Does double-blind peer review impact gender authorship trends? An evaluation of two leading neurosurgical journals from 2010 to 2019

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OBJECTIVE Publications are key for advancement within academia. Although women are underrepresented in academic neurosurgery, the rates of women entering residency, achieving board certification, and publishing papers are increasing. The goal of this study was to assess the current status of women in academic neurosurgery publications. Specifically, this study sought to 1) survey female authorship rates in the Journal of Neurosurgery (JNS) [not including JNS: Spine or JNS: Pediatrics] and Neurosurgery from 2010 to 2019; 2) analyze whether double-blind peer review (started in Neurosurgery in 2011) altered female authorship rates relative to single-blind review (JNS); and 3) evaluate how female authorship rates compared with the number of women entering neurosurgery residency and obtaining neurosurgery board certification.

METHODS Genders of the first and last authors for JNS and Neurosurgery articles from 2010 to 2019 were obtained. Data were also gathered on the number and percentage of women entering neurosurgery residency and women obtaining American Board of Neurological Surgeons (ABNS) certification between 2010 and 2019.

RESULTS Women accounted for 13.4% (n = 570) of first authors and 6.8% (n = 240) of last authors in JNS and Neurosurgery publications. No difference in rates of women publishing existed between the two journals (first authors: 13.0% JNS vs 13.9% Neurosurgery, p = 0.29; last authors: 7.3% JNS vs 6.0% Neurosurgery, p = 0.25). No difference existed between women first or last authors in Neurosurgery before and after initiation of double-blind review (p = 0.066). Significant concordance existed between the gender of first and last authors: in publications with a woman last author, the odds of the first author being a woman was increased by twofold (OR 2.14 [95% CI 1.43–3.13], p = 0.0001). Women represented a lower proportion of authors of invited papers (8.6% of first authors and 3.1% of last authors were women) compared with noninvited papers (14.1% of first authors and 7.4% of last authors were women) (first authors: OR 0.576 [95% CI 0.410–0.794], p = 0.0004; last authors: OR 0.407 [95% CI 0.198–0.751], p = 0.001). The proportion of women US last authors (7.4%) mirrors the percentage of board-certified women neurosurgeons (5.4% in 2010 and 6.8% in 2019), while the percentage of women US first authors (14.3%) is less than that for women entering neurosurgical residency (11.2% in 2009 and 23.6% in 2018).

CONCLUSIONS This is the first report of female authorship in the neurosurgical literature. The authors found that single- versus double-blind peer review did not impact female authorship rates at two top neurosurgical journals. https://thejns.org/doi/abs/10.3171/2020.6.JNS20902

KEYWORDS gender; female; authorship; publication; neurosurgery; residency; ABNS; American Board of Neurological Surgery

In recent years, efforts to recruit and retain underrepresented groups in academic medicine, including women and racial minorities, have increased.1,2 Making progress often starts with identifying and reducing unconscious biases that may prevent minority groups from advancing in academic medicine.3–5 Efforts to address these issues include initiating interventions to recruit and retain female faculty members,6 conducting departmental workshops on unconscious bias,7 and performing regular self-reflection on behaviors.4 In academic neurosurgery in particular, men outnumber women, and gender bias may serve as a barrier to academic advancement.8
Publications are vital to academic advancement, and recent studies have demonstrated a gender gap in high-impact medical journals and academic surgery in particular. Men who are associate and full professors in academic surgery publish nearly double to triple the number of papers compared with their female counterparts. It is possible that bias, including unconscious bias, in the peer-review process contributes to the gender gap in publications, as many journals use a single-blind process in which reviewers know the authors’ names and institutions.

Understanding the current publication trends and the potential presence of bias are critical so that the potential for women and underrepresented minorities in specialties such as neurosurgery can be better realized. The purpose of this study was to determine the rates of female authorship in the two premier neurosurgical publications, Journal of Neurosurgery (JNS) and Neurosurgery, over the last decade (2010–2019). In addition, analysis was completed on whether the double-blind peer-review process (initiated in Neurosurgery in 2011) affected rates of female authorship in this journal relative to the single-blind review process at JNS. Finally, we examined how the female authorship rates in the top neurosurgical publications compare with the rates of women entering neurosurgery residency and women achieving American Board of Neurological Surgery (ABNS) certification over the same time period.

Methods

Authorship Data

We manually collected the following data from articles published during 4 months (January–April) for each year between 2010 and 2019 in JNS and Neurosurgery, as well as all 12 months in 2010 and 2011 (in both journals) and 2013 (in Neurosurgery): article title, neurosurgical subspecialty (tumor, pediatric, spine, trauma, vascular, peripheral nerve, stereotactic and functional, or other), article type (e.g., clinical study, laboratory, technical note, as indicated by the journal), invited or noninvited, total number of authors, first author’s name, and last author’s name. We determined the gender of the first and last authors using authors’ names. For those with unclear gender based on their name, we conducted an online search (on sites including university web pages, LinkedIn, and conference websites) to check for headshots or gender pronouns. Names that remained unclear were marked as unknown and excluded from analysis (overall 3.0% of articles, 0.77% of articles from US institutions).

We selected this time frame in order to collect data on a full 2 years of publications before the implementation of the double-blind review process in Neurosurgery (2010–2011) and a full year of data after the initiation of double-blind review in Neurosurgery (2013). We selected 2013 as opposed to 2011 and 2012, because most of the articles published in 2011–2012 were submitted before the double-blind process was initiated at the beginning of 2011 by Neurosurgery’s editor-in-chief. In addition, we analyzed the first 4 months of publications from 2012 to 2019 in both JNS and Neurosurgery (as a representative sample of the full year) to look at rates of female authorship over the last decade across both journals. In general, there were 30–50 articles published per month in each journal. Other comparisons performed included correlations between genders of first and senior authors, and gender proportions between invited and noninvited articles.

Neurosurgery Resident Data

The National Resident Matching Program reports in 2009, 2011, 2014, 2016, and 2018 were used to determine the rate of entering women neurosurgery residents over the last decade, through the full name and gender (determined via name and picture on residency website; 0% of residents had unknown gender), as previously described.

ABNS Certification Data

To determine the rate of women receiving ABNS certification in neurosurgery, we queried the “Find a Neurosurgeon” tool on the ABNS website (https://www.abns.org/find-a-neurosurgeon/). For each of the 50 states, we searched and collected data on the name of each neurosurgeon, their gender (based on the neurosurgeon’s first name and further verified by cross-referencing with practice web pages, LinkedIn, and other online sources when unclear; 0% of neurosurgeons had unknown gender), and certification status in each year from 2010 to 2019.

Statistical Analysis

Data were collected in Microsoft Excel and analyzed in RStudio version 1.2.1335. Two-proportion z-tests and odds ratio tests were used to perform comparisons where appropriate. Significance was set at p < 0.05. When comparing rates of women first and last authors with the rates of entering women residents and women achieving ABNS certification status over the 10-year time period, we filtered our authorship data to only include authors from the US, since our entering resident and ABNS certification data were specific to the US (61.0% of authors were from US institutions).

Results

Authorship Trends

In our representative sample from 2010 to 2019, we analyzed 4028 articles (2103 in JNS and 1925 in Neurosurgery). Across these articles, 13.4% of first authors and 6.8% of last authors were women (Table 1). We did not find a statistically significant difference in women publication rates between the two journals during our baseline period (2010–2011). In addition, there was no statistically significant difference in publications authored by women between the journals during the combined 2010–2019 time point (first authors: 13.0% in JNS vs 13.9% in Neurosurgery, 95% CI of the mean difference −0.83% to 3.4%, p = 0.25). However, women accounted for a lower proportion of authors on invited papers (i.e., editorials or opinion pieces; 8.6% of first authors and 3.1% of last authors of invited articles were women) compared with noninvited
TABLE 1. Percentage of female first and last authors in two top neurosurgical journals

| Year | Mean 2010–2019 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|------|----------------|------|------|------|------|------|------|------|------|------|------|
| First author | | | | | | | | | | | |
| JNS | | 13.2% | 11.3% | 12.8% | 13.4% | 11.6% | 14.4% | 15.1% | 13.0% | 13.4% | 13.0% |
| Neurosurgery | | 13.0% | 13.4% | 15.4% | 11.9% | 11.6% | 9.1% | 10.1% | 13.0% | 12.4% | 13.4% |
| Mean across journals | | 13.1% | 12.9% | 12.4% | 13.4% | 10.9% | 10.9% | 10.6% | 13.4% | 14.2% | 15.9% |
| Last author | | | | | | | | | | | |
| JNS | | 4.5% | 8.2% | 8.2% | 6.8% | 3.9% | 9.3% | 7.5% | 4.9% | 4.9% | 6.0% |
| Neurosurgery | | 5.1% | 6.8% | 7.1% | 8.3% | 6.8% | 3.9% | 9.3% | 4.9% | 3.9% | 3.7% |
| Mean across journals | | 4.8% | 5.6% | 5.7% | 5.4% | 4.9% | 4.9% | 4.9% | 5.4% | 6.0% | 6.8% |

MD = mean difference.

Effect of the Double-Blind Review Process

There was no statistically significant difference in the proportion of women first authors in Neurosurgery 1 year before the double-blind peer review was initiated and 1 year after the double-blind peer review process was implemented. Specifically, 13.0% of first authors were women in 2010 versus 15.4% in 2013 (mean difference 2.38% [95% CI −0.30% to 3.40%], p = 0.44). There was a significantly higher percentage of women last authors in 2013 (9.3%) compared with 2010 (5.1%) (mean difference 4.28% [95% CI −0.19% to 8.76%], p = 0.042); however, this was likely an anomaly because 2013 has the highest number of women last authors in Neurosurgery in the entire 2010–2019 period (i.e., the percentage decreased after 2013). With first and last authors combined, there was no significant difference between the percentage of female authors before and after double blinding (2010: 9.18%, 2013: 12.4%) (mean difference 3.25% [95% CI −6.8% to 3.41%], p = 0.066).

Trends in Women Entering Neurosurgery Residency and Achieving ABNS Certification

The rate of women entering neurosurgery residency increased from 11.2% in 2009 to 23.6% in 2018 (Fig. 1 and Table 2). It should be noted that 2018 may have been a relative aberration as the percentage decreased in 2019. Although this rate doubled in the 10-year time frame, the increase over time was not statistically significant (β es-
timate of slope = 0.76 ± 0.64 percentage point increase per year; p = 0.325), which may be attributed to the small sample size. From 2010 to 2019, the rate of women achieving ABNS certification increased from 5.4% to 6.8% (Fig. 2 and Table 3), which was statistically significant (β estimate of slope = 0.14 ± 0.01 percentage point increase per year; p < 0.001). The relative proportion of women neurosurgeons with ABNS certification in each state is shown in Fig. 3 and Table 4.

Across the decade, the rate of US first authors who are female (14.3%) was slightly lower than the rate of women entering neurosurgery residency (18.0%) (95% CI −6.8% to 0.068%, p = 0.01416; Fig. 4). However, the rate of US last authors who are female (7.4%) was not significantly different from that of the ABNS-certified neurosurgeons who are female (6.2%) (95% CI −0.18% to 2.69%, p = 0.06174; Fig. 4).

Discussion

This first survey of trends in neurosurgical publications by women revealed several important findings. First, we found that different peer-review processes at JNS and Neurosurgery (single-blind vs double-blind review, respectively) were not associated with differences in publication rates based on gender. Second, last authorship mirrored the percentage of women achieving ABNS certification. Third, the percentage of women entering residency was slightly greater than the percentage of first authors who were women. This may foreshadow an increase in women first authors in the coming years, as the initial increase in incoming female residents may precede the rise in female first authorship due to the time needed for entering residents to produce a publication. Fourth, women account for a lower proportion of invited manuscript authors compared with noninvited manuscript authors. Finally, there was a significant concordance between gender of the first and last authors; the first author was twice as likely to be a woman when the last author was a woman. Although we did not find gender bias (in terms of gender publication rate differences in double-blind vs single-blind review) in the peer-review publication process at JNS and Neurosurgery, gender parity has yet to be achieved in academic neurosurgery.

Trends in Authorship in Other Subspecialties

Gender disparities in academic publishing span other medical subspecialties. A survey of the top 55 NIH-funded departments of surgery found that the median number of publications are lower for women surgical faculty than for men surgical faculty (median 43 [SD 97.5] publications for men surgical faculty vs 19 [SD 58] publications for women surgical faculty, p < 0.05), suggesting a need

| Year | No. of Female Neurosurgeons | No. of Total Neurosurgeons | % Female |
|------|-----------------------------|-----------------------------|---------|
| 2010 | 164                         | 3034                        | 5.41%   |
| 2011 | 176                         | 3153                        | 5.58%   |
| 2012 | 195                         | 3292                        | 5.92%   |
| 2013 | 210                         | 3451                        | 6.09%   |
| 2014 | 219                         | 3599                        | 6.09%   |
| 2015 | 229                         | 3752                        | 6.10%   |
| 2016 | 245                         | 3896                        | 6.29%   |
| 2017 | 256                         | 4036                        | 6.34%   |
| 2018 | 281                         | 4243                        | 6.62%   |
| 2019 | 297                         | 4345                        | 6.84%   |

Data are from the National Resident Matching Program.
to support opportunities for women faculty in academic surgery. This underrepresentation of women in academic publications has also been shown in other medical fields, including otolaryngology and dermatology, although these studies showed an increase in women authorship over time.\(^{15,16}\) A study done on gender difference patterns in four major radiology journals found that female first authorship papers received fewer citations than male first authorship papers, although this difference in number of citations has narrowed over time.\(^{17}\)

Another study that also examined gender differences in radiology journals found that there was a significant correlation between the gender of the first and corresponding authors.\(^{18}\) This finding, similar to what we reported in this study, was also present in other specialties. A study examining gender trends in two high-impact anesthesiology journals over a 15-year period showed that women were significantly more likely to be the first author on a paper with a female senior author compared with a paper with a male senior author.\(^{19}\) Likewise, a study examining three high-impact cardiology journals found that articles with a female senior author had significantly more female middle authors and were twice as likely to have a female first author as articles with a male senior author.\(^{20}\) These findings are indicative of female mentorship and highlight the importance of senior women neurosurgeons in creating opportunities for younger women. Although male mentorship may be equally instrumental in the success of younger women in neurosurgery, women mentors may have a unique role in serving as role models. Previous work demonstrated that, compared with male students, female students were more likely to rank same-sex surgeon role models as a positive influence and assign higher value to same-sex mentorship.\(^{21}\)

**Resident Trends**

We confirm a significant increase in women entering neurosurgery residency over the past decade (Fig. 1). Early mentorship is important in recruiting women into neurosurgery. A recent study found that 29.9% of female medical students considered neurosurgery as a career but felt dissuaded because of their gender, and 88% reported lacking a senior female medical student pursuing neurosurgery or female neurosurgical resident as a mentor.\(^{22}\) A study analyzing match data from 1990 to 2007 found that female gender was associated with a significantly lower odds of successful matching into a neurosurgery residency program, even when adjusting for academic factors such as United States Medical Licensing Association step 1 score.\(^{23}\) Another study performed on 2006–2008 medical school graduates found that women entering neurosurgery residency were more likely to enter programs with higher proportions of women residents.\(^{24}\) These studies, especially when taken together with our finding that the first author is more likely to be a woman when the last author is a woman, demonstrate that mentorship serves a key role in recruiting and promoting the success of women into the neurosurgery field.

It should also be noted that recruitment without efforts to facilitate retention can be detrimental to the time
and resources that departments invest in residents’ education as well as the individual residents themselves. In the 1990s, women were found to be nearly twice as likely as men to not complete neurosurgery residency (24% vs 12.8%).25 In the 2000s, the reported attrition rate among female neurosurgery residents was 17% versus 5.3% for male residents.26 Interestingly, a recent study on burnout in neurosurgery residents found that emotional exhaustion was significantly higher in women than in men,27 suggesting there may be barriers that need to be addressed to better realize the potential of women trainees.

### Career Trends and Challenges

We confirmed slow but steady growth in the number and proportion of women ABNS-certified neurosurgeons (Fig. 2), and a correlation with the proportion of women senior authors in publications at *JNS* and *Neurosurgery* (Fig. 4). A recent study reported that approximately 70% of women neurosurgeons obtain ABNS certification, and that this proportion has increased with time.28 The same study noted that women were disproportionately represented within the rank of assistant professor, compared with more senior positions, even when controlling for productivity factors.28 However, another study found that after controlling for institution, years in practice, PhD attainment, h-index, and number of publications, men and women were equally likely to attain full professorship.29

Women neurosurgeons face unique challenges, including balancing life events such as pregnancy and childcare, workplace discrimination and implicit bias, and internal battles, including imposter syndrome and low self-confidence.2 Across all physician specialties, a survey done on physicians working in United Kingdom found that women who were also parents were significantly less likely to have one or more publications as sole or joint authors compared with men who were also parents.30 A recent study showed that women neurosurgeons are paid less than men working similar jobs, and women are rarely mentored to become leaders or chairs within their neurosurgical departments.31 Similar to their increasing proportion of ABNS certification, women are slowly rising in neurosurgical academic ranks, although there remains room for improvement. Av-

### TABLE 4. 2019 data on female ABNS-certified neurosurgeons by state

| State/District | No. of ABNS-Certified Female Neurosurgeons | No. of ABNS-Certified Male Neurosurgeons | % Female ABNS-Certified Neurosurgeons |
|----------------|-------------------------------------------|------------------------------------------|---------------------------------------|
| Alabama        | 3                                         | 59                                       | 4.8%                                  |
| Alaska         | 1                                         | 9                                        | 10.0%                                 |
| Arizona        | 4                                         | 90                                       | 4.3%                                  |
| Arkansas       | 3                                         | 38                                       | 7.3%                                  |
| California     | 29                                        | 446                                      | 6.1%                                  |
| Colorado       | 9                                         | 81                                       | 10.0%                                 |
| Connecticut    | 7                                         | 57                                       | 10.9%                                 |
| Delaware       | 0                                         | 13                                       | 0.0%                                  |
| DC             | 0                                         | 28                                       | 0.0%                                  |
| Florida        | 20                                        | 296                                      | 6.3%                                  |
| Georgia        | 7                                         | 112                                      | 5.9%                                  |
| Hawaii         | 0                                         | 15                                       | 0.0%                                  |
| Idaho          | 0                                         | 25                                       | 0.0%                                  |
| Illinois       | 10                                        | 160                                      | 5.9%                                  |
| Indiana        | 8                                         | 67                                       | 10.7%                                 |
| Iowa           | 3                                         | 23                                       | 11.5%                                 |
| Kansas         | 1                                         | 28                                       | 3.4%                                  |
| Kentucky       | 1                                         | 57                                       | 1.7%                                  |
| Louisiana      | 7                                         | 67                                       | 9.5%                                  |
| Maine          | 1                                         | 21                                       | 4.5%                                  |
| Maryland       | 6                                         | 84                                       | 6.7%                                  |
| Massachusetts  | 12                                        | 90                                       | 11.8%                                 |
| Michigan       | 10                                        | 102                                      | 8.9%                                  |
| Minnesota      | 10                                        | 61                                       | 14.1%                                 |
| Mississippi    | 1                                         | 36                                       | 2.7%                                  |
| Missouri       | 3                                         | 92                                       | 3.2%                                  |
| Montana        | 1                                         | 19                                       | 5.0%                                  |
| Nebraska       | 3                                         | 22                                       | 12.0%                                 |
| Nevada         | 1                                         | 24                                       | 4.0%                                  |
| New Hampshire  | 1                                         | 19                                       | 5.0%                                  |
| New Jersey     | 4                                         | 109                                      | 3.5%                                  |
| New Mexico     | 0                                         | 14                                       | 0.0%                                  |
| New York       | 22                                        | 257                                      | 7.9%                                  |
| North Carolina | 15                                        | 137                                      | 9.9%                                  |
| North Dakota   | 3                                         | 9                                        | 25.0%                                 |
| Ohio           | 16                                        | 131                                      | 10.3%                                 |
| Oklahoma       | 3                                         | 49                                       | 5.8%                                  |
| Oregon         | 12                                        | 60                                       | 16.7%                                 |
| Pennsylvania   | 10                                        | 197                                      | 4.8%                                  |
| Rhode Island   | 3                                         | 9                                        | 25.0%                                 |
| South Carolina | 3                                         | 56                                       | 5.1%                                  |
| South Dakota   | 0                                         | 19                                       | 0.0%                                  |
| Tennessee      | 6                                         | 91                                       | 6.2%                                  |
| Texas          | 16                                        | 332                                      | 4.6%                                  |
| Utah           | 2                                         | 38                                       | 5.0%                                  |
| Vermont        | 1                                         | 5                                        | 16.7%                                 |
| Virginia       | 7                                         | 95                                       | 6.9%                                  |
| Washington     | 7                                         | 93                                       | 7.0%                                  |
| West Virginia  | 2                                         | 28                                       | 6.7%                                  |
| Wisconsin      | 3                                         | 73                                       | 3.9%                                  |
| Wyoming        | 0                                         | 5                                        | 0.0%                                  |

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women early in their career include sponsorship of women and networking opportunities, early discussions of career trajectories (e.g., academic vs nonacademic, clinical vs bench research), and robust support systems for surgeons who are parents.

Publication Trends in Neurosurgery

A recent letter to the World Federation of Neurosurgical Societies specified two obstacles that women face in publication: limited opportunities for high-quality research and few women involved in research. A study showed that pre-residency publications did not independently predict academic placement; however, having two or more publications during residency along with devoted research time before residency were associated with a higher likelihood of pursuing an academic career. These opportunities for research during residency should especially target the increasingly diverse pool of neurosurgical residents. Ensuring that women neurosurgical residents have access to high-quality research training will help women have successful careers in academic neurosurgery. We found that women were significantly less likely to author invited pieces than noninvited pieces; this may signify that women are being given fewer opportunities, perhaps due to unconscious bias on the part of those who select invited authors. Additionally, while we surveyed two top neurosurgery journals, women are also underrepresented in other prestigious journals such as JAMA, The Lancet, and the New England Journal of Medicine.

We obtained gender breakdowns of the editorial boards of JNS and Neurosurgery (Supplemental Tables 1 and 2). Although women accounted for a minority of the editorial board seats over the past decade, there has been a steep rise in the proportion of women representation in the last few years, particularly in JNS.

Limitations

This study is limited in that we investigated only two specific neurosurgical journals and had a restricted time period (2010–2019). We did not have access to the acceptance rate of submitted articles, so this study is not a direct measure of peer-review publication gender bias. Rather, we compared the final product of the peer-review process, i.e., published articles, at two journals that had similar baseline gender publication rates (i.e., before the initiation of double-blind peer review). Our finding that the percentage of entering women residents was slightly greater than the percentage of female first authors may reflect an increase in female first authors in the future. However, our conclusions are limited since we did not examine trends in current residents or the level of training of the first author (e.g., premedical student, medical student, resident, year of residency, postdoctoral fellow, or attending). Similarly, we could not reliably obtain information on author rank or years in practice at time of publication, which may confound our invited article authorship finding. Another important caveat is that we classified each individual’s gender based on their name and searched online when there was ambiguity. However, there were still some names that we could not classify, and names we may have misclassified.

To gather data on the number of ABNS-certified neurosurgeons, we relied on the ABNS website tool, which does not provide the retirement year for retired neurosurgeons. We excluded surgeons when we could not find a reliable retirement year, which may impact the data for the 2010–2018 years. Moreover, although we compare our calculated rate of ABNS-certified female neurosurgeons with the percentage of women last authors, the rate and number of ABNS-certified female neurosurgeons does not necessarily reflect the percentage of female neurosurgeons in academia (as not all who are board-certified practice in an academic setting), although recent studies have shown that the rate of women neurosurgeons entering academia is similar to the rate of total (male plus female) neurosurgeons entering academia; one-quarter to one-third of ABNS-certified neurosurgeons enter academia.
Future Directions

In the future, academic rank and career trajectories should be further investigated, such as examining whether junior female faculty members publish fewer works than senior female faculty members, and whether publication gaps exist between junior male and junior female faculty members, or between senior male and senior female faculty members. Such questions are difficult to assess retrospectively, as academic rank at the time of manuscript submission or publication cannot always be obtained online. However, such questions can be addressed, for example, by journals asking for academic rank as a question during the submission process. Similarly, since we found the proportion of women authoring invited manuscripts is significantly lower than the proportion of women authoring noninvited manuscripts, academic rank and years in practice for all invited authors should be investigated prospectively during the publication process, to ascertain whether women who have achieved the same academic success are receiving the same opportunities.

Another avenue of future investigation is gender breakdown of contributing authorships. We chose to focus this study on first and last authors, since these authors are often most key to creating and leading the project, but it is also important to understand the rates of neurosurgery publications with a woman author in any position on the publication, the percentage of authors on individual manuscripts who are women, and how these trends are changing over time.

Conclusions

This is the first report of female authorship rates in the neurosurgical literature and the most recent analysis of gender trends in neurosurgery. We found that single- versus double-blind peer-review does not impact female authorship in top neurosurgical journals. The rate of female senior authorship closely mirrors that of women obtaining ABNS certification. However, a significantly lower proportion of invited articles are authored by women compared with noninvited articles. We also showed a statistically significant concordance between the first author and senior author being women, suggesting the importance of female mentorship in promoting the success of younger women in academic neurosurgery.

Taken together, this study demonstrates that, although women remain a small minority in the field (only 6.8% of ABNS-certified neurosurgeons are women), a single- versus double-blind peer review process does not appear to impact publication rates at two top neurosurgery journals. To fully realize the advancement of women in academic neurosurgery, we must continue to improve mentorship for women, increase high-quality research opportunities, and eliminate perceived and existing barriers.

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Conception and design: Zygourakis, Mahajan. Acquisition of data: Mahajan, Wadhwa, Fatemi, Xu, Shan. Analysis and interpretation of data: Zygourakis, Mahajan, Fatemi, Benzil. Drafting the article: Mahajan. Critically revising the article: Zygourakis, Mahajan, Fatemi, Benzil. Reviewed submitted version of manuscript: all authors. Statistical analysis: Mahajan. Study supervision: Zygourakis, Fatemi.

**Supplemental Information**

**Online-Only Content**

Supplemental material is available with the online version of the article.

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