The quality of scientific output of 100 globally leading researchers in the field of allergology

Running title: The quality of scientific output in allergology

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Abstract

Background. The quality of science is an essential aspect of any research project. The problem how to establish science quality is still the matter of interest of academic societies.

Objective. The aim of the study was an evaluation of the scientific output of 100 global leading researchers in allergology.

Methods. The assessed scientific outputs, ranked by Hirsch index (the h-index), were compared with corresponding outcomes, and obtained with the use of a new index - called the Scientific Quality Index (SQI). SQI was calculated by adding the percent of papers, cited ≥10 times, out of all the published papers, and the mean citation score. Self-citations and the citations of all co-authors were excluded in both measures.

Results. In the current study, the following mean values were obtained for the assessed variables: the number of all the published papers: 25±8.4, the citation index: 344.6±215, the number of cited papers: 22.1.6±8.4, the number of papers cited at least 10 times: 9.4±4.8, the percent of papers cited at least 10 times, out of all the published papers, including those with no citation: 38.1±17.5, the mean number of citations per paper: 13.8±7.8, h-index: 9.4 ±2.9 and SQI: 51.8 ±24.2.

After SQI-based reclassification 4% of authors remained in their initial ranking position, established by h-index. As many as 51 of the authors were ranked higher by SQI, while 45 were ranked lower in comparison to h-index position.

Conclusion. SQI is a tool with a high potential to assess scientific quality and also allows to follow-up scientific outcomes in time, providing time-related changes in the scientific quality over the period of observation.

Key words: allergology, h-index, scientific output, Scientific Quality Index.

Introduction

The scientific output of an individual author may be evaluated by several tools, such as: the number of publications, the number of publications as the first or a senior author, the citation index, the total value of Impact Factor. These criteria express more the quantity of research output. Irrespective of quantitative aspects, one should remember that, in order to establish the author's individual position in scientific ranking, the quality of research output should be accounted for in an overall evaluation. Sometimes, some papers are regarded to be especially valuable, having more than 100 citations and classified to the category of highly cited publications. Nowadays, the most common method, used for the evaluation of the author's scientific output is h-index, proposed by Hirsch (1). In the Scopus database, everybody may easily check h-index values of scientific authors. H-index assesses both the quantity and the quality of research outcomes. In order to monitor the qualitative features of research activity, a new algorithm, called the Scientific Quality Index (SQI), was recently proposed (2-4). This index takes into account the mean number of citations per paper and the percentage of papers with the citation number not below 10 with regard to the number of all published papers. In our previously published studies, a classification was run, according to h-index and SQI, taking into account Polish researchers (2), the authors investigating osteoporosis (3) and a group of 480 global leading researchers in 12 different medical branches (4).
The aim of the current study was to concentrate on the scientific output of 100 leading scientific authors in the field of allergology.

Methods

Data for 100 global top researchers in allergology with the highest number of published papers, with their scientific output identified by the key word 'allergen', were derived from the Scopus database. The period of 5 years (papers published between 2014-2018) was taken into account. The data, necessary to establish consecutive bibliometric parameters, were collected in April 2019.
The following bibliometric parameters were accounted for: the number of all published papers, the h-index, calculated after the exclusion of self-citations and of the citations of all co-authors, the citation index (the number of citations), except of the citations by the first author and by all of his/her co-authors, the number of cited papers and the number of papers cited at least 10 times (both without self-citations and the citations of all co-authors) and the percent of papers, cited at least 10 times among all the published papers, including those with no citation.
Using the bibliometric parameters and data, derived from the Scopus database, the new index – SQI - was calculated for each of the analyzed scientists, according to the following formula: Parameter No. 1 + Parameter No. 2, where:

- Parameter No. 1 (the percent of papers cited ≥10 times) = the number of papers cited ≥10 times (excluding self-citations and the citations of all co-authors) divided by the number of all the published papers (including the papers with no citation) x 100%,

Parameter No. 2 (the mean number of citations per paper) = the total number of citations (excluding self-citations and the citations of all co-authors) divided by the number of all published papers (including the papers with no citation).

As the SQI calculation assumes the exclusion of self-citations and of the citations of all co-authors, we also made use of the h-index, calculated without either self-citations or the citations of all co-authors, instead of the 'standard' h-index, as described above.

Statistics

The Statistica software (StatSoft, Tulsa, OK, USA) was applied for statistical analysis. Descriptive statistics were presented as mean values and standard deviations. The normality of distribution of the analyzed data was verified, using the Shapiro-Wilk test. A correlation analysis was performed by means of the Spearman's rank correlation test and the coefficients of correlation were compared by the Fisher exact test. P values below 0.05 were considered statistically significant.

Results

In the current study, the following absolute and mean values were obtained for the assessed variables: the number of all the published papers: 25±8.4, the citation index: 344.6±215, the number of cited papers: 22.1.6±8.4, the number of papers cited at least 10 times: 9.4±4.8, the percent of papers, cited at least 10 times, out of all the published papers, including those with no citation (the first parameter of SQI): 38.1±17.5, the mean number of citations per paper (the second parameter of SQI): 13.8±7.8, h-index: 9.4 ±2.9 and SQI: 51.8 ±24.2.

Two separate rankings were established, based on h-index and SQI values. Only 4% of the authors were not affected in their initial position, established by h-index, after SQI-based reclassification. This observation is the most important finding of the study. Fifty-one (51) of the authors were ranked higher by SQI than by h-index, while 45 were ranked lower by SQI vs. their prior h-index position. The greatest drop, observed in the entire group, was by 59 ranking positions and the greatest upward shift amounted to 35 ranking positions. Also in the subgroup of 10 top leading researchers, ranked by h-index, 6 lost their initial ranking position after the reclassification by SQI. For example, the author with h-index based position No. 3 moved to position No. 62 by SQI (the greatest drop) and the subject on position No. 8 by h-index was granted a shift to position No. 56 according to SQI. **Figure 1** presents the corresponding ranking positions, in h-index and SQI

assessing systems for the researchers, rated 'top 10', according to, at least, one of the analyzed classification systems.

Table 1 presents a correlation analysis. The number of all the published papers, expressing the quantity of scientific output, correlated significantly with h-index, while SQI did not show much relationship with that variable. All the other parameters demonstrated a significant correlation trend between their h-index and SQI values. The coefficients of correlation were compared, using the Fischer test and all r values differed significantly.

The h-index and SQI correlated significantly with each other (0.86, $p < 0.0001$).

Discussion

Each of the methods, used to assess scientific outputs, may provide some essential information. For example, if the goal is to measure the scientific output through a quantitative approach, then the number of publications is an appropriate input. An indirect information, corresponding to the quantitative assessment, is provided in the total Impact Factor value. However, the scientific output should be also assessed with regard to its quality. This, at least to some extent, is provided by the citation index. H-index combines in its assessment perspective, both quantitative and qualitative approach. Neither a high number of papers nor a high citation index is a guarantee of high h-index values. Regular citations per paper are necessary to reach high h-index values. One may consider that h-index precisely expresses the quality of scientific output but a recently designed, new index, called Scientific Quality Index (SQI), provides differently biased information. Similarly to h-index, SQI has been designed to assess the quantity and the quality of scientific outputs, however, SQI has shown in practice to depend more on qualitative features in scientific outputs than h-index (2-4).

Therefore, we consider that the most important finding in the current study was the behavior of individual ranking positions, assessed by h-index and SQI. Almost all the authors changed their initial positions, when approached by the two ranking systems, the change being, sometimes, very big as for the author with his ranking position No 3 (according to h-index), who lost 59 places after in the SQI ranking system. Those changes occurred despite of the relatively strong correlation between h-index and SQI. Clearly, h-index and SQI, reveal different features in their scientific output assessment modes.

Two other important features of SQI should also be emphasized. *First,* SQI is a tool which excludes citations of the author and of all co-authors, being thus independent of any personal influence. And *second,* SQI has a unique feature to diminish its value over time. If new publications are not cited frequently enough, both SQI parameters will diminish and the final SQI score will decrease. All the other bibliometric variables demonstrate a cumulative pattern and thus do not decrease. This

outstanding feature of SQI enables long-term monitoring of dynamic changes in scientific output quality.

Concluding, SQI is a tool with a potential to identify and assess scientific quality. The unique SQI features allow to perform a specific follow-up of research outcome to monitor and assess changes in scientific quality over the period of observation.

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Table 1. A correlation analysis and comparison between r values for h-index and SQI.

Variable	r value for h-index	r value for SQI	p value according to Fischer test
The number of publications	0.31*	-0.11 (NS)	<0.01
Citation index	0.88**	0.76**	<0.01
The number of cited papers	0.60**	0.25***	<0.01
The number of papers cited ≥10 times)	0.98**	0.87**	<0.0001
The first parameter of SQI	0.84**	0.99**	<0.0001
The second parameter of SQI	0.82**	0.91**	<0.05

*$p < 0.01$

**$p < 0.0001$

***$p < 0.05$

Figure caption:

Fig 1. Corresponding ranking positions, provided by h-index and SQI, for researchers, rated among 'top 10' in, at least, one of the analyzed ranking systems.

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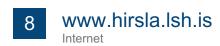
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