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Surgical Training/Education

Does academic authorship reflect gender bias in pediatric surgery? An analysis of the *Journal of Pediatric Surgery*, 2007–2017

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ABSTRACT

Background: Gender representation in academic publications has been considered a surrogate for gender equity in medicine, although this concept has not been evaluated in pediatric surgery.
Methods: First and last author genders for *Journal of Pediatric Surgery* articles from United States and/or Canadian institutions (2007, 2012, 2017) were identified. These data were compared to gender proportions for applicants to and matriculants in pediatric surgery fellowships as well as among American Pediatric Surgical Association (APSA) members.
Results: Authorship gender was identified for 632/640 primary articles (98.8%). From 2007 to 2017, the proportion of women as first authors increased from 33.0% to 53.9% ($p < 0.001$) and as last authors from 16.2% to 26.4% ($p = 0.01$). The proportion of women fellowship applicants rose from 35.9% to 57.6% ($p < 0.001$); among those who successfully matched the rise was nonlinear (20.5%–34.0%, $p = 0.16$). APSA junior and senior women membership proportions rose during the study period [from 28.1% to 43.4% ($p = 0.06$ for linear trend) and 17.9% to 24.4% ($p = 0.005$ for linear trend), respectively].
Conclusions: Over the past decade, the overall proportion of women authors in a leading academic pediatric surgery journal has increased significantly, although representation among last authors remains disproportionately low. The numbers of women applicants to pediatric surgery fellowship increased but there was not a concordant rise in the number of women accepted into training positions.
Type of study: Bibliometric analysis.
Level of evidence: n/a

The proportion of women entering medicine in the United States has increased markedly over the past 50 years; as of 2018, 47% of medical graduates were women. Out of all practicing physicians in 2017, 35% were women [1]. The proportion of women in academic medicine is 39% [2]. In general surgery, 36% of residents in 2017–2018 were women [3] although among active practicing general surgeons, only 21% were women [1]. At the leadership level, women represent only 13% of full professors [4] and 3.3% of surgery department chairs [5]. Over the past half century, pediatric surgery has seen an increase in women entering the field; women represented 58% of pediatric surgery fellowship applicants in 2017 [6]. Pediatric surgery is no different from surgery as a whole with a disproportional number of men in senior and leadership positions.

Previous studies have shown that first and last authorships are indirect measures of gender equity in academic medicine [7–10]. This should be particularly true for pediatric surgery since academic productivity is considered critical for both matching into a pediatric surgery fellowship and subsequent academic promotions. We examined gender distribution in first and last authorship of a leading pediatric surgery journal as a surrogate for gender equity in pediatric surgery.

1. Methods

We chose to audit content from the *Journal of Pediatric Surgery*, which is considered the leading pediatric surgery-specific journal in the United States and Canada. The years 2007, 2012 and 2017 were chosen since this decade represents both a time of accelerated growth in pediatric surgery training programs and increased national awareness of gender inequity in medicine.

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For each of these three years, published articles (original research articles, case reports, reviews, and lectures) were assessed for the year of publication, the type of article, and the gender of the first and last author of each paper. For this analysis we chose only articles whose last author was from an American or Canadian institution to allow for comparison to fellowship matriculation and graduation data from those two countries. Author gender was assessed by typical name recognition and internet searches for the individual using institutional information. Additional search strategies included examination of social media accounts (such as LinkedIn and ResearchGate), as well as the online gender identifying program, GenderAPI (https://gender-api.com). Articles were excluded in cases where gender was not identifiable. Only female and male genders were used as there were no individuals identified as nonbinary.

These data were compared to the gender distribution of practicing pediatric surgeons, estimated by evaluation of membership lists of the American Pediatric Surgical Association (APSA) for the years 2007, 2012 and 2017. Junior APSA members were defined as those in the category of general surgery residents or candidate members (enrolled in during or within 12 months of completion of pediatric surgery fellowship). In the year 2007 there was no general surgery resident membership category. Senior APSA members were defined as those in the categories of regular membership or associate membership (non-traditional training background). We did not include retired members, although in the year 2007 no distinction was made by APSA between retired members and those more than 65 years old but who might still be practicing. We chose to exclude those members listed as Senior/Retired, postulating that only a small minority of those >65 years in age would still be in practice.

To gain further insight into the proportion of women entering pediatric surgery, we examined pediatric surgery fellowship training applicants during the years 2007–2017. Gender proportions for each of the years were determined from data provided by the Electronic Residency Application Service (personal communication). Match data were inferred from A Genealogy of North American Pediatric Surgery: From Ladd until Now [11]. Additional data were obtained from the American Board of Surgery on pediatric surgery certificates issued between the years 2006 and 2017 (personal communication). Because certificates prior to 2012 were issued on a biannual basis, we were able to collect gender compositions of pediatric surgery certificate awardees for the years 2006, 2008, 2010, 2011, 2012, 2013, 2014, 2015, 2016 and 2017.

This study received exempt status from The University of Buffalo Institutional Review Board.

1.1. Statistical analyses

General descriptive statistics were used to describe gender proportions in authorship as well as the gender of graduated pediatric surgery fellows and APSA members. Trend significance was measured using the Cochrane–Armitage test.

2. Results

2.1. Publications

1338 eligible publications were examined, of which 632 were from the United States or Canada (Fig. 1). Of these, 24 (1.8%) were excluded owing to an inability to identify the gender of the first or last author. There were 31 (2.4%) manuscripts with a single author; these authors were assigned to the last author category. Among the articles analyzed, 251 (40.6%) of first authors and 139 (22.0%) of last authors were women. There was an increase in the proportion of women first and/or last authors over time (24.4% in 2007 vs 40.1% in 2017, $p < 0.001$). When stratified by author type over the same interval, the proportion of women as first authors increased from 32.8% to 34.8% to 53.9% ($p < 0.001$ for linear trend) and as last authors from 16.2% to 23.0% to 26.4% ($p = 0.01$ for linear trend) for each of the years studied (Fig. 2).

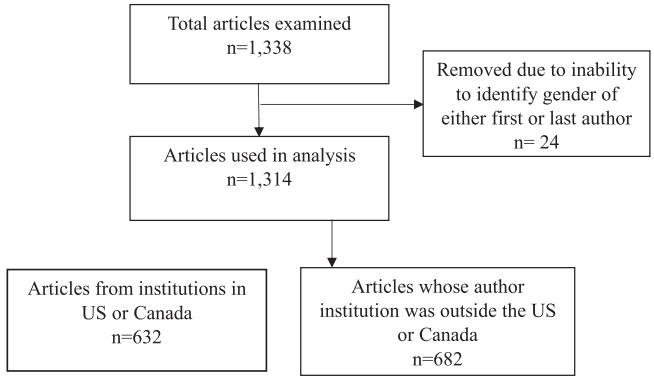

Fig. 1. Flowchart depicting number articles used in analysis.

2.2. Pediatric surgery fellowship training

The proportion of women applying for pediatric surgery fellowship training rose from 35.9% to 57.6% ($p < 0.001$ for trend) during the study period. Similar increases were not, however, seen in the pediatric surgery match, where the proportion of women among all matched applicants ranged from 20.5% to 50.0% but did not show a consistent increase ($p = 0.51$ for trend). This was corroborated by American Board of Surgery data on board certification in pediatric surgery during the same period. The percentage of certificates awarded to women showed a rise from 16.4% in 2006 to a peak of 46.5% in 2012, followed by a decrease to 33.3% in 2017 ($p = 0.98$ for trend) (Fig. 3).

2.3. APSA membership

APSA membership (excluding retired members), used as a surrogate measure of practicing pediatric surgeons, numbered 533 in 2007, 805 in 2012 and 929 in 2017. For the analysis, 8 (0.7%) and 9 (0.7%) members were excluded from the second and third years, respectively, owing to the inability to identify a gender. Although the proportion of female senior members remained low, representation of women among both junior and senior members rose, from 28.1% to 32.0% to 43.4% ($p = 0.06$ for linear trend) and from 17.9% to 21.2% to 24.4% ($p = 0.005$ for linear trend), respectively (Fig. 4).

3. Discussion

Since the first report about female representation in medical publications in 1976 by Benedek [12] there has been an exponential increase in the number of papers on the subject of gender representation in academic publications. Numerous studies have documented the

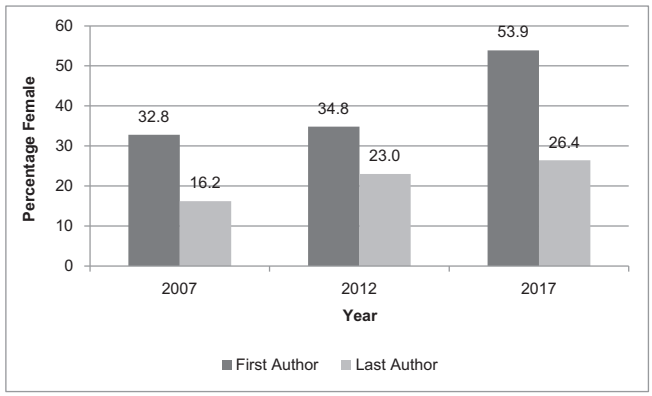

Fig. 2. Representation of women among first and last authors from United States and Canadian institutions of articles from the *Journal of Pediatric Surgery*, 2007–2017.

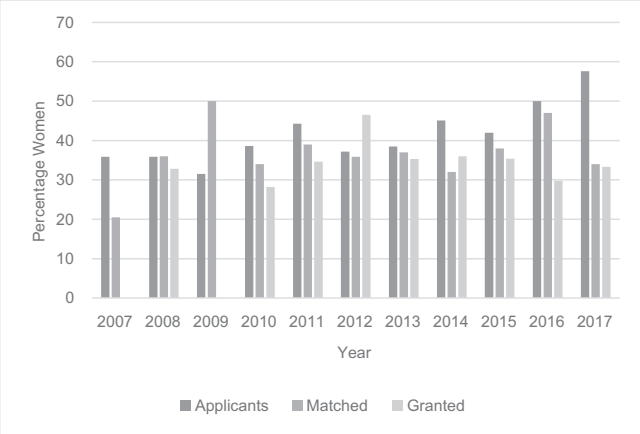

Fig. 3. Gender proportion trends in applicants to pediatric surgery fellowship programs, those matching in pediatric surgery and those granted pediatric surgery certificates from the American Board of Surgery, 2007–2017.

discrepancy between workforce representation and authorship [13–22]. Since authorship has significant implications for additional postgraduate training, promotion and tenure [7–10,13,23] this is an important metric to follow as institutions attempt to narrow the gender gap in leadership.

These studies have found that despite increasing representation of women in medical specialties, authorship (particularly last authorship) in medical journals has not mirrored this trend [13–22]. Explanations for these discrepancies have been varied but predominantly focus on the issue of disparities in the academic promotion of women [23,24]. Women in academic medicine are promoted at slower rates than their male colleagues and female representation in leadership positions lags behind that of men [24]. In 2017, academic clinical sciences faculty were represented by women at the instructor, assistant professor, associate professor and full professor levels 59%, 47%, 37% and 24% of the time, respectively [25]. Women in 2018 comprised 18% of all medical school department chairs [26] and 18% of all permanent or interim medical school deans [5]. For women seeking promotion, gender bias has long been acknowledged as a barrier to promotion [21,24]. There have not been any studies on gender discrimination within pediatric surgery to our knowledge; however in a survey administered to female surgeons at academic centers, 41% of women felt that they had experienced gender discrimination as staff surgeons, and more than half indicated that they felt gender had played a role in the challenges they faced in their careers, including barriers to promotion [25].

Our study demonstrates that there has been an increase in the percentage of women publishing as first or last authors in a leading pediatric surgery journal during the past decade. This increase was disproportionally in the number of first authors, who are likely to be trainees. There were significantly fewer women who were last authors. This study supports the hypothesis that inequity in publications mirrors the gender inequity in promotion since last authorship proportions roughly mirror senior APSA membership proportions. This suggests that women who become pediatric surgeons tend to publish as last authors at similar rates to male pediatric surgeons.

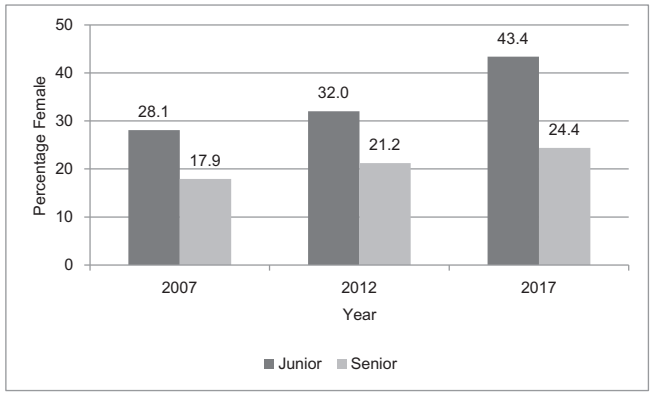

Fig. 4. Representation of women in junior and senior APSA membership categories, 2007–2017.

Although our study was designed to evaluate gender disparity in publications, we were distressed to find that this disparity seems to extend to those who match into pediatric surgery; despite a significant increase in women applying to pediatric surgery, the proportion of women who successfully match into pediatric surgery has not increased. This difference in gender proportion among pediatric surgery fellowship training applicants and those who matched – despite a strong representation of female first authors – raises concern for bias in the fellow selection process. This warrants careful evaluation and interventions. It is important to note that decisions about academic advancement, research, and manuscript writing are deeply personal and influenced by myriad factors, some of which may be related to implicit bias and perceptions thereof but may also include differences in family and clinical career aspirations. Nevertheless, we agree with others who feel that current best practices would suggest that fellowship program directors and others involved in the fellow selection process must become aware of their implicit biases and ways to proactively address these biases during the application process. We would propose that all interviewers and selection committee members should undergo individual testing with the Implicit-Association Test (https://implicit.harvard.edu/implicit/takeatest.html), to attempt to decrease inequities that result from implicit bias.

A key question when evaluating gender bias is how to define a bias-free state. Should we be striving for the goal of equal proportions of female last authors and female senior APSA members? Or should we aim higher? At the most basic level, any differences in authorship gender proportion that differ from population gender proportion may represent bias. The explanations for *why* these proportion differences exist are myriad, and include both inherently distasteful causes of active gender discrimination as well as more nuanced reasons that comprise personal choices and self selection (although personal choice is often driven by a system that makes it more difficult for females to advance). Unraveling these subtleties is beyond the scope of this study, but we hope to stimulate a conversation and reflection on balance and bias in our specialty.

Our study has limitations that should be noted. The three years studied could have resulted in sampling bias for data from this 10-year period. Additionally, we utilized APSA membership information to estimate actual numbers of junior and senior pediatric surgeons. Even though it is estimated that ~95% of pediatric surgeons belong to APSA, it is important to note that not all pediatric surgeons are members of the association. Our data on membership are based on a primarily North American professional organization and our authorship analysis focused on United States and Canadian authorship in order to make correlations with membership gender data. The findings about the entrance of new pediatric surgeons and upward movement of women within the field may not apply to other parts of the world. Further studies would need to be done to fully assess the status of women globally. Additionally, our study did not include race, sexual orientation or other potential intersectional issues that could worsen bias.

4. Conclusion

Over the past decade, the proportion of women publishing in a leading academic pediatric surgery journal has increased, although this progress is disproportionately as first rather than last author. This lag in last authorship may be a result of implicit bias in fellow selection process and academic promotion. One of the most concerning findings of our study was a trend suggesting that the proportion of women accepted into pediatric surgical fellowships is less than the proportion applying. Our data confirm

that pediatric surgery is no different from other specialties which have been previously studied; women in pediatric surgery are proportionally less likely to publish as last authors. This trend is likely to track along with likelihood of promotion and advancement into leadership roles. These data should serve to stimulate conversations and further research on how junior faculty – women and men alike – are mentored, and what explicit and implicit biases exist in academic advancement.

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References

[1] Association of American Medical Colleges. Active physicians by sex and specialty, 2017; table 1.3. Number and percentage of active physicians by sex and specialty, 2017. www.aamc.org/data/workforce/reports/492560/1-3-chart.html; 2017. [Accessed 12 August 2019].
[2] Association of American Medical Colleges. The state of women in academic medicine: the pipeline and pathways to leadership, 2015–2016; table 3: distribution of full-time faculty by department, rank, and gender, 2015. www.aamc.org/download/481182/data/2015table3.pdf; 2016. [Accessed 12 August 2019].
[3] Association of American Medical Colleges. Report on residents, table B3. Number of active residents, by type of medical school, GME specialty, and sex, 2017–18 active residents. www.aamc.org/data/493922/report-on-residents-2018-b3table.html; 2018. [Accessed 12 August 2019].
[4] Association of American Medical Colleges. U.S. medical school faculty, 2017. Washington, DC: Association of American Medical Colleges; 2018 Table 13. https://www.aamc.org/data/facultyroster/reports/486050/usmsf17.html.
[5] Association of American Medical Colleges. U.S. medical school faculty. Table 11: distribution of chairs by department, gender and race/ethnicity, 2015. https://www.aamc.org/download/481206/data/2015table11.pdf; 2015. [Accessed 12 August 2019].
[6] Association of American Medical Colleges. Historical specialty specific data. Pediatr Surge. 2018. https://www.aamc.org/download/360222/data/pediatricsurgery.pdf. [Accessed 12 August 2019].
[7] Glick PL CM, Escobar MA, Weiner DJ, Jones Sapienza SA, Mortellaro VE. A genealogy of North American pediatric surgery: from Ladd until now. 2.0 ed2019.
[8] Benedek EP. Editorial practices of psychiatric and related journals: implications for women. Am J Psychiatry. 1976;133(1):89–92.
[9] Diamond SJ, Thomas Jr CR, Desai S, et al. Gender differences in publication productivity, academic rank, and career duration among U.S. academic gastroenterology faculty. Acad Med. 2016;91(8):1158–63.
[10] Fishman M, Williams 2nd WA, Goodman DM, et al. Gender differences in the authorship of original research in pediatric journals, 2001–2016. J Pediatr. 2017;191:244–9 [e241].
[11] Franco-Cardenas V, Rosenberg J, Ramirez A, et al. Decadelong profile of women in ophthalmic publications. JAMA Ophthalmol. 2015;133(3):255–9.
[12] Jagsi R, Guancial EA, Worobey CC, et al. The "gender gap" in authorship of academic medical literature—a 35-year perspective. N Engl J Med. 2006;355(3):281–7.
[13] Kurichi JE, Kelz RR, Sonnad SS. Women authors of surgical research. Arch Surg. 2005;140(11):1074–7.
[14] Long MT, Leszczynski A, Thompson KD, et al. Female authorship in major academic gastroenterology journals: a look over 20 years. Gastrointest Endosc. 2015;81(6):1440–7 [e1443].
[15] Metheny WP, Jagadish M, Heidel RE. A 15-year study of trends in authorship by gender in two U.S. obstetrics and gynecology journals. Obstet Gynecol. 2018;131(4):696–9.
[16] Miller J, Chuba E, Deiner S, et al. Trends in authorship in anesthesiology journals. Anesth Analg. 2019;129(1):306–10.
[17] Piper CL, Scheel JR, Lee CI, et al. Gender trends in radiology authorship: a 35-year analysis. AJR Am J Roentgenol. 2016;206(1):3–7.
[18] Salinaro JR, Puechl AM, Havrilesky LJ, et al. Gender trends in gynecologic oncology authorship: implications for the critical evaluation of gender distribution in academic rank and leadership positions. Gynecol Oncol. 2018;151(3):542–6.
[19] Association of American Medical Colleges. U.S. medical school faculty, 2017, table 13: U.S. medical school faculty by sex, rank, and department, 2017. https://www.aamc.org/download/486102/data/17table13.pdf; 2018. [Accessed 12 August 2019].
[20] Beres A, Baird R, Puligandla PS. Success in the pediatric surgery match: a survey of the 2010 applicant pool. J Pediatr Surg. 2011;46(5):957–61.
[21] Abelson JS, Chartrand G, Moo TA, et al. The climb to break the glass ceiling in surgery: trends in women progressing from medical school to surgical training and academic leadership from 1994 to 2015. Am J Surg. 2016;212(4):566–72 [e561].
[22] Association of American Medical Colleges. U.S. medical school faculty. U.S. medical school department chairs by chair type and sex. https://www.aamc.org/data/facultyroster/498258/departmentchairsbysexandchairtype.html; 2018. [Accessed 12 August 2019].
[23] Association of American Medical Colleges. U.S. medical school faculty. U.S. medical school deans by dean type and sex. https://www.aamc.org/data/facultyroster/498260/medicalschooldeansbysexanddeantype.html; 2018. [Accessed 12 August 2019].
[24] Nakayama DK. Pioneering women in American pediatric surgery. J Pediatr Surg. 2018;53(11):2361–8.
[25] Seemann NM, Webster F, Holden HA, et al. Women in academic surgery: why is the playing field still not level? Am J Surg. 2016;211(2):343–9.
[26] Gilbert JR, Williams ES, Lundberg GD. Is there gender bias in JAMA's peer review process? JAMA. 1994;272(2):139–42.