h-index basically defines recognition, or the consistency of individual scientist or journal, in particular field. In this case the recognition means that the scientist has a larger number of papers, all of which received a relatively large number of citations and so called independent

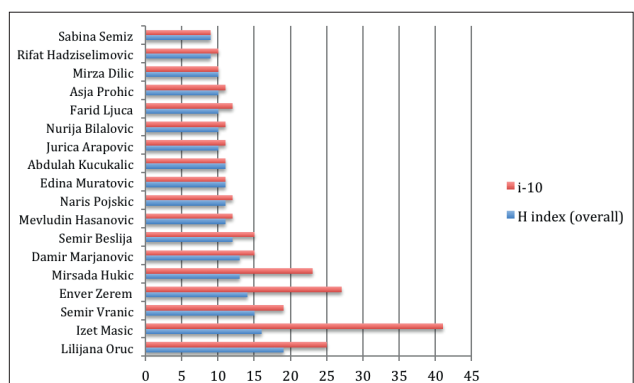


Figure 4. Correlation between H index and i-10 index (authors from Bosnia and Herzegovina) (i10-index = the number of publications with at least 10 citations)

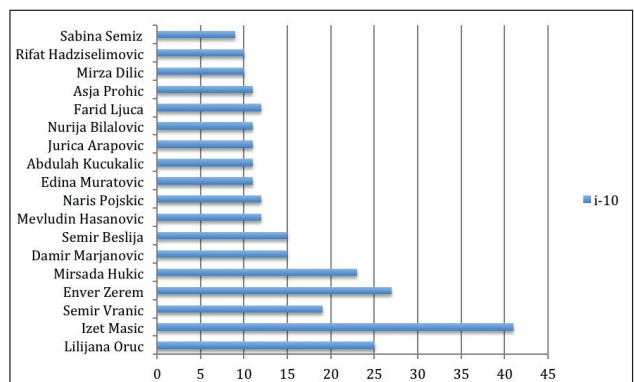


Figure 5. Top authors in the Biomedicine field from Bosnia and Herzegovina ordered by i-10 index

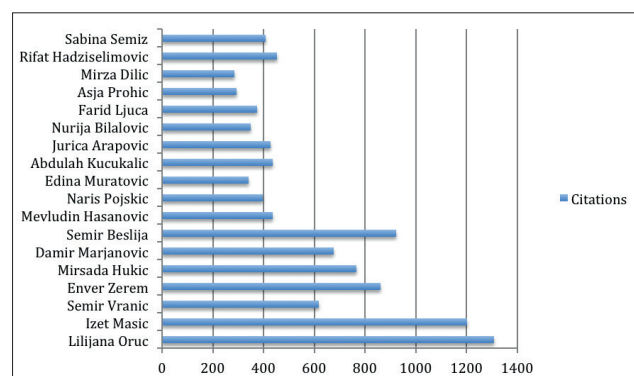


Figure 6. Top authors in the Biomedicine field from Bosnia and Herzegovina ordered by number of citations

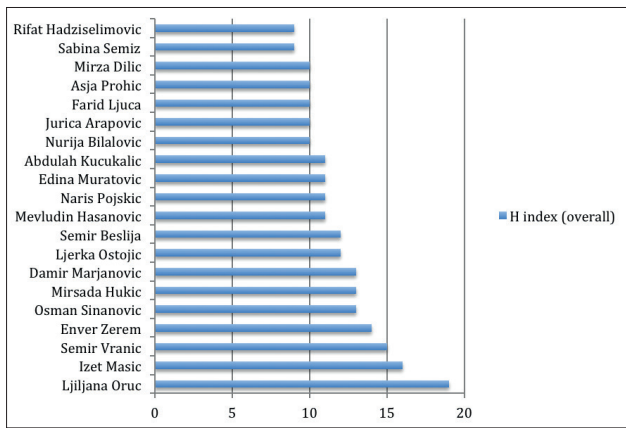


Figure 7. Top authors in the Biomedicine field from Bosnia and Herzegovina ordered by H-index (overall)

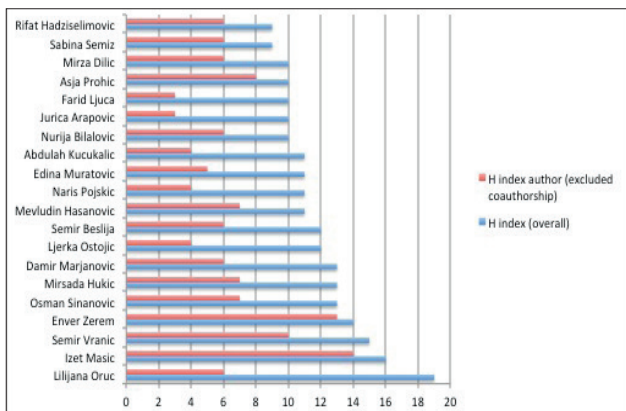


Figure 8. Top authors in the Biomedicine field from Bosnia and Herzegovina ordered by H-index: overall and excluded co-authorship

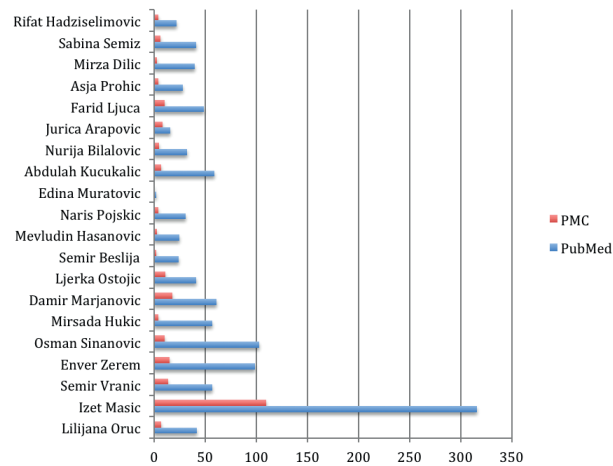


Figure 9. Correlation between number of articles on PMC (PubMed Central) and PubMed (authors from Bosnia and Herzegovina) (retrieved, July 2016)

citations. Independent citations are citations that the author receives from his unknown colleagues outside its institutions, and in the case of small country, outside their country. As for other indicators for validation of scientific work, also for the h-index in the interpretation of the values is important to take care not only about discipline or area, but also branches, as well as the actuality of the work the scientist deals with. Hirsch on the basis of its calculation, it is proposed as a guide for the evaluation of physicists the world's leading research universities for the advancement associate professor h-12, full professor h-18, and membership in the National Academy of

	H index (overall)	H index author (excluded co-authorship)	PubMed	PMC
Lilijana Oruc	19	6	42	7
Izet Masic	16	14	318	111
Semir Vranic	15	10	57	14
Enver Zerem	14	13	99	15
Osman Sinanovic	13	7	103	10
Mirsada Hukic	13	7	57	4
Damir Marjanovic	13	6	61	18
Ljerka Ostojic	12	4	41	11
Semir Beslija	12	6	24	2
Mevludin Hasanovic	11	7	25	3
Naris Pojskic	11	4	31	4
Edina Muratovic	11	5	2	0
Abdulah Kucukalic	11	4	59	7
Nurija Bilalovic	10	6	32	5
Jurica Arapovic	10	3	16	8
Farid Ljuca	10	3	49	10
Asja Prohic	10	8	28	4
Mirza Dilic	10	6	40	3
Sabina Semiz	9	6	41	6
Rifat Hadziselimovic	9	6	22	4

Table 1. Top 20 authors in the Biomedicine field from Bosnia and Herzegovina ordered by overall H- index, H-index excluded co-authorship, PubMed and PubMed Central databases (retrieved July.2016)

	H index (overall)	i-10	Citations
Lilijana Oruc	19	25	1308
Izet Masic	16	41	1202
Semir Vranic	15	19	618
Enver Zerem	14	27	861
Mirsada Hukic	13	23	767
Damir Marjanovic	13	15	677
Semir Beslija	12	15	922
Mevludin Hasanovic	11	12	436
Naris Pojskic	11	12	396
Edina Muratovic	11	11	342
Abdulah Kucukalic	11	11	437
Jurica Arapovic	10	11	429
Nurija Bilalovic	10	11	350
Farid Ljuca	10	12	374
Asja Prohic	10	11	294
Mirza Dilic	10	10	285
Rifat Hadziselimovic	9	10	453
Sabina Semiz	9	9	408

Table 2. Top authors in the Biomedicine field from Bosnia and Herzegovina (Osman Sinanovic and Ljerka Ostojic excluded because they do not have GoogleScholar profile) ordered by H-index, i-10 index and number of citations

Science of the United States of America the average $h=45$, except for some cases. It is proposed that as an indicator for successful scientist's physicists, with 20 years of research, h -index is 20, while the h -index of 40 indicates "outstanding scientists in the highly successful laboratory". Author also report citation examples of physicists Nobel Prize winners, whose h -index values range from 70 to 90. The average h -index physicist candidate for the Nobel Prize in the twenty-year period from 1985 to 2005 was 35. According to Hirsch, the most cited 10 scientists in the field of natural sciences, from 1983 to 2002, had a median h -index of 57, which is much higher than for physicists. But, natural sciences are too broad an area to be easily compared to the index of molecular biologists and biologist who specializes in ecology, or biodiversity or oristry or zoology. Most high index within top one hundred world ranking has Sigmund Freud (h -index=251). Cronin and Meho, conducted a study comparing the h -index and the total number of citations in the field of Information Science. They analyzed 31 scientists with the most citations from the Faculty of Information Science in the USA, in the period from 1999 to 2005 according to SSCI most cited IS scholars. The range of their h -index values was from 5 to 20, with the fact that they excluded self-citations. They proved that there is a positive correlation between the h -index and the number of citations, which suggests that the total number of citations is indeed reliable indicator of echo and impact of the articles of the scientists. The mean h -index for information sciences was 11, Oppenheim analyzed British scientists in the field of library and information sciences and got the mean h -index of 7. Conclusion is that the unfair self-citation strategy is mainly useful for authors that are less productive and that attract less citations from others (the most effective method to increase one's h -index is to produce work that is highly cited by other; the next best strategy is to be productive) (7). Hyland found that self-citation is 12% of all references in biology, engineering and physics, compared to 4% in sociology, philosophy, linguistics, or marketing (8, 9). The scientific community has shown great interest in the h -index as a scientometric indicator, so that Scopus and Web of Science databases, with the number of articles, number of citations, the average number of citations after automatic calculation of the h -index, including all kinds of quotes. Except for authors, h -index began to be increasingly used as an indicator for evaluating journals. 4et al. (6) have made a comparison of certain journals according to IF and h -index. The results showed that the journals Physical Review Letters, Astrophysical Journal and the Journal of the American Chemical Society are in the top 20 by the h -index, while according to the IF, these three journals were not among the top 100 journals, which shows an incomplete correlation of these two indicators. Based on all of the facts, h -index is certainly one of the indicators that contribute to the overall assessment of the scientific work of individual scientists, institutions, field, journals and so on. It would be nice to observe it separately, or regardless of the subject area, length of scientist's professional engagement, science productivity, co-authors, the total number of citations and the type of citations and other relevant parameters (6). Three bibliometric databases for analysis and evaluation of quotations through h index: Web of Science (Thomson Reuters), Scopus (Elsevier) and Google

Scholar. Although Google Scholar and Scopus seems to provide a greater number of citations (6) there are mixed information about h index. De Groote and Raszewski reviewed 31 member faculties located in US Midwest, and concluded that more than one database should be used to calculate the H -index. They further recommend that, as since the scales of h index differ between databases, comparisons between researchers should be done in a particular database (13, 17-25).

4. BOSNIAN AND HERZEGOVINIAN MEDICAL SCIENTIST ASSESSED BY H-INDEX

We analyze situation in Bosnia and Herzegovina. According to SCImago, Medical Archives has the biggest H -index in Bosnia and Herzegovina (H index for Medical Archives is 14) (Figure 1) (18, 23). According to Google-Scholar, $h5$ index (h -index for articles published in the last 5 complete years) is the biggest for Medical Archives and BJBMS, while $h5$ median (median number of citations for the articles that make up its $h5$ -index) is the biggest for Acta Informatica Medica and BJBMS (Figure 2 and 3). $H5$ -index has a correlation with the five year impact factor, but it is more robust and less affected by citation manipulation and it should be considered as an alternative to the journal's impact factor (8). H -index of Bosnia and Herzegovina in the field of medicine is lower than H -index of Serbia and Croatia, but higher than Montenegro. However, this software solutions (GoogleScholar, Publish and Perish) are not best choice for H -index determination, because GoogleScholar database has founded since 2009 (results for the previous period are not entirely clear). Google Scholar gives the largest number of publications, largest number of citations and the highest H -index, while he Web of Science gives the lowest averages (8). Top Bosnian and Herzegovinian scientists in the field of biomedicine are presented on Figures 4-9 and Table 1-2.

5. CONCLUSION

Analysis of the work of author, via the numerous indices is basically absurd, due to the large bias. One of the biggest problems is the presence of the wrong citing (it often happens that the number of citations to one article leads to several places). Surely, for ranking in the scientific world, there is not enough quality index (a real indicator). However, we can say that sometimes in the scientific world there is no need for ranking.

The fact remains that the h -index, has great potential in the academic community, but it still has not realistic indicator of the quality of work of one author. Academic community cries out for a new solution that would determine those the most important and best. Is it possible to accurately determine, to determine who is the best, that is already a different question.

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