

Medical School Experiences Shape Women Students' Interest in Orthopaedic Surgery

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Abstract

Background Orthopaedic surgery now has the lowest percentage of women in residency programs of any surgical specialty. Understanding factors, particularly those related to the medical school experience, that contribute to the specialty's inability to draw from the best women students is crucial to improving diversity in the profession. **Questions/purposes** (1) Does required medical school exposure to orthopaedic surgery increase the proportion of women choosing the specialty? (2) Do negative perceptions deter women from choosing orthopaedic surgery? (3) What proportion of orthopaedic faculty members are women, and what proportion of residents are women? (4) To what degree has gender bias been identified in the application/interview process?

Methods Two PubMed searches of articles between 2005 and 2015 were performed using a combination of medical subject headings. The first search combined "Orthopaedics" with "Physicians, women" and phrases "women surgeons" or "female surgeons" and the second combined "Orthopedics" with "Internship & Residency" or "exp Education, Medical" and "Sex Ratio" or "Sex Factors", resulting in 46 publications of which all abstracts were reviewed resulting in 11 manuscripts that were related to

the research questions. The Google Scholar search of "women in orthopaedic surgery" identified one additional publication. These 12 manuscripts were read and bibliographies of each reviewed with two additional publications identified and included.

Results Required exposure to orthopaedics was found to be positively associated with the number of women applicants to the field, whereas negative perceptions have been reported to deter women from choosing orthopaedic surgery. Orthopaedics has the lowest percentage of women faculty and women residents (14%) compared with other specialties; this suggests that same gender mentorship opportunities are limited. For women applying to orthopaedics, gender bias is most evident through illegal interview questions, in which women are asked such questions more often than men (such as family planning questions, asked to 61% of women versus 8% of men).

Conclusions Successful recruitment of women to orthopaedic surgery may be improved by early exposure and access to role models, both of which will help women students' perceptions of their role in field of orthopaedic surgery.

Introduction

Orthopaedic surgery has the lowest percentage of women in any residency program. In 2003, orthopaedics tied thoracic surgery for the lowest percentage of female residents at 10%. Although orthopaedics did see an increase to 14% in the number of women in residency programs in 2013 (most recent data), it has now been surpassed by every other medical specialty (Table 1) [3]. With women representing 47% of the medical student population [4], the fact that only a minority of women choose orthopaedics

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Table 1. Women residents as percent of total women and men residents in specialty [3]

| | | |
|--------------------------|------|------|
| Surgical specialty | 2003 | 2013 |
| Ophthalmology | 33% | 45% |
| Colon and rectal surgery | 31% | 39% |
| Surgery | 26% | 38% |
| Otolaryngology | 22% | 35% |
| Plastic surgery | 20% | 32% |
| Urology | 16% | 24% |
| Thoracic surgery | 10% | 20% |
| Neurological surgery | 11% | 16% |
| Orthopaedic surgery | 10% | 14% |

suggests that there is gender disparity in the specialty, and this may limit its ability to attract the best students.

Because of this disparity, the priority is to understand factors that increase gender diversity in orthopaedics. For many students, interest in a specialty begins in medical school, and the medical school rotation experience may have an important role in shaping interest and perceptions. Despite the positive aspects of a career in orthopaedic surgery, perceptions of how women fit into the specialty may have a negative impact on students' selection. Perceptions are also shaped by mentors, and it is important to understand if women mentors are available to women students. Once the student solidifies her interest and applies to residency, gender biases may be subtly portrayed, and these may have negative effects on perception as well.

Therefore, we asked the following research questions: (1) Does required medical school exposure to orthopaedic surgery increase the proportion of women choosing the specialty? (2) Do negative perceptions deter women from choosing orthopaedic surgery? (3) What proportion of orthopaedic faculty members are women, and what proportion of residents are women? (4) To what degree has gender bias been identified in the application/interview process?

Search Strategy and Criteria

Two PubMed searches limited to English language articles between 2005 and 2015 were performed using a combination of MeSH (medical subject headings) and text words as well as a Google scholar search. Full abstracts were reviewed of each article identified in the search; full-text manuscripts were reviewed for those articles related to the research questions. Inclusion criteria for including a publication in this review were manuscripts that related to one of the four research questions. The first PubMed search combined "Orthopedics" [MeSH and keyword variants] with the MeSH term "Physicians, women" along with

phrases including "women surgeons" or "female surgeons". In this search, 28 articles were identified and two articles were pertinent to the research questions. The remaining 26 publications were on topic such as unconscious bias among clinicians, patient dissatisfaction with rehabilitation after arthroplasty, medical conditions related to women surgeons, and osteoporosis. The second PubMed search combined "Orthopedics" with "Internship & Residency" [MeSH] or "exp Education, Medical" and the MeSH terms "Sex Ratio" or "Sex Factors" and resulted in 18 articles; nine were related to the research questions. The remaining nine publications were related to topics such as internship and empathy, medical residents' attitudes towards physiatry, managing stress, cultural competency, and career plans of orthopaedic residents. The Google Scholar search of "women in orthopaedic surgery" resulted in 14 articles of which four related to the research questions, one of which was not identified in the two PubMed searches. The bibliographies of the resultant 12 publications were reviewed for any additional sources. These 12 manuscripts were read and bibliographies of each were reviewed and two additional publications (one from 2001, one from 2004) were identified and included.

Results

Required exposure to orthopaedics was found to be positively associated with women application to the field. Interest in orthopaedics can begin before medical school. Male medical students are more likely to have developed their interest in orthopaedics before clinical rotations, whereas women in medical school are influenced more by their clinical rotations [5, 10, 11]. Baldwin et al. [5] showed that women entering medical school displayed greater baseline interest in general surgery and other surgical specialties compared with orthopaedics. Studying applications to orthopaedic residency programs, Bernstein et al. [6] found a 12% higher proportion of applications among schools with required instruction in musculoskeletal medicine (5.7% of medical students who had required rotations compared with 5.1% of those who did not). More striking was the 75% relative difference (2.0% versus 1.1%) in applications from women and the 35% difference (8.2% versus 6.1%) in applications from minority students.

Negative perceptions have been reported to deter women from choosing orthopaedic surgery. In a UK study, a greater number of female medical students had been exposed to negative attitudes regarding women orthopaedic surgeons [7]. Women also had negative perceptions of male dominance in the profession [5], a difficult lifestyle after surgical training (including difficulty balancing career and family) [5, 10], and increased physical demands of

orthopaedics [5, 10]. Women were also more likely to indicate that acceptance by senior faculty was a barrier to women entering orthopedics compared with general surgery (12% versus 6%, $p < 0.001$) [10]. Additionally, among medical students, 83% of women felt that it is more difficult for a woman to be promoted in orthopaedics [5].

Representation of women in orthopaedic departments as either faculty or trainees is low and in some programs nonexistent. At 13%, orthopaedic surgery has the lowest representation of female faculty ($p < 0.05$) compared with all other medical specialties, and it has a disproportionately low proportion (3.8%) of female full professors ($p < 0.05$) [8]. Of 76 orthopaedic departments surveyed by Nguyen et al. [14] in 2007, 20% had no female faculty, 20% had no female residents, all of the programs were chaired by men, and nearly all (97%) had a male residency program director. In an analysis of orthopaedic residency programs, Van Heest and Agel [21] identified a surprising number (45 of approximately 140–148 programs, number of programs vary slightly per year as programs with fewer than two residents per year were excluded) had no female residents during at least 1 of the 5 academic years reviewed, including nine programs that had no female residents during any of the years. With such low numbers, opportunities for gender congruent mentorship by a more senior resident within a residency program may be limited. Having a role model of the same gender or ethnicity has been reported to be a positive factor for 59% of women compared with 25% of men ($p < 0.001$) [10].

For women applying to orthopaedic surgery, gender bias is most evident through illegal questions, in which women are asked such questions more often than men. Although no gender bias was identified in initial residency application reviews [18], and the proportion of female and male applicants accepted to orthopaedic residency programs was similar [8], one study showed women were asked more illegal questions during their personal residency interview [9]. Applicants reported being asked about their marital status (24% female versus 7% male), family planning (61% female versus 8% male), gender (45% female versus 14% male), and children (33% female versus 4% male). Women were much less likely to rank a program when asked such questions during their interview [9].

Discussion

The very low proportion of women choosing orthopaedics highlights the specialty's inability to draw from the best women students. This disparity may derive partly from the medical school experience. Medical school exposure—to rotations and mentors—may shape students' perceptions and interests, and it is important to understand factors that

contribute to gender disparity in orthopaedics. The aim of this study was to identify potentially positive factors (eg, medical school exposure to orthopaedics; exposure to women orthopaedic surgeons as faculty and coresidents) and negative factors (negative perceptions of the specialty; gender bias in the application and interview process) impacting gender diversity in the profession.

Limitations

Limitations of this study are the paucity of research on this important topic. Publications identified in this study used few study designs. Databases were analyzed to identify the relative number of women compared with men in orthopaedic residencies and faculties [8, 14, 21]. These studies provide objective findings regarding the paucity of women in orthopaedics but do not shed light on factors influencing this outcome. Survey studies of trainees to identify factors influencing student interest in orthopaedics were typically of a single time point with relatively low numbers respondents (622 students [11]; 529 students [10]). Only one study performed a prospective, cohort study over 3 years in 342 students [5]. Finally only one survey studied the impact of medical school requirements for course work in musculoskeletal medicine relative to application rates of these students to orthopaedic residencies [6]. The potential for self-selection bias in survey studies is a limitation of this review.

Barriers to higher quality research on the topic of gender disparity in orthopaedic surgery are several. Longitudinal studies of larger cohorts of students are important and needed, but local factors influencing those students, and individual student factors, may limit a broad application of findings. Moreover, systemic factors such as lack of exposure to orthopaedics as a medical student may be trumped by personal interest related to prior athletic or medical experiences. The decision of a student to choose a career in orthopaedics is most likely influenced by several factors, making research into identifying specific positive factors all the more challenging. Finally, as many surgical specialties are becoming more gender-balanced (Table 1), it is unlikely that these specialties will be compelled to research gender diversity in their professions, limiting potential collateral research in orthopaedics or that public health groups such as the Office of Minority Health will prioritize funding of research into gender disparities in orthopaedics.

Both exposure to orthopaedics and positive perceptions of the specialty are required for a student to select this field of practice (Table 2). Creating opportunity for girls to learn about orthopaedics even before college may stimulate interest in the profession and grow the pipeline of future

Table 2. Pipeline programs*

| Entry point in pipeline | Name of program | Description of program | Source of funding | Metrics |
|-------------------------|--|---|---|--|
| Middle and high school | OiA: Orthopaedics in Action; sponsored by Perry Initiative [19] | Provides kits to science teachers to educate and excite students on engineering principles used in orthopaedics | Kits are purchased or donated to schools/science teachers; current corporate sponsors are Zimmer Biomet (Warsaw, IN, USA) and Stryker, Inc (Kalamazoo, MI, USA) | Program has been in existence for less than 2 years; metrics not yet available |
| High school | Perry Initiative High School Outreach Program [20] | Day-long programs at numerous locations in which girls perform mock orthopaedic surgeries and biomedical engineering experiments while learning from women surgeons and engineers | Local host covers cost of program; program free to students | See article in this symposium on early results |
| Medical school | Perry Initiative Medical Student Outreach Program [20] | Similar to Perry high school program but for female medical students | Local host covers cost of program; program free to students | See article in this symposium on early results |
| | Nth Dimensions [15] | A multiyear program with a summer internship and ongoing mentorship | Zimmer Biomet AAOS Diversity Advisory Board | See article in this symposium |
| | Mentorship Programs: Ruth Jackson Orthopaedic Society [17], J. Robert Gladden Orthopaedic Society [12], American Association of Latino Orthopaedic Surgeons [1]; AAOS Diversity Advisory Board [2] | Provides interested students with orthopaedic surgeon mentor | By individual groups | No published data |
| | NYU Summer Externship Program [13] | One month preceptorship with NYU orthopaedic faculty; scholarships for underrepresented minorities | NYU-HJD Department of Orthopaedic surgery | No published data |
| | Ruth Jackson Orthopaedic Society Guide for Women in Orthopaedic Surgery [17] | Guidebook of practical advice and tips to encourage and support women in orthopaedics | Self-purchase USD 6.95 | No published data |
| Medical school | AAOS Inaugural Medical Student Program (2016) [2] | Program during AAOS annual meeting for medical students | AAOS Annual Program Committee | New program |

* This table is not intended to be inclusive of all pipeline efforts supported by orthopaedic societies, academic departments, and other groups; AAOS = American Academy of Orthopaedic Surgeons; NYU = New York University; HJD = Hospital for Joint Diseases.

women orthopaedic surgeons. Sponsored by the Perry Initiative, Orthopaedics in Action™ [19] is a hands-on curriculum program for middle and high school STEM (science, technology, engineering, and mathematics) teachers featuring orthopaedic and engineering challenges (eg, in one module students determine the severity of scoliosis deformity and create a treatment plan). The Perry Initiative High School Outreach [20] program is a 1-day event supported by orthopaedic surgeons in which young women from their communities perform mock orthopaedic surgeries while learning from orthopedic surgeons and engineers.

Once in medical school, exposure to orthopaedics positively influences women to choose the profession and the curriculum during medical school should include a required musculoskeletal rotation. Similar to the high school program, orthopaedic surgeons can increase the exposure of women in medical school to orthopaedics by sponsoring a Perry Initiative Medical Student Outreach Program [20]. Formal mentorship programs such as Nth Dimensions [15] and the NYU Summer Externship Program [13] focus on underrepresented students with one-on-one mentorship. Many orthopaedic professional societies such as the Ruth Jackson Orthopaedic Society [17], the J. Robert Gladden Orthopaedic Society [12], and the American Association of Latino Orthopaedic Surgeons [1] support mentorship programs. Ensuring a pipeline, from early exposure before or during medical school, will stimulate young women's interest in orthopaedic surgery.

Although speculative, female medical students in the process of determining career choice may perceive a subconscious preference for male candidates from orthopaedic faculty. Once in a residency program, there may be less subconscious preference displayed by faculty; for example, one study showed no difference in performance between male and female residents, including faculty evaluations [16]. However, the findings in this study may not be representative of other programs because this residency had a relatively high number of female residents (20%) enrolled over the prior 10 years. As previously noted, many residency programs do not have that percent of women residents or have not sustained such a percent over time. Certainly other surgical specialties have enjoyed greater improvement in their gender diversity compared with orthopaedics. Urology, a specialty traditionally dominated by men, now has 24% women residents. No studies were identified that investigated the perception of male dominance in a surgical specialty to the percentage of women enrolled in the corresponding residency programs. Research into the potential role of perceived bias and unconscious bias in career selection by medical students is needed.

The opportunity for female medical students to observe and interact with successful female orthopaedic staff or fellow residents is often limited. Some training programs still have no female faculty [14], and some have no women orthopaedic residents [21]. Such programs would be less likely to attract female residents [10], perpetuating a negative cycle. Programs with limited diversity are encouraged to develop strategies to actively pursue improving their gender representation among residents and faculty.

Women are asked more illegal questions during residency interviews than men [9], and these questions may perpetuate perceived bias against women and may be detrimental to programs that ask them. In the single study identified that researched the prevalence of potentially illegal questions during residency interviews, approximately half of the female candidates surveyed reported ranking a program lower if asked a question about family planning. There are no data to identify if current orthopaedic residency programs that have few if any women ask illegal questions or more frequently ask illegal questions during their interview process as compared with orthopaedic programs with a higher percentage of women. Educating faculty on the negative influence of such questions and to avoid asking such questions may improve a program's ability to attract women candidates.

Conclusion

With gender equity in medical school, successful recruitment of women to orthopaedics will be enhanced by providing early exposure to the profession. Course work in musculoskeletal medicine and orthopaedic surgery rotations need to be mandated curriculum in medical school. Early exposure to women role models is also important in shaping students' (both male and female) perceptions about the specialty. Programs looking to attract the best women and men candidates must avoid asking illegal questions during the residency interview. Research into interventional programs, to increase early exposure or to increase role model representation, may provide steps toward minimizing gender disparity.

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