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# Women in Surgery Residency Programs: Evolving Trends from a National Perspective

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- BACKGROUND:** Similar numbers of men and women are currently graduating from United States (US) medical schools; therefore, surgery residency programs need to attract graduates of both genders. This study compared gender distributions of allopathic US medical graduates (USMG) from academic years 1999-2000 through 2004-2005. In addition, the gender distributions of USMG and international medical graduates (IMG; analyzed separately) entering accredited general surgery (GS) programs and USMG entering other surgical specialty programs were compared across academic years 2000-2001 through 2005-2006.
- STUDY DESIGN:** Data were extracted from the American College of Surgeons Resident Master File and the Association of American Medical Colleges FACTS Website and Data Warehouse. Chi-square statistics compared gender distributions across years for all USMG graduating and applying to GS programs each year between 1999-2000 and 2004-2005 and for USMG and IMG entering training between 2000-2001 and 2005-2006.
- RESULTS:** During the study period, the proportion of women increased significantly ( $p < 0.001$ ) among USMG (43% to 47%), USMG applying to GS programs (27% to 33%), and USMG entering GS residencies (32% to 40%); the percentages of women among IMG entering GS residencies ranged from 11% to 18%, with no apparent linear increase. Proportions of women among USMG entering training increased in most surgical specialties examined.
- CONCLUSIONS:** The gender gap among USMG entering GS training appears to be closing, concurrent with that of USMG overall during the study period. Surgery programs must continue to recruit and retain women to attract the best and brightest trainees. (J Am Coll Surg 2011;212:320-326. © 2011 by the American College of Surgeons)
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The proportion of men among physicians in the United States (US) has historically exceeded the proportion of women. This gender disparity remained particularly large among surgeons throughout the 20th century. In recent years, the number of women attending US medical schools has reached that of men.<sup>1</sup> However, there are no published reports indicating whether this trend has been paralleled by a proportional increase in the number of women electing to pursue surgical training or the number of women attaining positions in surgery training programs. This study addresses these questions by examining annual changes in the gender distribution of 3 related populations: all graduates of allopathic US medical schools (USMG) between academic years 1999-2000 through 2004-2005, USMG ap-

plicants to categorical positions of Accreditation Council for Graduate Medical Education (ACGME)-accredited general surgery (GS) residency programs for applicant years 2000 through 2005, and USMG entering categorical positions at ACGME-accredited GS training programs between academic years 2000-2001 to 2005-2006. Additionally, changes in the gender distribution of USMG were compared between those entering GS and the 7 other surgical specialties offering primary board certification at the time.

Studies have demonstrated that numerous factors may influence medical students' decisions to pursue surgery, such as perceptions of lifestyle, relationships with surgery residents and faculty during clerkships, anticipated workload during training, and personality and other individual factors.<sup>2-4</sup> In addition, some studies have identified gender differences in choice of medical specialty. Novielli and colleagues<sup>5</sup> found that, in one US medical school, women were less likely than men to express interest in GS when beginning medical school, more likely to lose interest in GS while attending medical school, and less likely to gain interest in GS while attending medical school.

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**Abbreviations and Acronyms**

AAMC	= Association of American Medical Colleges
ACGME	= Accreditation Council for Graduate Medical Education
ACS	= American College of Surgeons
ERAS	= Electronic Residency Application Service
GS	= general surgery
IMG	= international medical graduate
USMG	= United States medical graduate

Previous research has identified factors that may influence women's decisions to enter GS training. For example, some studies have reported that the presence of women role models during clerkships was positively associated with the number of women USMG who chose to pursue GS training.<sup>6,7</sup> Conversely, the absence of women role models may be a deterrent for women considering GS training.<sup>8</sup> Women are generally much less likely than men to meet a same-gender role model during their surgery clerkship because of the relatively small percentage of women on the surgical faculty of most programs.<sup>7</sup> Perceived gender-based discrimination has also been identified by several studies as an influencing factor; women are more likely than men to perceive gender-based discrimination while participating in GS clerkships, during residency selection, and in GS residency programs.<sup>7,9,10</sup> Finally, medical student perceptions of the incompatibility between career and family life in surgery training are well documented.<sup>7,8,10</sup> Although men and women may have similar concerns regarding lifestyle and family issues during residency training,<sup>8</sup> some studies suggest that women USMG may be more likely than men to consider family-related issues like parental leave policies when making their career choices.<sup>7,11</sup>

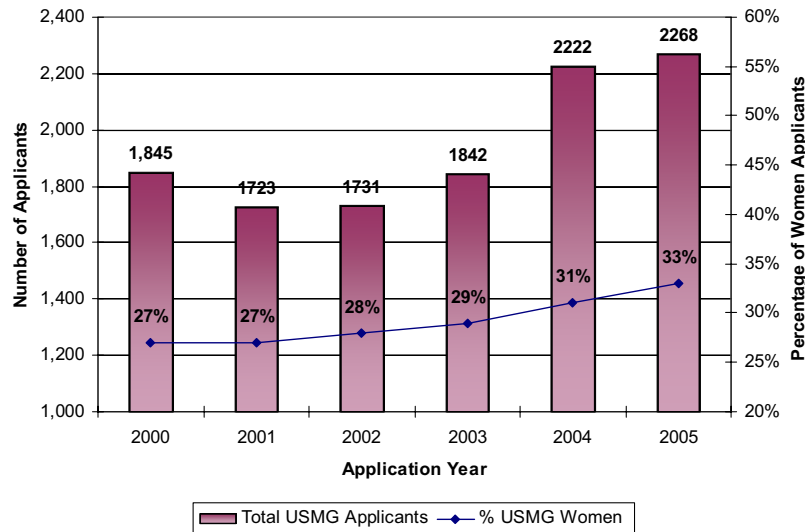
A common theme in the results of the aforementioned studies is that there may be factors related to the choice to pursue surgical training that are unique to or more relevant for women, and that these factors may be associated with an under-representation of women in surgery training programs relative to other specialties. Most of these studies examined either a single medical school or program, or a small sample of schools or programs and focus solely on USMG. When these studies reference the gender distribution in GS training, they generally refer to all residents, including USMG and international medical graduates (IMG). Each year, more than 20% of residents entering GS programs are IMG, most of whom are men (EC Davis, PG Blair, and AK Sachdeva, unpublished data, 2009). Such a sizable percentage of IMG could potentially confound comparisons between the percentage of women graduating from US medical schools and the percentage of women USMG entering GS training. No study, to our knowledge,

has stratified entering GS residents by US or international medical school in order to separately examine the percentage of women among USMG and among IMG entering GS training.

**METHODS**

Data from the American College of Surgeons (ACS) Resident Master File, the Association of American Medical Colleges (AAMC) FACTS Website, and Electronic Residency Application Service (ERAS) data from the AAMC Data Warehouse: Applicant Matriculate File were analyzed in this study. The ACS Resident Master File is a collection of data files obtained annually from the AAMC GME Track Census. Each year, the ACS identifies discrepancies and obtains missing information from residency programs and reconciles the data with previous years' files to compile exhaustive lists of residents and fellows beginning and completing training for each academic year. These files contain demographic and specialty information for residents enrolled in all ACGME-accredited programs in 14 surgical specialties. We used the ACS Resident Master File to identify all residents entering training in each of the surgical specialties offering primary certification between academic years 2000-2001 through 2005-2006: general surgery, neurosurgery, obstetrics and gynecology, ophthalmology, orthopaedic surgery, otolaryngology, plastic surgery, and urology. Residents in each specialty were stratified first by US or international medical school and then further stratified by gender, specifically to identify the percentage of women among allopathic USMG entering into each specialty for each academic year. Gender distribution trends for Canadian and osteopathic medical graduates were reported as separate groups. These groups were excluded from the main analysis for several reasons. First, Canadian and osteopathic medical graduates are not included in the AAMC FACTS Website table from which we extracted the gender distribution data. Second, most of the literature on gender distribution in GS focuses on allopathic US medical graduates. Finally, the number of residents in both of these categories is very low relative to US allopathic graduates and IMG.

For entering GS residents, in addition to calculating the percentage of women among USMG, we also calculated the percentage of women among IMG for each academic year. For purposes of this study, only categorical GS residents (residents appointed to the entire length of a program) were included in the analysis of GS residents. Residents in designated preliminary GS positions (residents already matched in a surgical specialty such as neurosurgery, otolaryngology, or urology) were considered entering residents in their respective specialties.



**Figure 1.** Total number of US medical graduate (USMG) applicants and percentage of women among USMG applicants to general surgery (GS) programs between 2000 and 2005. From 2000 to 2005 there was a 23% increase in the total number of USMG applicants to GS programs, concurrent with a 22% relative increase in the percentage of women among USMG applicants to GS programs.

The AAMC FACTS Website provides tabulated data on all applicants, matriculates, and graduates of allopathic US medical schools accredited by the Liaison Committee on Medical Education. With permission, we obtained the number and percentages of women graduating from US medical schools from academic years 1999-2000 through 2004-2005 from Table 31: Women Enrollment and Graduates in US Medical Schools, 1961-2008.<sup>1</sup>

The AAMC collects demographic and specialty data using ERAS, the application process for medical students applying to ACGME-accredited residency programs, and disseminates these data in aggregate through the AAMC Data Warehouse.<sup>12</sup> With permission, we obtained applicant data by gender, US or international medical school, and specialty for application years 2000 through 2005.

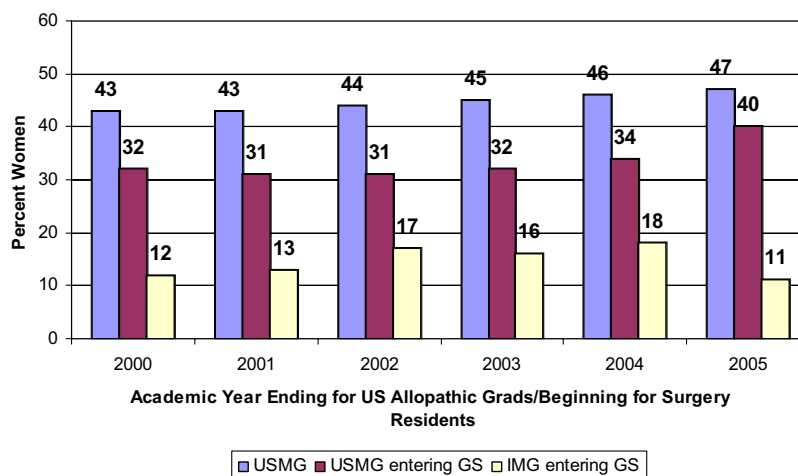
### Statistical analysis

The relative change in the percentage of women was calculated separately for USMG, USMG applying to GS programs, and USMG entering residencies in each surgical specialty by dividing the difference in the percentage of women between the first and last academic years by the percentage of women in the first academic year. Additionally, chi-square tests of independence with analysis of adjusted standardized residuals examined proportional variations in gender between academic years separately for graduates of US medical schools, allopathic US applicants of GS programs, and USMG entering categorical GS positions. Statistical analysis was conducted using PASW version 17 software (Chicago, IL).

### RESULTS

Among graduates of US allopathic medical schools, there was a 9% relative increase in the percentage of women between academic years 1999-2000 ( $n = 6,676$ ; 43%) and 2004-2005 ( $n = 7,412$ ; 47%). Additionally, there was a 22% relative increase in the percentage of women among US allopathic applicants to GS programs from applicant year 2000 ( $n = 506$ ; 27%) to 2005 ( $n = 754$ ; 33%; Fig. 1). Among residents entering into GS residency programs, the relative percentage of women among USMG entering GS training increased 25% from academic years 2000-2001 ( $n = 282$ ; 32%) to 2005-2006 ( $n = 384$ ; 40%) in a relatively linear fashion. In contrast, the percentage of women among IMG entering GS training ranged from 11% ( $n = 16$ ) to 18% ( $n = 31$ ) between academic years 2000-2001 and 2005-2006, with no apparent linear trend (Fig. 2). Additionally, the percentage of women among osteopathic graduates entering GS training increased by 50% from 2000-2001 ( $n = 4$ ; 18%) to 2005-2006 ( $n = 10$ ; 27%). Between 2 and 4 Canadian medical graduates entered GS training per year during the study period; the percentage of women among Canadian graduates entering GS training ranged from zero to 67%.

Chi-square statistics indicated that the proportion of women graduating from US allopathic schools increased significantly during the course of the study ( $p < 0.001$ ), as did the proportion of women among allopathic graduates applying to GS programs ( $p < 0.001$ ) and the proportion of women among USMG entering GS training ( $p <$



**Figure 2.** Percentages of women among graduates of US medical schools, US medical graduates (USMG) entering general surgery (GS), and international medical graduates (IMG) entering GS between the academic years ending for USMG and beginning for residency programs between 2000 and 2005.

0.001). The associated adjusted standardized residuals indicated that the relative proportion of women graduating from US medical schools in academic years 2003-2004 and 2004-2005 was significantly greater than expected by chance; the relative proportion of women among graduates of US medical schools in academic years 1999-2000 and 2000-2001 was significantly less than expected by chance. The relative proportion of women among US allopathic applicants to GS programs was significantly less than expected by chance during applicant years 2000 and 2001 and significantly greater than expected by chance during applicant years 2004 and 2005. Similarly, the relative proportion of women among USMG entering GS training in academic year 2005-2006 was significantly greater than expected by chance.

During the study period, the percentage of women among USMG entering training increased in all of the surgical specialties examined except for neurosurgery. GS had the fourth-highest relative percent increase between

academic years 2000-2001 and 2005-2006, behind urology (92%), otolaryngology (58%), and orthopaedic surgery (44%). By the end of the 6-year period, GS had the second highest percentage of women among USMG entering surgery training (40%), behind obstetrics and gynecology (82%; Table 1).

## DISCUSSION

Between academic years 2000-2001 and 2005-2006, the percentage of women among USMG entering GS training showed a clear increasing linear trend; the percentage of women among IMG entering GS training remained relatively low and more variable, with no linear increase. The percentage of women among IMG entering GS training was much lower than that of women among USMG entering GS training. IMG made up approximately 20% of entering GS residents during this period of study, so stratifying residents by US or international medical school in

**Table 1.** Percent of Women among USMG Entering Surgery Programs by Specialty: Academic Years 2000-2001 Through 2005-2006

Specialty	2000-2001		2001-2002		2002-2003		2003-2004		2004-2005		2005-2006	
	n	%	n	%	n	%	n	%	n	%	n	%
General surgery	282	32	282	31	259	31	300	32	355	34	384	40
Neurosurgery	22	14	8	6	22	18	22	13	20	12	18	11
Obstetrics/gynecology	766	78	748	76	776	80	692	79	709	81	726	82
Ophthalmology	151	36	137	33	138	34	134	34	148	36	153	39
Orthopaedic surgery	55	9	60	10	66	11	68	11	78	12	84	13
Otolaryngology	53	19	64	23	59	26	60	25	73	30	75	30
Plastic surgery	40	21	49	26	41	22	34	18	40	21	48	24
Urology	32	13	40	18	47	22	50	23	46	21	53	25

order to examine the gender distribution solely among USMG entering GS training resulted in a higher percentage of women among USMG entering training than has been previously reported.<sup>6-11</sup> Moreover, the relative increase in the percentage of women among USMG entering GS training during the study period was almost triple the relative increase in the percentage of women among graduates of US medical schools. During the course of the study period, the difference between the percentage of women graduating from US medical schools and the percentage of women among USMG entering GS training narrowed from 11% in 2000 to only 7% in 2005. This suggests that the gap between these 2 populations is closing with respect to gender distribution.

The number and percentage of US allopathic women applicants to GS programs increased significantly during the study, suggesting an increasing interest in GS by USMG women. Figure 1 shows that between 2000 and 2005, the 22% relative increase in the percentage of women among USMG applying to GS programs was concurrent with a 23% overall increase in the total number of USMG applying to GS programs. This suggests that the increased percentage of women USMG applicants is coming from an increased number of US applicants to GS programs, where the national number of positions has remained relatively stable. Additionally, during the period of study and beyond, this trend of increasing percentages of women can also be seen among all applicants to US medical schools, where the percentage of women applicants grew from 47% in 2000 to 51% in 2003 before leveling off at about 50% in subsequent years.<sup>12</sup> Among first-time applicants to US medical schools, women outnumbered men during a 6-year period between 2002 and 2007, and have remained at about 50% of first-time applicants in subsequent years. This suggests that the pool of potential US applicants to GS programs should continue to be equally distributed between the genders.

The gender gap seems to be closing, to varying degrees, not only in GS but also among most surgical specialties offering primary certification. The relative percent increase in women among USMG entering GS training during this 6-year period was among the highest of the specialties examined; only urology, otolaryngology, and orthopaedic surgery had higher relative percent increases. Each of these non-GS specialties initially had lower percentages of women among USMG entering training, resulting in larger relative percent increases over time. Furthermore, between academic years 2000-2001 and 2005-2006, GS surpassed ophthalmology to become the surgical specialty with the second highest percentage of women among USMG entering training, behind only obstetrics and gynecology.

Gender inequity issues in surgical specialty programs have been recognized and are being addressed not only in GS<sup>13-15</sup> but in other specialties as well.<sup>16</sup> Studies have addressed the gender gap and suggested ways in which to effectively recruit more women in other specialties such as neurosurgery<sup>16</sup> and orthopaedic surgery.<sup>17</sup>

Several authors have suggested in recent years that the culture of surgical education is changing.<sup>18,19</sup> Some evidence of this changing culture may also be contributing to the increased interest and enrollment of women in GS programs, emphasizing a greater recognition of the importance of gender diversity in surgical education. First, studies examining medical student perceptions of the 80-hour work week suggest that the mandate had a positive impact on medical students' perceptions of GS as a career choice.<sup>20,21</sup> Specifically, Arnold and colleagues<sup>21</sup> found that women medical students whose surgery clerkship occurred after implementation of the ACGME-mandated 80-hour work week were significantly more likely than women whose clerkship occurred before this implementation to perceive GS as a career that would allow for a good balance between professional and family life. This effect was not found among the men in the study. Women medical students were also less likely to hold negative perceptions of women surgeons' personal lives regarding child bearing, marriage, and mental health if their clerkship occurred after the mandate.<sup>21</sup>

Second, the percentage of women among surgical faculty in US medical schools increased by 29%, from 12.6% in 2000 to 16.3% in 2005.<sup>22</sup> This increase in the percentage of women among surgical faculty may have given women medical students more opportunity to meet women role models during their surgery clerkships, which has been identified in the literature as an important factor for women medical students in deciding whether or not to pursue a surgical career. Several studies have examined the influence of same-sex role models on career choices of medical students; a lack of women role models is repeatedly identified as a deterrent for women medical students choosing a specialty.<sup>7,9</sup> Furthermore, Neumayer and colleagues<sup>6</sup> found that the vast majority of women medical students in their study sample who chose surgery as a career graduated from medical schools with relatively high percentages of women among the surgical faculty.

Finally, several authors have suggested ways in which the culture of surgery can become more attractive to a wider range of women. Some of these include increased access to on-site day care and optional research years. Although these are easily measurable variables, further study would be needed to uncover any possible association between these suggestions and the increased proportion of women entering GS programs. (According to the American Medical

Association, currently approximately 40% of all ACGME-accredited GS residency programs offer on-site child care and approximately 64% of all GS programs offer optional research years.<sup>23</sup>) Other suggestions include departmental and institutional action against gender-based discrimination and sexual harassment;<sup>13</sup> several studies have demonstrated that women perceive discrimination and harassment based on gender significantly more often than do men during surgery clerkships.<sup>7</sup> These perceptions have been shown to affect one's choice of medical specialty.<sup>9</sup> Finally, several authors have suggested, explored, and examined perceptions of the prospect of part time and shared residency positions.<sup>6,14,24</sup> Although there is research to support the success of part time training in other nonsurgical specialties,<sup>25</sup> Borman<sup>15</sup> suggested that solid educational research is needed to determine if part time and shared positions would be appropriate for general surgery residencies.

One limitation to this study is the possibility of data missing from some programs during the first few years of the study. The academic years examined in this study represent the first 6 years the AAMC assumed responsibility for data collection from the American Medical Association using the GME Track Census. In the early years there were difficulties capturing data from some of the programs. Despite the best efforts of the ACS in contacting programs with missing information, it is possible that some (albeit very few) programs are still missing from the data files.

Future research needs to examine on a national scale the factors associated with women's decisions to enter surgery training programs that have been identified or suggested in previous studies. In particular, it may be very informative to examine residency programs with respect to both qualitative and quantitative characteristics, such as the percentage of women on the surgical faculty, the presence of on-site child care, policies regarding gender-based discrimination and maternity leave, and protected research years that may distinguish programs with relatively high versus relatively low percentages of women entering and completing surgery training. Surgery training programs need to effectively recruit the best and brightest students regardless of gender. Rose and colleagues<sup>26</sup> noted that unless programs in all specialties are able to recruit residents of both genders effectively, they will encounter increasingly smaller pools of talented applicants as the gender distribution among USMG continues to equalize. The results of this study indicate that regardless of the explanation, the gender gap among entering surgery residents has begun to close, concurrent with the growing proportion of both women US allopathic graduates and women USMG applying to GS programs. Surgery programs must continue to recruit and retain women in order to attract the best and brightest trainees.

### Author Contributions

Study conception and design: Davis, Risucci, Blair, Sachdeva

Acquisition of data: Davis

Analysis and interpretation of data: Davis, Risucci

Drafting of manuscript: Davis, Risucci, Blair, Sachdeva

Critical revision: Davis, Risucci, Blair, Sachdeva

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