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Quantifying gender disparity in physician authorship among commentary articles in three high-impact medical journals: an observational study

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ABSTRACT

Background Scholarship plays a direct role in career advancement, promotion and authoritative recognition, and women physicians remain under-represented as authors of original research articles.

Objective We sought to determine if women physician authors are similarly under-represented in commentary articles within high-impact journals.

Design/Setting/Participants In this observational study, we abstracted and analysed author information (gender and degree) and authorship position from commentary articles published in three high-impact journals between 1 January 2014 and 16 October 2018.

Primary outcome measure Authorship rate of commentary articles over a 5-year period by gender, degree, authorship position and journal.

Secondary outcome measures To compare the proportion of men and women physician authorship of commentaries relative to the proportion of men and women physician faculty within academic medicine; and to examine the gender concordance among the last and first authors in articles with more than one author.

Results Of the 2087 articles during the study period, 48% were men physician first authors compared with 17% women physician first authors (p<0.0001). Of the 1477 articles with more than one author, similar distributions were found with regard to last authors: 55% were men physicians compared with only 12% women physicians (p<0.0001). The proportion of women physician first authors increased over time; however, the proportion of women physician last authors remained stagnant. Women coauthored with women in the first and last authorship positions in 9% of articles. In contrast, women coauthored with men in the first and last author positions, respectively, in 55% of articles.

Conclusions Women physician authors remain under-represented in commentary articles compared with men physician authors in the first and last author positions. Women also coauthored commentaries with other women in far fewer numbers.

Strengths and limitations of this study

- A strength of our study includes the manual identification of inferred gender by first name and subsequent search of institutional websites and social media accounts for pictures and preferred pronouns, rather than reliance on internet gender identification programme.
- A limitation of our study is the lack of duplicate review of the inferred gender to provide additional validation of the results.
- Another limitation of this study, as well as all prior work in this area, is the use of binary gender and the inability to capture those potential authors who may identify as non-binary.
- Finally, we did not limit our authorship to those from US medical schools, and therefore the actual disparity between women physician authors and women US medical school physician faculty could be more or less pronounced.

INTRODUCTION

Although women have achieved gender parity in medical schools on both sides of the Atlantic,[1–3] they remain under-represented in academic medicine hierarchy, composing only 37% of associate professors and 25% of full professors.[4] The lack of advancement of women in academic medicine becomes even more pronounced within leadership in academic medicine, with women currently representing only 18% of permanent medical school chairs and 19% of permanent medical school deans.[5 6]

Publications in medical journals play an integral role in the academic promotion process, impacting the transition from assistant to full professor.[7] Prior work reveals that women remain under-represented as authors of original research articles in medical journals, and in some journals women representation has declined over time.[8–10] Prior evidence from subspecialty journals found that women physicians authored fewer perspective-type

pieces.[11 12] Moreover, the editors at *The Lancet* recently commented on its journal's under-representation of women authors of commentary articles.[13] Gender disparity in authorship among high-impact journals has far-reaching implications, given the importance of scholarship in career advancement, academic promotion and authoritative recognition.[14] In fact, the Association of American Medical Colleges (AAMC), the American Medical Association and the American College of Physicians have all highlighted the importance of achieving gender equity in academic medicine.[15–17]

Commentary articles are a unique category that can be written by authors at any stage of their career and offer authors the ability to either contribute novel opinions on timely, relevant topics in healthcare or propose new directions for scientific enquiry.[11 18–22] These articles are distinct from editorials or invited commentaries, which by definition restrict the pool of possible authors. However, the lack of specificity on the process for selecting commentary pieces and thereby the subjective nature of accepting commentaries for publication may lend itself to implicit bias, potentially in favour of men over women.[23–25] Prior studies have highlighted a disparity in authorship among men and women authors.[9 10 26] We chose to focus on men and women physician authors, as a disparity within physician authorship may contribute to the attrition of women physicians in academics. In addition the recently launched Time's Up Healthcare, a component of a non-profit organisation Time's Up, highlights the need to better understand and address inequities that women experience in healthcare.[27] Therefore, the primary objective of this study was to characterise recent trends in representation of women physician authorship of commentary articles within high-impact journals.

METHODS

We abstracted and analysed author information (gender, degree) and author position from *New England Journal of Medicine* (*NEJM*) Perspective, *Journal of the American Medical Association* (*JAMA*) Viewpoint, and *Annals of Internal Medicine* Ideas and Opinions articles published from 1 January 2014 to 16 October 2018. We selected these three top-ranked medical journals by *InCites Journal Citation Report 2018* impact factor.[28] We then searched the individual journal websites to extract articles during our study time period that were identified as one of the following: (1) *JAMA* Viewpoint, (2) *NEJM* Perspective and (3) *Annals of Internal Medicine* Ideas and Opinions. The gender of the author was determined by inspection of first name by a study team member. A separate study team member reviewed the data set for any missing data points. For the 20% of names that were androgynous or unfamiliar, we searched institutional websites, social media accounts such as LinkedIn, and internet search engines to find photographs or biographical paragraphs that included preferred pronouns such as he, she, her and him.[3 9 10 29–32] We successfully identified gender in 100% of cases. Authors with degrees that included MD, DO or MBBS were counted as physicians. Authors with any other degree (eg, JD, PhD, MPH and so on) without MD, DO or MBBS degree were counted as non-physicians. We abstracted the first and last authorship position data, as those are often a proxy for research team involvement, with the first author often contributing the most as the mentee and the last author providing leadership to the team as the mentor.[33–36] Given the first author position more consistently indicates a significant contribution to the manuscript compared with the last author position, our comparisons focused largely on the first author position.[37] Articles with single authors were counted towards the first author position.

Our observational analysis had three main objectives. First, we described 5-year trends in authorship of commentary articles by gender, degree (MD/DO/MBBS vs non-physician degree), authorship position and journal. Second, we compared the proportion of men and women physician authorship of commentaries relative to the proportion of men and women physician faculty within academic medicine. Lastly, among the subset of commentaries with more than one author, we examined the gender concordance among the last and first authors. The a priori rationale for this was to determine the role, if any, of gender concordance in the advancement of women physicians.

Statistical analysis

We calculated standard summary statistics (frequencies and percentages) for gender, first and last author positions, degree type, and journal. To determine changes in gender authorship over time, we used Cochran-Armitage test for trend, and Fisher's exact test to compare women with men authors by journal type. To compare the proportion of men and women physician first authors of commentary articles relative to the proportion of men and women physician faculty, respectively, in academic medicine, we used the AAMC as the comparison group, with the proportion of women physician faculty in academic medicine at 27% in 2014, 28% in 2015, 28% in 2016, 28% in 2017, and 29% in 2018, and the proportion of men physician faculty in academic medicine at 50% in 2014, 49% in 2015, 51% in 2016, 45% in 2017, and 45% in 2018,[38] and performed Fisher's exact test for each year. We performed additional subgroup analyses to compare (1) the proportion of women physician first and last authors with the proportion of women physician full professors in academics, and (2) the proportion of women to men authors for which there was a single author. For the former, we used the AAMC as the comparison group, with the proportion of women physician full professors at 22% in 2018, and Fisher's exact test was used for both. Additionally, we calculated 95% CI on the difference of the two binomial proportions (women physician faculty and women physician first authors, as well as men physician faculty and men physician first authors) using standardised statistics and inverting two one-sided tests.

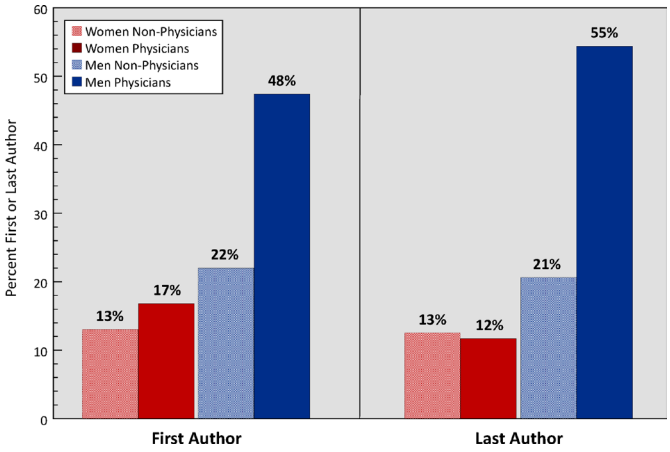


Figure 1 Authorship by position, gender and degree. The figure shows the total percentage of men and women authors in the first and last authorship positions by degree (MD/DO/MBBS vs non-physician degree).

We calculated standard summary statistics to assess for gender concordance among the first and last author positions. Analyses were conducted using SAS V.9.4 statistical software and StatXact (V.11; Cytel Studio, Cambridge, Massachusetts). We followed the Strengthening the Reporting of Observational Studies in Epidemiology reporting guidelines for observational studies.[39]

RESULTS

Proportion of authors by gender, degree, authorship position and journal

Of the 2087 articles during the study period from 1 January 2014 to 16 October 2018, a total of 921 were *JAMA* Viewpoint, 910 were *NEJM* Perspective, and 256 were *Annals of Internal Medicine* Ideas and Opinions. Men and women accounted for 1457 (70%) and 630 (30%), respectively, in the first author position. Of all first authors, 994 (48%) were men physicians compared with 355 (17%) women physicians (p<0.0001). Of all physician first authors, 74% were men physicians compared with 26% women physicians. Of the 1477 articles with more than one author, similar distributions were found with regard to last authors: 1114 (75%) and 363 (25%) were men and women, respectively. Of all last authors, 807 (55%) were men physicians compared with only 176 (12%) women physicians (p<0.0001; figure 1).

men and women physicians in the first author position represent, respectively, 42% (n=386) and 19% (n=174) in *NEJM*, 52% (n=477) and 13% (n=124) in *JAMA*, and 51% (n=131) and 22% (n=57) in *Annals of Internal Medicine* (table 1).

In those articles in which there was more than one author, men and women physicians in the last author position represent, respectively, 48% (n=264) and 13% (n=72) in *NEJM*, 67% (n=493) and 10% (n=74) in *JAMA*, and 65% (n=124) and 16% (n=30) in *Annals of Internal Medicine* (table 2).

Finally, of those articles with only a single author, women and men represent 31% (n=189) and 69% (n=421), respectively. Of all articles with a single physician author, women and men physicians represent 28% and 72%, respectively.

Proportion of women authors by journal

When comparing the proportion of women first authors by journal type, *JAMA* (24%, n=224) had the lowest proportion compared with either *NEJM* (35%, n=320) or *Annals of Internal Medicine* (34%, n=86) (p<0.001). In

Table 1 Proportion of men and women first authors by degree, journal and year

		2014	2015	2016	2017	2018
Journal	**First author position**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**
AIM	Women physicians	10 (21)	6 (13)	12 (23)	12 (24)	17 (28)
	Women non-physicians	6 (13)	5 (11)	9 (17)	5 (10)	4 (7)
	Men physicians	26 (54)	27 (59)	23 (44)	23 (46)	32 (53)
	Men non-physicians	6 (13)	8 (17)	8 (15)	10 (20)	7 (12)
	Total articles	48	46	52	50	60
JAMA	Women physicians	20 (12)	27 (13)	23 (12)	27 (14)	27 (18)
	Women non-physicians	16 (9)	18 (8)	19 (10)	26 (13)	21 (14)
	Men physicians	94 (54)	107 (50)	108 (58)	99 (51)	69 (45)
	Men non-physicians	43 (25)	64 (30)	35 (19)	41 (21)	37 (24)
	Total articles	173	216	185	193	154
NEJM	Women physicians	29 (16)	33 (18)	24 (13)	39 (20)	49 (29)
	Women non-physicians	30 (16)	15 (8)	37 (21)	39 (20)	25 (15)
	Men physicians	85 (45)	83 (46)	80 (45)	76 (39)	62 (37)
	Men non-physicians	43 (23)	49 (27)	38 (21)	42 (21)	32 (19)
	Total articles	187	180	179	196	168

AIM, Annals of Internal Medicine; JAMA, Journal of the American Medical Association; NEJM, New England Journal of Medicine.

Table 2 Proportion of men and women last authors by degree, journal and year

Journal	Last author position	2014 n (%)	2015 n (%)	2016 n (%)	2017 n (%)	2018 n (%)
AIM	women physicians	7 (21)	3 (10)	9 (21)	8 (24)	3 (6)
	women non-physicians	1 (3)	2 (6)	4 (9)	3 (9)	5 (10)
	men physicians	24 (71)	21 (68)	25 (58)	21 (62)	33 (66)
	men non-physicians	2 (6)	5 (16)	5 (12)	2 (6)	9 (18)
	Total articles	34	31	43	34	50
JAMA	women physicians	13 (9)	15 (9)	16 (10)	16 (11)	14 (12)
	women non-physicians	19 (13)	17 (10)	14 (9)	19 (13)	20 (17)
	men physicians	95 (63)	94 (58)	91 (58)	80 (54)	59 (50)
	men non-physicians	24 (16)	36 (22)	35 (22)	32 (22)	25 (21)
	Total articles	151	162	156	147	118
NEJM	women physicians	21 (18)	14 (13)	11 (10)	14 (11)	12 (12)
	women non-physicians	16 (14)	17 (16)	16 (15)	19 (15)	15 (15)
	men physicians	55 (47)	47 (45)	51 (48)	66 (52)	45 (46)
	men non-physicians	24 (21)	26 (25)	29 (27)	27 (21)	26 (27)
	Total articles	116	104	107	126	98

AIM, Annals of Internal Medicine; JAMA, Journal of the American Medical Association; NEJM, New England Journal of Medicine.

those articles in which there was more than one author, there was no significant difference in the proportion of women last authors by journal type: *JAMA* 22% (n=163), *NEJM* 28% (n=155) and *Annals of Internal Medicine* 23% (n=45) (p=0.049).

When comparing the proportion of women physician first authors by journal type, *Annals of Internal Medicine* had the highest proportion (22%, n=57), followed by *NEJM* (19%, n=174) and then *JAMA* (13%, n=124) (p<0.001). A similar distribution was found with the proportion of women physician last authors in those articles in which there was more than one author with *Annals of Internal Medicine* (16%, n=30), followed by *NEJM* (13%, n=72) and *JAMA* (10%, n=74) (p<0.001).

Proportion of authors by degree and authorship position over time

From 2014 to 2018, the proportion of women authors in the first author position gradually increased (2014–2018: 27% (n=111), 24% (n=104), 30% (n=124), 34% (n=148) and 37% (n=143), respectively, p<0.001). In contrast, there was no significant change in the ratio of women authors in the last author position over the same time period (2014–2018: 26% (n=77), 23% (n=68), 23% (n=70), 26% (n=79) and 26% (n=69), respectively, p=0.67).

Similarly, when examining physician authors over time, the proportion of women physician first authors initially remained constant from 2014 to 2016 (14% (n=59), 15% (n=66) and 14% (n=59), respectively) and recently increased to 18% (n=78) in 2017 and 24% (n=93) in 2018 (p<0.001; figure 2). In contrast, the ratio of women physician last authors did not significantly change between 2014 and 2018 (14% (n=41), 11% (n=32), 12% (n=36), 12% (n=38) and 11% (n=29), respectively, p=0.53).

Proportion of women physician first authors to women physician faculty in academics

women physician first authors were under-represented compared with women physician faculty in academics from 2014 to 2017. The proportion of women physician first authors was significantly lower than the proportion of women physician faculty in academics for years 2014–2017 (range of differences 8.6%–15.5%, p<0.001; figure 3). However, in 2018, there was no significant

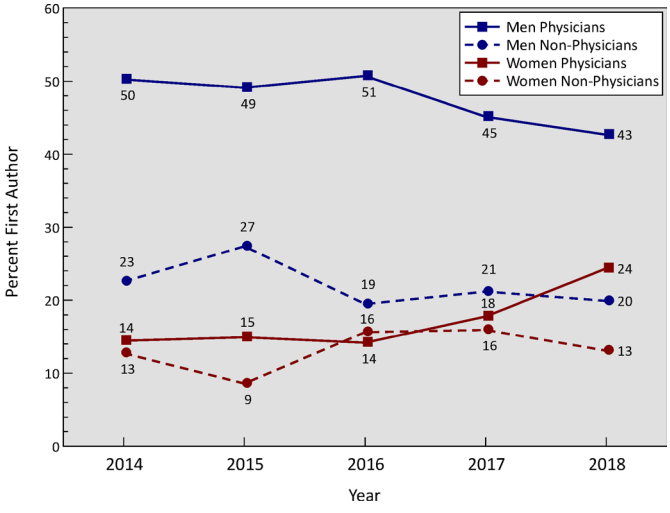
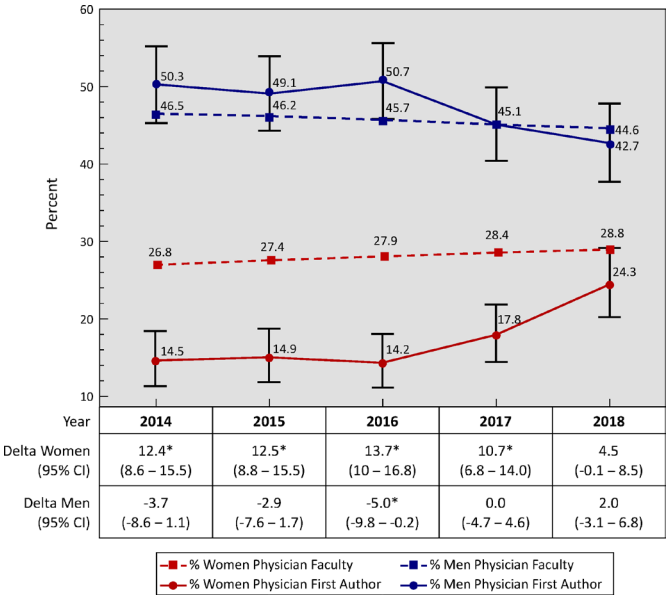


Figure 2 Per cent of first author by gender and degree over time. The figure shows the percentage of men and women first authors by degree (MD/DO/MBBS vs non-physician degree) over time from 2014 to 2018.



Year	2014	2015	2016	2017	2018
Delta Women (95% CI)	12.4* (8.6 – 15.5)	12.5* (8.8 – 15.5)	13.7* (10 – 16.8)	10.7* (6.8 – 14.0)	4.5 (-0.1 – 8.5)
Delta Men (95% CI)	-3.7 (-8.6 – 1.1)	-2.9 (-7.6 – 1.7)	-5.0* (-9.8 – -0.2)	0.0 (-4.7 – 4.6)	2.0 (-3.1 – 6.8)

Figure 3 Proportion of men and women physician first authors and men and women physician faculty over time. The figure shows the proportion of men and women physician first authors relative to the proportion of men and women physician faculty, respectively, over time from 2014 to 2018. *Indicates a statistically significant difference.

difference between women physician faculty and women physician first authors (4.5%, p=0.054; figure 3).

Proportion of men physician first authors to men physician faculty in academics

In contrast, there was no significant difference between the proportion of men physician faculty and men physician first authors for 2014–2015 and 2017–2018 (range of differences −3.7% to 2.0%, p>0.05 for all; figure 3). In 2016, the proportion of men physician first authors was significantly more (5%) than the proportion of men physician faculty (p=0.024; figure 3).

Proportion of women physician first and last authors to women physician full professors

women physician first authors (26%) were well represented compared with the proportion of women physician full professors in 2018 (22%). The difference between the proportion of women physician full professors and women physician first authors was 4% (95% CI 1.5% to 6.3%). In contrast, women physician last authors (18%) were under-represented compared with the proportion of women physician full professors in academics in 2018. The difference between the proportion of women physician full professors and women physician last authors was −4% (95% CI −6.9% to −2.0%).

Gender concordance within the first and last author positions

Of 1477 articles in which there was more than one author, women authors in the first and last positions were concordant in 132 (9%) articles, and men authors in the first and last author positions were concordant in 805 (55%) articles. In contrast, men last authors with women first authors accounted for 309 (21%) articles, and women last authors with men first authors accounted for 231 (16%) articles.

DISCUSSION

In three high-impact journals from 2014 to 2018, our analysis revealed that women physicians remain underrepresented in the first and last author positions (17% and 12%, respectively) compared with men physicians in the first and last author positions (48% and 55%, respectively). While the proportion of women physician authors in the first author position increased over time, the proportion of women physician authors in the last author position remained stagnant. In articles with multiple authors, the rates of women first authors were lowest when the last author was also a woman.

Prior studies have revealed a gender disparity in authorship of original research and editorial articles.[8–10] Recent studies have also shown a gender gap in the authorship of perspective-type articles.[11 12] To our knowledge, this is the first study to examine the role of gender concordance among first and last authors in commentary pieces of high-impact general medicine journals. In addition, we build on prior work by comparing the rates of women physician commentary authorship with the proportion of women physician faculty annually.[11]

Strengths and limitations

Our study does have some key limitations. We inferred the gender of authors and did not rely on self-identification, which has the potential for misclassification. While we performed additional internet searches to identify names that were androgynous or unfamiliar in 20% of cases, we did not review pictures or biographical data for each name. In addition, we did not have a separate study team member perform a duplicate review of the data set to provide additional validation of the results. Another limitation of this study, as well as all prior work in this area, is the use of binary gender and the inability to capture those potential authors who may identify as non-binary.[40] As medical journals accept submissions from outside of academia, including students, researchers and physicians from non-profit and private sectors, focusing on faculty in academia may, in fact, result in an underestimation of the gap.[20–22] Finally, we did not limit our authorship to those from US medical schools, and therefore the actual disparity between women physician authors and women US medical school physician faculty could be more or less pronounced. A prior study, however, has found that this disparity persists even when limited to US medical school faculty.[10] The strengths of our study include manual identification of gender by a study team member. Data derived from an online gender identification system, while easier to replicate and less resource-intensive, are unable to infer gender in a higher proportion of cases.[19 26 41]

One potential reason for this authorship disparity is a lack of sufficient ‘pipeline’ or women in academia to author commentary articles. If commentaries are authored by women at any stage of their career, then our analysis reveals

that women physician authors are under-represented compared with the proportion of women physician faculty in academic medicine from 2014 to 2017.[4 20–22] As such, this is likely not a viable explanation for this authorship disparity. Alternatively, if primarily full professors in academia author commentaries, then our analysis reveals that women physician first authors are well represented compared with the proportion of women physician full professors in academia, but are under-represented in the last author position. While this may offer one explanation for the authorship disparity, commentary articles do not specify career stage to qualify for authorship, such that we cannot validate whether the gender disparity in commentary authorship mirrors the gender disparity of senior-level physicians. Moreover, a recent study has shown that gender disparities in commentary articles cannot be explained exclusively by seniority.[19] Lastly, prior studies have shown that lack of sufficient pipeline is not generally a viable reason for gender disparities in academia.[42 43]

A second potential reason for the gender disparity in authorship rates is that women submit fewer manuscripts. We do not have access to the submission rates for the journals examined in this study; however, the multidisciplinary journal *Science* has reported that it receives a third fewer submission from women authors, compared with men authors, in the scientific fields they represent.[44] While a higher proportion of submissions by women may improve the gender disparity in authorship, studies within other fields have shown that with similar types of submissions women still have lower manuscript acceptance rates compared with men.[45] The current state of under-representation of women authors may also deter subsequent submissions by women. This concept of internalised bias, or 'imposter syndrome', has been shown to limit attempts or applications by women in other scenarios where gender parity is lacking.[46]

Another potential contributor to gender disparities in authorship of commentaries is institutional bias, defined as the 'practices, scripts, or procedures that work to systematically give advantage to certain groups or agendas over others'.[47] These biases are built into the fabric of the institution and can limit opportunities for certain groups of people, such as women.[48 49] Prior literature reveals evidence of pervasive implicit bias and gender discrimination in academics,[14 50–52] with subsequent limits in opportunities for recognition with publications, invited lectures, career advancement, promotion and leadership opportunities.[53–55] These biases can also influence the journal's selection process for commentaries. Studies have shown that these biases can become more pronounced with less defined processes.[56 57] In contrast to original research articles, there is a less specific set of guidelines listed on journals' website to assess the merit or quality of a commentary piece.[20–22] There may be instances in which submissions are encouraged or invited that are not readily apparent. We postulate that some of the differences seen in prior studies examining gender differences in authorship may be explained by differences in the selection process for commentary versus original research articles. For example, Ouyang *et al*[26] found that, in contrast to our study, there is a higher proportion of women first authors with women last authors in original research articles.[26] This conflicting finding may be explained by more pronounced biases in the selection of commentary articles that favour authorship by men in the first and/or last position. Furthermore, these institutional biases have been shown to limit mentorship and sponsorship opportunities for women.[58 59] Patton *et al*[60] found men mentees receive greater sponsorship compared with women mentees from both men and women mentors,[60] with women reporting difficulty in finding same-sex mentors.[61] This could further explain why women last author mentors had the lowest proportion of women first author mentees.

Experts have called for better data collection in publishing as a key first step to understanding disparities in publishing.[62] As more structured and objective processes have been shown to mitigate the effect of bias,[57] tracking metrics related to invitation, submission and acceptance of commentary articles may highlight where efforts should be directed to achieve parity in authorship. Additional strategies may include implicit bias training for editors as well as academic mentors and sponsors.[63] Mentors have an opportunity to be more deliberate in how sponsorship and other forms of micro-affirmations may be contributing towards gender disparities in career advancement in academia.[53 59] As sponsorship that develops organically, rather than formally, can exclude talented individuals, formal institutional sponsorship programmes are integral to supporting women in medicine.[64] Sponsors can both advocate for and assist women, including encouraging manuscript submissions to high-impact journals, applying for positions and overcoming aversion to self-promotion.[65] In addition, there is evidence that gendered associations of words in peer review exist and that the use of objective non-gendered language can promote gender equity in the selection process.[66] For example, minimising the use of words that are implicitly associated with what are perceived to be traditionally masculine traits, such as replacing 'leadership opportunity' with 'opportunity to make a contribution', has shown to promote gender equity in grant funding.[67 68] Lastly, additional strategies described in the literature include achieving parity at the editor-in-chief level within journals.[69 70] Our study included a women editor-in-chief in one of three journals. While this disparity in journal leadership needs to be mitigated, interestingly, in our study, a women editor-in-chief did not necessarily translate into a more equitable inclusion of authors for commentary pieces. Parity within journal and institutional leadership may need to be coupled with objective selection processes, formalised institutional sponsorship opportunities, and the use of non-gendered terminology in the peer review process to promote submission and acceptance of women-authored manuscripts.

CONCLUSIONS

Overall, our analysis reveals that women physicians are under-represented as authors in commentary articles. Experts recommend that a key first step in confronting this disparity include data collection on the extent of the gender disparity in authorship. The chasm among men and women authors in commentary pieces highlights the attenuation of the voice of women in academia, emphasising a need for greater efforts directed towards institutional support and sponsorship of these individuals.[65] Any posited solutions to achieve parity in authorship must be a part of a larger strategic vision to ensure medical research reflects the contributions of a diverse body of physician scientists.

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Patient consent for publication Not required.

Ethics approval Our institutional review board granted exempt status to this study.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available in a public, open access repository. Extra data can be accessed via the Dryad Data Repository at http://datadryad.org/ (doi:10.5061/dryad.t6855h4).

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