The Use of the $h$-index in Academic Otolaryngology

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Objective/Hypothesis: The $h$-index is an objective and easily calculable measure that can be used to evaluate both the relevance and amount of scientific contributions of an individual author. Our objective was to examine how the $h$-index of academic otolaryngologists relates with academic rank.

Study Design: A descriptive and correlational design was used for analysis of academic otolaryngologists’ $h$-indices using the Scopus database.

Methods: $h$-indices of faculty members from 50 otolaryngology residency programs were calculated using the Scopus database, and data was organized by academic rank. Additionally, an analysis of the $h$-indices of departmental chairpersons among different specialties was performed.

Results: $h$-index values of academic otolaryngologists were higher with increased academic rank among the levels of assistant professor, associate professor, and professor. There was no significant difference between the $h$-indices of professors and department chairpersons within otolaryngology. $h$-indices of chairpersons in different academic specialties were compared and were significantly different, suggesting that the use of this metric may not be appropriate for comparing different fields.

Conclusions: The $h$-index is a reliable tool for quantifying academic productivity within otolaryngology. This measure is easily calculable and may be useful when evaluating decisions regarding advancement within academic otolaryngology departments. Comparison of this metric among faculty members from different fields, however, may not be reliable.

Key Words: $h$-index, academic promotion, academic productivity, $h$-index in otolaryngology, faculty promotion, faculty productivity, otolaryngology faculty productivity, academic physician scientific productivity, academic rank determination, academic rank in otolaryngology.

Level of Evidence: n/a.

INTRODUCTION

J.E. Hirsch first described the $h$-index in 2005 as a potentially constructive approach to evaluate an individual author’s cumulative research impact. In attempting to appraise academic productivity, institutions rely primarily on criteria including number of publications, influential or significant publications, citations, research grants, and accolades. Although not the sole component, these measurements continue to play an important role in faculty member evaluation and consideration of tenure status, academic rank, and other advancement opportunities. The $h$-index, however, has gained popularity as an attractive alternative that can supplement and even replace some of these other measures, and has been examined in a diverse array of fields ranging from waste management to medical and surgical fields, including gastroenterology and urology.

The $h$-index is an author’s $h$ of the number of papers published ($N_p$) that have at least $h$ citations each, while the author’s other published papers have less than $h$ citations. Although seemingly complicated, this means that an author with an index of $h$ has $h$ publications that were cited by other authors by a minimum of $h$ times.

The $h$-index has both advantages and disadvantages. It is calculated using database calculators from Google Scholar, Scopus, and Web of Knowledge. This score takes into account the relevance and quality of an author’s scientific contributions, as opposed to simply the quantity of articles published. Another commonly used metric that proponents of the $h$-index point out as an advantage of this index is the number of times an author’s works has been cited by other papers. The latter can potentially be skewed if the author was just one of many authors on a single significant study. At the same time, there is debate over whether authors taking leading roles in such studies should count for more than the single additional point that such a paper would add to an $h$-index score. Both of these also demonstrate another criticism of the $h$-index; it does not account for the order an author is listed in a final manuscript.

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Although the \( h \)-index has its critics, it is still one of the few objective and easily calculable measures that can be used to evaluate both the relevance and amount of scientific contributions of an individual author. To the best of our knowledge, there has not been an analysis of how an otolaryngology faculty members’ \( h \)-index relates with academic rank. Our objective was to examine the relationship between these variables using the \( h \)-index calculator available from the Scopus database.

**MATERIALS AND METHODS**

The American Medical Association’s Fellowship and Residency Interactive Database Access System (FREIDA) was used to generate a list of all 105 otolaryngology residency programs in the United States. Fifty of these programs were chosen at random by selecting every other civilian program on the list. Listings from each program’s Web site were used to compile a list of faculty members organized by academic rank, including the categories of chairperson, professor, associate professor, and assistant professor. Division chiefs were counted under the “chairperson” category in programs where otolaryngology was a division of surgery and not its own independent department. Although all the chairpersons also held the rank of professor, they were counted only in the “chairperson” category, and not in the “professor” category, in order to avoid counting them twice in this analysis. Residency programs from which faculty directories did not include each physician’s academic rank were excluded. Additionally, any nonacademic faculty, that is, adjunct faculty or instructors, were not included in this analysis. The \( h \)-index of each faculty member was calculated using the Scopus database (http://www.scopus.com).

Twenty department chairpersons from different specialties were randomly selected from the same set of FREIDA institutions used in the otolaryngology analysis; specialties used included neurosurgery, orthopedic surgery, general surgery, internal medicine, anesthesiology, and radiology. The \( h \)-index of department chairpersons from the same 20 institutions in these specialties and otolaryngology were compared. All data was collected in May 2012.

**RESULTS**

\( H \)-index values calculated by the Scopus database were higher with increasing academic rank among the levels of assistant professor (4.63 ± 0.26 SEM), associate professor (8.13 ± 0.43), and professor (15.6 ± 0.74) (Fig. 1) for academic otolaryngologists. However, there was not a significant difference among the \( h \)-indices of professors and chairpersons (16.4 ± 1.2) within otolaryngology departments (t test, \( p > 0.05 \)).

Twenty otolaryngology department chairpersons were randomly selected, and their \( h \)-indices were compared to counterparts in different specialties from their institution (Fig. 2). A one-way ANOVA was used to analyze \( h \)-indices among chairpersons in neurosurgery, orthopedic surgery, general surgery, internal medicine, anesthesiology, radiology, and otolaryngology. Mean \( h \)-indices differed significantly across these four groups (\( F = 3.46, p < 0.005 \)), with chairpersons in general surgery (27.8 ± 3.56 SEM) and internal medicine (24.6 ± 3.44) having the highest \( h \)-indices.

**DISCUSSION**

Calculation of the \( h \)-index attempts to solve challenges associated with judging a particular author’s academic output. Although measuring the importance of one’s contributions can often be a difficult task when academic advancement is at stake, this tool produces a potentially “objective” quantification that can aid in this process. By taking into account both the amount of publications, as well as how frequently authors have been cited by others, the \( h \)-index is one of the first widely used metrics to evaluate the academic “relevance” of a faculty member’s publications. While this measure is more widely employed in other fields within the sciences, its use has recently increased for decisions regarding tenure and promotion within medicine.\(^{1,12}\)

Although the use of the \( h \)-index has many advantages, there are also several criticisms. An author’s \( h \)-index is defined as the number at which they have \( h \) papers that have been cited \( h \) times.\(^1\) Papers that have been cited at \( h \)-1 times or less are not included in this measure. Some have suggested that intentional self-
citation of papers that are nearly at an author’s $h$ can be a strategy used by some to self-inflate their scores.\textsuperscript{13} However, it can be difficult to sustain an increased $h$-index through self-citation unless an author repeatedly cites such papers that are at the margin of counting for their $h$-index. If an author already has an appreciable $h$-index, a single citation may not affect this metric since the paper has been cited by many others.\textsuperscript{14}

Another commonly noted limitation is that the $h$-index does not necessarily differentiate between the types of research an author publishes.\textsuperscript{15} There can be differences based on whether an author focuses on original research, basic science projects, or review papers. These differences are also responsible for the fact that the average $h$-index totals may be significantly different among different scientific disciplines.

There are numerous other limitations of the use of the $h$-index to measure academic output, including a lack of accounting for the order an author is listed in a manuscript, the number of “significant papers” written by an author, and the inability of this measure to take into account the stage of career of an author.\textsuperscript{1,16,17} In his original article, Hirsch did propose the use of $m$ to account for this difference, which is $h$ divided by how many years a scientist has been active. At this point, $m$ is not widely used.

In our analysis, we found that the $h$-indices increased with academic rank among academic otolaryngologists, and that there was no statistical significant difference in $h$-index values between professors and chairpersons in otolaryngology. However, the $h$-indices of otolaryngology chairpersons were lower than that of several other specialties (Fig. 2). There are several possible explanations for the lower mean $h$-index of otolaryngology chairpersons compared to those in other specialties. According to specialty data from the American Medical Association, there are approximately 9,000 active otolaryngologists, far fewer than the 27,000 general surgeons and 104,000 internists practicing in the United States.\textsuperscript{18} Since there are fewer otolaryngologists, there are fewer journals and overall publications, and consequently, a more limited audience for these journals. Conversely, internal medicine and general surgery likely have the highest $h$-index scores (Fig. 2) precisely for this reason. Therefore, comparing $h$-index metrics among members of different specialties may not appropriately reflect the quality and relevance of these physicians’ research.

It is also important to note that the sample used in Figure 2 is comprised entirely of department chairpersons, whose roles in research output may vary among different specialties. Although there was an overall statistically significant difference between the mean $h$-indices of the various academic ranks within otolaryngology (Fig. 1) (ANOVA, $p < 0.005$), otolaryngology chairpersons did not have a significantly higher $h$-index than otolaryngology professors ($t$ test, $p > 0.05$). Interestingly, one recent paper examining $h$-indices among neurosurgeons found a substantial difference between department chairpersons and professors.\textsuperscript{12} This either confirms the possibility of differing research roles for chairpersons between these fields, or may suggest differences in the strictness of authorship guidelines among journals of different specialties. While publishing companies in recent years have increasingly required listing individuals’ specific contributions to research for greater transparency, one recent paper examining authorship trends concluded that the implementation of such measures had had little effect on the number of authors per article.\textsuperscript{19} A large gap in the academic output between professors and chairpersons, which is not seen in otolaryngology, can potentially be promoted by the inclusion of “honorary” authors, such as heads of departments.\textsuperscript{20}

There were several limitations in this analysis. The Scopus database only accounts for citations since 1995, meaning that any works that were cited by authors before this time would not be included in the $h$-index. This likely underestimates the $h$-index of more senior faculty members, although the analysis still showed they had significantly higher $h$-indices than their junior colleagues. Additionally, there is the potential for differing calculations if one of the other $h$-index calculators, such as Google Scholar, had been used for this analysis. However, an article that compared Google Scholar and Scopus $h$-index results for neurosurgery faculty members demonstrated a high correlation between results from these two resources, making it unlikely that this affected our analysis significantly.\textsuperscript{12}

It is important to note that the $h$-index and other bibliometric parameters should comprise only a portion of the criteria used to evaluate academic physicians. Although scholarly productivity can be an important component of a faculty member’s value to an institution, bibliometric measures do not take into account several domains that the American Association of Medical Colleges (AAMC) has previously recommended for assessing the overall quality of educational contributions, including leadership, learner assessment, advising and mentoring, curriculum involvement, and teaching. A well-written Educator Portfolio includes the relevance of an academic physician’s contributions to the educational experience for medical students and residents, whether this includes the development of an academic program, teaching tool, teaching evaluations by peers and experts, or simply the amount of time spent teaching.\textsuperscript{21,22} As an example, academic faculty members dedicate significant but varying portions of their time to training residents and shaping available educational opportunities. Faculty with educationally related administrative responsibilities, such as residency program directors, make significant contribution that should be valued for promotion purposes but cannot be necessarily quantified using the $h$-index.

**CONCLUSION**

The $h$-index is a reliable tool for quantifying academic productivity. Increased incorporation of this metric could continue to refine the system of advancement at academic otolaryngology departments, potentially making promotion and hiring decisions more equitable. This measure reliably increased when evaluating the ranks of faculty members up the academic hierarchy from academic otolaryngology departments, potentially making promotion and hiring decisions more equitable. This measure reliably increased when evaluating the ranks of faculty members up the academic hierarchy from
assistant professor through professor, though there was no significant difference upon comparison between professors and chairpersons in otolaryngology. While use of this metric for comparing faculty within a field may be appropriate, comparing h-indices of faculty from different fields may not be meaningful.

BIBLIOGRAPHY


