

Speaker Gender Representation at the North American Neuromodulation Society Annual Meeting (2017–2021): Have We Made Progress in Closing the Gender Gap?

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Background: Speaker gender representation at medical conferences is a significant site of gender disparity. Our primary objective was to quantify the proportion of female speakers and compare plenary session opportunities by gender at the North American Neuromodulation Society (NANS) Annual Conference.

Methods: Data from the 2017–2021 NANS Annual Conference presentations were abstracted. Primary outcomes included gender composition of speaker slots, gender composition of individual speakers, and comparison of plenary speaker slots by gender. Secondary outcomes included comparisons of session size, age, professional degree, and number of presentations per speaker based on gender.

Results: Gender composition of annual speaker slots was (% slots presented by women): 2017:14.6%; 2018:20.5%; 2019:23.5%; 2020:21.0%; 2021:41.4%. Annual gender composition of individual speakers was (% women): 2017:18.7%; 2018:20.6%; 2019:24.6%; 2020:24.9%; 2021:33.8%. Of all speaker slots, the percentage of plenary slots did not differ based on gender, with 11.4% presented by female speakers versus 11.2% presented by male speakers (OR 1.0, 95% CI 0.7–1.5, P=0.893). Compared to male speaker slots, there was an association of lower age (43.9±5.6 vs 50.8±8.9, P<0.001), lower odds of holding a single doctorate degree (OR 0.3, 95% CI 0.2–0.5, P<0.001), and lower odds of holding a dual MD/PhD or DO/PhD degree (OR 0.3, 95% CI 0.1–0.5, P<0.001) in female speaker slots. Compared to male speakers, there was an association of higher number of presentations per female speaker at the 2021 NANS Annual Meeting (2.48±1.60 vs 1.79±1.30, P=0.008).

Conclusion: Although the volume of female speaker slots and individual speakers trailed behind their male counterparts, female speaker representation steadily increased at each subsequent annual NANS meeting. We identified no difference in plenary session slots based on gender.

Keywords: education, leadership, academic advancement, chronic pain, neuromodulation, gender

Introduction

Representation of women in medicine is increasing in the United States,¹ with women now comprising about one-half of medical school applicants and matriculants.² Yet, gender inequalities persist in academic institutions,³ as highlighted by fewer women achieving professorship rank, holding chairperson appointments, receiving invitations to journal editorial

roles, or occupying other leadership roles.^{4–8} While these disparities are evident across most medical disciplines, they are even more prominent in interventional and surgical subspecialties, such as interventional pain medicine.^{4,5} A significant issue is the “leaky pipeline” where women fall from the academic ladder, which in turn depletes the potential pool of female candidates for senior academic ranks and leadership positions.⁹ Prior studies have proposed potential explanations including inadequate time for women to rise through the ranks, significant family responsibilities, domestic responsibilities, lack of role models, inadequate mentoring, discrimination, and implicit biases in hiring and promotion.^{5,10} These observations suggest that the focus of our responsibilities should shift from merely increasing medical training access to instead equalizing opportunity for the female workforce to facilitate achievement of their full career potential, attain academic advancement, receive appropriate financial remuneration, and importantly feel supported in their career aspirations.³

Speaker gender representation at medical conferences is a notable area of gender disparity.¹¹ There is strong evidence highlighting that women are underrepresented as speakers across medical disciplines including emergency medicine, global health, and surgery.^{11–14} This occurrence is particularly highlighted by the presence of all-male panels in conference programs, colloquially coined as “manels”.¹¹ Despite many conferences having a 1:1 ratio of women and men among conference attendees, women spoke less than men with an equivalent academic standing;¹⁵ further, male attendees asked almost twice as many questions as female attendees, suggesting that factors such as an unwelcoming and “chilly” climate for women in academic medicine may play substantial roles.¹⁶ Even in situations where the volume of female speakers is well-represented in conference programs, they may be less likely to receive invitations to deliver highly coveted plenary sessions and keynote presentations.¹⁷ Speaker invitations to society conferences are vital to enhancing the speaker’s visibility and recognition in the field, opens doors for new collaborations with other prominent leaders, and helps establish the speaker as an expert in the field.¹⁸ Further, invited speakerships are a crucial component for the pathway to academic promotion.¹⁹ Specifically, presentation opportunities at plenary sessions or grand rounds sessions are assessed by promotion and tenure committees and are a marker of external recognition. Therefore, gender disparities in speaker opportunities can significantly affect career progression for women in medicine.

To better understand the inequity of female speaker representation in an interventional pain conference, we conducted a five-year analysis (2017–2021) quantifying the proportion of female speakers and factors associated with female speaker representation at the North American Neuromodulation Society (NANS) Annual Conference. Findings from this study would contribute to the scientific literature on gender representation in academic medicine, as well as advance the goals of the NANS organization in maintaining and training a diverse workforce.

Methods

Ethics

The project was deemed as exempt by the Mayo Clinic Institutional Review Board and conformed to principles per the Declaration of Helsinki.

Data Source and Extraction

The annual NANS conference is a well-known and well-attended interventional pain conference with a focus on neuromodulation interventions. The NANS organization and annual conference attracts membership from diverse specialties in pain medicine, including professionals in anesthesiology, physical medicine and rehabilitation, neurology, neurosurgery, emergency medicine, internal medicine, psychiatry, engineering, and other disciplines. Most NANS conference attendees are from the United States, although international delegates frequently attend NANS annual conferences as well as serve on various NANS committee boards. Further, NANS attendees and committee board members are well-represented by both faculty from academic institutions and clinical professionals working in private practice.

Data from the 2017–2021 NANS Annual Conference presentations were abstracted from a database maintained by the NANS society on 10/24/21. Although program data are publicly available for recent NANS conferences (past 1–2 years), data describing prior conferences are not publicly available and were obtained from a database maintained by the NANS

organization. Data variables extracted included: speaker first and last name, session title, type of session (plenary, thematic abstract, concurrent session), session size (number of speaker slots in that session), and professional degree(s). A plenary session, also known as general session or main session, is defined as a session where all conference attendees are gathered together to attend. When two or more breakout sessions are held at the same time, they are known as concurrent sessions. Conference attendees can choose which concurrent session to attend. For all sessions included in our analysis (plenary, thematic abstract, or concurrent session), speakers are offered these opportunities by invitation only. Furthermore, due to the Coronavirus Disease 2019 (COVID-19) pandemic, the 2021 annual meeting was held virtually and thus this manuscript can provide unique insights on gender representation in an online conference format.

Session and Speaker Identification

Two co-investigators (BL and RSD) performed manual chart review of all sessions. Inclusion criteria comprised of any speaker, regardless of professional degree (physician or non-physician), who presented in the main meeting. We excluded pre-conference sessions, poster abstract presentations, and problem-based learning discussions. Our justification for these exclusions was that these sessions are unlikely to be invited, and frequently include faculty who have designed the proposals for these sessions.²⁰ Further, poster abstract presentations were commonly presented by resident or fellow trainees, and there was no specific presentation time slot devoted to one poster presentation at a time. Poster abstract presentations were all presented concomitantly, while attendees rotated to view posters.

In terms of definitions, a speaker slot is only filled by one individual speaker. Since an individual speaker can deliver multiple presentations (eg fill multiple presentation slots), we provide data below on both individual speaker gender and the gender of the individual speaker filling a speaker slot. On the contrary, a session is comprised of multiple individual speakers.

Determination of Speaker Gender

While gender is a multidimensional and fluid concept that is determined by the individual, our study assumed binary gender identity to facilitate analysis. We utilized publicly available sources including online healthcare directories (www.healthgrades.com), state licensure boards, online curriculum vitae, and program websites to identify the gender of all speakers. Other methods have been described, such as a commercially available name-based gender identification software (Gender API, <http://gender-api.com/Munich>). This software utilizes multiple sources of data from governmental databases and social networks to determine gender identity of a name and assigns a probability score.²⁰ This modality was reserved as a last option to identify gender identity in our study.

Outcomes of Interest

Primary outcomes of interest included gender composition of speaker slots, gender composition of individual speakers, and comparison of plenary speaker slots by gender at the annual NANS meetings. Secondary outcomes of interest included comparisons of: session size by gender, age by gender, professional degree by gender, and number of presentations per speaker by gender. Session size was analyzed because larger session sizes may diffuse the prominence and visibility of individual speakers compared to smaller session sizes. Given the greater impact of childbearing and parenthood on women in academia, age was considered an important variable because it may take longer for female professionals to gain visibility in the field and obtain speaker invitations. Similarly, the type of professional degree may also play a role in speaker invitations, possibly favoring those with more advanced degrees and dual advanced degrees.

Statistical Analyses

We reported continuous outcomes as mean with standard deviation and dichotomous categorical outcomes as overall counts with percent. Univariable regression analysis was utilized to evaluate whether certain variables have a greater propensity for association with male or female gender. Specifically, variables assessed included: type of session, session size, age, professional degree, and number of presentations per speaker between female and male gender. The selected regression model was dependent on the outcome variable: binary logistic regression was conducted if the outcome variable consisted of two possible categorical outcomes (plenary vs non-plenary session); multinomial logistic regression

was conducted if the outcome variable consisted of three or more possible categorical outcomes (professional degree); and, linear regression was conducted if the dependent variable was continuous (session size, age, number of presentations per speaker). Effect sizes for logistic regression were presented as odds ratio (OR) with 95% confidence interval (CI), and effect sizes for linear regression were presented as β -coefficient with 95% CI. A P-value <0.05 was considered statistically significant.

Results

Baseline Characteristics and Gender Composition

Over the five NANS annual meetings studied, there were a total of 1583 speaker slots for individual presentations meeting our criteria (Table 1), which comprised of 376 slots presented by female speakers (23.8%) and 1207 slots presented by male speakers (76.2%). In total, there were 556 unique speakers, comprised of 143 (25.7%) female speakers and 413 (74.3%) male speakers.

The gender composition of annual speaker slots was as follows (% slots presented by women, Figure 1): 2017: 14.6%; 2018: 20.5%; 2019: 23.5%; 2020: 21.0%; 2021: 41.4%. Annual gender composition of unique individual speakers was as follows (% women, Figure 2): 2017: 18.7%; 2018: 20.6%; 2019: 24.6%; 2020: 24.9%; 2021: 33.8%.

Primary Outcomes of Interest

Of all speaker slots, the percentage of plenary speaker slots did not differ based on gender (Table 2), with 11.4% presented by female speakers versus 11.2% presented by male speakers (11.2%; OR 1.0, 95% CI 0.7–1.5, P=0.893).

Secondary Outcomes of Interest

There was no difference in session size between female speakers slots (9.1 ± 2.1) and male speaker slots (9.2 ± 2.0 ; β -0.1, 95% CI -0.3–0.1, P=0.397; Table 2). Although session size ranged from 5 to 20 speakers, approximately 88.3% of female speakers and 89.6% of male speakers presented in a session featuring 7–10 speakers. There was a significantly higher age in male speaker slots (50.8 ± 8.9 years) compared to female speaker slots (43.9 ± 5.6 years; β -6.9, 95% CI -8.3 – -5.5, P<0.001). Multinomial logistic regression revealed a lower representation of female gender in speaker slots filled by those holding a single doctorate degree (OR 0.3, 95% CI 0.2–0.5, P<0.001), and those holding a dual MD/PhD or DO/PhD degree (OR 0.3, 95% CI 0.1–0.5, P<0.001). There were 35 speaker slots filled by female advanced practice providers ([APPs], 9.3%), but no speaker slots filled by male APPs (P<0.001).

Table 1 Baseline Variables of Overall Sample

Variable	n (%) or Mean \pm SD
Speaker Slots	1583
Slots presented by female speakers	376 (23.8)
Slots presented by male speakers	1207 (76.2)
Speakers	556
Female	143 (25.7)
Male	413 (74.3)
Overall Session Type	1583
Plenary	178 (11.2)
Non-plenary session	1405 (88.8)
Mean Session Size	9.2 \pm 2.0

Notes: Number of observations per total (n/N) and percentage are provided for categorical variables, and mean and standard deviation (SD) are provided for all continuous variables. These descriptive statistics are reported as aggregate data for all five annual conferences analyzed. Certain variables (age, professional degree) are not reported here as these variables may change annually.

Gender Distribution of Speaker Slots at Annual Conference (2017-2021)

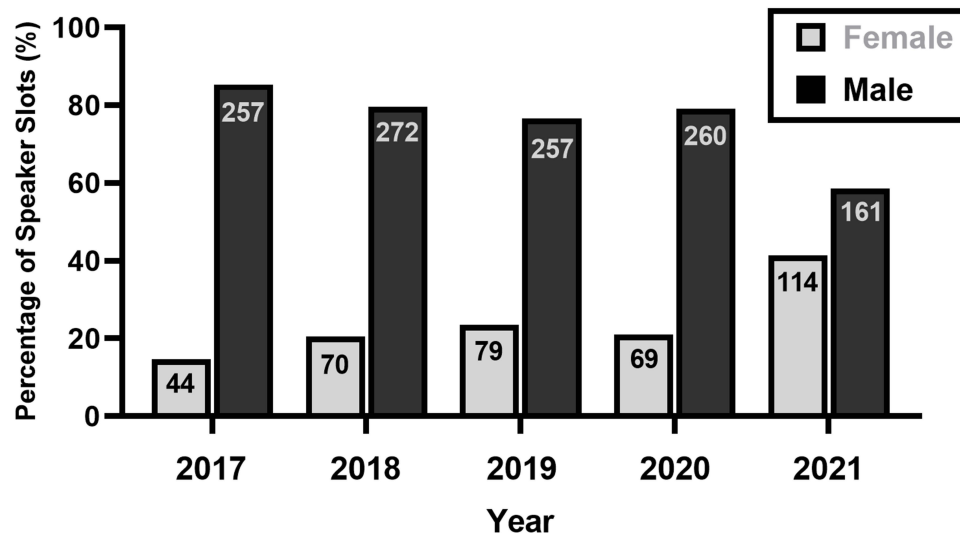


Figure 1 Gender Distribution of Speaker Slots at Annual Conference. The percentage of all speaker slots is stratified by gender and is presented for each separate annual NANS conference from year 2017 to year 2021. The absolute value is provided within each bar to reflect the absolute number of speaker slots filled by female and male speakers for that specific conference year.

Gender Distribution of Individual Speakers at Annual Conference (2017-2021)

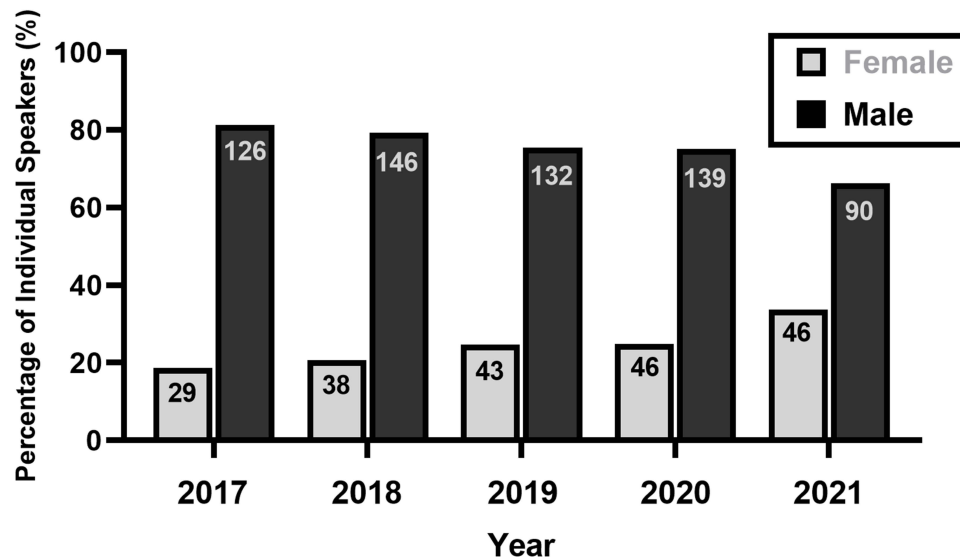


Figure 2 Gender Distribution of Speakers at Annual Conference. The percentage of all individual speakers is stratified by gender and is presented for each separate annual NANS conference from year 2017 to year 2021. The absolute value is provided within each bar to reflect the absolute number of female and male speakers for that specific conference year.

Compared to male speakers, there was an association of higher number of presentations per female speaker at the 2021 NANS Annual Meeting (2.48 ± 1.60 versus 1.79 ± 1.30 , $P = 0.008$; Table 3). No differences in number of presentations per speaker based on gender were identified in other NANS annual meetings or in the overall sample.

Table 2 Characteristics of Speaker Slots Stratified by Gender (Years 2017–2021)

Variable	Female (n=376)	Male (n=1207)	Odds Ratio or β-Coefficient (95% Confidence Interval)	P-value
Primary Outcome				
Type of Session ^a				
Plenary	43 (11.4)	135 (11.2)	OR 1.0 (0.7–1.5)	0.893
Non-Plenary Session	333 (88.6)	1072 (88.8)		
Secondary Outcomes				
Session Size ^b	9.1 ± 2.1	9.2 ± 2.0	β -0.1 (-0.3–0.1)	0.397
Age ^b	43.9 ± 5.6	50.8 ± 8.9	β -6.9 (-8.3 – -5.5)	<0.001*
Professional Degree ^c				
MD/DO/PhD only£	249 (66.2)	900 (74.6)	0.3 (0.2–0.5)	<0.001*
Dual MD/PhD or DO/PhD Degree	65 (17.3)	277 (22.9)	0.3 (0.1–0.5)	<0.001*
Advanced Practitioner	35 (9.3)	0 (0)	**1.6×10 ⁸	<0.001*
Undergraduate/Master’s Degree	27 (7.2)	30 (2.5)	1.00	-

Notes: For continuous outcomes, mean \pm standard deviation is presented. For categorical outcomes, overall count with percentage of total is presented. [£]This category involves having one doctorate degree (MD, DO, PhD, Ed, PharmD, JD, etc.). This category may or may not have additional non-doctorate advanced degrees (eg MBA, M.S.). Non-plenary sessions consisted of concurrent sessions and thematic abstract presentations. ^aBinary logistic regression was utilized to determine association based on gender. ^bLinear regression was utilized to determine association based on gender. ^cMultinomial logistic regression was utilized to determine association based on gender. Reference category was undergraduate/master's degree. **OR was very high; confidence interval not displayed. *P<0.05 indicates statistical significance.

Discussion

In this five-year cross-sectional analysis, we observed that the number of female speaker slots and individual female speakers were lower than male speaker slots and individual male speakers, respectively. Female representation has been steadily increasing at each subsequent annual meeting and achieved its highest volume in the 2021 annual meeting. This change is particularly highlighted by 41.4% of speaker slots held by women in the 2021 Annual NANS meeting versus only 14.6% of speaker slots held by women in the 2017 Annual NANS meeting. Importantly, we identified no difference in plenary session slots based on gender in the entire five-year sample. These findings highlight gradual improvements in speaker gender disparity at a major conference that attracts national and international professionals from diverse disciplines. Our observations contradict the existing literature on gender composition in other notable conferences from other medical fields, which generally highlight persistent underrepresentation in female composition and higher number of plenary invitations to male speakers.^{11–13,17}

Potential explanations for our findings include an increase in female leadership among the NANS organization committees, particularly within the scientific planning committee. This potential explanation is concordant with prior literature highlighting that inclusion of more women as conveners, who invite speakers and moderate conference sessions, may increase the proportion of women who are invited to speak at scientific meetings.⁹ Several studies have also highlighted that female leadership may be associated with higher proportion of female faculty and trainees in pain medicine²¹ and other medical specialties.²² Furthermore, the Women in Neuromodulation (WIN) section was recently created within the NANS organization with an overarching purpose to

educate, inspire, and encourage women working in the field of neuromodulation, regardless of medical specialty, to realize their professional and personal goals and to serve the discipline in addressing the issues inherent to training and maintaining a diverse and balanced workforce²³.

Table 3 Number of Presentations per Speaker by Gender

Number of Talks Per Speaker	Overall		2017		2018		2019		2020		2021	
	F (n=143)	M (n=413)	F (n=29)	M (n=126)	F (n=38)	M (n=146)	F (n=43)	M (n=132)	F (n=46)	M (n=139)	F (n=46)	M (n=90)
1	78 (54.5)	239 (57.9)	20 (69.0)	75 (59.5)	18 (47.4)	84 (57.5)	26 (60.5)	75 (56.8)	35 (76.1)	87 (62.6)	19 (41.3)*	54 (60.0)*
≥2	65 (45.4)	174 (42.1)	9 (31.0)	51 (40.5)	20 (52.6)	62 (42.5)	17 (39.5)	57 (43.2)	11 (23.9)	52 (37.4)	27 (58.7)*	36 (40.0)*
Mean ± SD	2.63 ± 3.19	2.92 ± 3.91	1.52 ± 0.99	2.04 ± 1.70	1.84 ± 1.05	1.86 ± 1.26	1.84 ± 1.33	1.95 ± 1.36	1.50 ± 1.07	1.87 ± 1.48	2.48 ± 1.60*	1.79 ± 1.30*
β (95% CI)	-0.3 (-1.0-0.4)		-0.5 (-1.2-0.1)		0.0 (-0.4-0.4)		-0.1 (-0.6-0.4)		-0.4 (-0.8-0.1)		0.7 (0.2-1.2)	
P-value	0.419		0.113		0.925		0.643		0.120		0.008*	

Notes: We provide overall counts (with percentage of total) for 1 presentation per speaker, and ≥2 presentations per speaker. We also provide mean (±SD) number of presentations per speaker. *Indicates p-value <0.05.

Abbreviations: F, female; M, male; SD, standard deviation.

These initiatives are crucial to motivate more prospective female professionals to consider pursuing interventional medical fields such as pain medicine, reduce the barriers toward academic advancement, and maintain and cherish diversity in a field that is already represented by diverse medical disciplines. Another potential explanation for the increase in female speakers is an increase in the female workforce. However, public specialty data from the Association of American Medical Colleges highlight that 19.0% of pain management physicians were female in 2019, which did not increase substantially from year 2015 when 18.3% of pain management physicians were female.²⁴ It is concerning that these percentages are unlikely to rise significantly in the near future since women represent about 22% of pain medicine fellows.²⁵

Although volume of female professionals in annual NANS meetings is gradually improving, some notable discrepancies in our data may raise concern. For instance, while speaker slots held by women increased to 41.4% at the annual 2021 meeting, individual female speakers actually comprised only 33.8% of total speakers. This discrepancy is explained by a higher number of presentations delivered per female speaker (2.48 ± 1.60) versus presentations per male speaker (1.79 ± 1.30 , $P=0.008$) at the 2021 NANS annual meeting. This occurrence may be advantageous by providing additional speaker opportunities, which in turn may increase visibility and recognition in the field. However, the burden of delivering multiple talks at each conference necessitates more resources, time, and commitment which may detract from other potential opportunities at the conference such as collaboration with other field experts and participation in other educational events (eg workshops). This also limits opportunities to a smaller number of women in the field. Due to the COVID-19 pandemic, the 2021 NANS annual meeting was the first fully virtual meeting held by NANS and the authors query whether the virtual format permitted more women to fulfill virtual speaker engagements. Because of the disproportionate burden of household and child care responsibilities that fall on female professionals,²⁶ it is plausible that the virtual format may have facilitated a higher acceptance and willingness to speak among invited female speakers. Future studies should investigate if the rate of speaker invitation to acceptance ratio differs between in-person meetings versus virtual meetings. It is important to note that the disparity in individual female speakers may be representative of the pain medicine field. Physician specialty data from the Association of American Medical Colleges reveal that only 19.0% of pain management physicians are women.²⁴ Further, a study of 3256 pain fellows from 2009 to 2019 revealed that the ratio of men to women pain fellows was between 5:1 and 3.7:1.²⁷ There are currently no data on gender representation in the field of neuromodulation, although it may approach the representation present in the pain medicine field.

While not the focus of this study, our analysis identified that there were no APPs represented as speakers in the 2017 annual meeting. With the advent of the 2018 annual meeting and each subsequent meeting thereafter, APPs gradually experienced greater representation among speakers. Potential explanations include the NANS leadership placing more emphasis on increasing diversity among speakers, attempting to increase conference attendance of APPs, and embracing and reflecting the multidisciplinary and team-based approach in pain medicine. Interestingly, male APP speakers did not deliver any presentations throughout the entire five-year study period. This is likely explained by a higher proportion of females among all APPs,^{28,29} and is a future area of investigation for the NANS organization. Male APP speakers have been included in the NANS APP pre-conference sessions, although this is not reflected in this analysis because pre-conference sessions were excluded.

Another notable conference devoted to neuromodulation and interventional pain medicine is the International Neuromodulation Society (INS). Given the substantial heterogeneity of combining datasets from two separate societies and cancellation of the two recent in-person INS meetings, we decided not to abstract and combine data from the INS annual meetings. However, this may be an area of future investigation to determine the external validity of our study findings. Other areas that warrant investigation include racial representation among speakers, implementation and assessment of strategies to promote speaker diversity, and dissemination of content devoted toward diversity in neuromodulation.

Conclusions in the present study are constrained by study methodology, ascertainment of speaker details, and assumptions that the NANS database accurately reflected all speakers. Notable study limitations include a retrospective cross-sectional study design that may omit certain key variables such as metrics of peer-reviewed publication productivity (eg Hirsch-index), institutional leadership positions (eg division chair, program director), and

NANS society leadership positions. These variables may be important components in determining visibility of the individual, and may be associated with invitations to present at the annual NANS conference. Missing data for certain variables (eg age) may impact study findings. Reporting bias may impact data extracted from public databases. The 2021 annual meeting was held virtually while the other annual meetings were held in-person, introducing some heterogeneity into our analysis. Finally, we categorized gender using a binary construct that did not account for non-binary people. Inclusion of non-binary people would have further highlighted the representation of another under-represented cohort in academic medicine. Further investigation is also warranted on other diverse populations in academic medicine such as sole parents, same-gender couples, those living outside the couple structure, dual career academic couples, those with complex and multiple caring duties, those conducting migrant academics, and those conducting academic medicine in remote locations that are distant from travel hubs. Future research on this topic may highlight implications on the intersection between care, mobility, and academic medicine. Future studies should determine if the recent increase in female speaker representation at the NANS annual meeting will be maintained in future annual meetings and approach male speaker representation. As aforementioned, even when female and male representation in conference attendance is similar, studies have highlighted that women speak far less than men. Future studies of the NANS annual meetings or other similar meetings should determine if length of presentations differ based on gender. Studies on gender representation among other society roles, such as committee leadership positions and other membership roles, may contribute to the literature. Concordant with this study's objective and the NANS mission of promoting diversity, we also welcome future studies assessing speaker representation based on race and other sociodemographic variables (eg geographical location).

Conclusion

Although the volume of female speaker slots and individual female speakers trailed behind their male counterparts, female speaker representation steadily increased at each subsequent annual NANS meeting. In 2017, only 14.6% of speaker slots were held by women. However, a peak of 41.4% of speaker slots held by women was attained in the 2021 Annual NANS meeting. Importantly, there was no difference in plenary session slots based on gender. There was an association of lower age, lower odds of single doctorate degree, and lower odds of dual MD/PhD or DO/PhD in female speaker slots versus male speaker slots. Future studies are warranted to confirm the external validity of our findings to other notable society meetings.

Author Contributions

RSD was involved in study conception, study design, data collection, statistical analysis, manuscript composition, and final manuscript approval. All authors made significant contribution to the work reported (conception, study design, executing, acquisition of data, analysis or interpretation), drafted or revised or critically reviewed the article, agreed to the journal of submission, reviewed and agreed to all versions of the article before submission, during revision, and final version, and agree to take responsibility and accountability for the contents of the article.

Disclosure

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