Medical Hypothesis, Discovery & Innovation
Ophthalmology Journal

Original Article

Demographic correlations for 100 most-cited authors in ophthalmic research; a bibliometric study

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ABSTRACT

Background: To analyze the academic characteristics, career trajectory, scholarly publications, and demographic background of the 100 most-cited authors in ophthalmic literature.

Methods: In this observational cross-sectional study, a database containing every ophthalmology journal article from 1967 to 2018 was built using Scopus journal article information. The 100 authors with the most citations were identified, along with a control group of authors with at least five publications. Information about each author, such as gender, institution, and educational degrees were found from online web searches. Intra- and inter-group analyses were performed to identify correlations that may lead to having a high level of impact in ophthalmology literature.

Results: Of the 100 most-cited ophthalmologists, 56 practice in the United States (US) and only 12 are female. In an odds ratio (OR) analysis, highly-cited researchers more often lived in the US (OR, 2.97; $P < 0.001$), were male (OR, 2.4; $P = 0.02$), and graduated from an elite medical school (OR, 3.89; $P = 0.02$) and/or residency (OR, 3.67; $P = 0.02$), but were not from an undergraduate institution ($P = 0.75$). There was no difference in citation numbers between different ophthalmology subspecialties ($P = 0.22$) or advanced degrees (PhD, MPH in addition to MD). Women among the top-100-cited authors were more likely to author high impact journal articles ($P < 0.05$).

Conclusions: Among highly-cited ophthalmologists, practicing in the US and attending a top medical school or residency program may provide training for a successful research career in ophthalmology. Additionally, top female ophthalmologists participate in more influential research.

KEY WORDS

bibliometrics, ophthalmology, scholarly Impact, research productivity, visual science, optometry, scientific output

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How to cite this article: Clarke C, Smith ER, Wilde D, Doss B, Bodily R, Singer M. Demographic correlations for 100 most-cited authors in ophthalmic research; a bibliometric study. Med Hypothesis Discov Innov Ophthalmol. 2020 Winter; 9(4): 215-220.

DOI: https://doi.org/10.51329/mehdiophthal1408

INTRODUCTION

The impact of a career in ophthalmic research is based on a series of decisions. These include selecting a medical school and residency program, choosing between academic and private practice, whether to pursue fellowship training and/or additional advanced degrees such as a Master of Public Health (MPH), Master of Business Administration (MBA), or Doctor of Philosophy (PhD). These options can be instrumental in facilitating a fruitful academic career [1-4]. Previous studies have described the characteristics of American ophthalmology residency program directors [1], department chairs [2], and clinician-scientists receiving National Institute of Health (NIH) grants [3]. Gershoni et al. investigated the impact of subspecialty choice on research productivity, indicating uveitis as the highest field of interest and cataracts as the least [4]. However, it is unknown how other factors, such as prestige of clinical training, gender, and educational training toward advanced degrees, among others, correlate with overall research productivity in ophthalmology.

It is important for aspiring researchers to have accurate information on how these decisions may affect their future academic influence. More successful research productivity may translate into augmented grant funding, career promotion, and prestige [3]. To answer these questions, we developed a database including 115,091 peer-reviewed articles published in ophthalmology journals over more than 50 years. This study focused on the 100 most -cited researchers in our database to highlight correlations in researchers' careers, which may lead to a high level of impact in the field of ophthalmology.

METHODS

In this observational cross-sectional study, a Python script was used to search Elsevier's Scopus [5], the largest repository of peer-reviewed literature online, and compile a database of every journal article published from 1967 to 2018 in one of the top-50 ophthalmology journals, as identified by SCImago Journal ranking [6]. Due to Scopus's formatting limitations, the *Annals of Ophthalmology and Visual Sciences* were excluded. Authors were sorted according to the total number of citations, and the top-100 most-cited authors were selected for further analysis. A control group of 100 authors with at least five publications was selected using a random number generator from Microsoft Excel Version 2008 (Microsoft Inc., Redmond, WA, USA).

Three research assistants used Internet search engines to find a researcher' s curriculum vitae (CV) and demographic information, gender, country of practice and origin, degrees obtained (MD, PhD, MPH, *etc.*), university/college, medical school, residency, fellowship programs, practice type, and current academic rank. These CVs were readily available on academic websites as well as biographies posted on research profiles. For researchers trained in the United States (US), each university and medical school was ranked according to the 2018 US News and World Report rankings [6]. Residency programs were ranked as "elite" if they were found in the top-25 rankings on Doximity, Inc. (San Francisco, CA, USA) rankings on research productivity [7]. Although these rankings fluctuated during our sample period, we thought that the general tier of each program remained relatively stable and could be evaluated over time. The chi-square test was used to compare the control group to the top-100 researchers using IBM SPSS statistics for Windows version 25.0 (IBM Corp., Armonk, NY, USA).

To understand the careers of the top-100 researchers further, a model was created to account for differences in career length, as some researchers in our study first published in 1970 and others in 2010. This time series forecast projected total citations to 50 years from the year of each researcher's first publication and was conducted using IBM SPSS Statistics for Windows, version 25. A researcher's total number of citations at years 0, 5, 10, 20, 30, 40, and 50 were selected for time series analysis. The rest of the statistical analysis was conducted with STATA 14.2 (StataCorp LP, College Station, TX, USA). The Shapiro–Wilk test was performed for each year of analysis, and all years were found to lack normal distribution. The means for each variable at the year of analysis were provided by the Browne–Forsythe test and recorded. A Kruskal–Wallis test was performed to compare the distribution of the total number of citations for each variable. Spearman's rank correlation was used to analyze the matriculation year. Statistical significance was set at $P < 0.05$.

RESULTS

The Scopus database contained 49 ophthalmology-centric journals with 115,091 articles from 162,699 unique authors published over the 51 years between 1967 and 2018. The top-100 researchers by total citation count (Table 1) were more likely to work in the US (n = 56) than in Europe (n = 33) or Asia (n = 11) (Figure 1). Only 12 of the top-100 researchers were women. Two of the researchers did not have a medical degree (MD or DO); 39 had a PhD, while five had an MPH. Twenty investigators had a dual MD/PhD degree. Five ophthalmologists were currently working in private practice, and 20 were listed as department chairs based on their CV. In terms of researchers' educational backgrounds, 21 had graduated from a leading university, 28 from a top-tier medical school, and 32 from an elite residency program.

An odds ratio (OR) analysis comparison between the top-100 most-cited authors and a control sample of 100 random authors found that males (OR, 2.44) and physicians practicing in the US (OR, 2.97) were more likely to publish highly cited research ($P < 0.05$) (Table 2). An intragroup comparison of only US based researchers showed that authors who attended elite medical schools (OR, 3.89) and residency programs (OR, 3.67) were more likely to be in the top-100 list ($P < 0.05$). Highly cited authors were significantly more likely to have an MPH degree ($P = 0.01$) and less likely to be in private clinical practice ($P = 0.05$). The top-100 authors had significantly more last authorship throughout their careers ($P < 0.01$). Last authorship was also more common for male and US researchers ($P < 0.01$). There was no significant difference between matriculation years in graduate school between the control and the top-100 authors ($P = 0.98$). Looking at the first 5 years after the first publication, we found that the top-100 most-cited researchers were more likely to have a last authorship than our control researchers ($P < 0.01$), but the control had higher rates of first authorship ($P = 0.05$). Further analysis was performed on the top-100 researchers. After modeling the trajectory of total citations in the top-100, we found that earning a medical degree was associated with more citations at years 40 and 50 ($P = 0.02$ and 0.03, respectively). There were no statistically significant associations prior to year 40 (0, 5, 10, 20, and 30; $P = 0.13$, 0.09, 0.39, 0.53, and 0.18). A PhD had an opposite trend (Year 0, 5, 10, 20, and 30; P values = 0.02, 0.03, 0.01, 0.14, and 0.26). These researchers were more likely to publish high-impact materials early in their careers, with more citations at years 0, 5, and 10 (P values = 0.02, 0.04, and 0.01, respectively) than later. Earning an MPH also correlated with increased citations earlier in an author's career, with significantly more citations found at years 5, 10, and 20 (P values = 0.03, 0.03, and 0.03, respectively). However, by year 30, there was no statistically significant difference in citation numbers between these authors and the rest of the group ($P = 0.09$). The matriculation year was positively associated with more citations at years 5, 10, 20, 30, and 40 (P values = 0.02, 0.0001, < 0.001, < 0.001, and 0.02, respectively), and a career later in the study period was associated with more citations.

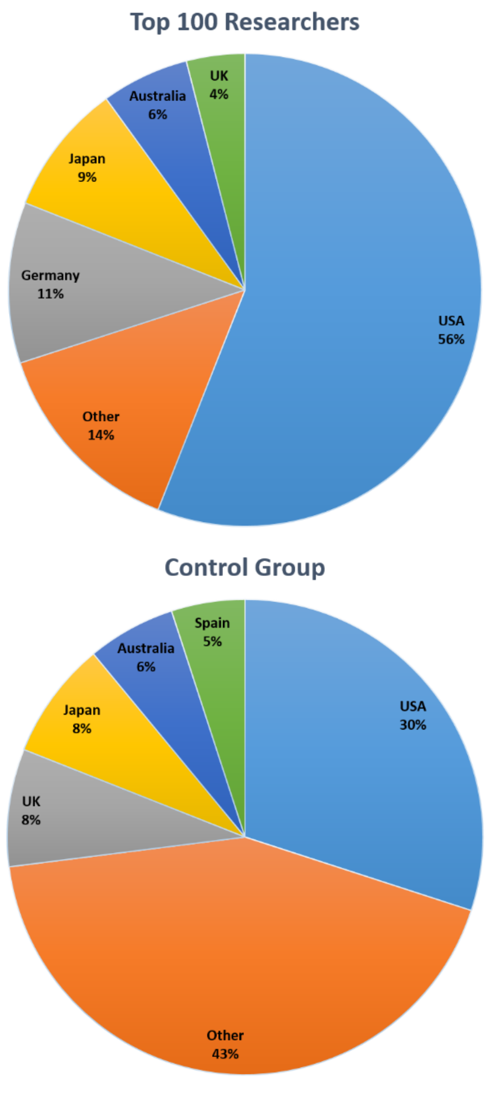

Figure 1: Country of current practice of top-100 most-cited authors in ophthalmology journals from 1967 to 2018, (TOP) top-100 researchers. (BOTTOM) A control group of 100 authors with at least five publications. Abbreviations: UK, The United Kingdom; USA, The United States of America.

Table 1: Top-100 authors in ophthalmology by citation count

Rank	Author	Citation Count	Rank			Rank	Author	Citation Count	Rank	Author	Citation Count
1	Richard Spaide	12009	**26**	Neil Bressler	5677	**51**	Michael Marmor	4484	**76**	Linda Zangwill	3672
2	Tien Y. Wong	11822	**27**	Tin Aung	5614	**52**	David Friedman	4418	**77**	Cynthia Toth	3654
3	Paul Mitchell	11015	**28**	Seang-Mei Saw	5337	**53**	Charles Foster	4396	**78**	Aimee Broman	3634
4	Robert N. Weinreb	9753	**29**	Peter A. Campochiaro	5270	**54**	Srinivas Sadda	4316	**79**	Kelly Nichols	3631
5	Jost B. Jonas	9299	**30**	Harry Flynn	5219	**55**	Graham E. Holder	4293	**80**	Robert Montés-Micó	3613
6	Shigeru Kinoshita	8401	**31**	Quan Dong Nguyen	5210	**56**	Susan Bressler	4276	**81**	Harminder Dua	3599
7	Harry A. Quigley	7684	**32**	Phillip J. Rosenfeld	5156	**57**	Michael Price	4213	**82**	Alon Harris	3582
8	William Feuer	7305	**33**	K. Bailey Freund	5019	**58**	Peter Laibson	4164	**83**	Gisele Soubrane	3577
9	Carol Shields	7082	**34**	Theo Seiler	5016	**59**	Francesco Bandello	4160	**84**	Lyndon Jones	3571
10	Jerry Shields	7023	**35**	Peter K. Kaiser	4964	**60**	James Fujimoto	4114	**85**	Manabu Mochizuki	3564
11	Ronald Klein	6995	**36**	Frederick Ferris III	4885	**61**	Ingrid Scott	4093	**86**	Paul Kaufman	3561
12	Stephen Pflugfelder	6981	**37**	Michael Bach	4884	**62**	Alain Bron	4078	**87**	David Huang	3559
13	Dennis C. Lam	6972	**38**	Donald Tan	4806	**63**	Eberhard Spoerl	4001	**88**	Konrad Pesudovs	3555
14	Christoph Baudouin	6938	**39**	Murat Dogru	4805	**64**	Michael Lemp	3997	**89**	Akitaka Tsujikawa	3542
15	Kazuo Tsubota	6837	**40**	Makoto Araie	4795	**65**	Larry Thibos	3968	**90**	Glenn Jaffe	3537
16	David M. Brown	6659	**41**	Hugh R. Taylor	4784	**66**	Anselm Kampik	3954	**91**	Claus Cursiefen	3535
17	Steven E. Wilson	6622	**42**	Yasuo Tano	4730	**67**	Tatsuro Ishibashi	3912	**92**	Joel Schuman	3526
18	Ursula Schmidt-Erfurth	6532	**43**	David S. Boyer	4728	**68**	Alan C Bird	3798	**93**	Christian Simader	3486
19	Jie J. Wang	6529	**44**	Jeffrey M. Liebmann	4706	**69**	Mark Willcox	3791	**94**	Christoff Koch	3481
20	Nagahisa Yoshimura	6521	**45**	Jorge Alió	4691	**70**	Friedrich Kruse	3775	**95**	Felipe Medeiros	3472
21	Robert Ritch	6287	**46**	Francis W. Price	4638	**71**	Peter Wiedemann	3769	**96**	Karl Bartz-Schmidt	3465
22	Barbara Klein	6080	**47**	Sohan Hayreh	4620	**72**	James McCulley	3766	**97**	Jason Slakter	3442
23	Josef Flammer	5914	**48**	Nathan Efron	4570	**73**	Laurent Itti	3732	**98**	Eberhart Zrenner	3412
24	Jeffrey S. Heier	5903	**49**	Jay Duker	4540	**74**	Donald Hood	3703	**99**	Gary Foulks	3383
25	Frank G. Holz	5886	**50**	Lawrence A. Yannuzzi	4528	**75**	Gerrit Melles	3685	**100**	Roman Rubio	3364

DISCUSSION

This bibliometric analysis is the first of its kind to investigate what aspects of clinical and educational training may lead to a higher impact in ophthalmology research. We found that attending an "elite" medical school or residency may have a substantial foundational impact on developing research *bona fides*. We also found that male and US researchers are more likely to be top researchers in the field of ophthalmology. We also found that there are only a few highly-cited female ophthalmologists, although these have a disproportionate impact.

Like many others, we found that women are underrepresented in ophthalmology research, with only 12 of the top-100 researchers being female. This is roughly equivalent to the gender disparity reported by Heng et al. In the analysis of the top-100 most-cited articles in ophthalmology, only 16% of the first authors were female [8].

Table 2: Comparison between top-100 most-cited ophthalmologists and a random sample of 100 ophthalmologists who had published at least five times in ophthalmology journals

All	Top-100, n (%)	Control, n (%)	Risk Ratio	95% CI	*P*-value
Male	88/100 (88)	75/100 (75)	2.44	1.15 - 5.12	**0.02**
US Residence	56/100 (56)	30/100 (30)	2.97	1.66 - 5.31	**< 0.001**
MD	79/100 (79)	70/100 (70)	1.61	0.85 - 3.07	0.14
PhD	39/100 (39)	44/100 (44)	0.81	0.46 - 1.43	0.47
MD/PhD	20/100 (20)	15/100 (15)	0.85	0.72 - 2.45	0.35
MPH	5/100 (5)	1/100 (1)	5.21	0.60 - 45.42	0.09
OD	3/100 (3)	3/100 (3)	1.00	0.20 - 5.08	1.00
US residents only					
Male	48/56 (86)	21/30 (70)	2.57	0.87 - 7.59	0.08
Top 25 College	21/50 (42)	6/16 (38)	1.21	0.38 - 3.84	0.75
Top 25 Medical School	28/45 (62)	6/20 (30)	3.89	1.24 - 11.90	**0.02**
Top 25 Residency	32/44 (72)	8/19 (42)	3.67	1.19 - 11.31	**0.02**
Fellowship Training	41/44 (93)	15/19 (79)	3.66	0.73 - 18.22	0.22
Private Practice	5/44 (11)	6/19 (32)	0.28	0.07 - 1.06	0.05
Chairman	7/44 (16)	2/19 (11)	1.61	0.30 - 8.57	0.57

Abbreviations: n, number; %, percentage; CI, confidence interval; MD, Medical Doctor; PhD, Doctor of Philosophy; MPH, Master of Public Health; OD, Doctor of Optometry; *P* < 0.05 is shown in bold. Note the denominator changes because information was not available for all of the researchers in each category. For example, we had gender information of all 56 of the US-based top-100 authors, but, only were able to obtain college information from only 50; hence, the denominator changed based on how many data points we were able to find with our internet search.

Studies have found that female researchers in ophthalmology are much more likely to be cited as first authors than as last authors, although this disparity contracts over time with a projected sex-neutral distribution of prestigious authorships by 2028 [9]. In our study, the gender disparity was smaller in the US-based subset than in the international one. Other researchers have found that subspecialist research is cited more often, and women are more likely to conduct general ophthalmology research [10]. This discrepancy in research continues as more females are applying to medical school than ever before [11]. There are currently higher rates of female practicing ophthalmologists (22.7%) and ophthalmology faculty members (35.1%) than there are female first authors in ophthalmology literature (16%) [7]. The subset of women who were at the top of the ophthalmology reference list was cited significantly more throughout their careers than were their male counterparts. In the business world, similar findings have been found in companies headed by female chief executive officers [12]. Future research must clarify this complexity in terms of gender disparities.

Because researchers with NIH funding are cited more often and top-tier research institutions generally have more NIH grants, one would suspect that graduating from a prestigious undergraduate, graduate, or residency program would lead to a stronger research background and higher citation numbers [4]. Our data demonstrated a statistically significant correlation of top-100 citation with top-tier medical school and residency training, but prestigious undergraduate education did not show a statistically significant correlation. Other studies have found that countries with more funding for ophthalmology research have higher productivity [13]. This finding is consistent with our results, as the top-100 researchers displayed an elevated proportion of authors with a residence in the USA, which leads the world in ophthalmology research funding [7].

Our study found that successful researchers tend to become last authors earlier in their careers and are also included in high citation papers earlier, compared to the control group. However, they were not awarded the first authorship as frequently as those in the control group. The role of managing a research team earlier in a career may pay dividends later.

One of the strengths of this study is the large dataset compiled, and various analyses performed. It is also applicable, as program directors in academic institutions are routinely asked to differentiate applicants for both faculty and resident positions.

Our study had some limitations due to its observational design. We relied solely on one dependent variable (i.e., citation numbers) to quantify success in the research. However, some academics have argued that first authorship is a better measurement of success [14]. Although the h-index is a well-accepted means of measuring a researcher's impact, this metric includes all of the researchers' works across medical fields, rather than only ophthalmology-centric journals [15]. Using internet searches to find *curricula vitae* posted online, implies the risk that the information posted was incorrect and/or outdated. Furthermore, our time series forecast measured citation rates at only a few points in a career, and our citation count was limited to the Scopus database. We hope that future research can tap into other demographic characteristics, such as race or regional differences.

CONCLUSION

We found a few significant variables that may aid in galvanizing a researcher's academic career. Among highly-cited ophthalmologists, practicing in the US and attending a top medical school or residency program may provide training for a successful research career in ophthalmology. Although females are a minority in the field of ophthalmology, leading female authors conduct more influential research. For all ophthalmologists, training at an "elite" medical school or residency and earning an MPH may lead to a successful research career in ophthalmology.

ETHICAL DECLARATIONS

Ethical approval: This study was an observational cross-sectional bibliographic study, and no ethical approval was required.

Conflict of interests: None.

FUNDING

None.

ACKNOWLEDGMENTS

None.

REFERENCES

1. Kloosterboer A, Yannuzzi NA, Gedde SJ, Sridhar J. Residency Program Directors of United States Ophthalmology Programs: A Descriptive Analysis. Am J Ophthalmol. 2020;209:71-6. doi: 10.1016/j.ajo.2019.09.003 pmid: 31525356
2. Dotan G, Qureshi HM, Saraf SS, Darnley-Fisch DA. Leadership of United States Academic Departments of Ophthalmology: Chairperson Characteristics, Accomplishments, and Personal Insights. Am J Ophthalmol. 2018;186:69-76. doi: 10.1016/j.ajo.2017.10.024 pmid: 29103964
3. Chao DL, Schiffman JC, Gedde SJ. Characterization of a clinician-scientist cohort in ophthalmology: a demographic analysis of k grant awardees in ophthalmology. Ophthalmology. 2013;120(10):2146-50. doi: 10.1016/j.ophtha.2013.02.021 pmid: 23631948
4. Svider PF, Lopez SA, Husain Q, Bhagat N, Eloy JA, Langer PD. The association between scholarly impact and National Institutes of Health funding in ophthalmology. Ophthalmology. 2014;121(1):423-8. doi: 10.1016/j.ophtha.2013.08.009 pmid: 24070807
5. Gershoni A, Vainer I, Reitblat O, Mimouni FB, Livny E, Blumenthal EZ, et al. Research productivity across different ophthalmic subspecialties in the United States. BMC Health Serv Res. 2019;19(1):778. doi: 10.1186/s12913-019-4590-3 pmid: 31675971
6. The Best Medical Schools for Research. 2021. Available from: https://www.usnews.com/best-graduate-schools/top-medical-schools/research-rankings.
7. Doximity. Doximity Residency Navigator: Opohthalmology; 2019 [March 25]. Available from: https://www.doximity.com/residency.
8. Heng Wong MY, Tan NYQ, Sabanayagam C. Time trends, disease patterns and gender imbalance in the top 100 most cited articles in ophthalmology. Br J Ophthalmol. 2019;103(1):18-25. doi: 10.1136/bjophthalmol-2018-312388 pmid: 30002071
9. Kramer PW, Kohnen T, Groneberg DA, Bendels MHK. Sex Disparities in Ophthalmic Research: A Descriptive Bibliometric Study on Scientific Authorships. JAMA Ophthalmol. 2019. doi: 10.1001/jamaophthalmol.2019.3095 pmid: 31415074
10. Kumar A, Cheeseman R, Durnian JM. Subspecialization of the ophthalmic literature: a review of the publishing trends of the top general, clinical ophthalmic journals. Ophthalmology. 2011;118(6):1211-4. doi: 10.1016/j.ophtha.2010.10.023 pmid: 21269704
11. S Heiser (2018). 'Women Were Majority of U.S. Medical School Applicants in 2018'. *AAMC: The Association of American Medical Colleges*. December 3, 2018. [May 20, 2020]. Available from: https://www.aamc.org/news-insights/press-releases/women-were-majority-us-medical-school-applicants-2018. Accessed: May 20, 2020.
12. Nordea (2017). 'Investing in female CEOs pays off'. nordea.com. 2017-08-09. [May 20, 2020]. Available from: https://www.nordea.com/en/press-and-news/news-and-press-releases/news-en/2017/investing-in-female-ceos-pays-off.html. Accessed: May 20, 2020.
13. Schulz CB, Kennedy A, Rymer BC. Trends in ophthalmology journals: a five-year bibliometric analysis (2009-2013). Int J Ophthalmol. 2016;9(11):1669-75. doi: 10.18240/ijo.2016.11.22 pmid: 27990374
14. Reddy S, Vu C, Choi YM, Wu JJ. Top-cited psoriasis authors in 4 high-impact dermatology journals: 2000-2012. Dermatol Online J. 2016;22(8). pmid: 27617948
15. Siudem G, Zogala-Siudem B, Cena A, Gagolewski M. Three dimensions of scientific impact. Proc Natl Acad Sci U S A. 2020;117(25):13896-900. doi: 10.1073/pnas.2001064117 pmid: 32513724