

Characteristics of Highly Ranked Applicants to General Surgery Residency Programs

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Importance: With duty hour debates, specialization, and sex distribution changes in the applicant pool, the relative competitiveness for general surgery residency (GSR) is undefined.

Objective: To determine the modern attributes of top-ranked applicants to GSR.

Design: Validation cohort, survey.

Setting: National sample of university and community-based GSR programs.

Participants: Data were abstracted from Electronic Residency Application Service files of the top 20-ranked applicants to 22 GSR programs. We ranked program competitiveness and blinded review of personal statements.

Main Outcomes and Measures: Characteristics associated with applicant ranking by the GSR program (top 5 vs 6-20) and ranking by highly competitive programs were identified using *t* and χ^2 tests and modified Poisson regression.

Results: There were 333 unique applicants among the 440 Electronic Residency Application Service files. Most applicants had research experience (93.0%) and publi-

cations (76.8%), and 28.4% had Alpha Omega Alpha membership. Nearly half were women (45.2%), with wide variation by program (20.0%-75.0%) and a trend toward fewer women at programs in the South and West (38.0% and 37.5%, respectively). Men had higher United States Medical Licensing Examination Step 1 scores (238.0 vs 230.1; $P < .001$) but similar Step 2 scores (245.3 vs 244.5; $P = .54$). Using bivariate analysis, highly competitive programs were more likely to rank applicants with publications, research experience, Alpha Omega Alpha membership, higher Step 1 scores, and excellent personal statements and those who were male or Asian. However, the only significant predictors were Step 1 scores (relative risk [RR], 1.36 for every 10-U increase), publications (RR, 2.20), personal statements (RR, 1.62), and Asian race (RR, 1.70 vs white). Alpha Omega Alpha membership (RR, 1.62) and Step 1 scores (RR, 1.01) were the only variables predictive of ranking in the top 5.

Conclusions and Relevance: This national sample shows GSR is a highly competitive, sex-neutral discipline in which academic performance is the most important factor for ranking, especially in the most competitive programs. This study will inform applicants and program directors about applicants to the GSR program.

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SIGNIFICANT CHANGES HAVE occurred in surgical education during the past decade, including the implementation of duty hour limitations, the initiation of new integrated subspecialty training paradigms, and a potentially changing applicant pool with more women entering medical school. It is possible that these developments have altered the characteristics of applicants for general surgery residency (GSR) training.

At the time of residency application, medical students and their schools submit subjective and objective personal data as part of the Electronic Residency Application Service (ERAS) program; these data are used by surgical faculty

and program directors to choose applicants for interviews and subsequent ranking for the residency match. The purpose of this study was to analyze ERAS files to identify the attributes that

See Invited Critique at end of article

resulted in a high ranking for surgical residency. We chose to focus on the top 20 applicants ranked by individual programs, believing that this cohort would be likely to match at those programs and would therefore stand as a measure of the attributes of the applicant pool to surgical residency programs in general.

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Table 1. Participating Programs by Geographic Region

Region	Northeast	East	South	Midwest	West
Percentage of women applicants	48.3	56.7	38.0	48.8	37.5
Programs	Albany Medical Center, Abington Memorial, Cornell University, Brigham and Women's Hospital, University at Buffalo, University of Connecticut	Howard University, Eastern Virginia Medical School, University of Maryland	Atlanta Medical Center, Emory University, Medical University of South Carolina, University of Tennessee at Chattanooga, University of Texas at Houston	Midwest Community Program, ^a Ohio State University, University of Chicago, Washington University in St Louis	Oregon Health Sciences University; University of California, Davis; University of California, Los Angeles; University of California, San Diego

^aHospital chose not to be named.

METHODS

Approval by the Albany Medical Center Institutional Review Board was obtained with the understanding that specific applicant identifiers from the ERAS file would be removed, and names would be redacted from the personal statements. Following an e-mail solicitation to program directors or chairs at 34 GSR programs approved by the Accreditation Council for Graduate Medical Education, 22 programs (64.7%) agreed to provide the ERAS files of their 20 highest-ranked applicants to the first postgraduate year class in 2011. Variables of interest were then extracted from the ERAS file for analysis. When applicants applied to multiple programs in the study, each application (not applicant) was considered individually. For the purpose of analysis, programs were divided into geographic regions (East, Northeast, South, Midwest, and West) and ranked by each author for competitiveness (1 signifies highly competitive; 2, very competitive; and 3, competitive). The program ranks were then averaged across authors and classified into the above 3 categories based on tertiles: top 7 as highly competitive, middle 7 as very competitive, and bottom 8 as competitive. The blinded personal statements were ranked on a 1-to-5 scale by all authors, with each applicant being reviewed by at least 3 authors. The ranks were then averaged, rounded to the nearest whole number, and reclassified into 3 categories: best (very high or high),^{1,2} good (average),³ and below average (fair or poor).^{4,5} The individual applicant characteristics were described by geographic region and program competitiveness. Last, we grouped the applicants by their ranking within the program, comparing the top 5 with those ranked 6 to 20. Applicant characteristics were compared by competitiveness and region of the program and by ranking of the programs. Both χ^2 and *t* tests were used for statistical comparison of characteristics across categories. Modified Poisson regression was used to assess the characteristics independently associated with applicant ranking by GSR program (top 5 vs 6-20) and by being ranked by highly competitive programs. Statistical significance was set at .05 for all analyses. STATA 11.1 statistical software (StataCorp LP) was used for analysis.

RESULTS

The 440 applications from the 22 GSR programs included 333 unique applicants. The mean age was 27.4 years (range, 23.2-44.5 years; median, 26.8 years; and 75th percentile, 28.1 years), and 45.2% were women, with wide

variation by program (20%-75%). There was a trend toward fewer women ranked in the top 20 in programs in the South and West (**Table 1**).

The mean United States Medical Licensing Examination (USMLE) I score for all applications was 234.4, with significantly higher scores for men than for women (238.0 vs 230.1; *P* < .001). The mean USMLE II score was 245.1 and was similar for both sexes. When USMLE scores were analyzed by competitiveness of the program as ranked by the authors (**Table 2**), there was a linear and significant correlation for USMLE I scores. The USMLE II scores were significantly lower for competitive programs but were similar for highly competitive and very competitive programs. Highly competitive programs were more likely to receive applications from students who had been elected to the Alpha Omega Alpha (AOA) Honor Medical Society and those with more research experience and publications. The only statistically significant finding from analysis of racial status was that highly competitive programs were more likely to have applicants who were self-described as Asian. On multivariate adjustment, the likelihood of being ranked by highly competitive programs increased 1.36 times (95% CI, 1.23-1.50, *P* < .001) for every 10-unit increase in the USMLE I scores, 2.20 times for students with publications (1.34-2.46, *P* = .001), 1.62 times for students with better personal statements (1.02-2.60, *P* = .04), and 1.70 times for Asian students compared with white students (1.25-2.31, *P* = .001).

Table 3 compares applications ranked in the top 5 by individual programs with those ranked 16 to 20. Except for a higher fraction of AOA members and higher USMLE I scores in the top 5 group, there was little distinction between candidates in the 2 groups. The likelihood of being ranked in the top 5 was 1.62 times (95% CI, 1.10-2.37, *P* = .01) higher among those with AOA membership and increased 1.13 times (1.00-1.3, *P* = .05) for every 10-unit increase in USMLE I scores.

DISCUSSION

The process of selecting medical students for surgical residency is complex and endeavors to reconcile the attri-

Table 2. Comparison of Applicants by Program^a

Characteristic	Program			All Programs	P Value	
	HC ^b	VC ^c	C ^d		HC vs VC	HC vs C
Mean (95% CI) [range]						
USMLE I	242.7 (239.8-245.5) [196.0-274.0]	237.1 (234.0-240.2) [205.0-263.0]	225.1 (222.8-227.4) [199.0-264.0]	234.4 (232.6-236.1) [196.0-274.0]	.009	<.001
USMLE II	250.6 (247.4-253.8) [194.0-278.0]	249.8 (247.3-252.3) [222.0-272.0]	238.1 (235.5-240.7) [198.0-272.0]	245.1 (243.4-246.9) [194.0-278.0]	.70	<.001
Women	37.9	47.9	49.4	45.2		.10
Personal statement						
Best	27.3	25.2	16.4	22.8		.002 ^e
Good	60.4	59.0	54.6	57.9		
Fair to poor	12.2	15.8	29.0	19.3		
AOA	47.1	33.6	7.5	28.4		<.001 ^e
Research	97.1	96.4	86.3	93.0		<.001 ^e
Publications	90.7	77.9	63.8	76.8		<.001 ^e
Race						
Black	5.0	4.3	11.9	7.3		<.001 ^e
Hispanic	2.1	6.4	17.5	9.1		
Not provided	10.7	5.7	8.8	8.4		
Other or Asian	25.7	13.6	13.1	17.3		
White	56.4	70.0	48.8	58.0		

Abbreviations: AOA, Alpha Omega Alpha; C, competitive; HC, highly competitive; USMLE, United States Medical Licensing Examination; VC, very competitive.

^aData are given as percentages unless otherwise noted.

^bInstitutions included Brigham and Women's Hospital; Cornell University; Emory University; Oregon Health Sciences University; University of Chicago; University of California, Los Angeles; and Washington University in St Louis.

^cInstitutions included Eastern Virginia Medical School; Medical University of South Carolina; Ohio State University; University of California, Davis; University of California, San Diego; University of Maryland; and University of Texas at Houston.

^dInstitutions included Albany Medical Center, Abington Memorial, Atlanta Medical Center, University at Buffalo, Midwest Community Program (hospital chose not to be named), Howard University, University of Connecticut, and University of Tennessee at Chattanooga.

^eP values are for χ^2 tests comparing proportions.

Table 3. Comparison of Applicants by Ranking^a

Characteristic	Ranking			P Value
	1-5	16-20	All	
Mean (95% CI) [range]				
	237.7 (234.4-240.9) [201.0-274.0]	233.2 (231.1-235.3) [196.0-274.0]	234.4 (232.6-236.1) [196.0-274.0]	.03
	246.7 (243.4-250.0) [194.0-278.0]	244.6 (242.5-246.6) [198.0-278.0]	245.1 (243.4-246.9) [194.0-278.0]	.29
Female sex	38.2	47.6	45.2	.09
Personal statement				
Best	21.3	23.3	22.8	.85
Good	60.2	57.1	57.9	
Fair to poor	18.5	19.6	19.3	
AOA	39.1	24.9	28.4	.005
Research	94.6	92.4	93.0	.45
Publications	78.2	76.4	76.8	.70
Race				
Black	7.6	6.4	7.3	.12
Hispanic	7.3	14.6	9.1	
Not provided	9.1	6.4	8.4	
Other or Asian	18.8	12.7	17.3	
White	57.3	60.0	58.0	

Abbreviation: AOA, Alpha Omega Alpha.

^aData are given as percentages unless otherwise noted.

butes of individual students, including students' assessment of their own suitability for a training program, with the program's aspirations to select the most academically qualified candidates who will be a suitable fit for the program's training goals. The training program char-

acteristics are based on clinical experience, reputation, and the ultimate career paths of their graduates. The process of matching candidates and programs is administered by the National Residency Match Program. The ranking and ultimate selection of residents by programs

depends in large part on the information contained in the ERAS file submitted by students, augmented by face-to-face interviews (the results of which were not part of this study).

Several authors have examined the relationship of applicant characteristics to performance as residents. Bell et al¹ found that an online survey tool (TriMetrix Personal Talent Report; Target Training International, Ltd) was not predictive of applicant ranking by the program. Evaluating only residents matched at their program, Alterman et al² reported that USMLE I performance, high performance outside of medicine, and interview data had predictive value for residency performance as measured by graduation rates, American Board of Surgery In-Training Examination scores, and Accreditation Council for Graduate Medical Education core competency evaluations. In a study of 77 residents from 1 university and 1 community-based university-affiliated program, Tolan et al³ found that USMLE scores were predictive only of medical knowledge and that other factors, including female sex, AOA membership, and number of honors received during medical school, were predictive of higher overall competency.

The current study focused on the match process rather than subsequent residency performance. The 333 applicants in the study are a select group and likely are a representative sample of the best applicants to GSR programs nationwide. If each of them matched during the first postgraduate year in 2011, they would occupy nearly one-third of the available 1108 categorical general surgery spots in the 2011 match.⁴ While it is a convenience sample of program directors willing to participate, we compiled applications from a geographically and academically diverse group of programs from which to analyze the characteristics of top applicants for general surgery training. It is a fair assumption that ranking the top 20 candidates for a program would almost guarantee matching at the program if the student ranked that program highly enough. Stated another way, most programs go below the 20th spot on their rank list to fill their resident complement.

In a survey of 262 surgical program directors and chairs, Makdisi et al⁵ found that USMLE I was the single most important factor in screening, although final selection was relatively subjective and based on a combination of interviews, USMLE scores, research experience, and personal judgment. The mean USMLE I and II scores among our applicants (234 and 245) were higher than the nationwide sample of US senior medical students from the 2011 match (227 and 238).⁴ The mean USMLE scores of applicants to GSR are lower than some other surgical specialties (plastic surgery, orthopedic surgery, otolaryngology, and neurosurgery) but still higher than most other specialties (anesthesia, emergency medicine, family medicine, neurology, OB/GYN, pathology, pediatrics, physical medicine and rehabilitation, and psychiatry).⁴ While the USMLE score is not the sole criterion for ranking applicants for residency training, our categorization of the competitiveness of the program had a strong correlation with the USMLE scores (Table 2). The most

highly competitive training programs were more likely to receive applications from and assign a high rank to students with higher USMLE scores and AOA membership. Many of us who advise students in applying for surgical residency spend significant time counseling students about their personal statements. Surprisingly, there was very little correlation with our grading of the personal statements, the competitiveness of the programs to which the students applied, or top 5 ranking by the individual program. After reviewing the personal statements for this study, one of the authors (S.W.A.) stated, "I have to admit that I seldom read the personal statements, and now I remember why." Similarly, White et al⁶ evaluated personal statements from applicants to the Scott and White surgical residency and found little interrater reliability and a lack of objective criteria for evaluation.

During the past 20 years, there has been an increase in the percentage of women entering medical school, from 38.6% in 1990 to 47% in 2010.⁷ A recent analysis by Davis et al⁸ showed that the proportion of graduates of US medical schools entering surgical residency increased from 32% of accounted-for positions in 2000 to 40% in 2005. Our data, showing that 45.2% of highly ranked applicants were women, suggest that GSR training has kept pace with the proportion of medical school classes that are female. This bodes well for the future of general surgery, which depends on the quality of our trainees.

The new resident duty hour requirements, which set a global limit of 80 hours per week, were instituted in 2003 and subsequently amended in 2011.^{9,10} In 2008, the American College of Surgeons expressed concern that restrictions on duty hours would result in poorly trained surgeons, which would then adversely affect patient safety and quality of care.¹¹ In a systematic review of articles regarding effects of Accreditation Council for Graduate Medical Education duty hour restrictions on surgical residents and faculty, Jamal et al¹² concluded that the limitations had a positive effect on residents but a negative effect on surgical faculty. In contrast, a survey of University of Wisconsin medical students during their third-year clerkships found that the 80-hour workweek had not improved the interest of male or female medical students in surgery.¹³

No comprehensive examination has explored the effect of integrated training programs in plastic surgery, vascular surgery, and thoracic surgery on GSR applications. There is the belief, however, that the integrated 0 + 5 programs will attract better candidates for training in those disciplines than the traditional 5 + 2 training programs. Chikwe et al¹⁴ compared the applications to integrated thoracic surgery residency at Mount Sinai Medical Center. There was no difference in the overall USMLE I scores of traditional fellowship vs integrated residency applicants but a significant difference for candidates who were shortlisted (score of 252 vs 222, $P = .03$). Zayed et al¹⁵ examined the characteristics of applicants to integrated vascular surgery at the Stanford University training program and found that applicants to the integrated program had significantly higher USMLE scores, were more likely to be AOA members,

and were more likely to be female. It is unclear whether integrated surgical training programs will siphon highly qualified medical students from general surgery or if these programs are attracting a different pool of applicants.

Our study has certain limitations. Regarding training programs, our grouping into tiers was subjective and not based on any tangible rating system of the medical center or program, quality of fellowships the residents obtain, pass rates on American Board of Surgery examinations, or other criteria. Regarding applicants, we did not evaluate possibly important characteristics, including interview scores, grades in surgery core clerkships, quality of research publications, completion of an externship at the target program, quality of medical school, and personal qualities. Finally, as some programs do not necessarily rank candidates purely by the quality of the applicant, the top 5 analyses may be inaccurate.

On the basis of our analysis of ERAS files, we conclude that GSR training programs are still attracting high-quality applicants to the specialty. The students who are ranked highly by training programs (at least in the top 20) had high USMLE scores, and 28.4% of the applicants were AOA members. Nearly all have done research, and most have publications. The stratification of programs by competitiveness may allow students applying to surgery to measure their applications against the highest-ranked students at a range of programs. There was a range of USMLE scores of students ranked in the top 20, even at the highly competitive residencies. The personal statement could not differentiate candidates in this highly qualified cohort, suggesting that its inclusion as a required element of applications should be reevaluated. Clearly, additional attributes beyond USMLE scores resulted in high ranking. We hope that our study provides useful information for residency program directors to compare their own programs with representative programs across the country.

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