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Representation of Women on Editorial Boards of Medline-Indexed Spine, Neurosurgery, and Orthopedic Journals

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ABSTRACT

Background: Both neurosurgery and orthopedic surgery are male-dominated specialties. However, the prevalence of women appears to be even lower in the spine surgery field. We intend to determine this prevalence on the editorial boards of spine, neurosurgery, and orthopedic journals.

Methods: The gender of editorial board members of Medline-indexed spine, neurosurgery, and orthopedic journals was systematically analyzed in 2019, and female representation was compared among these fields.

Results: In the 34 journals included (5 spine, 13 neurosurgery, and 16 orthopedic journals), women represented 8.84% (*N* = 185/2094) of editorial board members. Their representation was 5.53% (*N* = 30/542) in spine, 8.58% (*N* = 47/548) in neurosurgery, and 10.77 % (108/1003) in orthopedic journals. Only 5.4% (*N* = 2/37) of the editors-in-chief were women. The likelihood of having female members was higher in orthopedic than in spine journals (OR = 2.06; 95% CI = 1.35–3.13; *P* = 0.001). Neurosurgery journals did not show a significant greater likelihood of having female editorial board members than spine journals (OR = 1.60; 95% CI = 0.99–2.57; *P* = 0.058).

Conclusions: The representation of women on editorial boards of spine, neurosurgery, and orthopedic journals is very low and appears to be even lower for spine surgery. However, it is still not understood whether or not women are barred from advancing in academics by gender bias within these specialties.

Level of Evidence: 2.

Other and Special Categories

Keywords: spine, neurosurgery, orthopedics, editorial board, feminism, sexism, gender

INTRODUCTION

Women rarely specialize in neurosurgery or orthopedic surgery. Although only limited data have been published so far, prior censuses suggest that the representation of women is even lower within the field of spine surgery.[1–8] However, this representation appears to be increasing over time for neurosurgery and orthopedic surgery—yet considerable variations are observed across different countries.[1,9–12] In fact, this can be clearly seen as the proportion of women in societies, residencies, and practice grows over the years.[2–5,11] Likewise, several studies indicate that the mean age in these settings is lower for women than for men.[4,5,13,14]

Regarding neurosurgery and orthopedic surgery, a low prevalence of women is also observed among leadership positions such as heads of department, professors, and chairpersons. The proportion of women as first and senior authors is also low for articles published in orthopedic, neurosurgery, and spine surgery journals, whereas it seems to be a little higher in the latter compared to the former.[15,16] Nevertheless, the low representation of women within these fields is multifactorial. Although not fully understood, the reasons reported include the nature of the fields of neurosurgery and orthopedic surgery and their associated lifestyle as well as gender discrimination.[13,14,17–23] Data related specifically to the field of spine surgery are scarce.

The authors hypothesize that the representation of women also varies among editorial boards of spine, neurosurgery, and orthopedic surgery journals, following the aforementioned patterns. To the best of our knowledge, the representation of women on editorial boards of spine and neurosurgery journals has not been previously assessed, though it has been evaluated for prominent orthopedic journals.[24] Therefore, this study aims to determine and compare the prevalence of women on the editorial boards of Medline-indexed spine, orthopedic, and neurosurgery journals.

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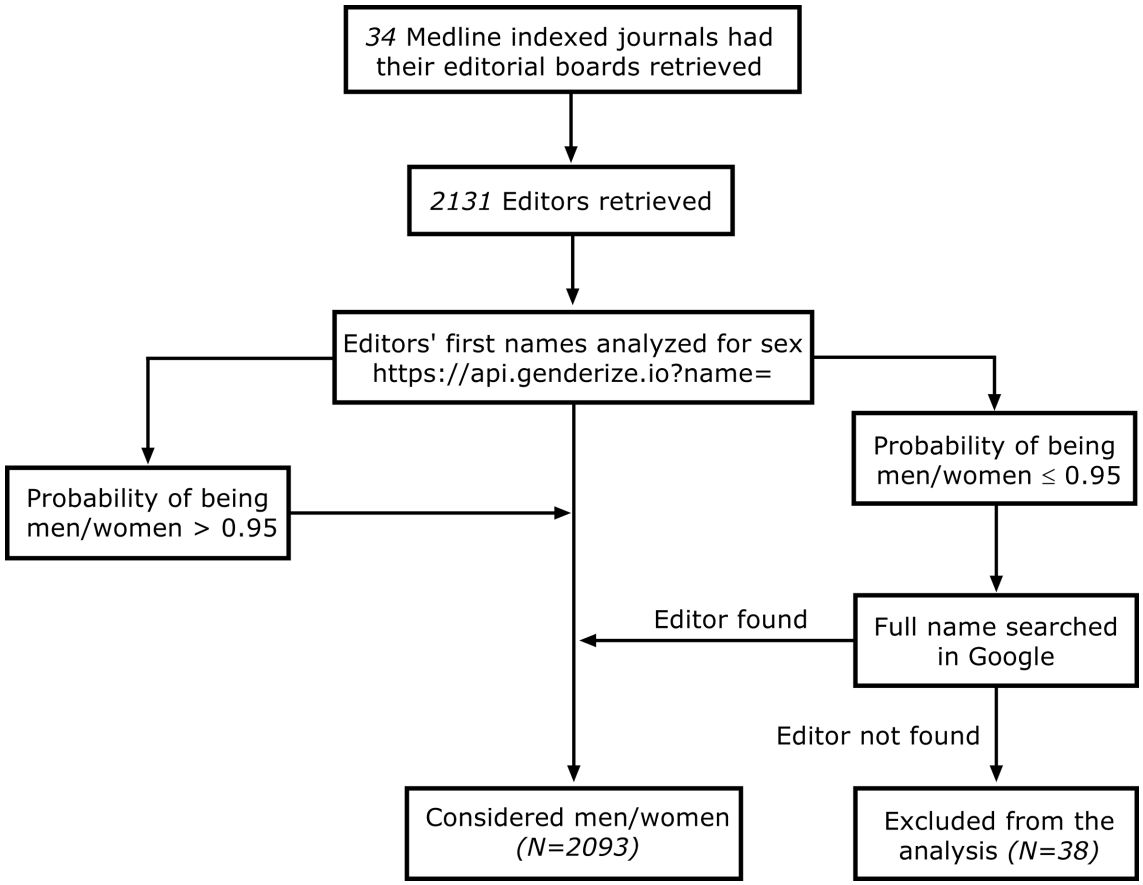

Figure 1. Flowchart detailing the gender determination of editorial board members of spine, neurosurgery, and orthopedic journals.

METHODS

Analysis of Editorial Board Members' Gender

We analyzed the gender and position of the editorial board members of spine, general neurosurgery, and general orthopedic journals. The members' gender was defined by typing their first name—which was retrieved from the journal website—in a gender identifier (https://api.genderize.io?name=) between August and October of 2019. This tool has been validated,[25] and it was used by several previous publications.[26–29] With a priori probability of 95% to correctly predict gender based on a first name, a study showed that this tool alone predicted the gender of 73% out of 3 million authorships with full first names from the *JSTOR* network database.[25] We used the same cutoff point. That is, when the probability (P) of the name being male or female was >0.95, this was considered the members' gender. However, when $P \leq 0.95$, the full name was searched in Google to determine his or her gender. When the gender was unavailable, the members were excluded from the analysis. Figure 1 illustrates the strategy for gender analysis.

Journal Selection

To be included, the journals should were required to (1) be indexed in Medline identified by typing "spin," "ortho," and "neuro" in the results of "currently indexed" in the Medline search bar), (2) have the Journal Citation Reports 2018 and 5 Year impact factor available (retrieved from https://jcr.clarivate.com in June 2019), and (3) have their website and publications in English. Orthopedic and neurosurgery journals that specifically addressed subspecialties other than spine were excluded.

Statistical Methods

Statistical analysis was performed with SPSS statistical software version 23.0 (IBM). Categorical variables were presented as number and percentages and compared by the χ^2 test. The OR was calculated with a 95% CI for these variables. Multiple comparisons were adjusted by the Bonferroni procedure. Continuous variables were presented as mean and standard deviation. Statistical significance was set at $P < 0.05$.

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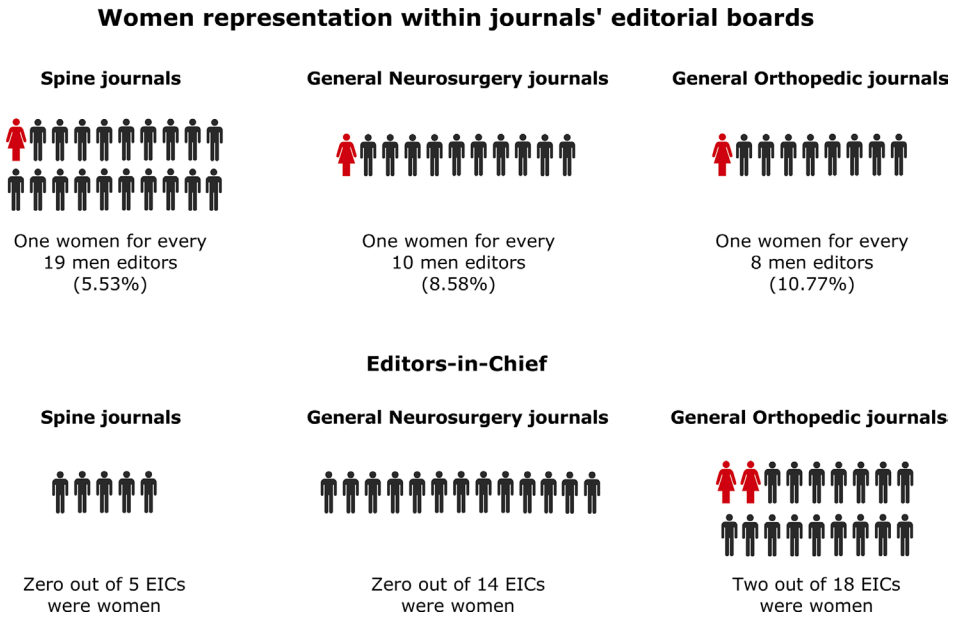

Figure 2. Representation of women on editorial boards of spine, neurosurgery, and orthopedic journals; EIC, editor-in-chief.

RESULTS

General Findings

A total of 34 journals were included (5 spine, 13 neurosurgery, and 16 orthopedic journals), and 2093 out of a total of 2131 editorial board members had their gender retrieved. Women represented 8.84% (n = 185/2093) of all board members. Their representation was 5.53% (n = 30/542) in spine journals, 8.58% (n = 47/548) in neurosurgery journals, and 10.77% (108/1003) in orthopedic journals (Figure 2). A list with the prevalence of women on the editorial boards of all journals included in this analysis, stratified by journal subgroup, is shown in the Table. Two of the 34 journals did not indicate their editors-in-chief (EICs) (1 neurosurgery and 1 orthopedic surgery journal). Conversely, 2 journals had 3 EICs (1 neurosurgery and 1 orthopedic surgery journal), and 1 journal had 2 EICs (orthopedic surgery journal). The total number of EICs was 37. Only 5.41% (n = 2/37) of them were women—both from orthopedic journals and, hence, none from spine or neurosurgery journals.

Comparison of the Proportion of Women Among Spine, Neurosurgery, and Orthopedic Surgery Journals

The likelihood of having female board members was higher for orthopedic than for spine journals (OR = 2.06; 95% CI = 1.35–3.13; P = 0.001). There were no statistically significant differences in this likelihood when comparing orthopedic to neurosurgery journals (OR = 1.28; 95% CI = 0.90–1.84; P = 0.184) and when comparing neurosurgery to spine journals (OR = 1.60; 95% CI = 0.99–2.57; P = 0.058).

DISCUSSION

Representation of Women in Neurosurgery, Orthopedic Surgery, and Spine Surgery

Data from prior censuses and surveys of association/society memberships suggest a low representation of women among neurosurgeons and orthopedic surgeons, which appears to be even lower for spine surgeons. Indeed, the representation of women among orthopedic spine surgery fellows in the United States during the 2018 to 2019 period was 7.1%. Among neurosurgery and orthopedic surgery residents, this prevalence in the same period was 17.3% and 14.7%, respectively.[2] In 2017, spine societies also had a very small number of female members, with 5.4% for the North American Spine Society,[7] 3.3% for the Scoliosis Research Society[7], and 1.5% for the Cervical Spine Research Society.[30] By August 2020, 6.4% of 1286 members of the AO Spine Latin America community were women (data collected by personal contact).

By 2016, women represented 6.1% of the American Board of Neurological Surgery certified practicing neurosurgeons.[6] Similarly, women represent 5.8% of orthopedic surgeons in the United States, according to the 2018 Orthopaedic Practice in the United States Survey.[5] However, a recent systematic review of publications regarding women neurosurgeons around the world showed that the proportion of female neurosurgeons varied widely among countries.[1] Among the 55 countries

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Table. The prevalence of women on the editorial boards of spine, neurosurgery, and orthopedic surgery journals.

Journal Category and Title	% of Female Editorial Board Members (*n*/N)	2018 JIF	5-Y JIF
Spine	**5.53 (30/542)**[a]	-	-
The Spine Journal	6.45 (8/124)	3.196	3.720
Spine	3.57 (5/140)	2.903	3.616
Journal of Neurosurgery: Spine	5.88 (1/17)	2.998	3.390
European Spine Journal	8.92 (14/157)	2.513	2.870
Clinical Spine Surgery	1.92 (2/104)	1.726	1.730
Neurosurgery	**8.58 (47/548)**[a,b]	-	-
Journal of Neurosurgery	15.00 (3/20)	4.130	4.483
Neurosurgery	15.03 (23/153)	4.605	4.415
Neurosurgical Focus	0.00 (0/4)	2.891	3.665
Neurosurgical Review	11.76 (2/17)	2.532	2.382
Neurosurgery Clinics of North America	0.00 (0/2)	2.553	2.323
World Neurosurgery	10.94 (14/128)	1.723	2.135
Acta Neurochirurgica	1.72 (1/58)	1.834	2.097
Journal of Neurosurgical Sciences	5.45 (3/55)	1.883	1.796
Neurologia Medico-Chirurgica	0.00 (0/58)	1.651	1.442
British Journal of Neurosurgery	0.00 (0/13)	1.481	1.313
Neurochirurgie	6.67 (1/15)	0.948	0.974
Journal of Neurological Surgery Part A	0.00 (0/9)	1.060	0.950
Turkish Neurosurgery	0.00 (0/16)	0.896	0.901
Orthopedics	**10.77 (108/1003)**[b]	-	-
The Journal of Bone and Joint Surgery	15.46 (15/97)	4.716	6.101
CORR	13.04 (12/92)	4.154	4.478
Acta Orthopaedica	10.00 (1/10)	3.217	3.575
JAAOS	8.00 (2/25)	2.348	3.322
Journal of Orthopaedic Research	21.99 (31/141)	3.043	3.156
International Orthopaedics	13.64 (3/22)	2.384	2.523
Journal of Orthopaedic Trauma	4.35 (6/138)	1.826	2.376
The Orthopedic Clinics of North America	0.00 (0/6)	2.475	2.364
JOSR	10.00 (4/40)	1.907	2.292
AOTS	0.00 (0/6)	1.973	2.085
OTSR	7.14 (1/14)	1.572	1.968
Orthopedics	4.76 (5/105)	1.608	1.720
Journal of Orthopaedic Science	2.00 (1/50)	1.257	1.468
Orthopaedic Surgery	0.89 (5/56)	1.331	1.395
Journal of Orthopaedic Surgery	12.57 (22/175)	0.957	1.099
AOTT	0.00 (0/26)	0.896	0.916
Total	**8.84 (185/2093)**	-	-

Abbreviations: AOTS, Archives of Orthopaedic and Trauma Surgery; AOTT, Acta Orthopaedica et Traumatologica Turcica; CORR, Clinical Orthopaedics and Related Research; JAAOS, Journal of the American Academy of Orthopaedic Surgeons; JIF, journal impact factor; JOSR, Journal of Orthopaedic Surgery and Research; OTSR, Orthopaedics & Traumatology: Surgery & Research.

For each journal category, journals are arranged from highest to lowest 5-y JIF.

[a]Journal categories of spine and neurosurgery do not differ significantly from each other at the 0.05 level.

[b]Journal categories of neurosurgery and orthopedic surgery do not differ significantly from each other at the 0.05 level.

analyzed, those with the highest proportion of female neurosurgeons were Italy (36%), El Salvador (29%), Denmark (26%), Uruguay (26%), and Finland (25%). In contrast, the countries with the lowest proportion were Kosovo (0%), Cyprus (0%), South Korea (1.7%), and Kazakhstan (2%).

Significant variations also occurred in the orthopedic surgery field. The proportion of female orthopedic surgeons was 6.6% in Brazil,[12] 7.2% in Argentina[10], and 6.6% in Mexico.[9] Among 18 European countries, the overall proportion was 9%. The countries with the greatest female representation were Spain (29%), Norway (17%), and Denmark (16%), while the ones with the lowest representation were Ireland (0.9%), Kosovo (1.3%), and Slovenia (3%). However, this representation appears to be increasing. In fact, the proportion of orthopedic female trainees of these 18 countries was 20 %.[11]

A study reported that the proportion of female applicants for orthopedic surgery fellowships from 2010 to 2014 varied from 7% to 10% annually. Fellowships for the subspecialty of spine orthopedics had the lowest rate of female applicants (3%; N = 15/525).[8] Moreover, following neurosurgical residency training in the United States, 27% of women went on to apply for fellowships from 1964 to 2013, with 13% of them choosing spine surgery.[31] In 2017, spine societies also had a very small number of female members, with 5.4% for the North American Spine Society,[7] 3.3% for the Scoliosis Research Society[7], and 1.5% for the Cervical Spine Research Society.[30]

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Representation of Women in High Positions

Editorial Boards

Typically, women are underrepresented on the editorial boards of medical journals. Indeed, at 6 prominent medical journals in 2010 to 2011, the proportion of female reviewers ranged from 16.6% (*The New England Journal of Medicine* [*NEJM*]) to 28.8% (*British Medical Journal* [*BMJ*]). However, the proportion of female EICs at these journals was relatively high (57.1%; N = 4/7, 1 journal had 2 EICs during the period).[32] Another study with major general surgery journals also showed an underrepresentation of women on editorial boards, with an overall proportion of 20% (N = 568/2816). The proportion of female EICs was lower (11%; N = 4/36).[33] In the present study, we showed a very low proportion of female members on editorial boards of neurosurgery (8.6%), orthopedic (10.8%), and spine journals (5.5%), although this proportion varied substantially across journals—especially among neurosurgery and orthopedic surgery journals. Variations may have occurred due to chance as well as due to the demographics of the country of origin of specific journals or particularities of EICs or other members of the editorial boards. The proportion of female editorial board members was significantly lower for spine journals than for orthopedic journals, and statistically similar between spine surgery journals and neurosurgery journals. Only 2 out of 18 EICs of 16 orthopedic journals and none of the EICs of 13 neurosurgery and 5 spine journals were women. These numbers are in line with the overall low representation of women, which could possibly mean that, once they enter these fields, their chances of attaining editorial board membership are not different from their male counterparts.

Authorship

As to the representation of women on editorial boards, the proportion of women in the authorship of medical articles is low. One study analyzed more the 1.5 million medical papers from 2008 to 2015, showing an overall proportion of 35% female authors. Women represented 40% of first authors and 27% of last authors.[34] Regarding spine surgery, a study showed that, in the same 5 spine journals that we analyzed, female representation significantly increased for first and senior authorship from 6.5% and 4.7% (1978–1994) to 18.5% and 13.6% (2010–2016, P < 0.001), respectively.[15] Meanwhile, an analysis of 6 major orthopedic journals showed that the while the proportion of women as first authors increased from 0.76% in 1987 to 5.9% in 2017, senior authorship for women decreased from 2.0% to 1.2% in the same period.[35] For 2 prominent neurosurgical journals, the proportion of women as first authors showed a statistically significant increase from 2003 (12%) to 2018 (16.5%) (P < 0.01), with no significant changes in senior authorship (11.7% in 2003 vs 10.5 % in 2018; P > 0.05).[16]

Leadership Positions

In the medical community, women are also underrepresented in leadership positions. Among 1273 faculty at 24 medical schools in the United States, women were less likely to hold senior leadership positions than men.[36] In American medical schools, women in 2020 represented only 19% deans and 21% of department chairs.[37,38] In spine surgery, neurosurgery, and orthopedic surgery, gender disparities also appear to be more pronounced among leadership positions. A 2012 study including 1052 neurosurgeons—of whom 8.8% were women—from American neurosurgery programs demonstrated that while 10.9% and 12.4% of assistant and associate professors were women, women comprised only 3.7% of full professors and only 1 out of the 84 programs evaluated had a female chairperson.[39] Furthermore, a report on the 2015 to 2016 academic years showed that while women make up 17.8% of overall academic faculties in orthopedics, they represent only 8.7% of the higher professorial ranks—with a higher proportion in the lesser instructor ranks—while only 1% of orthopedic surgery department chair positions were occupied by a woman.[30] A similar pattern was observed in a report regarding spine surgery, with women being only 4.9% of all spine surgeons involved in residency training in neurosurgery and orthopedic surgery. The same report showed that the number of women goes down with the rise to higher academic ranks.[40]

Reasons Behind the Underrepresentation of Women

Women are underrepresented in spine surgery, neurosurgery, and orthopedic surgery undoubtedly due to multiple factors. The reasons range from the nature of the fields of neurosurgery and orthopedic surgery and their associated lifestyle to gender discrimination and sexual harassment.[13,14,17–23] In fact, surveys on female neurosurgeons conducted in Europe reported that 72% of the responders felt at a disadvantage when compared to their male colleagues.[21] Also, an Indian survey demonstrated that 72.7% of female neurosurgeons were discouraged from pursuing careers in neurosurgery.[14] Similarly, a survey for the American Academy of Orthopaedic Surgeons demonstrated that discrimination, bullying, sexual, and non-sexual harassment were much more frequent for women (81%) than men (35%), with 54% of female orthopedic surgeons reporting episodes of sexual harassment.[23]

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Medical students are also exposed to gender discrimination, with discouragement and negative attitudes toward women pursuing careers in neurosurgery or orthopedic surgery.[22,41]

Like any subspecialty, training a spine surgeon takes a long time, usually including a neurosurgery or orthopedic surgery residency followed by ≥1 year in spine fellowship training. Since the representation of women is a growing phenomenon, still incipient in orthopedic surgery, neurosurgery, and spine surgery[2,3,5,42] female professionals in these fields are generally younger and have less years of experience than their male counterparts.[4,31,43] Given that leadership positions—such as head of department, full professorship, editorial board membership, and senior authorship of articles in high-impact journals—are usually attained by the most experienced professionals, it is possible that not enough time has passed for a higher proportion of women to be represented in such positions. Still, gender-related bias seems to be ubiquitous in the medical community and may contribute to gender disparity in leadership positions.[44]

Whether there are specific additional factors that discourage women from becoming spine surgeons or that hinder their ascension to high-ranking positions once they enter the field, however, is still a point of debate.

Limitations

This study presents a few limitations. First, it included only Medline-indexed journals, only journals with articles and websites in English, and only journals with impact factors available. These restrictions may lead to the under- or overestimations of the representation of women—which cannot be extrapolated to all spine, neurosurgery, and orthopedic journals worldwide. Second, we did not evaluate whether the prevalence of women on editorial boards has been changing over time, since prior boards were lacking in many journals. Third, our systematic strategy of determination of editorial board members' gender is prone to inaccuracy—although we used a validated tool.[25] In fact, the most reliable method would be asking the editorial office of each journal for the prevalence of women in their editorial boards. However, we believed that some journals might have delayed answering, refused to answer, or ignored the requests. Fourth, we did not evaluate the surgeons' likelihood of becoming members of editorial boards according to their gender. This could be performed by comparing the proportion of women in the editorial boards to their proportion in their field (ie, spine surgery, orthopedic surgery, or neurosurgery). Yet, this analysis would probably be inaccurate because editorial boards comprise surgeons from several different countries, whereas available censuses of spine surgeons are restricted to specific countries.

CONCLUSION

The proportion of female editorial board members in neurosurgery, orthopedic, and especially spine journals is very low. It follows the pattern of overall low representation of women within these fields, which also appears to be lower for spine surgeons when compared to orthopedic and neurosurgeons.[2,4–8,30] However, it is still not understood whether women are barred from advancing in academics by gender bias within these specialties. Whether these numbers simply reflect the low proportion of women in the studied specialties or whether it represents gender-related bias regarding progression to high-ranking positions is yet to be determined. We believe that a future survey with international societies' members would be a reliable approach to compare the proportion of women within editorial boards of spine surgery, orthopedic surgery, and neurosurgery with the proportion of women in these societies.

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