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RESEARCH ARTICLE

Research Productivity and Impact of Saudi Academic Ophthalmologists: Trends in H-index, Sex, Subspecialty, and Faculty Appointments

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Abstract:

Objectives:

This study aimed to assess the scientific output of academic ophthalmologists in the Kingdom of Saudi Arabia in terms of the H-index, sex, subspecialty, and faculty appointments.

Methods:

This cross-sectional study used data extracted from publicly available sources. Saudi academic ophthalmologists and their academic rankings were identified from their respective university websites. The H-indices were collected from the Scopus, Web of Science, and Google Scholar databases. Descriptive, univariate, and multivariate analyses were performed to explore the association of the H-index with sex, academic ranking, and subspecialty.

Results:

A total of 93 Saudi academic ophthalmologists were included in the study. Men comprised 77% of the academic positions and tended to have higher academic positions than women. The mean H-indices for men and women were 5.04±5.21 and 4.19±4.31, respectively (p=0.54). The mean H-indices of lecturers, assistant professors, associate professors, and professors were 1±0.1, 3.06±3, 7.7±68, and 10±10.25, respectively. The H-index had a positive correlation with a faculty appointment with an unadjusted beta coefficient for professors of 8.264 (95% CI, 5.967 to 10.560) (p<0.001). Ocular pathology and glaucoma were the highest in research productivity, with mean H-indices of 11±9.8 and 7.8±7.5, respectively. Compared with the most common specialties of the cornea and anterior segment, the H-index had a significantly positive correlation with glaucoma and ocular pathology subspecialties at 3.442 and 8.500 unadjusted beta coefficients, respectively (p=0.015 and p=0.004, respectively). The top three subspecialties with female underrepresentation were general ophthalmology, surgical retina, and glaucoma.

Conclusion:

This study provides insights into the research productivity of Saudi academic ophthalmologists. A high academic ranking was associated with high research productivity, as measured by the H-index. Gender variation was noted in the academic and subspecialty representations.

Keywords: Bibliometric analysis, H-index, Research, Ophthalmology, Subspecialty, Ophthalmologists.

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1. INTRODUCTION

Scientific research and laboratory studies play a crucial role in developing and advancing many science-related fields, besides medicine, especially in this era of advanced technology. In medicine, clinical research has been shown to improve healthcare outcomes in developed countries, including survival rates and quality of life for patients. Many governments and healthcare agencies provide sustained financial support for clinical research [1]. In academic

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medicine, research, productivity, and impact are crucial considerations for faculty members' assessment to receive awards and promotions [2].

The quality of research can be assessed through many bibliometric parameters, such as the H-index developed by Jorge Hirsch in 2005 [3]. According to Hirsch, "a researcher has an index h if h of his or her total papers (N_p) have at least h citations each" [3]. Hirsch reported that the H-index of 12 and 18 would be the standard value for promotion to associate professor and full professor, respectively. Thus, the H-index has been used as an important bibliometric parameter for academic promotion and awards among academic clinicians [2]. Similar studies have been conducted in other countries regarding research productivity among American and Canadian ophthalmologists [4, 5], and similar trends were observed in Saudi Arabia concerning Saudi plastic surgeons and Saudi neurosurgeons [6, 7].

Studies have shown that the percentage of women compared to men in ophthalmology is still lower than the percentages in other specialties, and the percentage of women in ophthalmology has decreased in recent years [8]. Women produce disproportionately fewer publications in areas where research is costly, such as high-energy physics, potentially due to funding allocation regulations and procedures. Women are less likely to participate in collaborative projects that result in publication and are far less likely to be identified as the first or last authors of research papers. There is no consensus on the causes of gender inequality in research output and collaboration. Probable factors may be bias, childbearing, or rearing [9]. The reasons for women's lower productivity must be identified, and measures must be devised to provide a fairer working environment for all physicians, regardless of gender [10].

A recent study conducted in Canada included data from 696 ophthalmologists. The mean H-indices for lecturers, assistants, associates, and full professors were 4.0±5.6, 5.6±5.0, 8.8±6.3, and 15±12, respectively. The H-index had a significant positive correlation with faculty appointments. Individuals with higher faculty appointments tended to have higher H-indices, but there was no significant difference in the mean H-index between lecturers and assistant professors. There was, however, a significant difference in the H-index between assistant and associate professors and associate and full professors [4]. Another research study on 366 full-time academic hand surgeons in the United States and Canada showed that the distribution of primary faculty appointments was in orthopedic surgery (70%) and plastic surgery (30%). They found that the mean H-index was 10.2±9.9 and was strongly correlated with academic rank and supposed that the H-index had high sensitivity and specificity for predicting academic rank [11]. Other researchers have investigated the relationship between the h, m, and e indices and academic rank for 2,061 academic orthopedic surgeons in the United States. Among 976 assistant professors, 504 associate professors, 461 professors, and 120 chairs, the mean h, m, and e indices increased with each academic rank [12]. For neurosurgeons working in the United Kingdom, the H-index was correlated with academic position, with a higher value for professor position [13]. Similarly, among academic otolaryngologists in the United States, the mean H-index increased through the rank of professor, from 4.31 for an assistant professor to 14.89 for a professor [14]. In Saudi Arabia, a study that focused on board-certified plastic surgeons scoring a mean index of 1.7 and publishing a mean of five articles found that more publications and a higher academic rank predicted a higher H-index [7]. However, little is known about Saudi academic ophthalmologists. Therefore, this study aimed to assess the scientific output of academic ophthalmologists in the Kingdom of Saudi Arabia in relation to the H-index, sex, subspecialty, and faculty appointments.

2. METHODS

This cross-sectional study was conducted in April 2022 using data extracted from publicly available sources. We identified all governmental and nongovernmental universities that encompass a college of medicine in Saudi Arabia. Academic ophthalmologists were identified from their respective university websites; some colleges did not mention the names of the academic ophthalmologists, and hence, we contacted them to obtain the information. Data related to academic ranks and subspecialties were identified through official universities' websites, linked-in profiles that contain their academic rank and subspecialty, social media platforms that contain the required data, and by direct contact with those whose data were not publicly available after obtaining their consent. Academic ophthalmologists were classified into four faculty appointment groups: (1) lecturers, (2) assistant professors, (3) associate professors, and (4) full professors. Individuals with adjunct positions in two or more programs were selected for their highest faculty appointment at one institution to eliminate duplicates. The following subspecialties were identified: (1) cornea and anterior segment, (2) glaucoma, (3) medical retina, (4) surgical retina, (5) oculoplasty, (6) ocular pathology, (7) ocular genetics, (8) pediatric and strabismus, (9) individuals with more than one subspecialty were assigned as double subspecialties, and (10) individuals who did not have a fellowship in ophthalmology subspecialties during the timeframe of the study conductance were assigned as general ophthalmology.

H-indices were collected from Scopus (www.scopus.com), Web of Science (www.webofknowledge.com), and Google Scholar accounts (https://scholar.google.com/), which were automatically assigned to each author in their archives. Most of the researchers have a similar H-index in these platforms. However, a few researchers have a slight difference in their H-index that did not exceed 2. The main factor that contributes to the noted difference is the coverage of published material by the three different citation databases; while Google Scholar includes on its H-index calculation citations in journals (both peer-reviewed and non-peer-reviewed), books, conference papers, and student theses, Scopus and Web of Science, take into account mainly their own database of published, peer-reviewed scientific articles, and only some books. In the present study, the highest H-index value among individuals with different H-index in the databases was considered. For individuals who did not have an assigned H-index in the above-mentioned databases, we manually calculated the approximate

H-index based on the total number of published papers and the citation for each paper in their respective ResearchGate accounts. The H-index was based on all papers published by each individual up to 2022. This study was approved by Standing Committee for Scientific Research, Jazan University (Ref#: REC-43/02/006).

2.1. Statistical Analysis

All statistical analyses were performed using SPSS v26. Descriptive analysis was used for the demographic data. Non-parametric analytical tools, such as the Mann−Whitney test for the differences in H-index between sexes and the Kruskal−Wallis test to compare the H-index across faculty rankings, were used. A multivariate linear regression model was used to explore the potential predictors of the H-index based on sex, academic ranking, and subspecialty. Statistical significance was set at 0.05. For ethical considerations, the collected information is already publicly available and used only for scientific purposes.

3. RESULTS

A total of 108 ophthalmologists were identified from about 29 colleges of medicine; 15 individuals were excluded for the following reasons: non-Saudi, unavailable data, or retired/resigned academic ophthalmologists (Table **1**). The majority of Saudi academic ophthalmologists were male (77.4%). The most prevalent subspecialties were the cornea and the anterior segment (38.7%), followed by retinal surgery. Most participants had an academic ranking of assistant professors (66%), whereas only 17% were full professors. The mean H-index was slightly higher for male Saudi academic ophthalmologists (5.04±5.21) than that for female Saudi academic ophthalmologists (4.19±4.31); however, the difference was statistically insignificant (p=0.54).

Table 1. Characteristics of Saudi academic ophthalmologists N (%).

Faculty Appointment (N= 93)	-
Lecturer	3 (3)
Assistant professor	61 (66)
Associate professor	13 (14)
Full professors	16 (17)
Subspecialty (N=93)	-
Cornea and anterior segment	36 (38.7)
Glaucoma	10 (10.8)
Medical retina	4 (4.3)
Oculoplasty	7 (7.5)
Double subspecialty	9 (9.7)
Surgical retina	11 (11.8)
Oculogenetics	1 (1.1)
Ocular pathology	2 (2.2)
Paediatric and strabismus	10 (10.8)
General ophthalmology	3 (3.2)
Gender (N=93)	-
Women	21 (22.6)
Men	72 (77.4)

Table 2. Predictors of H-index on the basis of gender, subspecialty, and faculty appointment.

		95% CI		
Predictor	**Unadjusted β Coefficient**	**Lower**	**Upper**	***P-value***
Intercept	3.054	0.57	5.54	0.017
Faculty Appointment	-	-	-	-
Lecturer	-0.568	-6.57	5.43	0.851
Associate professor	4.915	2.48	7.35	**< 0.001**
Full professors	8.264	5.97	10.56	**< 0.001**
Assistant professor	Reference	-	-	-
Subspecialty	-	-	-	-
Glaucoma	3.442	0.68	6.21	**0.015**
Medical retina	-0.277	-4.61	4.06	0.899
Oculoplasty	-0.183	-3.40	3.03	0.910
Double subspecialty	0.780	-2.09	3.65	0.590
Surgical retina	2.656	-0.03	5.35	0.053

(Table 2) contd.....

General ophthalmology	-0.568	-6.57	5.43	0.851
Oculogenetics	0.946	-7.11	9.00	0.816
Ocular pathology	8.500	2.83	14.17	**0.004**
Paediatric and strabismus	-3.219	-6.39	0.05	**0.047**
Cornea and anterior segment	Reference	-	-	-
Gender	-	-	-	-
Women	-1.108	-3.47	1.26	0.354
Men	Reference	-	-	-

Note: F-test (df) = 5.953 (79), P< 0.0001; R^2= 0.50.

Fig. (**1**) shows the relationship between sex and academic ranking among Saudi academic ophthalmologists. We found that 17.2% of the academic ophthalmologists were full professors (n=16), and the majority of them were male (n=14, 82.4%). Similarly, most Saudi associate professors of ophthalmology were males (n=10, 71.4%). Although the highest number of women was found within the group of assistant professors (n=16), they only constituted 24.4% of the ophthalmologists in that group. Male ophthalmologists tended to have a higher academic rank, but the difference was not statistically significant (*p*=0.64).

Fig. (**2**) shows the H index correlated with academic rank. The mean H index for lecturer, assistant professor, associate professor, and professor were 1, 3.06, 7.76, and 10, respectively. H index was found to have a significant correlation with academic ranking; individuals with high academic rank tend to have a high H index. A significant difference was observed in the Kruskal-Wallis test (P <0.001). A series of Mann-Whitney Tests were also performed to identify the significant differences. No significant difference was found in the mean H index between lecturer and assistant professor (P=0.09) and between associate professor and professor (P= 0.37). However, a significant difference was found when comparing the mean H index of a professor with the mean H index for an assistant professor and lecturer (P<0.001, P=0.007), respectively. Similarly, a significant difference was observed between the mean H index of an associate professor and the mean H index for an assistant professor and lecturer (P<0.001, P=0.008), respectively.

Fig. (**3**) shows the H-index for each subspecialty. Ocular pathology, glaucoma, and double subspecialty were the highest in research productivity, with an H-index of 11±9.8, 7.8±7.5, and 5.7±6.1, respectively. In contrast, general ophthalmology had the lowest, with a mean H-index of 1.

Fig. (**4**) shows gender in correlation with subspecialty among Saudi academic ophthalmologists. According to our data, most of the academic ophthalmologists were males constituting 77% (n=72), while females represented 23% (n=21). The top three subspecialties with the highest male representation were general ophthalmology, surgical retina, and glaucoma (100%, 90.9%, and 90%, respectively). On the other hand, the top three subspecialties with the highest female representation were ocular genetics, medical retina, and pediatric and strabismus (100%, 75%, and 70%, respectively).

As shown in Table **2**, the unadjusted beta coefficient for men as a predictor of the H-index was -1.108, with a 95% confidence interval (CI) of -3.471−1.255. However, this difference was not statistically significant (*p*=0.354). Three subspecialties, glaucoma, ocular pathology, and pediatric and strabismus, showed significant results compared to the most common specialty of the cornea and anterior segment. Glaucoma, ocular pathology, and pediatric and strabismus showed an unadjusted beta coefficient of 3.442 (95% CI 0.678–6.206; *p*=0.015), 8.5 (95%CI 2.832–14.170; *p*=0.004), and -3.219 (95%CI -6.387–-0.051; *p*=0.057), respectively. The negative beta coefficient for pediatric ophthalmology and strabismus indicated that the subspecialty was more likely to have a lower H-index than that of other subspecialties. The F-test, which assessed the model fit to the dataset, yielded 5.953 with 79 degrees of freedom, indicating a good fit that was statistically significant (*p*<0.001).

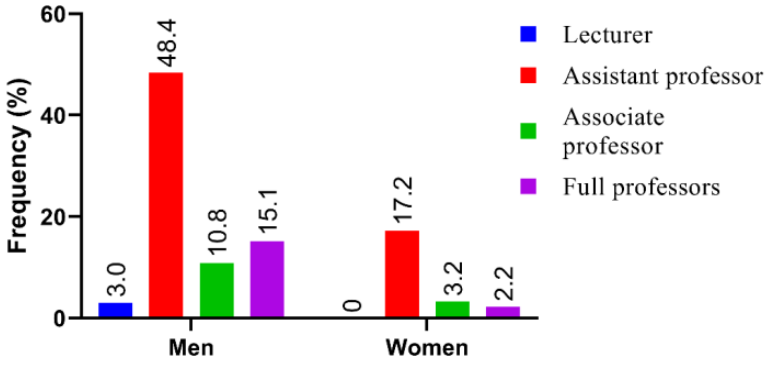

Fig. (1). Distribution of academic rank among genders (percentages out of total).

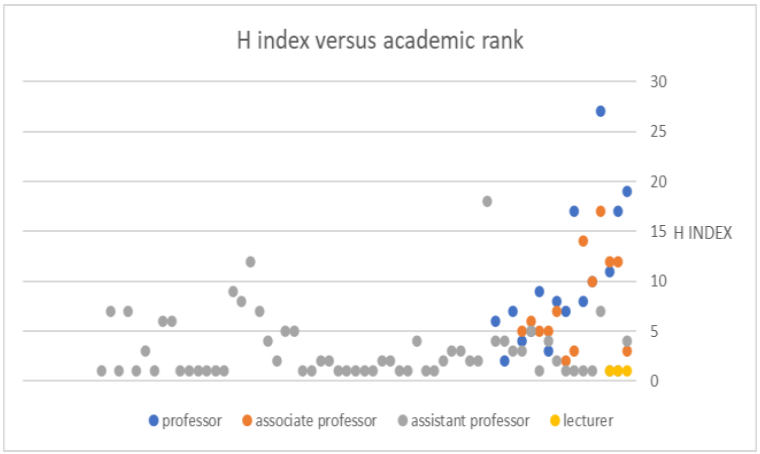

Fig. (2). H-index correlated with academic rank.

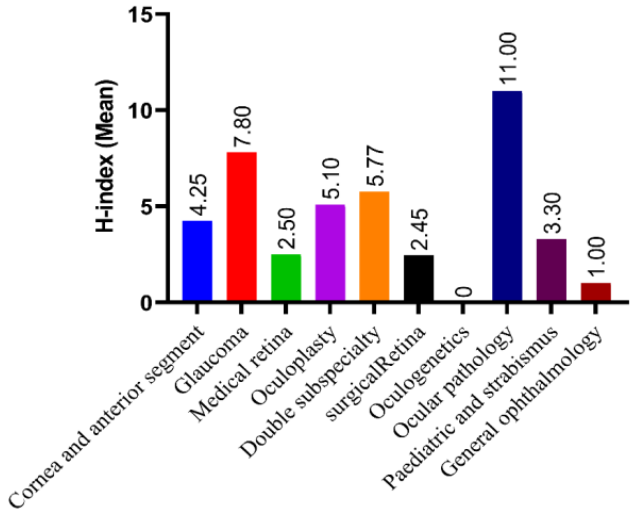

Fig. (3). H-index by subspecialty among the study participants (percentages out of total).

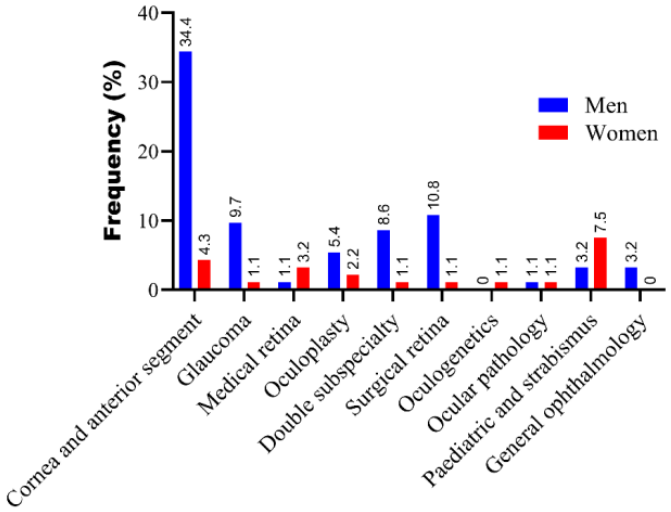

Fig. (4). Distribution of subspecialty by genders (percentages out of total).

4. DISCUSSION

To the best of our knowledge, this is the first study to compare the influence and productivity of academic ophthalmologists in Saudi Arabia. Our findings indicate a significant relationship between faculty appointment progression and H-index. This result is consistent with the research conducted by academic ophthalmologists in Canada

[4]. The statistically significant increase in the H-index from assistant to full professors found in our study is consistent with the findings of Lopez *et al*. [15] and Tanya *et al.* [4]. In our study, we found a tendency for higher H-indices to be related to the male sex. Several studies on Canadian academic ophthalmologists have shown a significant association between a higher H-index and male researchers [4]. This is a measurable indicator that is objective and simple to calculate. This may be useful as a supplement to evaluate research productivity, a crucial element in academic ophthalmology for promotion.

According to a comprehensive analysis of research productivity in academic societies, there were no gender differences at the associate or full professor level. However, gender inequalities in the H-index tended to disappear as academic rank increased [16]. Our results showed that among 93 academic ophthalmologists, 72 (77.4%) were men and 21 (22.6%) were women, indicating fewer women representation among academic ophthalmologists. Similar observations have been made in Canada, where women comprise 27% of academic ophthalmologists. Prior studies reported that in 2011, women comprised 20.5% of all practicing ophthalmologists, an improvement from 3.1% in 1970 [17].

According to faculty appointments, women had a less representative percentage in this study across all academic ranks. In comparison with another study, it was found that men were more likely to have more faculty appointments than women (p=0.007). There was a greater representation of men with increasing university rank [4]. Our study also showed the underrepresentation of women in academic ophthalmology with a wider gap in senior faculty positions; a quarter of the assistant professors were women. Similarly, women were dramatically underrepresented in the academic surgical retina, comprising only 9% of the faculty members. Potential reasons for this degree of gender disparity include "extra years of training, more emergency calls, and less predictable schedules," which differentiate the surgical retina from other subspecialties in ophthalmology [18].

The results of the present study are in agreement with those of Canadian and American studies, which also included eleven subspecialties [4, 5]. The top three subspecialties were cornea and anterior segment (38.7%), retina surgery (11.8%), and glaucoma (10.8%). These findings were consistent with those of a Canadian study, which reported that the top three subspecialties were comprehensive (27%), anterior segment and cornea (14%), and glaucoma and retina surgery (13%) [4]. However, our findings contradicted the findings of an American study [5], which reported that the top three subspecialties were vitreoretinal (22%), cornea and external disease (16%), and comprehensive (15%). The least subspecialty in our study was oculogenetics medical retina (1%) compared to low vision (1%) and ocular oncology (1%) in the Canadian and American studies, respectively.

Our study revealed that general ophthalmology, surgical retina, and glaucoma represented the highest male representation (100%, 90.9%, and 90%, respectively). This result was similar, in part, to Tanya *et al*. [4], who reported retinal surgery (93%) as the top subspecialty among male participants, followed by retinal medical (79%) and oculoplasty (76%). Compared to the oculogenetics subspecialty, where males were not identified, the least subspecialty was the retina medical and ocular pathology compared to the least subspecialty (uveitis and low vision) reported by the Canadian study, in terms of male individuals [4].

Concerning the top subspecialties among the female sex, our study revealed that ocular genetics, medical retina, and pediatric and strabismus were the highest in females, representing 100%, 75%, and 70%, respectively. However, this result contrasted with that of Tanya *et al*. [4], who reported that the top three subspecialties with the greatest representation of women were uveitis (55%), low vision (50%), and neuro-ophthalmology (46%). The subspecialty in which women were not identified in our study was general ophthalmology. The least common subspecialties were double subspecialty and retinal surgery compared to the Canadian study, where the least common subspecialty was retinal surgery [4].

Ten subspecialties were included in our study, with a mean H-index of 4.85. This result, compared to other studies, was in accordance with the findings reported by Tanya *et al*. [4] (mean H-index ranged from 4.5 to 16.7) but contradicted with results reported by Thiessen *et al*. [5], who reported that the mean H-index was 10.56. Our results revealed that the H-indices were higher in the glaucoma subspecialty compared to Canadian and American studies, where higher H-indices were reported in the ocular oncology subspecialty.

CONCLUSION

A significant correlation was found between increased faculty appointments and research production and impact. We observed a pattern of sex differences in H-index-measured productivity. Significant sex differences in faculty appointments were also apparent, with fewer women practicing academic ophthalmology.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by Standing Committee for Scientific Research, Jazan University (Ref#: REC-43/02/006).

HUMAN AND ANIMAL RIGHTS

No animals were used in the studies that are the basis of this research. All the humans were used in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2013 (http://ethics.iit.edu/ecodes/node/3931).

CONSENT FOR PUBLICATION

Data related to academic ranks and subspecialties were identified through official universities' websites, linked-in profiles that contain their academic rank and subspecialty, social media platforms that contain the required data, and by direct contact with those whose data were not publicly available after obtaining their consent.

STANDARDS OF REPORTING

STROBE guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

The data supporting the findings of the article is available publicly.

FUNDING

None.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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Declared none.

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