Impact of Fellowship Training on Research Productivity in Academic Ophthalmology

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OBJECTIVES: To assess whether scholarly impact of academic ophthalmologists, as measured using the *h-index*, is affected by fellowship training status and to further characterize differences in productivity among the various subspecialties and by departmental rank.

DESIGN: A descriptive and correlational design was used. In total, 1440 academic ophthalmologists from 99 ophthalmology training programs were analyzed. The *h-index* data were obtained from the Scopus database. Faculty members were classified by academic rank and grouped into 10 categories based on fellowship training: anterior segment, corneal and external disease, glaucoma, uveitis and ocular immunology, vitreoretinal disease, ophthalmic plastic surgery, pediatric ophthalmology, neuro-ophthalmology, ophthalmic pathology, and "other." A one-way analysis of variance or Student *t* test using Microsoft Excel and "R" statistical software were used for comparison of continuous variables, with significance set at $p < 0.05$.

SETTINGS: Faculty working in academic ophthalmology residency training programs in the United States whose information is stored in the American Medical Association's Fellowship and Residency Electronic Interactive Database.

RESULTS: Fellowship-trained ophthalmologists had significantly higher research productivity, as measured using the *h-index*, than non–fellowship-trained ophthalmologists in this study ($p < 0.0005$). Academic ophthalmologists trained in vitreoretinal disease or ophthalmic pathology had the highest scholarly productivity compared with those in other ophthalmology subspecialties ($p < 0.05$). There was a significant increase in scholarly productivity with increasing academic rank from Assistant Professor to Professor ($p < 0.05$). A significant difference in productivity between fellowship-trained and non–fellowship-trained ophthalmologists existed individually only at the level of Assistant Professor ($p < 0.0005$).

CONCLUSION: Academic ophthalmologists with fellowship training have significantly higher scholarly output than non–fellowship-trained ophthalmologists do, as measured using the *h-index*. Research productivity increases with departmental academic rank from Assistant Professor to Professor. (J Surg 72:410-417. © 2015 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: fellowship training, academic promotion, research productivity, scholarly productivity, ophthalmology, *h-index*

COMPETENCIES: Medical Knowledge, Professionalism, Practice-Based Learning and Improvement

INTRODUCTION

Subspecialty training in ophthalmology has become increasingly common over the past 2 decades. Data from the San Francisco Ophthalmology Fellowship Match and the American Society of Ophthalmic and Plastic Reconstructive Surgery fellowship match reveal that approximately 64% of US ophthalmology residents graduating in 2014 entered a fellowship training program. Currently, 3 subspecialty areas—vitreoretinal disease, cornea and external disease, and glaucoma—capture more than 75% of all residents who match into fellowships.[1]

An anonymous survey sent to 222 graduating ophthalmology residents in 2012 revealed several factors that

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influenced career choices among trainees. Residents who sought subspecialty training had on average a greater desire to acquire special skills, to enter a (perceived) prestigious field, and to be concerned with a favorable job market. By contrast, lifestyle considerations such as anticipated work hours and geographic preferences were more important to residents choosing a comprehensive ophthalmology career. Residents who chose comprehensive ophthalmology careers were more likely to plan to practice in a private group practice, whereas those seeking subspecialty training were more likely to intend to practice in an academic setting or were undecided in their future practice type.[2]

Scholarly productivity in the form of research contributions is exceedingly important in determining appointment and promotion within academic medicine.[3,4] Greater research productivity has been associated with better clinical care and enhanced research opportunities, which may be factors in the decision to pursue subspecialization.[4,5] Increased research output may lead to greater prestige in the field, another factor influencing many graduates who pursue fellowship training.[2] Despite its obvious importance, quantifying research contribution is nevertheless complicated and should in theory reflect the cumulative significance of an individual's publication history.[6] Several metrics related to research productivity are commonly used in this evaluation process, such as the total number of publications, funding history, and frequency of citation; however, none of these measures reliably convey the overall quality of scholarly output.[7]

The *h-index* was first described in 2005 by Dr. J. E. Hirsch as a tool to assess scholarly productivity. It is an easily computable index and gives an estimate of the broad impact of a scholar's cumulative research contributions, taking into account both the quantity and quality of publications.[8] Briefly, an individual with an *h-index* of *n* has published *n* number of articles, each of which has been cited in the peer-reviewed literature *n* times. Thus, for example, an individual with an *h-index* of 15 has published 15 articles that have each been cited at least 15 times in the literature. If this individual with an *h-index* of 15 has published 50 articles overall, this means that his other 35 articles have been cited less than *h* (15) times in peer-reviewed journals. Therefore, this measurement gauges the general influence of an author's scholarly contributions and is not disproportionately affected by one or a handful or heavily cited publications.[3]

Studies using the *h-index* have repeatedly shown that there is a strong association between the *h-index* and academic advancement, procurement of funding from the National Institutes of Health (NIH), and other measures of scholarly impact in many fields including otolaryngology, radiology, urology, neurosurgery, and anesthesiology.[3,6,9-12] In otolaryngology, it has been found that fellowship-trained academic practitioners have greater research productivity, as measured using the *h-index*, than their non–fellowship-trained colleagues.[3] There have been no previous studies comparing whether postresidency fellowship training has a similar impact on scholarly influence in ophthalmology.

The purpose of this study was to determine whether the scholarly impact of faculty members of academic ophthalmology departments, as measured using the *h-index*, is correlated to fellowship training status. In addition, our study aimed to further characterize the differences in research productivity among academic ophthalmologists by subspecialty and by academic rank.

MATERIALS AND METHODS

A list of academic ophthalmology residency training programs in the United States was generated using the American Medical Association's Fellowship and Residency Electronic Interactive Database. Faculty information such as academic rank and fellowship training was obtained from online listings taken from the website of each academic department. Faculty members whose academic rank was undeterminable from their online profiles or whose program's website did not present pertinent information regarding fellowship attainment were excluded from this analysis. Additionally, nonacademic, nonphysician, and part-time faculty were not included in this study. The subspecialties included in this study were obtained from the San Francisco Ophthalmology Fellowship Match[1] and comprise anterior segment, cornea and external disease, glaucoma, uveitis and ocular immunology, vitreoretinal diseases, ophthalmic plastic surgery, pediatric ophthalmology, neuro-ophthalmology, ophthalmic pathology, and "other" fellowships. "Other" fellowships were those fellowships that were not listed specifically from the San Francisco Ophthalmology Fellowship Match including ocular oncology, molecular ophthalmology, ophthalmic genetics, ocular pharmacology, and ocular immunology. The initial Fellowship and Residency Electronic Interactive Database search yielded 117 ophthalmology training programs from which 18 institutions were excluded. After application of the exclusion criteria, 1440 academic ophthalmologists from 99 departments were examined. To obtain data concerning an individual's *h-index*, the Scopus database (http://www.scopus.com) was used to search for each author as this database covers more than 40 million publication records from 18,500 peer-reviewed venues. The Scopus database has been previously used in this manner in a plethora of medical and basic sciences.[3,6,9-36] Although other *h-index* database calculators such as Google Scholar or ISI Web of Knowledge exist, studies have published similar results when comparing them, suggesting a strong correlation between *h-indices* obtained from either Google Scholar or Scopus.[11] In addition, geographic location of the ophthalmologists' department was obtained and grouped into one of the following regions designated by the US Census