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Women's Authorship of Reviews in Ophthalmic Journals Over Time

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Purpose: To investigate prevalence and trends in women's authorship of articles in ophthalmic review journals over 2 decades.

Design: Literature survey.

Methods: Total number of authors, and number and gender of first and senior (last-named) authors, were identified in all full reviews published in *Prog Retin Eye Res*, *Surv Ophthalmol,* and *Curr Opin Ophthalmol* for the calendar years 1999, 2009, and 2019. The gender of authors was assigned manually by multiple methods. The subspecialty area of each review was captured by keyword and text search. Country of origin was determined from attributions of first and senior authors.

Results: The gender of 841 first and senior authors was assigned unequivocally for 471 articles (96%). The frequency of women's authorship rose significantly over time (1999, 2009, 2019) for both first authors (19%, 32%, 44%; $P < 0.001$) and senior authors (16%, 19%, 29%; $P = 0.018$). The number of single-author reviews decreased significantly over time ($P < 0.001$), as did the proportion of reviews with neither a first nor a senior woman author ($P < 0.001$). Women's first authorship increased over time for reviews on glaucoma ($P < 0.001$), while women's senior authorship increased for anterior segment/cataract ($P = 0.036$). The proportion of reviews with a woman first or senior author did not differ by country of origin ($P = 0.887$ and $P = 0.520$, respectively).

Conclusions: Women's authorship of articles in ophthalmic review journals increased significantly over the 20-year period, but a gender disparity remained: in 2019, more than 55% of first authors, and more than 70% of senior authors, were men.

Key Words: authorship, eye and vision, gender, ophthalmology, review articles

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Previous studies of gender disparity in medicine and global health have outlined the importance of the participation of women in senior and leadership roles.[1,2] Gender equality may improve health outcomes and drive economic development,[1] whereas under-representation of women may reduce research quality and competitiveness.[2] Interventions to support gender equity in academic medicine have been designed[3–5] and put into practice,[2] but challenges remain.

Research outputs, and an individual's publication record, in particular, are often considered essential in academia for initial appointment to a position, for promotion and progression to leadership roles, for grant funding, and for peer recognition. However, a gender disparity in the authorship of articles in the peer-reviewed general medical literature has been recognized for decades.[6–9] Articles addressing gender disparity in the authorship of original articles and editorials in journals with an ophthalmic focus have also concluded that women are in a minority, but that their contributions are increasing over time.[10–15]

To our knowledge, previous studies of gender disparity in the authorship of ophthalmology articles have not considered review papers alone. Unlike original articles, reviews are largely invited, with the invitees targeted as leading authorities within their fields. Given the acknowledged gender disparity across academic medicine, an investigation focused specifically on the authorship of reviews is of considerable interest. Herein, we aimed to document changes in gender disparity in the authorship of review articles over the significant timeframe of 20 years. Given previous publications have identified gender inequality in different subspecialty areas of ophthalmology[13,15] and in the country of origin of publication,[12] we also examined the subspecialty and origin of each review.

METHODS

Selection of Review Articles

In July 2020, the range of Elsevier Scopus-indexed, English-language journals in the discipline areas of ophthalmology, eye and vision sciences was examined, and 4 journals dedicated to the publication of review articles were identified: *Prog Retin Eye Res* (PRER), *Surv Ophthalmol* (SO), *Curr Opin Ophthalmol* (COO), and *Annu Rev Vis Sci*. Publication of *Annu Rev Vis Sci* commenced in 2015, and since the journal did not provide longitudinal data, it was excluded from this survey. A 10-year sampling

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interval followed that used by other investigators who used a similar methodology.[6,10,12] For the 3 journals with at least a 20-year history of publication (*Prog Retin Eye Res*, *Surv Ophthalmol*, and *Curr Opin Ophthalmol*), the past issues archives were searched for the calendar years 1999, 2009, and 2019. All reviews listed in the tables of contents of the relevant issues of these journals (490 in total) were selected for analysis. Editorials, Opinion Pieces, and Letters to the Editors were excluded.

Identification of First and Senior Author Gender

The total number of contributing authors and the gender of the first (first-named) and senior (last-named) authors for each selected review article were recorded. Binary categorization of gender (either woman or man) was used. To assign authorship gender, 2 coauthors (DG and JMM) first performed a web-based Google search on the individual's name, followed by the addition of the term "and ophthalmology" and/or the contact details provided in the article, in the case of multiple returns. Gender was assigned manually from biographical details provided on web pages, including an individual's clinical practice page, tertiary institution page and research outputs page, and from conference reports. Gender identification was confirmed by public usage of specific gender pronouns (woman: she/her; man: he/his), and no inferences were made from the person's given name or photograph alone. Gender could not be ascertained for 19 first or senior authors and the corresponding reviews (3.9% of the total) were removed from the analysis. Gender was identified unequivocally for 841 first and senior authors from a total of 471 articles.

Subspecialty Area and Country of Origin

Subspecialty area (anterior segment/cataract; glaucoma; retina; neuro-ophthalmology; oculoplastics, orbit, ocular pathology, or oncology; education; global ophthalmology; pediatric ophthalmology; other) of each review was captured by keyword search and in case of ambiguity by examination of the full text, and assigned by one clinical coauthor (DG), with subsequent review by a second clinical coauthor (JRS). Countries of origin were determined from both the first and the senior author's institutional affiliations separately, and collapsed into regional areas (Australia and New Zealand; United States and Canada; the United Kingdom and Ireland; Continental Europe; Other). If more than 1 country was listed in the institutional affiliations of an author, the first listed was used.

Statistical Analyses

The number of review articles for each selected journal, the subspecialty area of the review, number of authors, gender of first and senior authors, and their country of origin, analyzed over time, are summarized in Table 1. For single-author papers, the author was included in analyses for both first and senior authors. Chi-squared (Chi^2) tests of independence were performed to assess differences in the frequency of author gender across the journal, publication year, subspecialty area and geographical location, with significance set at $P < 0.05$. All analyses were performed using the Statistical Package for the Social Sciences (SPSS version 25.0, IBM Corp, Armonk, NY, US). Where a significant difference was detected, further analyses were performed amongst individual groups, with significance levels adjusted using Bonferroni correction to control for multiple comparisons. Changes in the frequency of individual authorship and collaborations across publication years were similarly analyzed.

TABLE 1. Categorization of Identified Review Articles for Each Selected Year of Publication

	1999	2009	2019
Journal title			
Progress in Retinal and Eye Research (PRER)	27	22	41
Survey of Ophthalmology (SO)	75	50	51
Current Opinion in Ophthalmology (COO)	72	82	51
Subspecialty area			
Retina	32	28	39
Anterior segment/cataract	32	27	34
Glaucoma	36	16	17
Neuro-ophthalmology	13	10	4
Oculoplastics, orbit, ocular pathology, or oncology	12	17	12
Education	15	21	9
Global ophthalmology	10	16	3
Pediatric ophthalmology	9	4	13
Other*	15	15	12
Number of authors			
1	63	34	4
2	51	47	33
3	24	37	35
4 or more	36	36	71
Gender of first author†			
Woman	33	49	63
Man	141	105	80
Gender of senior author†			
Woman	28	29	41
Man	146	125	102
Geographical area of first author†			
Australia and New Zealand	14	8	10
United States and Canada	111	104	74
United Kingdom and Ireland	15	7	11
Continental Europe	26	21	29
Other‡	8	14	19
Geographical area of senior author†			
Australia and New Zealand	12	7	9
United States and Canada	117	104	80
United Kingdom and Ireland	15	8	13
Continental Europe	24	23	27
Other§	6	12	14
Total number of reviews	**174**	**154**	**143**

*Included: Optics/Refraction (13), Information technology (9), Refractive surgery (11), Uveitis (8), and Low Vision (1).

†For single-author papers, gender was counted for both first and senior authorship.

‡Included: South and East Asia (24); Western Asia and Middle East (10); Central and South America (6); South Africa (1).

§Included: South and East Asia (18); Western Asia and Middle East (9); Central and South America (4); South Africa (1).

RESULTS

Gender of First and Senior Authors Over Time and Across Review Journals

The frequency of women's authorship of reviews in ophthalmic journals rose significantly over time for both first authors (Fig. 1A, $P < 0.001$) and senior authors (Fig. 1B, $P = 0.018$), with a higher incidence of women's authorship in later publication years in both cohorts. Comparisons amongst individual

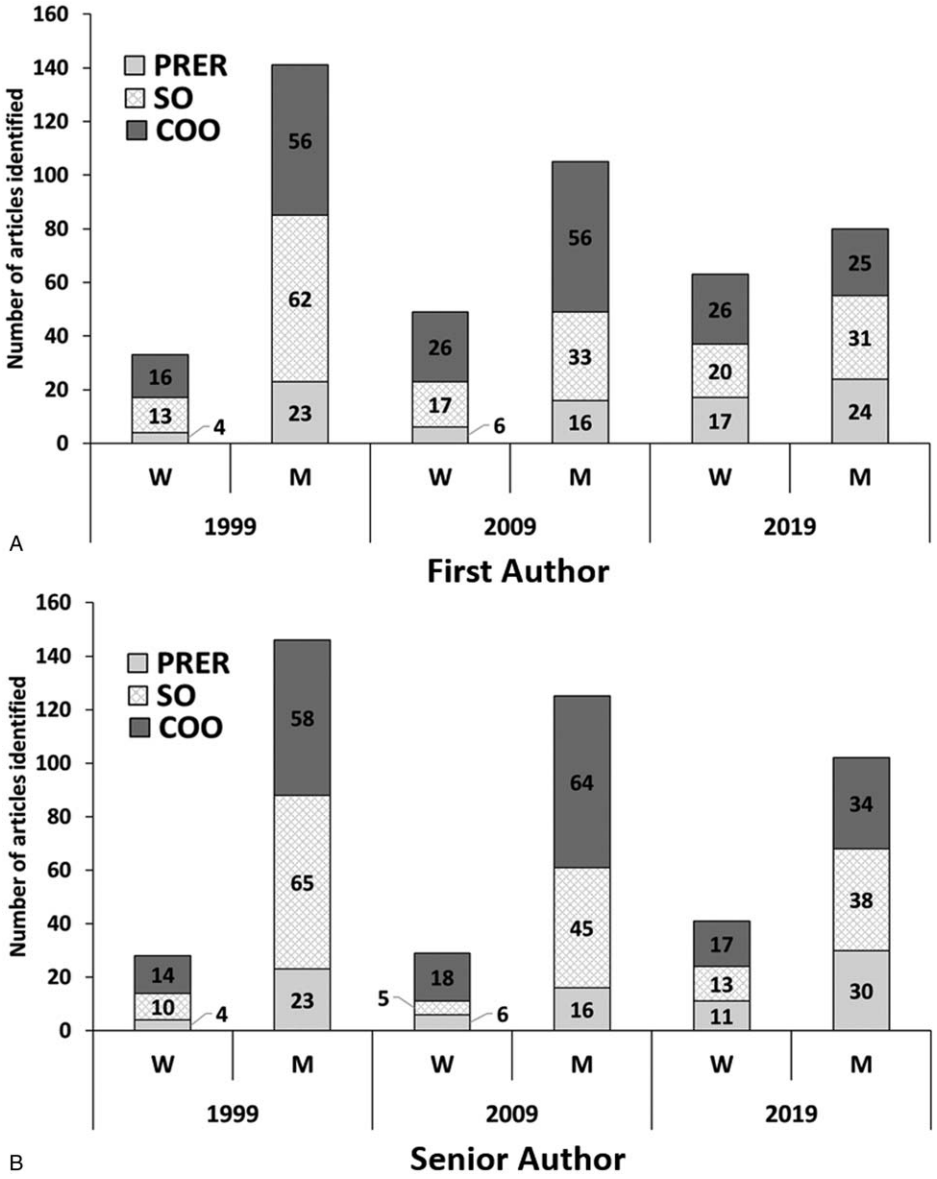

FIGURE 1. Number of identified review articles, stratified by gender of the author, year of publication, and journal identity. First author (A), and senior (last-named) author (B). Single-author papers were counted in categories of both first and senior authors. Journal abbreviations: *Prog Retin Eye Res* (PRER); *Surv Ophthalmol* (SO); and *Curr Opin Ophthalmol* (COO). The frequency of women's authorship for both first authors ($Chi^2 = 23.30$, df = 2, $P < 0.001$) and senior authors ($Chi^2 = 8.08$, df = 2, $P = 0.018$) rose significantly over time. Women's *first* authorship rose significantly from 1999 to 2009 ($Chi^2 = 6.53$, df = 1, $P = 0.011$) but not from 2009 to 2019 ($Chi^2 = 4.22$, df = 1, $P = 0.040$). The difference between 1999 and 2019 was significant ($Chi^2 = 22.23$, df = 1, $P < 0.001$). Overall increase in women's first authorship was significant for COO ($Chi^2 = 11.27$, df = 2, $P = 0.004$) and SO ($Chi^2 = 8.22$, df = 2, $P = 0.016$) but not for PRER ($Chi^2 = 5.61$, df = 2, $P = 0.061$). Women's *senior* authorship did not rise significantly between 1999 and 2009 ($Chi^2 = 0.26$, df = 1, $P = 0.612$) or between 2009 and 2019 ($Chi^2 = 3.46$, df = 1, $P = 0.063$), although a significant difference was detected between 1999 and 2019 ($Chi^2 = 6.57$, df = 1, $P = 0.010$). The change over time was not significant for any of the 3 individual publications analyzed alone (all df = 2, all $P > 0.05$). Analysis comparing proportions of women first and senior authors across publications at individual time points was non-significant (all df = 2, all $P > 0.10$), and no significant differences were detected in the proportions of women first authors ($Chi^2 = 1.04$, df = 2, $P = 0.595$) or women senior authors ($Chi^2 = 4.10$, df = 2, $P = 0.129$) across the total number of publications.

publication years demonstrated that women's first authorship rose significantly between 1999 and 2009 ($P = 0.011$), but the further apparent increase from 2009 to 2019 did not reach significance following Bonferroni correction ($P = 0.040$). Overall, however, the difference between 1999 and 2019 was significant ($P < 0.001$). The increase in women's first authorship was significant for *Curr Opin Ophthalmol* ($P = 0.004$) and *Surv Ophthalmol* ($P = 0.016$), but not for *Prog Retin Eye Res* ($P = 0.061$). In contrast for senior authorship of reviews in ophthalmic journals, the incidence of women's senior authorship did not rise significantly between 1999 and 2009 ($P = 0.612$), or between 2009 and 2019 ($P = 0.063$), although a significant difference was detected between 1999 and 2019 ($P = 0.010$). The change over time was not significant for any of the 3 individual publications analyzed alone (all df = 2, all $P > 0.05$). No significant difference was found in the proportions of women first authors ($P = 0.595$) or women senior authors ($P = 0.129$) across the total number of publications examined for the 3 qualifying journals, and an analysis comparing proportions of women first and senior authors across publications at individual time points was also nonsignificant (all $P > 0.10$).

Collaborative Authorship and Gender of First and Senior Authors Over Time

A significant reduction in the number of single-author papers identified in each publication year over time was identified ($Chi^2 = 52.07$, df = 2, $P < 0.001$), with fewer single-author publications in the later cohorts. This difference was significant both from 1999 to 2009 ($Chi^2 = 7.17$, df = 1, $P = 0.007$) and from 2009 to 2019 ($Chi^2 = 23.01$, df = 1, $P < 0.001$). The reduction was significant for all 3 journals examined (*Prog Retin Eye Res*: $Chi^2 = 19.43$, df = 2, $P < 0.001$; *Surv Ophthalmol*: $Chi^2 = 15.80$, df = 2, $P < 0.001$; *Curr Opin Ophthalmol*: $Chi^2 = 21.97$, df = 2, $P < 0.001$). When single-author papers were excluded, the proportions of first and senior authors who were women both increased significantly over time ($Chi^2 = 22.83$, df = 2, $P < 0.001$ and $Chi^2 = 11.53$, df = 2, $P = 0.003$, respectively). The proportion of published reviews that had a woman as neither first nor senior author also reduced significantly over time ($Chi^2 = 43.66$, df = 2, $P < 0.001$).

Gender and Subspecialty Interest

There was no significant difference found in the proportion of publications with a woman first author, when compared across subspecialty areas in all 3 journals ($Chi^2 = 2.91$, df = 8, $P = 0.940$). This was also the case when the proportions of women senior authors were compared ($Chi^2 = 7.10$, df = 8, $P = 0.526$). When data for each subspecialty area were considered independently (Table 2), there was a significant increase in the proportion of women first authors for papers on glaucoma ($Chi^2 = 19.04$, df = 2, $P < 0.001$), but not for other areas (all df = 2, all $P > 0.05$). A significant increase was also found for women senior authors for publications on anterior segment/cataract ($Chi^2 = 6.65$, df = 2, $P = 0.036$), but not for other areas (all df = 2, all $P > 0.05$).

Gender and Country of Origin of First and Senior Authors

No significant difference was found in the proportion of publications with a woman first author ($Chi^2 = 1.14$, df = 4, $P = 0.887$) when compared across geographical location of first author for any of the three journals. This was also the case for woman senior author ($Chi^2 = 3.23$, df = 4, $P = 0.520$). The majority of first (61%) and senior (64%) authors were located in North America (US and Canada).

DISCUSSION

In 3 ophthalmic review journals, sampled in 3 calendar years over a 20-year timeframe from 2009 to 2019, we found that women's authorship rose significantly for both first-named authors (19% to 44%) and last-named (senior) authors (16% to 29%). Our findings for review papers are in good agreement with other studies that have variously investigated authorship of original articles, brief reports, and editorials in ophthalmology journals over recent timespans of 5 to 30 years.[10–15] In all instances, the proportion of first and last-named women authors increased over time, more so for first than senior authors, but was always less than 50%.

Reviews occupy a specialized niche in the medical literature in that, unlike original articles describing primary research findings or case reports, they are frequently invited or commissioned by a journal editor or editorial board member. The invitation will often be extended to a senior researcher, considered to be an expert in the field, who may then seek to include colleagues and more junior members of the research team as coauthors. The individual to whom the invitation to prepare a review was first made will usually, by established convention, be the last-named or senior author. This convention may not be followed in the authorship sequence of original articles,[16] but for our focus here on reviews, we were reasonably confident that the last-named author was, in reality, the senior and arguably most expert of the authorship team. In 2019, 71% of senior authors of reviews in ophthalmic journals were men.

Given that authorship of reviews commonly reflects perceived expertise, it is pertinent to consider our findings in relation to speaker invitations at medical conferences. Recently, both the Director of the US National Eye Institutes, Dr. Frances Collins, and the Director of the UK Wellcome Trust, Sir Jeremy Farrer, have spoken out against the all-man speaker panel, or "manel".[17] While this issue has not been investigated in the field of ophthalmology, researchers working in other medical disciplines have highlighted the lack of women faculty invited on to the program of major conferences. A recent survey of urology conferences held between 2019 and 2020 indicated that over 80% of faculty were men, and two-thirds of panels were manels.[18] A similar survey of pain medicine webinars hosted by medical societies or industry found that 1 in 5 presenters were women.[19]

TABLE 2. Author Gender by Subspecialty Area Over Time

	First author*						Senior author*					
	1999		2009		2019		1999		2009		2019	
Subspecialty area	**Woman**	**Man**	**Woman**	**Man**	**Woman**	**Man**	**Woman**	**Man**	**Woman**	**Man**	**Woman**	**Man**
Retina	5	27	10	18	14	25	5	27	6	22	8	31
Anterior segment/cataract	6	26	8	19	15	19	3	29	10	17	10	24
Glaucoma	3	33	4	12	11	6	2	34	1	15	4	13
Education	6	9	5	16	2	7	4	11	5	16	3	6
Oculoplastics, orbit, ocular pathology, oncology	3	9	5	12	5	7	2	10	2	15	5	7
Neuro-ophthalmology	4	9	3	7	2	2	4	9	1	9	1	3
Global ophthalmology	1	9	5	11	2	1	3	7	2	14	1	2
Paediatric ophthalmology	1	8	2	2	7	6	1	8	1	3	4	9
Other	4	11	7	8	5	7	4	11	1	14	5	7
Total	**33**	**141**	**49**	**105**	**63**	**80**	**28**	**146**	**29**	**125**	**41**	**102**

*For single-author papers, gender was counted for both first and senior authorship.

The number of single-authored reviews in ophthalmology decreased significantly from 36% to 3% over 20 years, indicative of an increase in multiauthored submissions and possibly reflective of ever-increasing mentorship of more junior researchers within teams. The proportion of reviews on which neither first nor senior author was a woman decreased significantly over time, but the implications of this finding are uncertain, given that we did not determine the gender of middle authors. We did not find any significant preference for women collaborating with other women as first and senior authors over time. With respect to the ophthalmic subspecialty area on which each review was focused, we noted an increase in women's first authorship for glaucoma and an increase in last authorship for anterior segment/cataract over time, but for virtually each time point and each of the 9 subspecialty areas examined, men predominated as both first and senior authors. Limited comparable literature exists, but others have also found a preponderance of men's authorship on articles dealing with glaucoma.[15]

In summary, we have documented an increase in the proportion of women's first and senior authorship of ophthalmic review articles over 20 years from 1999 to 2019, consistent with findings for other types of publication, but with men predominating as both first and last-named authors. A strength of this study was that, using multiple search strategies, the gender of first and senior authors was able to be assigned unequivocally for 96% of the articles first considered for examination. Other studies that have relied largely on web-based inference tools for gender identification[10,13,15] have generally been unable to match this level. However, limitations of our work include our focus on binary categorization of gender as either a woman or a man,[1] and on gender determination for first-named and last-named authors only, in the case of multiauthored reviews.

It has been argued that ophthalmology is relatively "woman-friendly" amongst the medical specialties, in that it affords the choice of a medical or surgical practice, or both, and the possibility of a balance between work and family life.[20] However, the evidence from the recent past supports the contention that, whereas women and men share similar career and leadership aspirations,[21] the former have not always been supported to succeed within academic medicine generally[21,22] and in ophthalmology more specifically.[23] Given the importance of authorship of publications in the peer-reviewed literature for academic success in ophthalmology, the continuing promotion of women as first and senior authors of reviews in the ophthalmic literature is appropriate and should be encouraged.

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