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Academic benchmark of highly influential ophthalmologists listed in the ophthalmology power list

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OBJECTIVE: To review the academic benchmark of highly influential ophthalmologists listed in the ophthalmology '2020 Power List'.

METHODS: In this cross-sectional study, the academic profiles, achievements, and bibliometric profiles of all ophthalmologists listed in the 'Power List of 2020', regarded as the most influential figures in ophthalmology today, were analysed.

RESULTS: Ninety-five ophthalmologists were studied, after excluding 10 non-ophthalmologist figures that are also listed. Their mean age is 63 ± 11.7 years, with a strong male predominance (84.2%, $n = 80$ males, $P < 0.001$). All have a medical doctorate degree, and 31% ($n = 29$) have a Philosophy Doctor (PhD) degree. Fifty-three percent ($n = 51$) are graduates of medical schools in the United States (US). However, non-US ophthalmologists have a higher percentage of PhD degrees (41%, 18/44) vs. US ophthalmologists (22%, 11/51, $P = 0.069$), and also a longer duration of post-residency training (5.8 ± 3.1 vs. 1.8 ± 0.9 years, $P < 0.001$). The most common subspecialty was cataract and anterior segment surgery (42%, $n = 40$). The mean and standard deviation of the total number of papers published by ophthalmologists were 307.4 ± 226.3, with a mean citation record of 11,835.7 ± 13,330.5, and a mean h-index of 46.9 ± 27.9.

CONCLUSIONS: The ophthalmologists listed on the 'Power List of 2020' are leaders with high accomplishments and an established interest in research evidenced by a high record of publications and an exceptional bibliometric profile. The list contains more US figures with a gender disparity, demonstrating a greater difficulty for international ophthalmologists, especially women, in achieving this high level of recognition.

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INTRODUCTION

Every year, the 'Ophthalmologist' journal publishes a list of approximately 100 of the most influential worldwide figures in ophthalmology. These figures are considered to have the greatest present impact in ophthalmology and appearing on such a prestigious list is highly coveted. The candidates are nominated by the readers of the magazine and are then selected by the magazine's committee. The top ten most influential ophthalmologists are ranked, while the remainder are listed in alphabetical order. Many factors are required in order to be listed in such a prestigious group, including academic achievements, industrial ties and impact, and international recognition of the importance of one's work and contribution to ophthalmology advancement.

Previous studies of influential ophthalmology figures have primarily focused on the academic profile and achievements of academic department leaders in the United States (US), describing their demographics, educational background, field of interest, and academic productivity [1]; however, to the best of our knowledge, none have assessed these characteristics in highly selected international ophthalmologists, who are considered to be the most influential in ophthalmology today. In our study, we attempted to bridge this gap by providing a snapshot of one's achievements required to be listed in such a prestigious professional list.

METHODS

A cross-sectional study analysing all the ophthalmologists listed in the 'Ophthalmology Power List' was published in the ophthalmologist journal in March 2020, analysing their demographics, educational background, professional training, academic appointments, research achievements, and bibliometric profiles. Ninety-five ophthalmologists were analysed following the exclusion of 10 non-ophthalmologists appearing on the list. The study was exempt from IRB approval as it collected only non-restricted publicly available data.

Information on each individual was then retrieved from freely available online sources, including programs' websites and newsletters, and web posted curriculum vitae. The Google database engine was searched for data in the English language between the years 1995 and 2020. The information collected on each individual included: gender, medical school attended and graduation year, additional academic graduate degrees earned, residency and fellowship programs completed, subspecialty practiced, and academic appointment. Scholarly activity data were collected using Harzing, A.W. (2007) Publish or Perish software (www.harzing.com, London. United Kingdom) that retrieves and analyses academic citations from external data sources, including Google Scholar,

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which was used for data collection in this study. The data were incorporated into an Excel spreadsheet (Microsoft, Inc., Seattle, WA). Data collected and analysed via the Publish or Perish software included the total number of papers published, number of citations, h-index, contemporary h-index (hc-index), age-weighted citation rate (AWCR), and multi-authored h-index (hm-index). These bibliometric markers have been previously described and are currently accepted as indicators of the importance of one's academic work. In brief, the h-index reflects the number of papers a person has co-authored, that were cited in the medical literature at least h times [2]. The contemporary h-index (hc-index) adds time relevancy, giving less impotence to older publications [3]. The AWCR, measures the average number of citations of an entire academic output, adjusted for the age of each manuscript [4]. The hm-index is determined in analogy to the h-index, but it is calculated by counting the papers fractionally according to the number of authors, for example, only one quarter for four authors [5].

Statistical analysis

Statistical analysis was conducted using Prism version 7 (GraphPad Software, San Diego) and R version 3.4.2 (R Development Core Team 2017). Descriptive statistics are provided, mostly describing the mean and standard deviation of each category. Comparison of groups was performed using the Analyses of Variance (ANOVA) statistical test, and Fisher's exact test was used for analysis of grouped nominal variables. All statistical tests used were two-tailed, and statistical significance was defined as a P value below 0.05.

RESULTS

Overall, 95 ophthalmologists (mean age 63 ± 11.7 years) were analysed. There is a strong male predominance (84.2%, $n = 80$, $P < 0.001$), and male ophthalmologists are significantly older than female ophthalmologists on the list (63.5 ± 11.7 compared with 55.5 ± 9.84 years, $P = 0.035$). Gender differences in all parameters are presented in Table 1.

Education and training

Fifty-three percent ($n = 51$) of ophthalmologists listed are graduates of US medical schools and 47% ($n = 44$) are international medical school graduates ($P = 0.558$), most commonly from the United Kingdom ($n = 19$), Germany ($n = 4$), and China ($n = 3$). The top three universities attended are Harvard Medical School, 12% ($n = 11$), Johns Hopkins University School of Medicine, 6% ($n = 6$), and the University of London, 6%, ($n = 6$). Thirty-one percent ($n = 29$) have a Philosophy Doctor (PhD) degree and 11% ($n = 10$) have a Master's degree in addition to having a medical doctor (MD) degree. The proportion of physicians having a PhD degree is higher among non-US ophthalmologists (41%, $n = 18$) compared with US graduates (22%, $n = 11$, $P = 0.047$). However, there was no gender difference in PhD degrees earned by men (30%, $n = 24$) and women (33%, $n = 5$, $P = 0.768$). Differences in the achievements of US and non-US figures are presented in Table 2.

Subspecialty and position

Fifty-five percent ($n = 48$) are graduates of a US residency program, most commonly from Massachusetts Eye and Ear Infirmary (6%, $n = 6$), and Wills Eye Hospital (6%, $n = 6$). Eighty-four percent ($n = 80$) completed a fellowship program, most commonly at Bascom Palmer Eye Institute (10%, $n = 9$), Wilmer Eye Institute (7%, $n = 7$), and Wills Eye Hospital (7%, $n = 7$). Fifty-four percent ($n = 54$) did a clinical fellowship, 24% ($n = 23$) both clinical and research fellowships, and 3% ($n = 3$) a research fellowship. The most common clinical fields of training are cataract and anterior segment surgery (42%, $n = 40$), glaucoma (26%, $n = 25$), and medical retina (19%, $n = 18$, Table 3). Overall, the mean duration of post-residency training is 3.3 ± 2.8 years. However, non-US ophthalmologists have longer post-residency training (5.8 ± 3.1 years) compared with US graduates (1.8 ± 0.9 years, $P < 0.001$). There are no gender differences in the duration of post-residency training (males 3.1 ± 2.4 vs. females 4.3 ± 4.3 years, $P = 0.3$).

Academic appointment

Eighty-four point two percent ($n = 80$) of listed ophthalmologists are full professors, 5% ($n = 5$) are associate professors, 2% ($n = 2$) are assistant professors, and one is a presidential professor. Fifty-two percent ($n = 50$) are members of a scientific journal's editorial board, with 15% ($n = 14$) serving as editors-in-chief. Interestingly, only one woman is an editor-in-chief compared with 13 men ($P < 0.001$, two proportions test).

Academic productivity

The mean number of papers published by ophthalmologists on the list is 307.4 ± 226.3, with a mean citation record of $11{,}835.7 \pm 13{,}330.5$. The mean h-index of these individuals is 46.9 ± 27.9, the mean hc-index is 27.9 ± 14.5, the mean AWCR is 1090.8 ± 1075.9, and the mean hm-index is 23.27 ± 14.9. The number of papers published, citation record, h-index, hc-index, AWCR, and hm-index of males and females, as well as the US and non-US ophthalmologists, are similar (Tables 4 and 5).

DISCUSSION

This study analysed the gender, demographics, academic background, and research achievements of the present 95 most influential ophthalmology figures as described in the '2020 Ophthalmology Power List', the only existing list that ranks ophthalmologists by their impact on the field of ophthalmology today, demonstrating a greater representation of US and male figures. Previous studies mostly examined the academic profiles and achievements of US ophthalmology leaders [1]. To the best of our knowledge, this is the first international study that focuses on the question: what does it take to become a worldwide influential figure in the field of ophthalmology today?

It is clear that these people dedicate substantial effort and time to innovative research, as evidenced by a remarkable number of publications that are widely cited, resulting in an extremely high h-index (46.7). For comparison, the h index of US ophthalmology department chairs is 24 and their average publication number is 108 [1], reflecting the exceptional impact listed ophthalmologists have on innovative research.

Another example of a higher interest in academic research is the rate of PhD degree holders, which is 31% among listed ophthalmologists compared with 8% of US academic department chairs [1]. Another demonstration of the high recognition given to these individuals is that the majority of them are editorial board members, including 15% who are editors in chief. All these parameters indicate that in order to become a great influence in the ophthalmology field, one needs to achieve a high level of scientific accomplishment. Furthermore, the vast majority of the figures on the list have a surgical subspecialty, and many of them have multiple subspecialties. A similar trend has been shown in plastic surgery [6] and neurological and orthopaedic surgery [7]. It seems that a combination of clinical and scientific high achievements is needed in order to become such an influential ophthalmologist in present times.

Gender inequality has been described previously as one of the most challenging issues in health and scientific fields in our time [8–11]. In our study, we demonstrated that a male predominance also exists among leading worldwide ophthalmologists, as 84% of the listed persons are men. Interestingly, female ophthalmology leaders are significantly younger, which is possibly the result of the general trend of more female physicians entering ophthalmology in recent years. It can be hoped that as time passes, the proportion of females joining the list will increase, especially since there was no gender difference in the bibliometric profile of lised individuals. A male predominance was also found in the number

Table 1. Gender differences in the achievements of the most influential ophthalmology figures in 2020.

		Female	Male	*P* value
No.		15	80	
USA (%)	No	5 (33.3)	39 (48.8)	0.414
	Yes	10 (66.7)	41 (51.2)	
Sex (%)	Female	15 (100.0)	0 (0.0)	<0.001
	Male	0 (0.0)	80 (100.0)	
Masters (%)	No	(13 86.7)	72 (90.0)	1
	Yes	2 (13.3)	8 (10.0)	
PhD (%)	No	10 (66.7)	56 (70.0)	1
	yes	5 (33.3)	24 (30.0)	
Position (%)	Chairperson/chief	3 (20.0)	36 (45.0)	0.026
	Vice chair	0 (0.0)	5 (6.2)	
	Program director	4 (26.7)	4 (5.0)	
	Service director	3 (20.0)	6 (7.5)	
	Consultant	5 (33.3)	25 (31.2)	
	Research or industry positions only	0 (0.0)	4 (5.0)	
Subspecialty (%)	Cataract and anterior segment surgery	2 (15.4)	21 (28.4)	0.085
	Cornea and external eye disease	1 (7.7)	11 (14.9)	
	Corneal surgery	0 (0.0)	2 (2.8)	
	Glaucoma	0 (0.0)	19 (25.7)	
	Medical retina	7 (53.9)	11 (14.9)	
	Neuro-ophthalmology	0 (0.0)	1 (1.4)	
	Ocular oncology	1 (7.7)	1 (1.4)	
	Uveitis	0 (0.0)	1 (1.4)	
	Vitreoretinal surgery	2 (15.4)	8 (10.9)	
Second subspecialty (%)	Cataract and anterior segment surgery	1 (33.3)	13 (46.4)	0.92
	Cornea and external eye disease	0 (0.0)	3 (10.7)	
	Corneal surgery	0 (0.0)	1 (3.6)	
	Glaucoma	1 (33.3)	6 (21.5)	
	Ocular oncology	0 (0.0)	2 (7.2)	
	Uveitis	0 (0.0)	1 (3.6)	
	Vitreoretinal surgery	1 (33.3)	2 (7.1)	
Third subspecialty (%)	Cataract and anterior segment surgery	0 (0.0)	3 (60.0)	N/A
	Neuro-ophthalmology	0 (0.0)	1 (20.0)	
	Uveitis	0 (0.0)	1 (20.0)	
Academic appointment (%)	Assistant professor	1 (7.7)	1 (1.3)	0.006
	Associate professor	2 (15.4)	3 (4.0)	
	Presidential professor	0 (0.0)	1 (1.3)	
	Professor	10 (76.9)	70 (93.3)	

No. number, *N/A* not applicable.

of full professors (93.3% of males compared with 76.9% of females), a trend that was demonstrated in other medical fields as well [12–14]. Furthermore, only one woman was editor-in-chief of a scientific journal, compared with 13 males appearing on the list. Without doubt, these differences emphasize the lack of parity in rank and leadership by gender in medicine, indicating that more work is needed to achieve the desired goal of gender equality in the higher-level positions in ophthalmology.

The study demonstrated that 54% of the ophthalmologist leaders on the list graduated from US medical schools. The two medical schools attended by the greatest number of leaders were Harvard Medical School (11.6%) and the Johns Hopkins University School of Medicine (6.3%). Interestingly, these two institutions were the top two US medical schools in 2021, according to the US News ranking [15]. The three fellowship programs training the largest number of leaders were the Bascom Palmer Eye Institute (9.5%), the Wilmer Eye Institute (7.4%) and the Wills Eye Hospital (7.4%). Leaders in other fields of medicine also frequently attend these medical schools and affiliated hospitals. Our study identified several geographic differences. Non-US individuals had a higher proportion of obtaining a PhD degree (41% vs. 22%) and also had a longer duration of post-residency training (5.8 ± 3.1 years versus 1.8 ± 0.9 years), indicating that a higher educational investment is needed from international ophthalmologists in order to achieve recognition as an ophthalmology global leader. However, there were no differences in the total number of papers published, citations, h-index, hc-index, AWCR, and hm-index between US and non-US graduates, further emphasizing that the same amount of

Table 2. Differences in the achievements of US and non-US most influential ophthalmology figures in 2020.

USA graduates		No.	Yes	*P* value
No.		44	51	
US (%)	No	44 (100.0)	0 (0.0)	<0.001
	Yes	0 (0.0)	51 (100.0)	
Sex (%)	Female	5 (11.4)	10 (19.6)	0.414
	Male	39 (88.6)	41 (80.4)	
Masters (%)	No	38 (86.4)	47 (92.2)	0.56
	Yes	6 (13.6)	4 (7.8)	
PhD (%)	No	26 (59.1)	40 (78.4)	0.069
	yes	18 (40.9)	11 (21.6)	
Position (%)	Chairperson/chief	19 (43.2)	20 (39.2)	0.329
	Vice chair	2 (4.5)	3 (5.9)	
	Program director	1 (2.3)	7 (13.7)	
	Service director	3 (6.8)	6 (11.8)	
	Consultant	17 (38.6)	13 (25.5)	
	Research or industry positions only	2 (4.5)	2 (3.9)	
Subspecialty (%)	Cataract and anterior segment surgery	12 (30.0)	11 (23.4)	0.631
	Cornea and external eye disease	5 (12.5)	7 (14.9)	
	Corneal surgery	2 (5)	0 (0.0)	
	Glaucoma	8 (20.0)	11 (23.4)	
	Medical retina	8 (20.0)	10 (21.2)	
	Neuro-ophthalmology	1 (2.5)	0 (0.0)	
	Ocular oncology	1 (2.5)	1 (2.1)	
	Uveitis	1 (2.5)	0 (0.0)	
	Vitreoretinal surgery	2 (5.0)	7 (14.9)	
Second subspecialty (%)	Cataract and anterior segment surgery	9 (56.2)	5 (33.3)	0.56
	Cornea and external eye disease	2 (12.5)	1 (6.7)	
	Corneal surgery	0 (0.0)	1 (6.7)	
	Glaucoma	3 (18.8)	4 (26.7)	
	Ocular oncology	0 (0.0)	2 (13.4)	
	Uveitis	1 (6.2)	0 (0.0)	
	Vitreoretinal surgery	1 (6.2)	2 (13.3)	
Third subspecialty (%)	Cataract and anterior segment surgery	2 (50.0)	1 (100.0)	0.659
	Neuro-ophthalmology	1 (25.0)	0 (0.0)	
	Uveitis	1 (25.0)	0 (0.0)	
Academic appointment (%)	Assistant professor	1 (2.5)	1 (2.1)	0.544
	Associate professor	2 (5.0)	3 (6.3)	
	Presidential professor	0 (0.0)	1 (2.1)	
	Professor	37 (92.5)	43 (89.6)	

No. number, *US* United States.

Table 3. Subspecialties of the most influential ophthalmology figures in 2020.

Subspecialty	No.
Cataract and anterior segment surgery	40
Glaucoma	25
Medical retina	18
Cornea and external eye disease	16
Vitreoretinal surgery	13
Ocular oncology	4
Corneal surgery	3
Uveitis	3
Neuro-ophthalmology	2

scientific productivity is required in order to make a great impact on the ophthalmology world today and be listed as the 100 most influential figures in this field.

The male and US predominance on the list could be explained by socio-political reasons that affect research across scientific fields, including gender differences in research output and collaboration. Women tend to publish fewer articles, are less likely to participate in collaborations that lead to publication, and are far less likely to be listed as either first or last author on a paper compared to their male colleagues [16, 17]. This could be attributable to bias, childbearing, lower acceptability of funds, or other variables. The US is one of the most prolific nations when it comes to scientific publications. Studies in the field of Ophthalmology have demonstrated that papers affiliated with the US were associated with publication in journals with a higher impact factor, higher publication rate, and shorter publication time

Table 4. Comparison of academic productivity measurements of male vs. female ophthalmologists appearing on the 2020 power list.

Academic productivity measurement, mean (standard deviation)	Female	Male	*P* value
Total number of papers published	293.87 (266.75)	308.50 (218.50)	0.819
Citations	10298.53 (13932.26)	12110.89 (13189.91)	0.629
Years	26.07 (10.02)	37.10 (14.34)	0.005
h-index	40.53 (29.95)	48.20 (27.29)	0.328
hc-index	27.13 (15.41)	28.34 (14.29)	0.768
AWCR	1124.72 (1227.43)	1094.22 (1044.46)	0.92
hm-index	19.42 (16.16)	23.95 (14.52)	0.279

Hc-index Contemporary h-index, *AWCR* Age-weighted citation rate.

Table 5. Academic productivity measurement of US vs. non-US most influential ophthalmology figures in 2020.

Academic productivity measurement, mean (standard deviation)	US graduates	non-US graduates	*P* value
Total number of papers published	299.41 (194.29)	312.04 (250.74)	0.787
Citations	9755.89 (8808.68)	13609.61 (16009.77)	0.159
Years	34.05 (13.85)	36.49 (14.70)	0.409
h-index	45.25 (21.62)	48.49 (32.19)	0.573
hc-index	28.14 (10.91)	28.16 (16.95)	0.995
AWCR	989.42 (777.80)	1193.60 (1267.18)	0.356
hm-index	22.36 (11.90)	23.99 (16.98)	0.594

US united states, *hc-index* Contemporary h-index, *AWCR* Age-weighted citation rate.

[18, 19]. This could explain why the majority of leaders on this list of highly achieving scientific figures are from the US.

Limitations of this study include reliance on program websites and newsletters, as well as the AAO members' directory and the online curriculum vitae websites, which may not be fully updated. The list of ophthalmologists studied was based on a single source, using the 'Power List of 2020', that may not include other influential figures in ophthalmology. Additionally, we based our study on publicly available information, excluding other important elements of leadership such as industry ties, generating income, and innovations in patient care and surgical technique.

In conclusion, recognition as an influential figure in ophthalmology requires tremendous work with an established record in research. The list demonstrated geographical and gender disparity, containing a higher number of US males than females. It can be hoped that in future years, these disparities will narrow until they disappear completely.

SUMMARY

What was known before

- Previous studies of influential ophthalmology figures have primarily focused on the academic profile and achievements of academic department leaders in the United States. However, to the best of our knowledge, none have assessed these characteristics in highly selected international ophthalmologists.

What this study adds

- This original article demonstrates that the ophthalmologists listed on the Power List of 2020 who are considered to be the most influential in ophthalmology today are leaders with high accomplishments and an established interest in research evidenced by a high record of publications, and exceptional bibliometric profile. The list contains more US figures, with a gender disparity, demonstrating a greater difficulty for international ophthalmologists, especially women in achieving this high level of recognition.

DATA AVAILABILITY

The datasets generated during the current study are available from the corresponding author on reasonable request.

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AUTHOR CONTRIBUTIONS

RS collected, cleaned, analysed the data and drafted and revised the paper, AT wrote the statistical analysis plan, EB collected and analysed the data, EZ collected and analysed the data, AG-designed data collection tools and revised the paper. GD initiated the project, designed data collection tools, analysed the data and drafted and revised the paper.

COMPETING INTERESTS

The authors declare no competing interests.

ADDITIONAL INFORMATION

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