An Analysis of Gender Bias in Plastic Surgery Resident Assessment

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ABSTRACT

Background Previous studies have shown men and women attending physicians rate or provide operating room (OR) autonomy differently to men and women residents, with men attendings providing higher ratings and more OR autonomy to men residents. Particularly with the advent of competency-based training in plastic surgery, differential advancement of trainees influenced by gender bias could have detrimental effects on resident advancement and time to graduation.

Objective We determined if plastic surgery residents are assessed differently according to gender.

Methods Three institutions' Operative Entrustability Assessment (OEA) data were abstracted from inception through November 2018 from MileMarker, a web-based program that stores trainee operative skill assessments of CPT-coded procedures. Ratings are based on a 5-point scale. Linear regression with postgraduate year adjustment was applied to all completed OEAs to compare men and women attendings' assessments of men and women residents.

Results We included 8377 OEAs completed on 64 unique residents (25% women) by 51 unique attendings (29% women): men attendings completed 83% (n = 6972; 5859 assessments of men residents; 1113 of women residents) and women attendings completed 17% (n = 1405; 1025 assessments of men residents; 380 of women residents). Adjusted analysis showed men attendings rated women residents lower than men residents ($P < .001$); scores by women attendings demonstrated no significant difference ($P = .067$).

Conclusions Our dataset including 4.5 years of data from 3 training programs showed men attendings scored women plastic surgery residents lower than their men counterparts.

Introduction

As of 2019, more than half of all enrolled medical students in the United States were women.[1] However, women continue to be underrepresented among the majority of surgical specialties, and there has been some debate regarding why women are less likely than men to choose surgical careers.[2–4] Two hypotheses are that surgery may favor agentic traits that are stereotypically associated with maleness and that the surgical lifestyle is perceived as incompatible with motherhood.[4,5] Additionally, previous studies in surgical and non-surgical specialties have shown that men and women trainees are assessed differently, with men assessors providing higher ratings and more operating room (OR) autonomy to men trainees.[6–9]

One specialty that is approaching gender parity is plastic and reconstructive surgery. Recent data indicated that the women-to-men ratio of its board-certified workforce was 1:5.3 and its integrated plastic surgery resident workforce was 1:1.4.[2] The relative frequency of women within this specialty caused us to consider if plastic and reconstructive surgery training is also subject to implicit gender bias. Additionally, in 2018, four US plastic surgery training programs implemented an Accreditation Council for Graduate Medical Education (ACGME) and American Board of Plastic Surgery approved pilot of competency-based, time-variable training, as opposed to time-based training. Gender imbalances in performance ratings in this new paradigm could have high-stake effects on an individual's length of training. A previous study we performed showed that, as a group, women plastic surgery residents consistently underrated their OR skills compared both with their men colleagues and with attending physicians' assessments of their performance.[10] Therefore we performed the current study to determine if men and women plastic surgery residents are assessed differently by attending surgeons according to attending physician gender.

Methods

This retrospective review analyzed data from 3 academic US plastic surgery training programs that have used MileMarker's Operative Entrustability Assessment (OEA) to assess resident performance in

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Editor's Note: In a conscious effort to be inclusive, the Journal is using Man and Woman as adjectives, rather than Male and Female, to indicate how physicians identified in this study.

the OR. Programs' total annual resident complements comprised 12 (n = 2 programs) and 30 (n = 1 program) trainees. During the study period, faculty complements comprised 6, 9, and 36 plastic surgeons. Gender data were obtained by identifying individuals' preferred pronouns. Both smaller training programs were in cities with populations less than 75 000; the large program was located in a city with a population of more than 600 000. All 3 programs trained residents using the integrated plastic surgery 6-year training track. The larger program also trained residents (2 per year) using the 3-year independent plastic surgery training track and required integrated residents to participate in a mandatory research year between postgraduate year (PGY) 2 and PGY-3. While 2 included programs (1 small and 1 large) are participating sites in the Consortium for Competency-Based Plastic Surgery Training (CCBPST), data collected for the current study were minimally impacted by this paradigm shift, as the first 2 residents matched into the small CCBPST site July 1, 2018.

MileMarker is a web-based program capable of storing trainee self-assessments and their associated attending assessments of residents' capacity for future autonomy for any CPT-coded procedure. Currently, there are more than 10 000 complete case assessments housed within MileMarker representing plastic surgery trainees in the integrated and independent (3 clinical years after completing a primary surgical residency) training tracks. In this study we followed previous studies' methods for including independent trainees' PGY-6–PGY-8 data by categorizing it as comparable to integrated trainees' PGY-4–PGY-6 data, respectively.[11,12] We extracted all OEA data, from inception through November 15, 2018, completed by the 3 plastic surgery programs. The OEA was developed in 2013[13] and has validity evidence for assessment of operative skills for plastic surgery cases.[14,15] It uses a 5-point Likert-type scale with verbal anchors, where 1 = attending will need to perform entire case; 2 = attending physically led resident through case; 3 = attending verbally led resident through case; 4 = resident performed case with minor attending guidance (considered competent); and 5 = resident would be able to perform entire case alone and can take junior resident through case (see TABLE 1). OEAs are formative assessments used as an opportunity to increase operative performance feedback and track residents' operative skills over time. Complete OEAs are defined as those containing a trainee self-assessment as well as an attending surgeon assessment.

Residents initiate the assessment on a smart device or computer by entering the primary CPT code for the case performed, complete a self-assessment using the 1–5 scale, and then either hand their smart device, or click for MileMarker to email the assessment, to the attending for completion. Attending surgeons check and may correct CPT coding, rate the resident on the same 1–5 scale, link the case to the appropriate milestone from the Plastic Surgery Milestone Project (PSMP),[16] and may leave comments regarding the resident's performance. While case assessments are grouped according to the PSMP Milestones, the OEA scale is independent from the PSMP.

OEA scores are given as whole numbers and only one score is awarded per case; a score of 4 or more indicates a resident's ability to perform the procedure independently. We used the 2-sample *t* test and linear regression adjusting for resident gender, PGY, and attending years of experience to compare men and women attendings' assessments of men and women residents. Results are expressed as the regression coefficient (Coeff), odds ratio (OR), and mean. Although the OEA is similar to a Likert scale, it may be viewed as an interval scale because the same residents and attendings use it repeatedly, perceiving the scale similarly each time it is used.[17] Statistical significance was set at $P < .05$.

The reporting of results from this resident quality improvement initiative is approved by the Johns Hopkins Medicine Institutional Review Board.

Objectives
To determine if plastic surgery residents are assessed differently according to gender.

Findings
Men attendings scored women plastic surgery residents lower than their men counterparts during postgraduate year (PGY) 1 to PGY-4 while women attendings' scores of men and women residents demonstrated greater similarity.

Limitations
Three programs are represented, and data may not be generalizable to other programs; residents may have preferentially selected the cases assessed.

Bottom Line
Implicit biases can interfere with attendings' ability to accurately identify resident operative skills; recognizing and addressing potential biases is vital to ensuing appropriate competence and advancement of all trainees.

Results

We included 8377 OEAs completed by 64 unique residents (25% women) and 51 unique attendings (29% women) at 3 training programs. Men residents contributed 82% and women residents 18% of the completed OEAs. Men attendings completed 83% (n = 6972, 5859 [85%] assessments of men and 1113 [75%] of women residents) and women attendings completed 17% (n = 1405, 1025 [15%] assessments

TABLE 1
OEA Scoring System Used for Resident Self-Assessments and Attending Surgeon Assessments of Resident Operative Performance

Numerical Score	Text Anchor	Long Definition
Level 1	Demonstrative guidance	The attending will need to perform the entire surgery with the resident assisting and observing.
Level 2	Physical guidance	The attending will be able to position the resident as the operator and the attending as the assistant to perform the surgery. The resident can be led motion by motion through the surgery.
Level 3	Verbal guidance	The attending will be able to discuss the case with or instruct the resident as the operator, but the resident will be able to mark and perform the surgery with the attending verbally assisting, advising, and correcting as necessary.
Level 4	Supervisory guidance	The attending will need to be present for the case to provide minor guidance if needed or requested; the resident will be able to perform the entire surgery.
Level 5	Consultatory guidance	The resident would be capable of performing the operation alone (guidance by the attending is not needed) or may lead a more junior resident through the surgery.

Abbreviation: OEA, Operative Entrustability Assessment.

of men and 380 [25%] of women residents) of OEAs (TABLE 2). Univariable logistic regression of resident OEA completion rates demonstrated that, when compared to men residents, women residents were almost 2 times more likely to have been evaluated by women attendings (OR 1.96, 95% CI 1.71–2.24).

Unadjusted analysis demonstrated that both men and women attendings rated men residents significantly higher than women residents (3.46 vs 3.14; $P < .001$; TABLE 2). However, stratifying by resident PGY and adjusting for attending years in practice demonstrated that men attendings rated women residents significantly lower than men residents (Coeff = -0.218; $P < .001$; 95% CI -0.311 to -0.197; FIGURE). This is most apparent during the first 4 years of integrated residency (PGY-1–PGY-4) and the first year of independent residency (PGY-6), with men attendings rating women residents 1 PGY level below their men peers at integrated PGY-2 and PGY-4 and independent PGY-6. Conversely, OEA scores by women attendings demonstrated no significant difference between men and women residents (Coeff = -0.061; $P = .22$; 95% CI -0.159 to 0.037). Of note, women attending ratings of women residents were an average of 0.28 points lower than their ratings of men residents during integrated PGY-5/independent PGY-7 (see the FIGURE), though this difference did not reach statistical significance.

Discussion

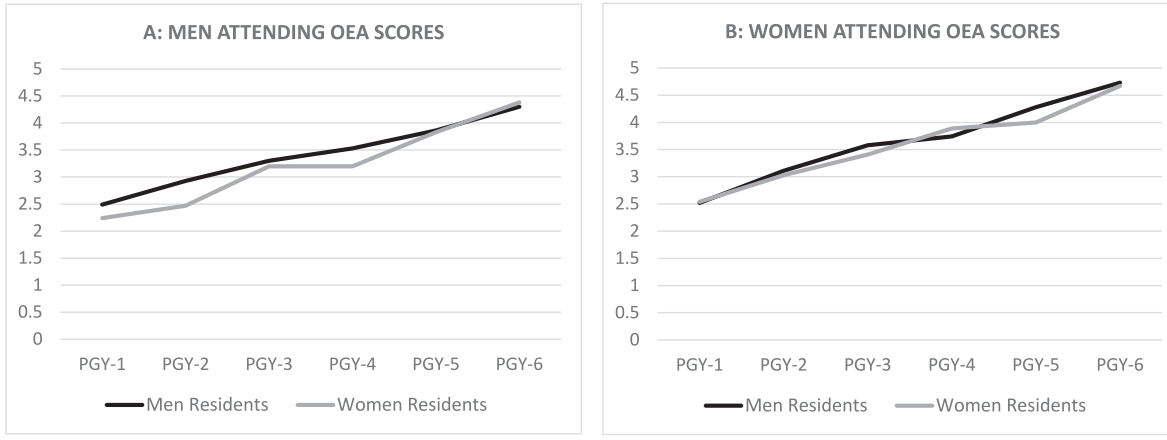
Our dataset, which included 4.5 years of data from 3 training programs, showed that, despite controlling for attending years in practice, men attendings scored women plastic surgery residents' operative skills significantly lower than their men counterparts during PGY-1 to PGY-4. This difference is greatest during PGY-2 and PGY-4 when men attendings rated women residents' operative skills equivalent to men residents' PGY-1 and PGY-3 operative skills, respectively. However, men attendings' assessments of men and women residents were similar during PGY-5 and PGY-6. In contrast, assessments completed by women attendings demonstrated no statistically significant differences between men and women residents.

On average, men and women attendings' scores of PGY-6 residents' operative performance were greater

TABLE 2
Unadjusted Analysis of Men and Women Attending Plastic Surgeons' Ratings of Residents Stratified by Gender

Gender	No. of Assessments (%)	Mean OEA Scores	Mean Delta	95% CI	*P* Value
Men Attendings					
Men Residents	5859 (85)	3.46	0.285	3.436–3.487	< .001
Women Residents	1113 (75)	3.18		3.11–3.244	
Women Attendings					
Men Residents	1025 (15)	3.52	0.299	3.456–3.574	< .001
Women Residents	380 (25)	3.22		3.109–3.323	

Abbreviation: OEA, Operative Entrustability Assessment.



FIGURE

OEA Scores by Men and Women Attendings Stratified by Resident Postgraduate Year and Gender

Note: Scores adjusted for attendings' years in practice. (A) Mean men attending scores for women residents are one postgraduate year (PGY) level behind men residents' scores during PGY-2 and PGY-4. (B) Women attendings scores of men and women residents demonstrate greater similarity.

Abbreviation: OEA, Operative Entrustability Assessment.

than 4, exceeding the threshold needed for achieving independent operative competency. This indicates agreement regarding graduating residents' operative skills (those included in this study were qualified to graduate when they completed their time-based training) and disagreement in skill levels in the preceding years of training. The question of interest is, why do these perceived skill differences occur?

In a 1998 study by Rand et al of 974 American Board of Internal Medicine resident assessments, men attendings (n = 203) were found to rate men residents (n = 85) significantly higher than women residents while women attendings' (n = 52) ratings of women residents (n = 47) trended higher but did not reach statistical significance.[6] A 2017 multi-institution study by Dayal et al that analyzed 2 years of ACGME Emergency Medicine Milestones data comprising 359 residents and 33 456 direct observations found that female residents were rated below, and effectively behind, their male counterparts by both male and female attendings.[7] In 2017 a multi-institution study of thoracic surgery training analyzed 596 cases completed by 33 residents (18% women) and assessed by 48 faculty (12% women).[8] The authors found that the independent factors significantly associated with increasing resident OR autonomy were level of training, case difficulty, *and male gender.* These studies echo our findings, particularly during PGY-2 through PGY-4 for which men attendings rated women residents' OR skills at the same level as men residents' PGY-1 through PGY-3 skills, respectively: 1 year behind their men peers.

However, there is some encouraging data. In 2018, Thompson-Burdine et al analyzed third-party assessments of residents from 4 specialties (plastic, thoracic, vascular, and general surgery) performing a laparoscopic procedure.[9] This study, including 56 faculty and 73 residents performing 223 cases, demonstrated no differences in provision of OR autonomy by attendings to male and female residents. Importantly, this study required that a knowledgeable third-party observer take notes in the OR on both resident and faculty surgeon entrustment as each case was performed. Given findings by Yanes et al that being observed often improves or exaggerates improvement in provider performance,[18] it is possible that being observed and assessed by a third-party may help neutralize a certain amount of unconscious bias.

One possible explanation for perceived differences in operative skills is men attendings may be unconsciously responding to how men and women residents present themselves in the OR. Numerous studies have found that women tend to underrate and men tend to overrate their performance.[19–23] This reflects our experience documented in a study we published in 2020 in which we found women PGY-1 and PGY-3–PGY-6 residents significantly underrated and men PGY-2–PGY-6 residents significantly overrated their operative performance compared to attending assessments.[10] Given the finding by Sandhu et al that residents' self-perceived autonomy was significantly associated with attending-awarded OR entrustability,[24] men attendings may be more likely to award more entrustability to individuals displaying confident behaviors and requesting increases in autonomy rather than based on actual operative readiness. Similarly, resident self-assessments may be priming attendings' thoughts, contributing to unconscious anchoring of attendings' ratings. Another explanation is that gender may be used as an oversimplified

marker for congruent personalities, which has been independently associated with increasing OR autonomy.[25] This may help explain our finding that, compared to men residents, women residents were almost 2 times more likely to be assessed by women attendings. Finally, it is possible that differences in assessment scores reflect the different rates at which residents mature during training. However, were this the case, we would expect to see more similar resident assessment scores from men and women attendings over the course of training.

Women plastic surgery attendings seemed less affected by these stereotypical behaviors. We did note a nonsignificant difference in PGY-5 resident ratings. While this may be due to the subgroup's small sample size, one theory is that, this being the first chief year, women attendings may be holding women residents to a higher standard than their men peers.[26] The causes behind this may consciously or unconsciously come from the women faculty's own experiences of needing to be better than or being held to a different standard than their men colleagues and wanting their women trainees to be equal to this measure of competence.[26] This may be worthy of future study in a larger sample as biased ratings of chief residents can have high-stakes, potentially delaying graduation within a competency-based, time-variable training track.

Stratifying residents and attendings by gender is an oversimplification; the circumstances contributing to one's affect are multifactorial and may include race/ethnicity, culture, sexual orientation, religious beliefs, economic background, professional development/maturation, and more. Regardless, introducing interventions such as implicit bias training and deep listening[27] may prompt attending surgeons to consider how they may be differentially assessing operative skills or awarding OR autonomy, whether based on heuristics (eg, projected confidence) or demonstrated competence. This is vital to accurately and equitably assess the skills and knowledge of both the quiet, understated, or possibly self-derogatory learner and the vocal, confident, or assertive trainee.

As plastic surgery continues its pilot of competency-based, time-variable training, being able to accurately identify the operative skills of all residents early in training is vital to ensuing appropriate advancement of all trainees. The convergence of resident data in PGY-6 further emphasizes this need. In competency-based, time-variable programs, residents will be identified as demonstrating competence and potentially eligible to complete training in less than 6 clinical years well in advance of the final training year. If women residents are being rated lower than men residents due to implicit bias and not lesser technical performance, this may have negative consequences on their ability to graduate in less than 6 clinical years. This would constitute one more barrier in what has been shown to be an obstacle course of barriers to women in academia,[27–29] one that occurs early and the experience of which can have a lasting adverse effect on women's future career and leadership aspirations.[30–32] Additionally, while it is easy to focus on the "lower" scores of women, we must also consider the "higher" scores of men to ensure we are not graduating individuals who are confident but not yet competent. Fortunately, techniques employed to determine competence in the cautious trainee may be similarly employed to confirm knowledge one may assume is present in the confident trainee.[33]

This study has several limitations. While we examined data from 3 institutions, these groups are not necessarily equally represented in the number of completed OEAs. However, exploratory analyses indicate that these results are consistent across institutions. We intend to reassess these findings at additional sites to determine if they hold across other training programs. Although the intent is for all cases to be assessed using the OEA, they are not. Case selection may be subject to "cherry picking" by residents since residents initiate the assessments, and not all OEAs are completed immediately after the case, which may introduce recall bias into the sample. Because our sample contains more completed assessments for men residents, additional investigation is warranted to determine if feedback-seeking behaviors differ between men and women residents. However, given the high number of assessments completed, we believe that these data are representative of residents' operative skills. Additionally, we did not have a non-binary gender category at time of data collection, and this group is not represented. Finally, this study contains more men than women person-years with fewer women than men attending physician years and more women residents represented in the junior PGYs.

Conclusions

Our dataset including 4.5 years of data from 3 training programs showed women plastic surgery residents were scored significantly lower than their men counterparts by men attending surgeons; this was most apparent during PGY-2 and PGY-4. Women attending surgeons' ratings demonstrated no statistically significant differences between men and women residents.

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