

H-index and How to Improve it?

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ABSTRACT

The h-index is an index that attempts to measure both the productivity and citation impact of the published work of a scientist or scholar. The index is based on the set of the scientist's most cited papers and the number of citations that they have received in other publications and on the distribution of citations received by a given researcher's publications. The h-index is important for individual users as well as scientific research institutions, universities and main journal editors. There are a lot of methods to improve your h-score. It takes a lot of work and to promote papers and journals, but it is all part of developing as a researcher, working together with your community and improving communication methods.

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INTRODUCTION

Evaluation of the quality and relevance of articles, after they have been accepted and published as scientific papers, which should be the result of serious research work, relies mainly on the qualified members of the academic community, who are of the same or similar professional interests.¹⁻⁶ Being a part of the academic community, we often encounter terms, such as indexing, and citations. According to the Tibor Toth, who wrote in an article published on the website of open encyclopedia of information: Indexing is a term that derives from the concept of index of publications, such as Index Medicus, Science Citation Index and Current Contents.^{2,3}

The assessment of the achievement of every scientist, and thus indirectly determining his reputation in the scientific community of these publications, especially journals, is done through the so-called impact factor.⁷ Impact factor shows how many times a scientific article in a specific journal receives average number of quotes (citations) (Graphs 1 and 2). The idea of impact factor for

the first time is mentioned by the American researcher Eugene Garfield, in an article published in the journal of 'Science' in 1955, which was the basis for the publication of the science citation index (SCI) in 1961. Today, the journal impact factor is extracted from publication under the title journal citation reports (JCR), which is produced by Thomson Reuter's publishers. The best measure of the importance of the journal is its echo factor, which shows how many articles published in it are cited.^{7,8} For example, if the journal has impact factor from 0.10 to 0.30 in a certain period, it means that on average every tenth to every third article published in the journal is cited once. In other words, the impact factor tells us how much the journal is used, or how much it is important for the scientists.

Evaluation of scientific productivity and assessment of the published articles of researchers and scientists can be made through the so-called h-index.^{2-4,6,8} Index is calculated on the basis of the list of publications ranked in the order of time when they are quoted. The value of this index is equal to the number of documents (N), in the list that have N or more citations.

The quality of published results of a scientific work largely depends on the knowledge resources that have been used in the preparation of it, which means that it should be considered to serve the purpose and the very relevance of the information used for it. The relevance of data for research specifically described and contributes the search for resources.

In the ranking of the journal in terms of their qualitative contributions to science research valuable contribution brings SCImago Journal and Country Rank, as Internet portals that publish indicators of journals from countries around the world. This instrument for measuring the scientific competitiveness on a global scale was developed based on the source of information contained in the Scopus database.

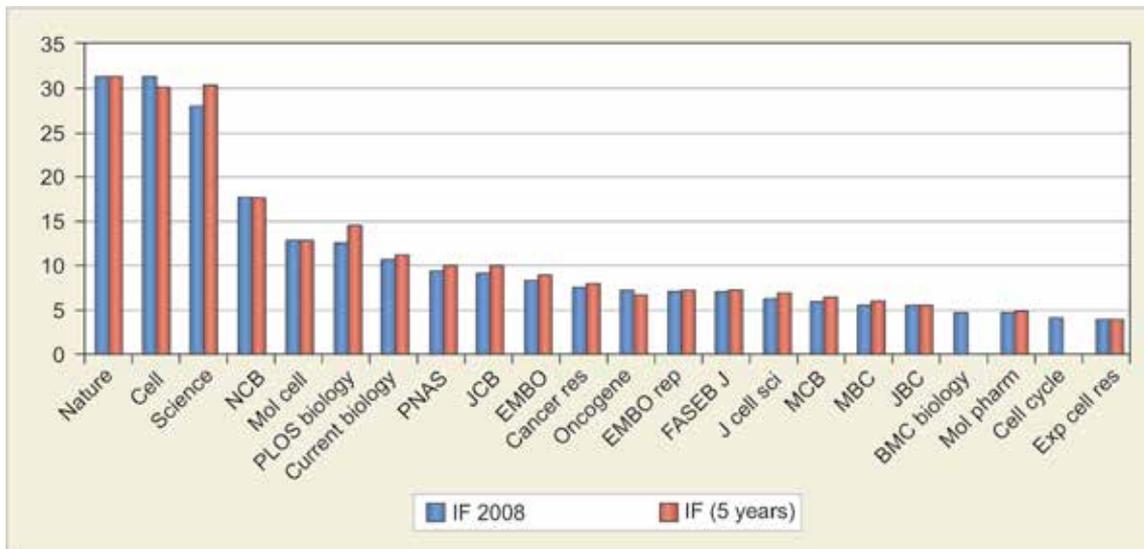
H-INDEX

The h-index is an index that attempts to measure both the productivity and citation impact of the published work of a scientist or scholar. The index is based on the set of the scientist's most cited papers and the number of citations that they have received in other publications. The index can also be applied to the productivity and impact of a as well as a group of scientists, such as a department or university or country.⁴

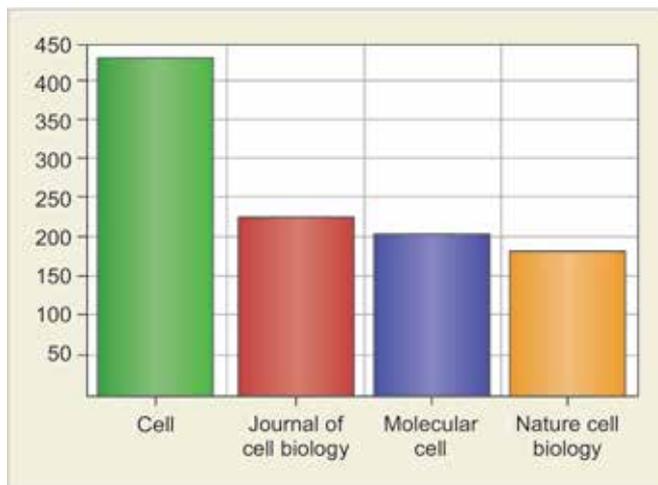
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Graph 1: Impact factor journal ranking⁹



Graph 2: H-index of the four most cited journals^{10,11}

The index was suggested in 2005 by Jorge E Hirsch, as a tool for determining theoretical physicists' relative quality and is sometimes called the Hirsch index or Hirsch number.⁴

The index is based on the distribution of citations received by a given researcher's publications. Hirsch writes: A scientist has index h if h of his/her number of papers (N_p) have at least h citations each, and the other ($N_p - h$) papers have no more than h citations each.

In other words, a scholar with an index of h has published h papers each of which has been cited in other papers at least h times. Thus, the h -index reflects both the number of publications and the number of citations per publication. The index is designed to improve upon simpler measures, such as the total number of citations or publications. The index works properly only for comparing scientists working in the same field; citation conventions differ widely among different fields.⁴

The h -index is important for individual users as well as scientific research institutions, universities and main

journal editors. As we saw, there is a way to calculate the values of h -index for individual authors, for every article, institution, publishing house or journal. Any of these users try to maximize the value of their h -index because it represents a direct evaluation of the quality of their work.

The h -index is an attempt to measure productivity and the impact of the published scientific work of a scientist or student. As such it is applicable to a group of scientists, a country or scientific institution. When calculating the h -index for one author, or a single journal, it reflects the number of published works as well as the number of quotes taken from individual publications.

Despite the fact that it is relatively new (it was described for the first time in 2005), the h -index has become an important measure (Figs 1 and 2) of career development.⁴

Weaknesses of the h -index¹³

Critics of the metric suggest it is limited in the following ways:

- It counts a highly-cited paper regardless of why it is being referenced, e.g. for negative reasons
- It does not account for variations in average number of publications and citations in various fields (some traditionally publish and cite less than others)
- It ignores the number and position of authors on a paper
- It limits authors by the total number of publications, so shorter careers are at a disadvantage
- It has relatively low resolution in that many scientists end up in the same range since it gets increasingly difficult to increase the h -index the higher it gets (an h -index of 100 corresponds to a minimum of 10,000 citations).

	Country	Documents	Citable documents	Citations	Self-Citations	Citations per Document	H index
1	United Kingdom	375.099	302.540	5.341.629	1.284.907	15,13	436
2	Germany	303.493	266.911	3.594.608	906.989	12,31	364
3	France	208.165	179.015	2.438.178	486.629	12,01	356
4	Italy	187.390	166.756	2.246.743	446.968	12,77	333
5	Netherlands	111.103	99.432	1.925.982	332.131	19,01	325
6	Sweden	70.457	65.177	1.267.870	200.233	18,80	278
7	Switzerland	68.922	60.933	1.060.037	126.494	16,55	273
8	Belgium	55.136	49.208	843.656	104.613	16,28	253
9	Spain	127.422	108.542	1.075.971	230.548	9,23	244
10	Denmark	37.660	33.959	667.990	91.637	18,79	229
11	Finland	31.884	30.129	653.376	87.839	21,22	226
12	Austria	42.247	37.369	530.896	66.569	13,20	184
13	Norway	26.784	24.304	406.564	53.707	16,48	181
14	Ireland	15.850	13.559	196.450	15.834	14,71	140
15	Greece	33.217	29.673	271.456	41.735	9,72	136
16	Portugal	10.817	9.849	99.112	11.662	10,57	110

Fig. 1: H-index according to the authors from particular countries¹²

Fig. 2: Available at: <https://wiki oulu.fi/display/tor/1.3.1.7.10+SCImago+Journal+and+Country+Rank> (May 02, 2014)

It, like all metrics, is based on data from the past and may not be a valid predictor of future performance. However, in a follow-up publication Jorge Hirsch demonstrated that the h-index is better than other indicators (total papers, total citations, citations per paper) at predicting future scientific achievement.¹³ Some authors consider that the time dependence of the h-index is better than h-index alone, because it is important to describe the expected career evolution of a scientist's work or of a journal's production in a fixed year.¹⁴

How to Calculate h-index?

The publication record of an individual and the citation record clearly are data that contain useful information. That information includes the number of papers (N_p)

published over number of (n) years, the number of citations (N_c) for each paper (j), the journals where the papers were published, their impact parameter, etc. (Figs 3 and 4). This large amount of information will be evaluated with different criteria by different people.⁴

Google Scholar Citations provide a simple way for authors to keep track of citations to their articles. You can check who is citing your publications, graph citations over time, and compute several citation metrics.¹⁶ The h-index can be calculated using Google Scholar.

In the Web of Science h-factor only scientific articles published in journals which have ISI-recognition (determined by Thomson-Reuters) are considered citeable (so not articles in other journals, chapters in books, etc.). In the Scopus h-factor a larger pool of journals is included,

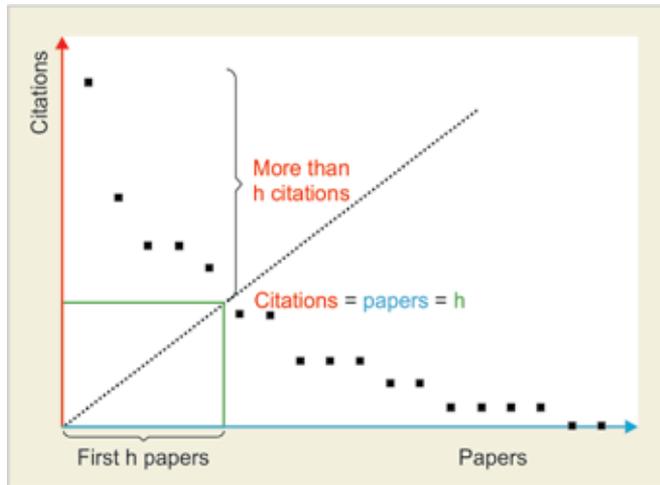


Fig. 3: H-index from a plot of decreasing citations for numbered papers

while in google citations and in 'publish or perish' (www.harzing.com/pop.htm) the h-factor is likely to be higher as it also considers articles in a wide range of journals, book chapters and reports as citable.¹⁷

How to Improve h-index

Universities are very competitive environment. Quantitative indicators, like the h-index, are becoming more and more important in this competition.¹⁸ Despite the fact that its relatively new (it was described for the first time in 2005), the h-index has become an important measure of career development.⁴ A good way to increase citation index is self-citation. More self-citation can double the h-index very fast. A research paper found that many self-citations can even increase the number of citations by others. The citation should be relevant but irrelevant

citation can also increase h-index.¹⁸ Double publication of the some paper for a conference, and later with slightly different name in a paper, can also increase citation index. Both papers should have many self-citations.¹⁸ Plagiarism is an illegal and unethical way to improve h-index.¹⁸

Another important way is cooperation with colleges. If you cite your college and he also cites you then you have both significant increases of number of citations. This cooperation can be expanded to a larger unit of people, promoting larger scientific communities and increasing the value and number of citations considerably.¹⁸

Another way to increase your h-index is self-citation of the paper that has a slightly smaller number of citations than what is your actual h-index. For example, if you have a paper with six citations, and your actual citation number is seven, this single citation will increase your h-score to seven. This is because the paper will now have seven citations. Even irrelevant citation can improve your h-score. On the other hand, if you cite a paper that has a hundred citations, your h-index will not go up. In conclusion, it is preferable to have more papers that were cited a similar number of times, as 10 papers, everyone used as a reference 10 times will give you an h-index score of 10.

Frequently choosing low quality journals (the best measure of the importance of the journal is its echo actor)^{19,20} and conferences to disseminate paper while some publishers do not prevent you from citing a huge number of irrelevant (also own) works and from writing nonsense.¹⁸ Collaboration with a famous first author can gain more citation.¹⁸ Everytime your co-author gets cited, or self-cites, you also get cited.

h-index

- In 2005, physicist Jorge E. Hirsch developed the h-index as a process for quantifying the output of an individual researcher.
- Hirsch argues: "I propose the index h, defined as the number of papers with citation number $\leq h$, as a useful index to calculate the scientific output of a researcher" (2005).
- Note that the h-index is one of many available bibliometric measures.

Reference: Hirsch, J. E. (2005). An index to quantify an individual's scientific research output. *Proceedings of the National Academy of Sciences of the United States of America*, 102(46), 16569-16572. doi:10.1073/pnas.0507655102

Calculate Your h-index

- To manually calculate your h-index, organize articles in descending order, based on the number of times they have been cited (see below example)
- Web of Science, Scopus, and Google Scholar can also be used to calculate an h-index for that particular citation-tracking database.

Interpreting

In the below example, an author has 6 papers that have been cited 33, 30, 20, 15, 7, 6, 5 and 4 times. This tells us that the author's h-index is 6.

Articles	Citation numbers
1	33
2	30
3	20
4	15
5	7
6	6
7	5
8	4

Key Tools

- Given Scopus and Web of Science's citation-tracking functionality, they also calculate an individual's h-index based on content in a particular database.
- Likewise, Google Scholar collects citations and calculates an author's h-index via the [Google Scholar Citation Profile](#) feature.
- Note that each database may determine a different h-index for the same individual as the content in each database is unique and different.

Fig. 4: Site that explain how to calculate an h-index¹⁵



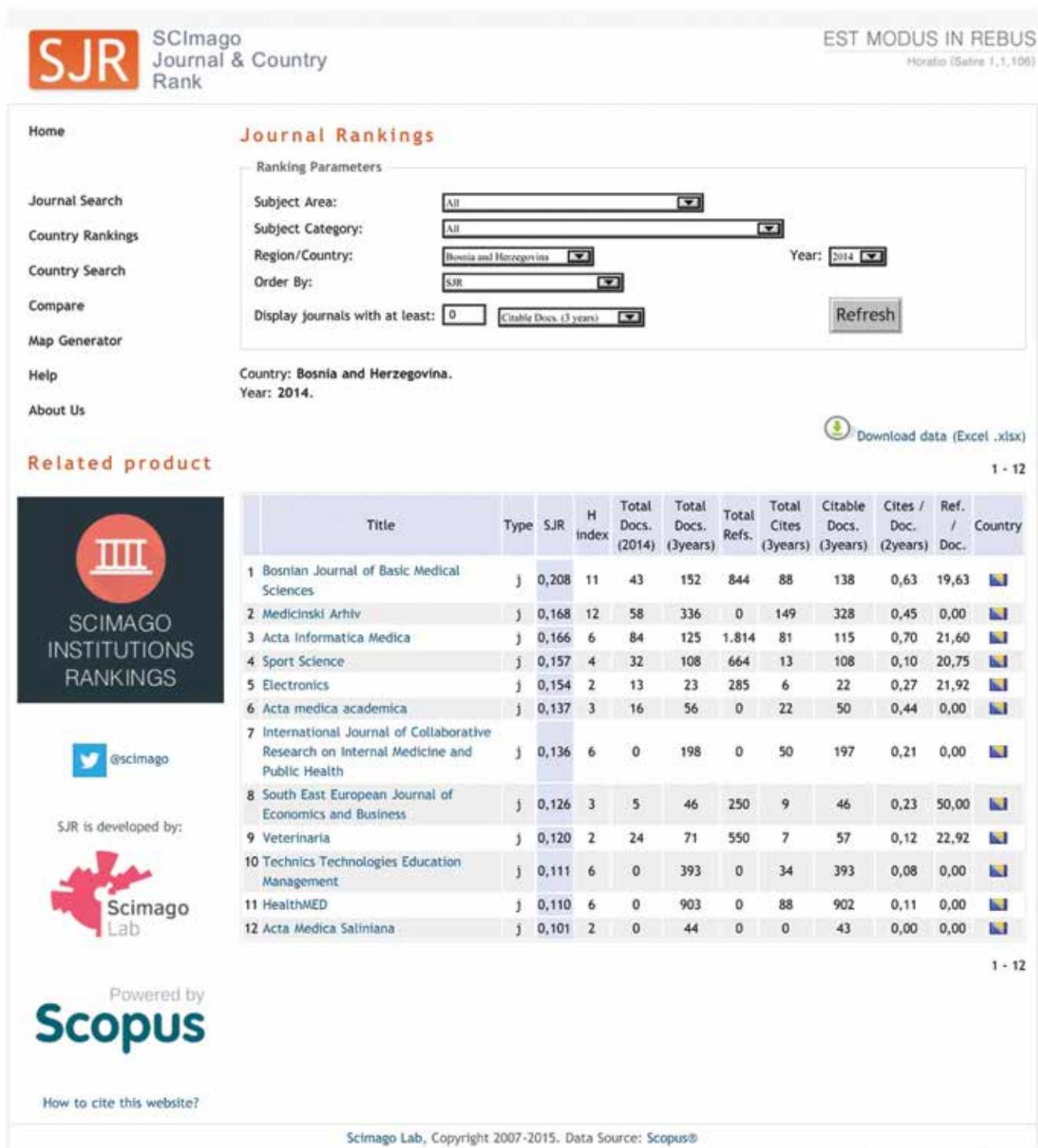


Fig. 5: H-index of indexed journals in Bosnia and Herzegovina in 2014¹²

Publishing in well-known and established journals is the second most important factor; the papers from such journals are more frequently cited.¹⁸ Working together with recognized members of the scientific community is a quick way to gain more recognition.

Attending the conferences and research meetings may help you to promote your work and search for new collaboration opportunities. Running a blog can also be the way to promote your work.¹⁸

Another important factor is availability of papers for search and download. The paper should be searchable, that means that paper can be found using the search machine, such as Google Scholars, PubMed, ResearchGate, etc. Publish in open access. Unfortunately the authors of the mentioned paper did not even try to determine, what the influence is of open access on h-index. Openness can trigger more citations.¹⁸ Two kinds of bibliographic tools are used to make scientific publications available

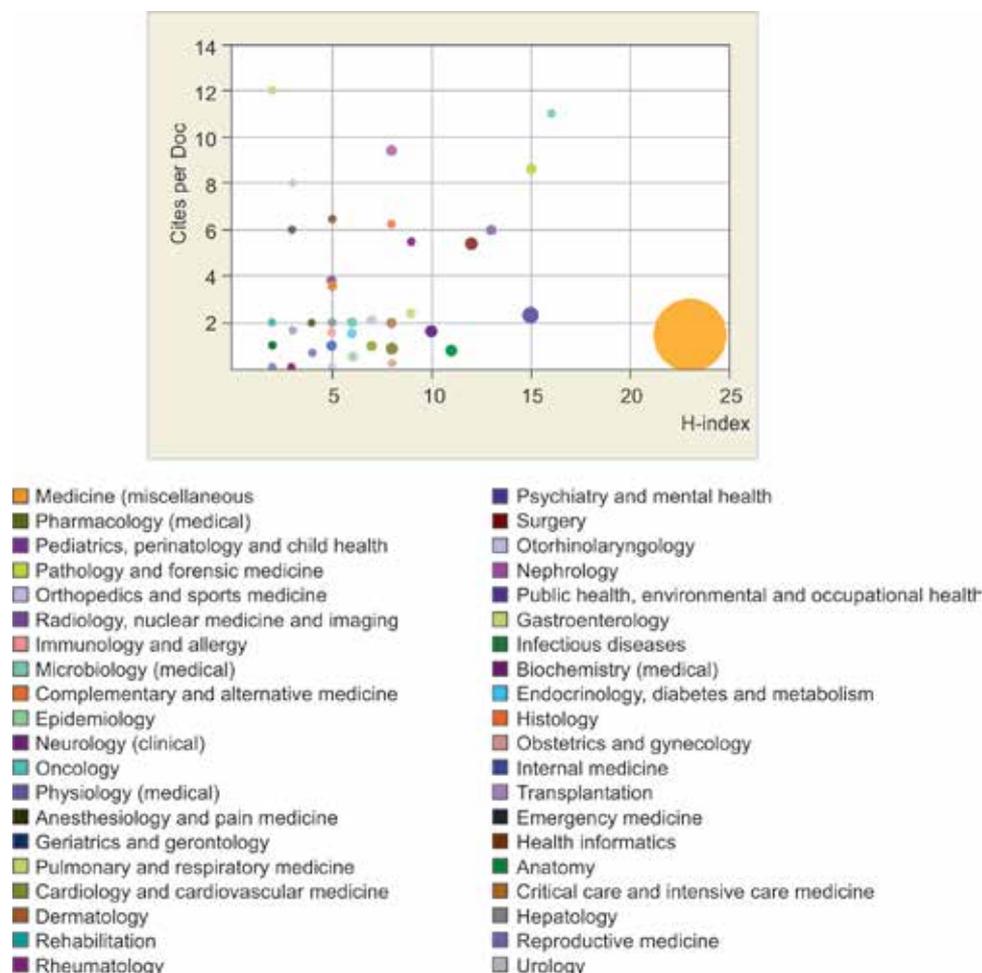


Fig. 6: Cites/Doc. (2 years) parameter vs h-index for medicine fields in period 2012 to 2013 in Bosnia and Herzegovina²⁰

online. First kind makes publications available publicly. Another kind requires access fee.

A lot of online scientific journals allow only access to abstract while the full text access requires payment or subscription and registration. If you publish your work in one of such journal it is important to upload copy of your work to one of the online databases, such as ResearchGate. ResearchGate was founded in 2008²¹ by a virologist and computer scientist Ijad Madisch. ResearchGate uses a crawler to find PDF versions of articles on the homepages of authors and publishers. ResearchGate uses a crawler to find PDF versions of articles on the homepages of authors and publishers. These are then presented as if they had been uploaded to the website by the author. Free registration is required to access to ResearchGate.²¹

Cyril Labbé has catalogued computer-generated papers that made it into more than 30 published conference proceedings between 2008 and 2013. Sixteen appeared in publications by Springer, which is head quartered in Heidelberg, Germany, and more than 100 were published by the Institute of Electrical and Electronic Engineers (IEEE), based in New York.²² Both

publishers, which were privately informed by Labbé, say that they are now removing the papers.

The above mentioned papers are generated by SCIGen. That is a program that generates random computer Science research papers, including graphs, figures and citations. It uses a handwritten context-free grammar to form all elements of the papers.^{23,24} The purpose of this program is to prove that a paper will be published by some publisher without reviewing its contents. In 2015 in B&H about 25 journals are issued in the field of biomedical and life sciences in general—h-index of medical archives for 2014 is 12 (according to scimagojr.com) and is the highest among the journals in B&H (Figs 5 and 6).

CONCLUSION

There are a lot of methods to improve your h-score. It takes a lot of work and to promote papers and journals, but it is all part of developing as a researcher, working together with your community and improving communication methods. Some of these methods might be unethical and inappropriate. Evaluation of scholars work would be most reliably done after reviewing of all his papers and citations. That is the best way to see if the h-score is a true representation of the researcher's accomplishments.

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