

Has Female Authorship in Family Medicine Research Evolved Over Time?

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ABSTRACT

PURPOSE Studies conducted in medical fields other than family medicine show that gender differences in publication rates are pronounced in many, but not all, fields of medicine. Our objective was to assess possible gender differences in publication rates in family medicine journals.

METHODS Using MEDLINE, we collected information on all journal articles published in 3 family medicine journals in the United States (*Family Medicine*, *Journal of the American Board of Family Medicine*, and *Annals of Family Medicine*) during the period 2008 to 2017. Gender of first and last author for each article was assigned using first names. The gender breakdown of the editorial boards during this time period was also examined.

RESULTS For the 3 journals combined during the period 2008 to 2017, 46.1% (1,209/2,623) of first authors were female, and 38.6% (857/2,223) of last authors were female. For all journals combined, there was a statistically significant increase in first authorship (43.2% in 2008 vs 52.1% in 2017; $P < .001$) and last authorship (28.8% in 2008 vs 41.8% in 2017; $P < .001$) over time. The editorial boards of the journals combined were 37.2% (279/749) female, and this did not increase significantly over the time period studied (35.5% in 2008 vs 39.2% in 2017; $P = .49$).

CONCLUSIONS Representation of female authors in family medicine journals is increasing, yet last authorship remains low, and there is variation between journals in terms of gender equity. Future studies can evaluate the reason for these differences and offer solutions to publications as they try to increase their female authorship.

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INTRODUCTION

After decades of underrepresentation in medicine, women are now entering many specialties, including family medicine, at greater rates than men.¹ Despite the increasing proportion of female physicians in family medicine, they continue to be underrepresented in the highest levels of professional attainment, particularly in academic settings.² In 2018, although more than 50% of family medicine faculty were female, only 35% of full professors were female.² This gap in seniority might exist because as women have been increasing in numbers in academic medicine, alternative routes to advancement in academia, such as the clinical educator track (CET), have emerged. Although tenure is offered on the CET, it is rare, and faculty on this track are less likely to be promoted.³ In addition, over the past 30 years, the percentage of tenured or tenure-eligible faculty has decreased from 60% to 30%, and this decrease has been more pronounced for women.³ In 2011, 75% of the medical schools that offered a CET had more women on this track than men, yet only 20% of schools had more women on the traditional tenure track.³ These trends have serious implications with regard to who is motivated to conduct and publish research. Furthermore, because academic promotion is dependent on scholarly activity, such as publication in peer-reviewed journals,^{4,5} these trends underscore the importance of gender parity in publication rates.

Conflicts of interest: authors report none.

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Many researchers have studied gender differences in publication rates as one proxy for gender disparities in academic medicine.⁶⁻¹¹ A study examining the differences in publication rates of original research in pediatric journals found that women are publishing at greater rates than men as first authors, yet they continue to be underrepresented as last authors.⁸ In addition, an examination of high-impact internal medicine journals over the last decade showed that although the representation of women as first authors increased, it has started to plateau, and a gender gap still exists.⁷ Such data for family medicine journals are limited, but an article published a decade ago showed that women first-authored only one-third of original articles in the family medicine journals studied.¹¹ Our objective was to examine if gender differences in family medicine publication rates have changed over the past decade by examining 3 high-impact family medicine journals in the United States: *Family Medicine*, *Journal of the American Board of Family Medicine*, and *Annals of Family Medicine*.

METHODS

Data Source

We used publicly available data from MEDLINE to obtain all articles published from 2008 to 2017 in the 3 highest-impact family medicine journals in the United States: *Family Medicine*, *Journal of the American Board of Family Medicine*, and *Annals of Family Medicine*. We excluded *American Family Physician* because a majority of the articles are classified as review articles as opposed to original research. The publicly available data included ordered author list, article title, journal, year of publication, funding source, and article type. MEDLINE categorizes articles into more than 100 different categories; we reviewed each article's categorization and excluded articles that were not deemed original research (inclusion and exclusion criteria are listed in Supplemental Table 1, <https://www.AnnFamMed.org/content/18/6/496/suppl/DC1/>). To obtain information regarding editorial boards, we used the names of the editors listed in the first edition of each journal for each year studied. To obtain these lists, we first searched the journal websites. If the editorial board was not listed online for the year of interest, we obtained a scanned copy of the journal's cover page for that year from the librarian at our institution.

Measures

We looked only at first and last authorship when determining gender for the articles. This is aligned with other published bibliometric analyses that examined gender differences in authorship. If only 1 author was on a paper, they were counted as a first author because

the first author position is traditionally the author responsible for the conceptualization and writing of the manuscript. We considered last author in our analysis because traditionally, the last author is the most senior author on the research team.¹² If an organization was listed in the last authorship position, we used the last individual author listed instead of the organization.

Analysis

First names of first and last authors for all articles and sample years were digitally extracted and matched to US Social Security records from 1950 to 2000. First names were coded as male or female if they had been assigned to the respective gender in more than 60% of instances in the US Social Security records. The gender for names that could not be identified via the automatic coding was manually assigned using 2 rounds of reviews with a third round of reconciliation, conducted with Google searches and examination of institutional websites (Supplemental Table 2, <https://www.AnnFamMed.org/content/18/6/496/suppl/DC1/>).

We used manual assignment to test the accuracy of the above-described automated process. For the even-numbered sample years, 2 reviewers separately assigned gender to the first and last authors based on first name. If the reviewer was unsure of gender based on first name, institutional websites were searched for photographs or gender-identifying pronouns. A third reviewer resolved any differences between reviewer 1 and 2 (Supplemental Table 2). We compared manual assignment and automated assignment for the even-sample years and found a 98.4% match rate for first author gender and a 98.0% match rate for last author gender.

Once all genders were assigned, we calculated the proportion of all first authors who were female for each year for the journals separately and then as a whole. We repeated the same process for last authors.

Statistical Analyses

We used the Cochran-Armitage trend test to measure significance in the proportional trends over time by journal. We used χ^2 tests to examine overall differences in first author gender, last author gender, and editorial board member gender between journals. We conducted multiple logistic regression on the outcome of female first authorship with article as the unit of analysis and journal as the independent variable. We controlled for number of authors (1, 2, 3-5, 6-8, 9-25), year of publication (2008-2017), and funding reported (no funding reported, funding reported). We repeated this regression analysis for female last authorship. Finally, we repeated these analyses using the average across the 3 journals as the journal reference category. We used

a *P* value of .05 to account for significance. We used Stata version 16.0 (StataCorp, LLC) for analysis.

RESULTS

Of a total of 3,672 articles identified, 1,020 were excluded because they were not categorized as original research (Supplemental Figure 1, <https://www.AnnFamMed.org/content/18/6/496/suppl/DC1/>). Eleven articles were excluded because gender of the first author could not be identified, 10 were excluded because gender of the last author could not be identified, and 8 were excluded because the author was cited anonymously. A total of 400 articles had only 1 author listed. Because we included solo-authored articles in the first-authorship category, we identified a total of 2,623 articles with a first author and 2,223 articles with a last author.

Overall, we found that 46.1% (1,209/2,623) of the articles included had a female first author, and 38.6% (857/2,223) of the articles had a female last author (Table 1). During the period 2008 to 2017, there was a statistically significant increase in female first authorship from 43.2% (104/241) to 52.1% (139/267) ($P < .001$) and female last authorship from 28.8% (55/191) to 41.8% (94/225) ($P < .001$) (Supplemental Table 3, <https://www.AnnFamMed.org/content/18/6/496/suppl/DC1/>). During this time period, editorial boards increased from 35.5% female (27/76) to 39.2% female (29/74), but this was not a statistically significant change ($P = .49$).

When analyzing each journal independently, we found that *Family Medicine* had the greatest overall proportion of first and last female authors (50.2% [498/993] and 46.2% [344/745], respectively), and the *Annals of Family Medicine* had the least overall proportion of first and last female authors (42.3% [302/714] and 32.0% [202/632]) (Table 1). Although the proportion of female first authors did increase for all 3 journals over the study period, this trend was only significant for the *Journal of the American Board of Family Medicine* ($P < .001$) (Supplemental Table 3 and Figure 1). Female last authorship increased over the study period for *Family Medicine* ($P = .03$) and the *Journal of the American Board of Family Medicine* ($P = .04$) but showed no significant change for the *Annals of Family Medicine* ($P = .21$) (Supplemental Table 3 and Figure 2).

Overall, 37.2% (279/749) of the editorial boards of the journals were female during the time period studied (Table 1). The *Journal of the American Board of Family Medicine* had the least

Table 1. Representation of Women Among First Authors, Last Authors, and Editorial Boards Across 3 Family Medicine Journals, 2008-2017

	No. Female/ No. Total	Percent
Overall		
First author	1,209/2,623	46.1
Last author	857/2,223	38.6
Editorial board	279/749	37.2
Family Medicine		
First author	498/993	50.2
Last author	344/745	46.2
Editorial board	94/196	48.0
Journal of the American Board of Family Medicine		
First author	409/916	44.7
Last author	311/846	36.8
Editorial board	62/244	25.4
Annals of Family Medicine		
First author	302/714	42.3
Last author	202/632	32.0
Editorial board	123/309	39.8

proportion of women on their editorial board (25.4% [62/244]), and *Family Medicine* had the greatest proportion of women on their editorial board (48.0% [94/196]). Although the proportion of women on the editorial boards for *Family Medicine* and the *Journal of the American Board of Family Medicine* increased from 2008 to 2017, the trend over time was not significant (Supplemental Table 3 and Figure 3). There was no increase over time for the *Annals of Family Medicine*.

The regression model results were consistent with the results discussed above, showing that articles were more likely to have a female first author in 2017

Figure 1. Female first author, 2008-2017.

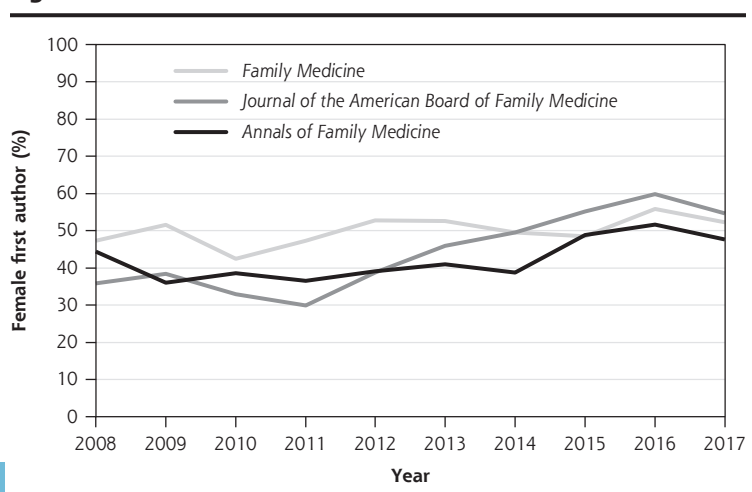
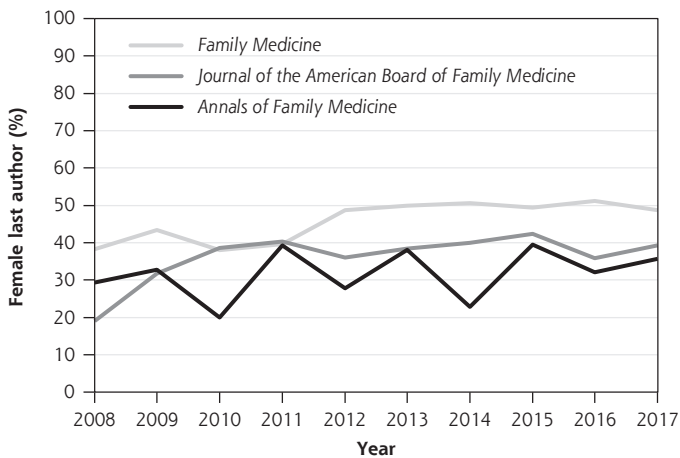
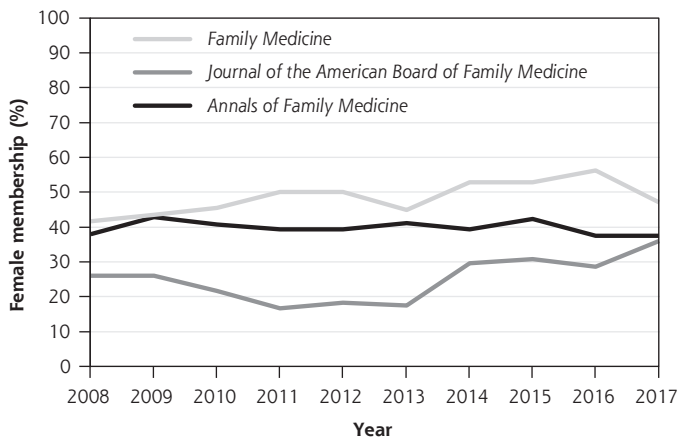


Figure 2. Female last author, 2008-2017.**Figure 3. Female editorial board membership, 2008-2017.**

compared to 2008 ($P = .011$, odds ratio [OR] = 1.6) (Figure 4 and Supplemental Table 4, <https://www.AnnFamMed.org/content/18/6/496/suppl/DC1/>) and more likely to have a female last author in 2017 compared to 2008 ($P = .003$, OR = 1.92) (Figure 5 and Supplemental Table 4). We also found that solo-authored articles were less likely than articles with 3 to 5 authors to have a female first author ($P < .001$, OR = 0.53), and articles with reported funding were more likely than articles with no reported funding to have a female first author ($P < .001$, OR = 1.65) (Figure 4).

Compared to articles in *Family Medicine*, articles in the *Journal of the American Board of Family Medicine* and *Annals of Family Medicine* were less likely to have a female first author ($P < .001$, OR = 0.636 and $P < .001$, OR = 0.576, respectively) when controlling for year, number of authors, and funding type (Figure 4, Supplemental Table 4).

DISCUSSION

The present descriptive and regression results showed a statistically significant increase in female first and last authorship over the decade studied, which aligns with trends examined in other primary care specialties.⁶⁻⁸ In the final year studied, approximately one-half (52.1%) of articles overall had female first authors, but only 41.8% of articles had female last authors. Our regression results also showed that a greater number of authors and reported funding increase the odds that the first author will be female.

Given the increase of women in academic medicine over the past decade, it makes sense that articles published on later dates showed greater odds of having a female first or last author. It is also not surprising that women were less likely to be first authors if they were solo authors. Solo authorship is generally awarded to senior researchers; therefore, this finding likely represents the overall gap between men and women in achieving full professorship in academia. Although the lag time for reaching professorship in a traditionally male-dominated profession is a factor, there are many other factors that might explain gender discrepancy in senior academic positions and thus last authorship. Multiple studies have shown that the current culture of academic medicine has been perceived as less conducive to career advancement for women¹³ because of a lack of gender-concordant mentorship and role modeling,¹⁴ work environments that are not supportive of personal life,¹⁵ sexism,¹⁶ and feelings of isolation or not belonging.¹⁷

We found it interesting that the odds of having a female first author increased if the authors reported that the research was grant funded. Whereas it makes sense that grant-funded research would be more likely to be published, the question is why is first authorship less likely to be female if there is no grant funding? Previous studies have shown that male and female science faculty view male scientists as more competent, even when they have the same qualifications as their female counterparts.¹⁸ This gender bias could also be present in the review process, making it less likely for a woman to be published unless she has been "prevetted" by grant funding. It is also possible that women themselves are less likely to submit to a journal unless they have received grant funding. Previous work has shown differences in self-perceived competency to perform research, with female physicians rating themselves

lower than their male counterparts.¹⁹ Perhaps this difference in perceived abilities leads women to submit less often to journals unless their research has been “legitimized” by grant funding.

There are many possible explanations for our present results, but the most obvious question is whether gender bias is a factor, and if so, what journals can do about it. Methods such as double-blinding reviews have been suggested as a solution, and although previous literature has shown that double-blinding the review process can increase female representation in authorship,²⁰ our present study did not validate this assertion. The journal with the most female representation in authorship, *Family Medicine*, does not use a double-blinded review process. What appears to be more likely is that the gender composition of the editorial board might impact female authorship. A previous study on the trends of female first authorship found that the journals with female editors-in-chief had the greatest rates of female first authorship.⁷ Furthermore, research has shown that male editors are

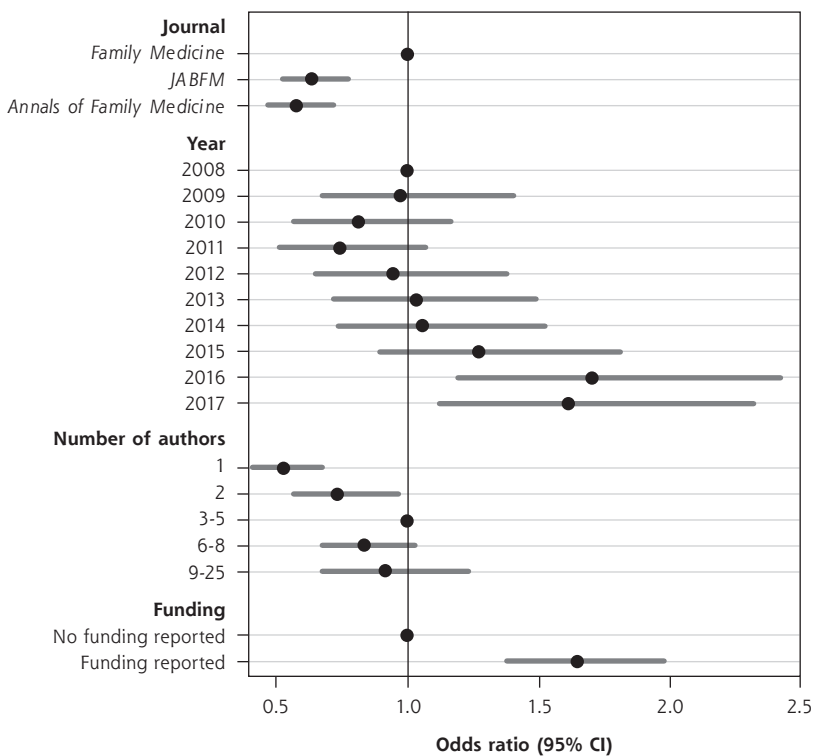
more likely to assign manuscripts to male reviewers and that male reviewers are more likely to recommend rejection of articles written by authors of the opposite gender.^{6,21} Interestingly, the editorial board of *Family Medicine* was 48.0% female overall for the period 2008 to 2017, whereas the *Journal of the American Board of Family Medicine* and *Annals of Family Medicine* had much lower numbers of female editors (25.4% and 39.8%, respectively).

Finally, it is possible that it is not the acceptance rates of female-authored articles that explains our findings but instead submission rates. Perhaps women are less likely to submit articles overall or more likely to submit to one journal over another. To our knowledge, there are no known studies of gender differences in submission patterns, but such a study could help explain these results.

There are several limitations to the present study. First, the potential for misclassification of gender due to androgynous names is possible, yet our study used similar, if not more rigorous, methods of classifica-

tion compared to other similar bibliometric analyses.^{7,8} Not only did we search websites for androgynous or unfamiliar names, we also had 2 independent reviewers assigning genders and a third reviewer resolve discrepancies. Along these lines, our analysis considered binary gender only because of the data available to us. As we continue to explore traditionally under-represented groups in academic medicine, we also need to study potential differences in publication rates for other groups of physicians such as under-represented minorities or the LGBTQ community. Second, family medicine faculty might be publishing in journals other than *Family Medicine*, *Journal of the American Board of Family Medicine*, and *Annals of Family Medicine*. Conversely, these aforementioned journals may also include authors from fields other than family medicine. Despite these possible confounders, all 3 journals studied are representative of the family medicine research world, and therefore the representation of women as authors

Figure 4. Logistic regression for likelihood of an article having a female first author.

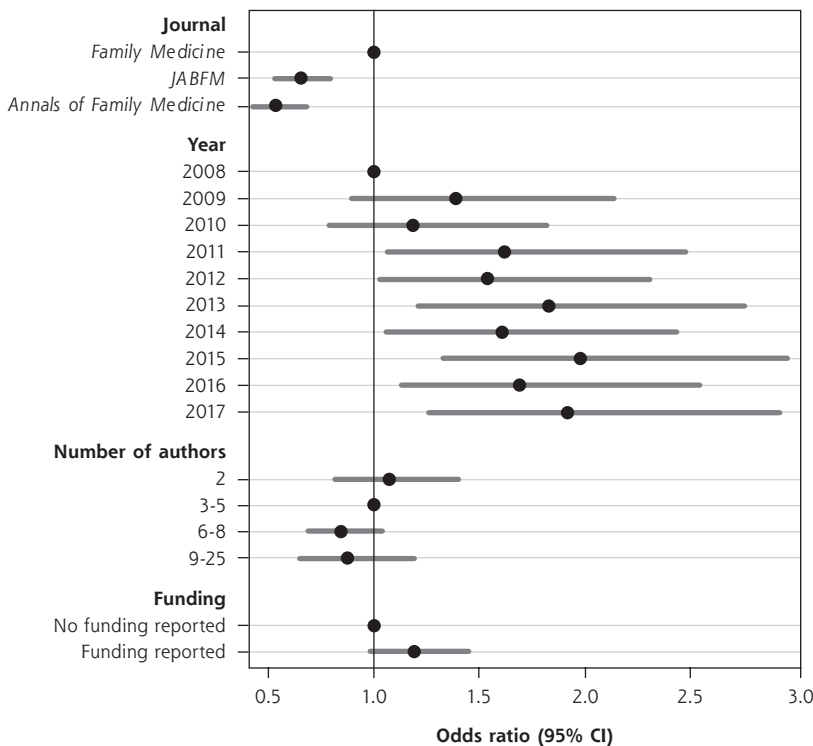


JABFM = *Journal of the American Board of Family Medicine*.

Note: N = 2,623. Includes articles categorized as original research articles. Controlled for publication year (2008-2017), number of authors (1, 2, 3-5, 6-8, 9-25), and funding type (reported, not reported).

Sources: *Family Medicine*, *Journal of the American Board of Family Medicine*, *Annals of Family Medicine*, 2008-2017, via MEDLINE.

Figure 5. Logistic regression for likelihood of an article having a female last author.



JABFM = Journal of the American Board of Family Medicine.

Note: N = 2,223. Includes articles categorized as original research articles. Controlled for publication year (2008-2017), number of authors (1, 2, 3-5, 6-8, 9-25), and funding type (reported, not reported).

Sources: Family Medicine, Journal of the American Board of Family Medicine, Annals of Family Medicine, 2008-2017, via MEDLINE.

workplace culture that is conducive to family life, incorporating protected research time into the workday, and developing formal mentorship programs might help close the gender gap in academic family medicine and research. The importance of increasing female representation in peer-reviewed publications is essential to closing gender gaps in the highest levels of academic medicine and for ensuring appropriate representation of thoughts and ideas in the field of family medicine.

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Key words: bibliometrics; authorship; gender gap; academic medicine

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and editors should also be representative. Third, the present data do not represent acceptance or rejection rates; therefore, it might be possible that any gender difference we found is not based on bias in the review process but instead on other factors such as productivity or submission patterns. Finally, our analysis focused only on original research, yet there are other types of scholarly work to which women likely contribute such as review articles, editorials, and narrative pieces. Nonetheless, academic institutions consider publication of original research in peer-reviewed journals essential for promotion, which is why we chose to highlight this study type.⁴

Overall, female representation in family medicine publications is increasing, but there is room for growth. Journals should strive to have editorial boards that mirror the specialty of family medicine for the sake of role modeling and engaging all genders in academic research. Academic centers can also take steps to support women researchers. Hiring diverse faculty (particularly in leadership positions), creating a

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