


An Otolaryngologist's Guide to Understanding the H-index and How It Could Affect Your Future Career

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Abstract

Objectives. The h-index is a measure of research output and contribution that shows strong correlation with academic promotion in medicine. The purpose of this article is to clearly explain how h-index scores are calculated and how otolaryngologists can effectively and advantageously use these scores for their career development.

Data Sources. PubMed.

Review Methods. We performed an up-to-date PubMed literature review describing the design of the h-index and how to use it effectively along with its role in academic medicine, including otolaryngology.

Conclusions. H-index scores are used as a metric for scientific output that considers the number of publications and the number of times each is cited. Search engines can automatically calculate h-index scores for one's work. Studies also revealed significant positive correlations that the h-index has from fellowship involvement, which could be beneficial for career advancement in academic medicine.

Implications for Practice. Aspiring academic otolaryngologists should create a research profile to link and calculate the h-index for publications, submit to well-read high-impact journals for increased viewership and citations, and expand on foundational and personal research topics. Future studies should evaluate faculty and resident awareness of h-indices in the otolaryngology department to see how we can further address any underlying barriers. Otolaryngologists with the knowledge and tools necessary to maximize h-index scores and produce high-quality research in modern-day medicine not only provide potential advantages in career development but also bring significant contribution to the field of otolaryngology and patient care.

Keywords

h-index, academic medicine, research productivity, academic otolaryngology, scholarly impact, fellowship training

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The h-index was created in 2005 by J.E. Hirsch to make a more holistic index for scientific output by a researcher. It can give a robust estimate of the impact of a scientist's cumulative research contributions.¹ Rather than focusing solely on the quantity of publications or number of citations, the h-index considers both and has shown strong correlation in career advancement within academic medicine. A physician's contribution to medicine is more than just hands-on patient care; medical research led by physician-scientists has made lasting impacts in human advancements through discovery of new medications and procedures.

A variety of studies have shown that a higher h-index correlates with higher faculty rank.^{2–11} In terms of academic rank among 14 surveyed medical specialties, assistant professors scored an h-index score between 2 and 5, associate professors 6 and 10, and full professors 12 and 24.⁸ Among hand surgeons, although many factors play into determining academic rank, the h-index was the strongest correlative factor.⁷ Other studies have shown positive correlation with the h-index and academic rank within the fields of ophthalmology, neurosurgery, urology, and radiology.^{6,9–11} As components of promotion become more multifaceted, the importance of the h-index for rank advancement becomes seamlessly evident.

The h-index score through the lens of otolaryngologists can be found in several studies regarding academic promotion and fellowship. There is, however, no comprehensive review to date of these studies discussing h-index impact in otolaryngology, as well as no study giving an explicit blueprint of how the h-index score could be utilized in one's future otolaryngology practice and career. In practice, the effective use of the

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h-index score is becoming an utmost necessity in the ever-changing dynamics of one's advancement in academic medicine. The purpose of this article is to clearly explain the calculation of the h-index, fully review its associated relationship with career advancement in otolaryngology, and outline how to improve one's score with guidelines.

Methods

We performed an up-to-date PubMed literature review to better understand the design, setbacks, and effective use of h-index scores as well as the relationship that it has in academic medicine with emphasis on otolaryngology. The search was performed with the following key terms: h-index, academic medicine, research productivity, and scholarly impact. To target otolaryngology data, the terms "academic otolaryngology" and "fellowship training" were added to the search. Inclusion criteria were original articles in the English language. Articles were reviewed by multiple authors, and relevant information was extracted to produce a review of the subject. We present findings on the h-index score and the associations that it has with academic medicine, emphasizing otolaryngology and fellowships within the field, as paired with guidelines to use h-index scoring effectively.

Discussion

H-index Score

The h-index score is used as a metric for scientific output that considers the number of publications and the number of times each is cited. For example, an h-index of 10 means that an author has published 10 articles, each of which has been cited at least 10 times.¹ All other articles that have not been cited by other literature are not included in the h-index score, which means that the total number of published works is not factored into this metric.

There are multiple academic search engines (e.g., Scopus, Google Scholar, and World of Science) that give estimates of an author's h-index alongside other publishing statistics. The most commonly used database, Scopus, automatically calculates a researcher's h-index.¹² But this considers only indexable articles found online; thus, some articles by professors prior to major internet indexing are likely missed by calculations made by Scopus.¹² Google Scholar is available to the public for free, which is a major advantage; however, discrepancies in h-index calculation have been found. World of Science requires an author's last name and initials to search for publications, which can lead to more difficulty finding results. While Scopus links multiple variations of names and institutions to consolidate the database, Google Scholar does not and the calculated scores therefore vary by institution.¹²

The number of times cited is largely dependent on the journal in which the work is published. For many specialties, journals and magazines are often smaller and not cited as frequently as higher-impact journals. Submitting original work to higher-impact journals may increase the likelihood of being cited, thus influencing an h-index score. It is also important to consider the impact of review articles and meta-

analyses, as these types of studies would be more likely to be cited than other study designs.¹³ In addition, keeping track of published work by linking variations of one's name to an account on Scopus or ORCID ID may reduce the chance of a publication being missed by automated engines. Given that this metric identifies the greatest common factor between number of publications and number of times cited, h-index scores can be inflated by citing one's own work in subsequent articles. For example, if an author had 3 publications with 3, 3, and 2 citations, by citing the third in the next work, the author's h-index would rise to 3. Increasing one's h-index score in this way could serve as an incentive to continue building on one's medical innovation but could also have a tendency to limit any additional novel ideas in one's research.¹⁴

Lastly, although the h-index is one of the most popular measures of research output, it is important to briefly discuss other measures that exist. In fact, the g-index and e-index were developed in response to limitations of the h-index score and may start playing a bigger role in the future. The g-index was introduced in 2006 and is defined as "the largest number such that the top 'g' articles received together at least g² citations."¹⁵ For example, if you have 4 publications with citations of 12, 4, 3, and 0, you will have a g-index of 4 because the sum of citations is greater than 16 but not greater than 25, even though the h-index would be 3. One can see how the g-index is better at recognizing articles that have received considerably high citations, which shows that the publication is valuable to the literature. The e-index, developed in 2009, is a metric that complements the h-index. Specifically, it catches publications that are highly cited but underestimated in the h-index score.¹⁵ Awareness of these measures can be useful as they begin to play potential roles in multifaceted estimations of impactful research output.

The lack of awareness of one's h-index score or understanding how the h-index score is calculated can hinder progress in academic output. In 2021, a study in Germany attempted to interview university professors, including professors in medicine, to measure their knowledge on self-estimating their h-index scores. They found that about 40% of their sample of 1017 professors did not know the details of the h-index or incorrectly estimated the h-index score when they thought they knew it.¹⁶ There was no report on how professors in medicine specifically did on competency of their own h-index scores, and to our knowledge, no studies in the literature have evaluated h-index awareness in otolaryngology. Future studies should investigate the awareness of the h-index score in otolaryngology faculty and residents to help determine how much education may be needed.

Furthermore, there appears to be a gender gap between the h-indices of women and men. While this difference could be attributed to bias, studies have offered a variety of reasons, which could give insight to factors that affect the h-index. Specifically in otolaryngology, women compose an underrepresented proportion of fellowships and even less so in leadership positions.¹⁷ One reason why women may have lower research productivity is due to the preexisting lack of women in the field and hence less availability of mentors.¹⁸ Other factors include having greater roles in supporting

family life, educational medicine, or clinical service.^{18,19} Despite these obstacles, female otolaryngology faculty are now capable of raising their h-index scores to match or exceed those of their male peers.^{18,20,21} This demonstrates that despite a late start or other obligations, one can still recover later on and achieve higher academic ranking. As mentioned later in our guidelines, however, researching and publishing earlier in the career allows for more exposure, influence, and citations to be made, thus increasing the h-index score.

In an ever-increasingly competitive world, measures of aptitude often become more important than the content itself. Though the h-index provides great convenience, it may become a higher priority than actual scientific novelty. Although the h-index measures research productivity, research itself is very diverse in nature. From clinical research to bench research and case reports, the h-index does not account for the type of research conducted.^{2,19} Impactful research stems from basic science and clinical studies, but the timeline of each varies greatly. Generally, basic science research takes place over a greater amount of time than clinical studies, resulting in fewer publications. Although the publication could have lasting impacts, it would not likely be able to greatly raise a researcher's h-index. Each research field has a different h-index as compared with other fields, so this could alleviate some of the disparity caused by research type. For example, a field focused on time-intensive basic sciences would have a relatively low h-index when compared with a field that frequently publishes fast-paced case reports. When applied within a certain field, the disparity in h-index would likely not cause an issue, although it could when translating to a field that has a higher relative h-index.

Furthermore, it is not only the diversity of research and its scholarly impact that can be underestimated by the h-index score but also the diversity of the researchers. Scholarship relating to health inequity and diversity, equity, and inclusion is assuming increasing importance and rigor in otolaryngology–head neck surgery.^{22,23} Specifically, a recent comprehensive analysis revealed that ethnic diversity among 5 million investigators was highly correlated with scientific impact while outperforming their nondiverse counterparts.²⁴ The h-index score could be limited in its ability to capture the paramount impacts that researchers of diverse background have used to augment medical research.

Additionally, it is important to consider that the h-index score could underestimate quality work that is significantly valuable for the medical literature.¹⁵ For example, 1 article can be cited 300 times in the literature but have a collective h-index score of 1 if 2 other articles received only 1 citation each. The g-index and e-index were developed to help amend this flaw, but they have yet to gain as much utilization as the h-index.¹⁵ Even with modifications of the indices used to track productivity, the lack of discoverability of unindexed articles as well as later exposure to publishing in one's career can still limit the usability of indices in most settings.

H-index in Otolaryngology

In general, otolaryngology graduates who chose a career in academic medicine had a higher number of mean publications than graduates who went into private practice.²⁵ Regarding promotion within academic otolaryngology based on h-indices, Svider et al conducted a study showing statistical differences in h-indices among various academic positions.² Specifically, they found that h-index scores trended positively as one went from assistant professor to associate professor and later professor positions, thus further showing a correlated weight in academic promotion. Chairpersons in otolaryngology programs had the highest scholarly impact as measured by h-index scores and the greatest external grant funding when compared with vice chairs and residency program directors.²⁶

Additionally, in otolaryngology, studies have taken special interest on how fellowship training can later be associated with greater h-index scores as well as research output and academic involvement. In 2012, Eloy et al found that fellowship-trained individuals had statistically higher academic productivity based on h-index when compared with otolaryngology colleagues who did not pursue fellowship.³ A study by Moffatt et al later on suggests that although this difference may be starting to become smaller, involvement in academic medicine is higher in fellowship-trained otolaryngologists.⁴ Furthermore, among the fellowship-trained individuals, the average h-index score for faculty under each subspecialty has been analyzed in several studies and can be referenced in **Table I** for a summary of the findings.

Faculty with otology and head and neck cancer fellowship training consistently have the highest h-index values (12.4 and 12.8, respectively) among colleagues trained in other subspecialties of otolaryngology.^{3,4,27,28} Of note, rhinologists are having higher publication rates annually in comparison with the other subspecialties and are approaching h-index values similar to those of faculty with otology and head and neck cancer training (10.2).⁴ With fellowship training in rhinology being a relatively recent development, these results demonstrate high research proficiency within the subspecialty that has the potential to outpace other subspecialties in the coming years.²⁸ Otolaryngology faculty in other subspecialties, such as laryngology, pediatrics, facial plastics, and sleep, were noted to have lower h-index scores (9.8, 9.0, 8.2, and 7.4, respectively) and research production than colleagues of the other fields.

One can see how fellowships could be advantageous in increasing the h-index score, which would increase the likelihood to acquire higher positions in academic medicine. In fact, studies mentioned earlier make proposals for the h-index score to be a useful metric in academic promotions, while other surgical subspecialties have already begun utilizing it in their decisions on conferring promotions and tenures.^{2,3,11,27} Though this is merely a correlation and not causation, it could be useful to participate in a fellowship as an investment in one's h-index. Perhaps fellowships provide catalyst opportunities for research or dedicated mentors to guide and develop effective research

Table 1. Studies Reporting Mean H-index Values Among Fellowship-Trained Faculty.^a

Otolaryngology fellowship	Mean H-index scores				Overall
	Eloy (2012; n = 1001) ^{3,b}	Moffatt (2021; n = 1704) ⁴	Shires (2021; n = 838) ²⁷	Svider (2013; n = 94) ²⁸	
Head and neck oncology	11.6	14.8	12.0		12.8
Otology	10.3	14.4	12.5		12.4
Rhinology	8.5	12.4	9.6	6.7	10.2
Laryngology	8.6	11.9	8.9		9.8
Facial plastics	7.2	9.9	7.4		8.2
Pediatrics	8.9	10.3	7.8		9.0
Sleep			7.4		7.4
No fellowship	6.5	12.1	7.1		8.6

^aBlank cells indicate *not applicable*.

^bn = the number of total faculty in each sample size.

skills, which have been shown to be key in academic development.⁶ Early engagement in research has been correlated to higher h-index scores, attainment in National Institutes of Health (NIH) funding, and higher academic rank as compared with those without formal experiences.²⁹ These learning environments provide mentorship with scholarly products that allow an otolaryngologist to overcome limitations that some otolaryngology programs might experience.

To expand on providing otolaryngologists further avenues in research involvement, it is important to consider variabilities in residency and fellowship programs regarding research opportunities that are provided by grant funding. Not only would this provide fewer hoops to jump through in moving research projects forward, but it would also bring great-quality research and increase the likelihood of multiple citations. Throughout the last decade, for example, otolaryngologists who have completed head and neck cancer fellowship programs have reportedly higher h-indices than their peers in other subspecialties and non-fellowship-trained colleagues.^{3,4,27,28} It is important to take into account, however, that this subspecialty may be given the most extensive federal and institutional funding, as research in cancer may be recognized as a more worthy cause than other otolaryngology-related maladies. In fact, one study examined if NIH funding had any impact on one's scholarly output. Shires et al reported that the h-index score was significantly correlative ($P < .0001$) with the degree of NIH funding at a given institution as well as becoming an otologist and head and neck cancer surgeon.²⁷ Studies have yet to fully quantify how research funding is allocated among residencies and fellowships within otolaryngology, but a budding otolaryngologist wanting academic career advancement or a higher h-index score may want to consider working in subspecialty or residency program that conducts meaningful research with minimal to no restrictions.

Implications for Practice

Several barriers to continuing research have been identified, such as time constraints from personal and professional duties, statistical knowledge deficits, and a lack of interest.¹⁹

Through the early development of time management skills and prioritization, potential otolaryngologists can prepare themselves to deal with time constraints. In a culture of research for the sake of building a competitive CV, it is important to consider one's motivation for research.¹⁷ By finding inspirational mentors, one can develop a genuine interest in research and acquire the necessary skills to build a robust academic medicine career. Mentorship can help better understand why research is so important for patient care and how it informs one's future practice as well.

It is important to equip oneself with publishing strategies. In addition to the volume of produced works, other characteristics, such as quality, availability, and accessibility, should be considered when publishing.³⁰ A legible and well-written article attracts more attention and has a higher likelihood of being published in a visible and prestigious journal.³⁰ Due to the formula of the h-index, the longer that an article has been published and available, the more likely that it will have been cited. The h-index also does not depreciate over time, meaning that the longer a researcher has been active, the higher the h-index value. In addition to this, residents who published as first authors before starting their program were more likely to continue publishing during their residency.¹⁷ This shows that the earlier exposure that one has with publications, even before residency, could help compound the investment into one's h-index score over time.

Even though many studies have examined the important association that these scores have with academic promotion, academic otolaryngologists should bear in mind that there are many paths of excellence and scholarship in medicine that go beyond research endeavors. Humanitarian outreach, education, clinical patient care, legislature involvement, and national leadership/committee membership are all worthy of academic scholarship and potential promotion.³¹ It is important to acknowledge these kinds of accomplishments and to discover a personal balance in one's growth as a physician to avoid too much emphasis on research that could be harmful for one's overall wellness.³²

In summary, we hope that the insight provided will help otolaryngologists have the tools necessary to maximize

h-index scores and understand their academic impact. Additionally, it may be necessary to conduct studies to evaluate faculty and resident awareness of h-indices in the otolaryngology department to see how we can further address any underlying barriers. Lastly, it is important to strive toward producing high-quality research in modern-day medicine not only to potentially provide advantages in career development but also to bring significant contribution to the field of otolaryngology to maximize patient care.

Author Contributions

David C. Moffatt, data acquisition, manuscript writing, and manuscript revisions; **Puja Shah**, data acquisition, manuscript writing, and manuscript revisions; **Alex E. Wright**, data acquisition, manuscript writing, and manuscript revisions; **Kenneth Zon**, data acquisition and manuscript writing; **Harold S. Pine**, data acquisition and manuscript writing.


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