Evidence of Specialty-Specific Gender Disparities in Resident Recruitment and Selection

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ABSTRACT

Background Specialty-specific gender disparities are multifactorial, yet one area that is lacking from this discussion is the impact of recruitment and selection.

Objective Customized data reports were utilized to compare trends in the gender representation of applicants and residents within 11 surgical and medical specialties between 2013 and 2018.

Methods Applicant data was obtained from the Electronic Residency Application Service (ERAS) and resident data from the Accreditation Council for Graduate Medical Education (ACGME). Eleven specialties with the highest number of applications per applicant were included (dermatology, emergency medicine, general surgery, neurological surgery, obstetrics and gynecology [OB/GYN], orthopedic surgery, otolaryngology, plastic surgery, radiation oncology, radiology, urology). A Cochran–Armitage trend test assessed for changes in the proportion of females within the total applicant group and the corresponding matched resident group. A *t* test was utilized to compare the mean proportion of females for ERAS and ACGME data.

Results Otolaryngology, plastic surgery, radiation oncology, and urology had no significant changes over the study period. Dermatology, general surgery, and orthopedic surgery demonstrated increased gender diversity in applicants over time, while OB/GYN demonstrated decreased gender diversity. General surgery and neurological surgery showed increased gender diversity in resident representation over time. Emergency medicine and radiology had increased gender diversity, and OB/GYN had decreased gender diversity in matched residents compared to applicants.

Conclusions Our findings provide baseline data, but also illustrate evident gaps in our understanding and attempts to improve gender diversity. A multifaceted approach to obtaining and assessing data from all stages of residency recruitment and selection is necessary to support these efforts.

Introduction

In January 2020, the Association of American Medical Colleges (AAMC) Board of Directors endorsed a statement and call to action for leaders in the academic medicine community to address gender inequities at their institutions.[1]

For decades, the benefits of gender diversity have been recognized and valued in the business sector,[2,3] with studies showing that companies with at least 20% women managers performed better financially and were more innovative.[4,5] Despite anticipated benefits, medical specialties such as neurological surgery[6–8] and orthopedic surgery[9] have struggled to increase female representation, and obstetrics and gynecology (OB/GYN)[10,11] has struggled to increase male representation within their resident ranks and subsequent workforce.

Specialty-specific gender disparities are multifactorial, involving factors in the training and practice environment (eg, role models, mentorship/sponsorship, lifestyle, leave policies, pay, research funding, leadership positions) as well as broader societal influences (eg, stereotypes, bias, discrimination, harassment).[12] Residency programs are uniquely positioned to directly influence access to their specialty through the impact of recruitment and selection.[13,14] While there have been attempts to evaluate the effects of residency recruitment and selection over time, nuances in respect to data collection and reporting time frames have made this challenging.[15]

The objective of this study is to utilize customized data reports to compare trends in the gender representation of applicants and residents from various surgical and medical specialties between 2013 and 2018 and to better understand how the selection process might influence gender composition.

Methods

In order to examine the impact of the residency application and selection process on gender diversity, the specialties with the greatest number of applications

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per applicant were chosen for analysis. Within the literature, a higher number of applications per applicant has been identified as a surrogate for specialty competitiveness[16,17]; therefore, all specialties with over 50 applications per applicant during Electronic Residency Application Service (ERAS) 2019 were included in the study.[18] The following specialties met this criterion: dermatology, emergency medicine, general surgery–categorical, neurological surgery, OB/GYN, orthopedic surgery, otolaryngology, plastic surgery–integrated, radiation oncology, radiology-diagnostic, and urology. Fee-based custom reports were obtained on applicants and residents from 2013 to 2018, with gender categorized as female and male in the available datasets. Applicant data from ERAS was acquired from the AAMC.[19] Resident data from the graduate medical education (GME) track was obtained from the American Medical Association.[20]

For the 11 competitive specialties that met inclusion criteria, the proportion of females was plotted over time from 2013 to 2018, comparing ERAS data (ie, total applicants) to Accreditation Council for Graduate Medical Education (ACGME) data (ie, matched residents). Programs that have a preliminary year (dermatology, radiation oncology, and radiology) were offset by 1 year in order to appropriately capture representation in the first postgraduate year within their matched specialty. As a result, these fields have 1 less year of data. A Cochran–Armitage trend test was performed for each specialty to assess for linear trends in the proportion of females within the total applicant group and the corresponding matched resident group from 2013 to 2018. The Cochran–Armitage test is used in categorical data analysis when the aim is to test for the trend in a series of binomial proportions across the level of an ordinal variable. The range and mean proportion of female applicants and matched residents from 2013 to 2018 was calculated for each specialty. A t test was utilized to compare the mean proportion of females for ERAS and ACGME data. For all statistical analyses, the threshold for significance was set at $P < .05$.

The Institutional Review Board of the US Air Force 59th Medical Wing evaluated this study and granted a "not human research" determination.

Objectives
The objective of this study was to compare trends in the gender representation of applicants and residents from various surgical and medical specialties between 2013 and 2018, using customized data reports.

Findings
Over the study period, only 2 specialties (general surgery and neurological surgery) had a significant increase in the proportion of female residents who matched.

Limitations
Our study is limited by the datasets accessible for analysis, as specialty-level data is only available from the applicant and resident stages, neglecting all components of the selection phase (screening, reviewing, interviewing, and ranking stages).

Bottom Line
In this study, we found relative stagnation in efforts to improve gender diversity with continued disproportionate overrepresentation of the majority gender in multiple competitive specialties, which is particularly noteworthy in those without a critical mass.

Results

ERAS

ERAS data represents the total applicant group and provides a surrogate measure of recruitment capabilities. Four of the specialties had a significant change in the proportion of female applicants from 2013 to 2018 (FIGURE 1, TABLE 1). Over time, 3 specialties had an increased proportion of females, including general surgery, OB/GYN, and orthopedic surgery. The proportion ranges and the Cochran–Armitage trend test P values were reported as follows: General surgery increased from 0.311 (95% CI 0.297–0.325) to 0.382 (95% CI 0.367–0.397, $P < .001$); OB/GYN increased from 0.756 (95% CI 0.739–0.773) to 0.793 (95% CI 0.777–0.809, $P < .001$); orthopedic surgery increased from 0.121 (95% CI 0.103–0.139) to 0.155 (95% CI 0.135– 0.175, $P = .004$); whereas dermatology had a decreased proportion of female applicants, moving from 0.649 (95% CI 0.615–0.683) to 0.574 (95% CI 0.541–0.607, $P = .001$).

ACGME

ACGME data represents those applicants who matched and became residents in their respective specialties, providing a surrogate measure of selection practices. Two of the specialties had a significant change in the proportion of female residents who matched, both of which increased from 2013 to 2018 (FIGURE 1, TABLE 1). General surgery increased from 0.349 (95% CI 0.330–0.368) to 0.393 (95% CI 0.369–0.417, $P < .001$). Neurological surgery increased from 0.151 (95% CI 0.101–0.201) to 0.233 (95% CI 0.179–0.287, $P = .022$).

ERAS vs ACGME

Comparing the mean proportion of females between the ERAS and ACGME data provides additional insight into selection practices (TABLE 2). Three specialties were found to have significant differences. Emergency medicine had a mean proportion of 0.338 females in the applicant group and 0.358 in the

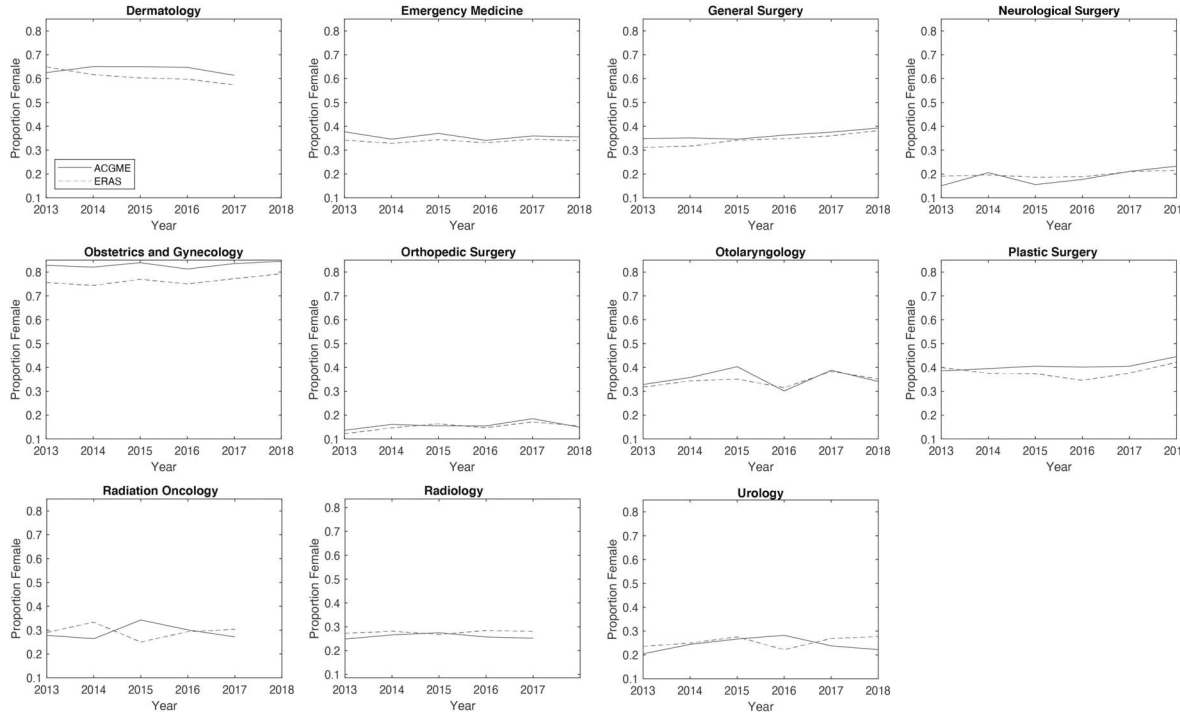

FIGURE 1
Female Proportion Trend for ERAS and ACGME Data by Specialty From 2013–2018
Abbreviations: ERAS, Electronic Residency Application Service; ACGME, Accreditation Council for Graduate Medical Education.

matched group, representing a 2% higher proportion of female residents (95% CI 0.005–0.035, $P = .015$). OB/GYN had a mean proportion of 0.764 female applicants in the ERAS dataset and 0.830 in the ACGME dataset, representing a 6.6% higher proportion of female residents (95% CI 0.046–0.086, $P < .001$). In contrast, the proportion of females in radiology was 0.277 in the total applicant group and 0.260 in the matched group, which represents a 1.7% lower proportion of female residents (95% CI –0.031, –0.004, $P = .012$). Thus, within these 3 specialties there appears to be a disproportionate overrepresentation or underrepresentation of females in the matched resident group compared to the total applicant group.

TABLE 1
Cochran–Armitage Trend Test of ERAS Applicant Data and ACGME Matched Resident Data by Specialty (2013–2018)

Specialty	ERAS, *P* Value[a]	ACGME, *P* Value[a]
Dermatology	*.001*	.34
Emergency medicine	.35	.16
General surgery	**<.001**	**<.001**
Neurological surgery	.15	**.022**
Obstetrics and gynecology	**.001**	.11
Orthopedic surgery	**.004**	.12
Otolaryngology	.09	.43
Plastic surgery	.34	.17
Radiation oncology	.42	.42
Radiology	.27	.49
Urology	.10	.17

Abbreviations: ERAS, Electronic Residency Application Service; ACGME, Accreditation Council for Graduate Medical Education.
[a] For *P* values < .05, bold stands for an increasing trend and italics stands for a decreasing trend.

Specialty Breakdown

Just over one-third (4 of 11, 36.4%) of the specialties did not have any significant changes in the proportion of females when evaluating ERAS and ACGME data from 2013 to 2018 (TABLES 1 and 2). These specialties included otolaryngology, plastic surgery, radiation oncology, and urology. Therefore, these specialties exhibited relative stability in the proportion of females in regard to both recruitment and selection over the studied time period.

One specialty, general surgery, had a significant change in the proportion of females in both the total applicant group and matched resident group (TABLE 1). Furthermore, there was no significant difference in the proportion of females when applicant data were directly compared to matched resident data (TABLE 2). Thus, general surgery increased the proportion of female residents by increasing the number of females in the total applicant pool and then maintaining a

TABLE 2
Mean and Range Female Proportion of ERAS and ACGME Data by Specialty (2013–2018)

Specialty	ERAS Data		ACGME Data		*P* Value[a]
	Mean	Range	Mean	Range	
Dermatology	0.608	0.574–0.649	0.637	0.614–0.651	.09
Emergency medicine	0.338	0.328–0.346	0.358	0.341–0.377	**.015**
General surgery	0.343	0.311–0.382	0.363	0.346–0.393	.17
Neurological surgery	0.198	0.187–0.216	0.189	0.151–0.233	.55
Obstetrics and gynecology	0.764	0.743–0.793	0.830	0.813–0.845	**<.001**
Orthopedic surgery	0.151	0.121–0.171	0.157	0.137–0.185	.54
Otolaryngology	0.344	0.315–0.383	0.353	0.301–0.403	.62
Plastic surgery	0.382	0.346–0.421	0.406	0.385–0.445	.10
Radiation oncology	0.294	0.250–0.333	0.292	0.264–0.343	.91
Radiology	0.277	0.268–0.284	0.260	0.249–0.275	**.018**
Urology	0.255	0.222–0.277	0.243	0.205–0.282	.44

Abbreviations: ERAS, Electronic Residency Application Service; ACGME, Accreditation Council for Graduate Medical Education.
[a] *P* value represents *t* test comparing ERAS to ACGME. *P* values in bold are significant ($P < .05$).

proportionate representation throughout the selection process.

Two specialties had a significant change in the proportion of female applicants, but this did not translate to a significant change in the proportion of female residents (TABLE 1). More specifically, dermatology had a decrease and orthopedic surgery had an increase in the proportion of female applicants. Neither of these specialties had a significant difference in the proportion of females when the applicant data was compared to the matched resident data (TABLE 2). Thus, while there was a notable change in the proportion of females from a recruitment perspective, it was not enough to translate to a change in corresponding residents. Likewise, there was one specialty, neurological surgery, which had a significant change in the proportion of females in the matched resident group but did not have a change in total applicants (TABLE 1). Neurological surgery also did not have a significant difference between ERAS applicant data and ACGME matched resident data (TABLE 2). Therefore, neurological surgery increased the proportion of female residents through selection practices, without a corresponding increase in recruitment; however, this selection influence was subtle, as it was not found to be a significant change when directly comparing the ERAS applicant data and ACGME matched resident data.

As noted previously, 3 specialties were found to have significant differences between ERAS data and ACGME data, suggesting a disproportionate overrepresentation or underrepresentation of females (TABLE 2). The most notable example of this occurred within OB/GYN, which had a mean proportion of 0.764 female applicants and 0.830 female matched residents, representing a 6.6% higher proportion of females in the matched resident group (95% CI 0.046–0.086, $P < .001$). From 2013–2018, OB/GYN also had a significant increase, from 0.756 (95% CI 0.739–0.773) to 0.793 (95% CI 0.777–0.809, $P < .001$), in the proportion of female applicants. Therefore, while these 2 findings did not lead to a significant change in the trend of ACGME data over time, they likely both contributed to the maintenance of the female majority in OB/GYN, which reached a peak of 0.845 (95% CI 0.826–0.864) in 2018.

Discussion

Our study utilized nationally collected data from ERAS and ACGME for 11 competitive specialties to provide insight on gender diversity trends. Changes in the gender proportion in the applicant (ERAS) data over time reflects the impact of recruitment efforts. Differences in gender proportion between the resident (ACGME) data and the applicant (ERAS) data reflects the impact of the selection process. Gender equity increased for some programs over time or between the pool of applicants and the selected residents, while gender equity decreased or stayed the same for others. While these aggregate findings provide baseline data that can assist specialties with their efforts to improve gender diversity, they also illustrate evident gaps in our understanding.

Chervenak and colleagues introduced the concept of "affirmative inclusion" in 2017 as a corollary to affirmative action, whereby affirmative inclusion provides direction for specialties in which a gender (males in the case of OB/GYN) are underrepresented.[21] The authors suggested 2 steps for implementing affirmative inclusion: (1) grow the applicant pool and (2) admit competitive male applicants. For the latter,

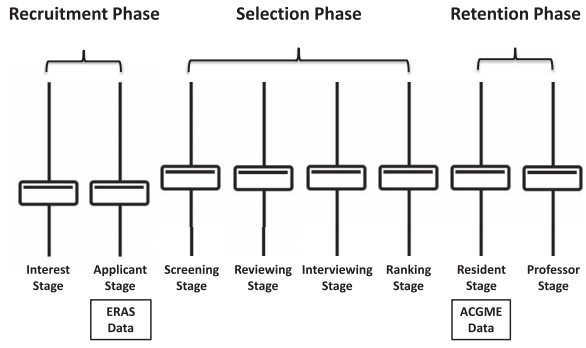

FIGURE 2
Illustration of the Medical Education Continuum

Abbreviations: ERAS, Electronic Residency Application Service; ACGME, Accreditation Council for Graduate Medical Education.

Note: Illustration includes a series of stages that are subdivided into representative phases, including recruitment, selection, and retention.

they advised programs to intentionally invite competitive male applicants for interviews and to rebalance the rank list to ensure that competitive males are included among the top-ranked applicants.[21] These recommendations highlight a few of the key decision points (ie, reviewing and ranking stages, respectively) that occur during residency selection (FIGURE 2).

A closer look at the work of Hewett et al highlights the information that can be gained by examining the various stages of selection.[22] In their study, the authors evaluated a total of 4117 applicants to one radiology residency program from 2008 to 2014, a specialty in which females are underrepresented.[22] The proportion of females compared to total applicants at the stages of invitation to interview, rank, rank in the top quartile, and match was determined for each year. While female applicants made up a greater proportion of interviewees, ranked candidates, and highly ranked candidates compared to the applicant pool, the proportion of matched female residents was no different than the proportion of female applicants.[22] As a result, the authors concluded that the source of the specialty-wide gender gap in radiology is more directly related to the pipeline of female applicants (ie, recruitment capabilities) rather than discrimination (ie, selection practices).

Studies show that when the size of a minority group reaches a certain threshold, or critical mass, around 15%, a qualitative change takes place in the nature of group interactions.[23,24] The minority group is able to organize and reinforce itself, allowing members to achieve and retain positions of authority in a self-sustaining process.[24] This lack of critical mass has been recognized as a potential deterrent for female applicants to pursue a given specialty with historic underrepresentation, thus influencing recruitment.[6,25–27] While critical mass has been defined as a strong minority of *at least* 15%, there is literature to support that this threshold is even higher during the selection process.[23] When examining a university's hiring decisions for academic positions, Johnson and colleagues found that when females made up 1 in 4 finalists (25%), there was a 0% chance that a female would be hired.[28] If, however, females made up 50% of the applicant pool, the likelihood of selecting a female went up to 50%.[28] Heilman and colleagues evaluated the impact of female representation within an applicant pool of 8 individuals for a managerial position.[29] When representation was less than 25%, they discovered that female applicants were judged to be less qualified and were less likely to be recommended for hiring.[29] In contrast, there was a significant shift in these findings once female applicants constituted 37.5% of the applicant pool. These insights may help to explain why those specialties that have not reached or are hovering around a 25% gender minority (ie, females in orthopedic surgery and neurological surgery and males in OB/GYN) have had a harder time improving gender diversity. Intentional efforts to impact representation at various stages of the application and selection process can help to provide a level of critical mass that has been shown to reduce the impact of unconscious bias.

Our study is limited primarily by the datasets available for analysis. The data from ERAS and ACGME is only available in a binary format (ie, female and male). Therefore, we are unable to provide any evaluation or interpretation for individuals who identify as gender diverse or gender expansive. In addition, we are substantially limited in our ability to assess the impact of gender on recruitment and selection because we only have data on the proportion of female applicants and matched residents.

When the medical education continuum is conceptualized to include the many stages that comprise selection, it becomes quite apparent that important data is missing. The National Resident Matching Program sits at the crossroads of applicants and matched residents. It was recently announced that the program will collect demographic data starting with the 2022 Main Residency Match.[30] This data could provide some insight at the national level as to whether there is disparity when transitioning from the applicant stage through the interviewing stage and on to the resident selection stage. This includes how residency programs weigh components of the application, select applicants to interview, and determine rank lists. However, to truly understand

the gender representation during the screening, reviewing, and ranking stages, individual institutional assessments are needed, as recommended by the AAMC.[1,22] This could potentially identify whether programs are basing decisions on selection criteria that differ (or may be viewed differently) for female and male applicants. Ultimately, both national specialty-level data and individual program-level data will be necessary to appropriately target and perform ongoing assessment of efforts to improve gender equity.

Conclusions

In this study, we have showed relative stagnation in efforts to improve gender diversity with continued disproportionate overrepresentation of the majority gender in multiple competitive specialties, which is particularly noteworthy in those without a critical mass.

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