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Are Self-Identified "Disadvantaged" Students Less Likely to Enter Surgical Residencies? A Single-Institution Study

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Brief Title: Surgical residency pathways and socioeconomically disadvantaged students

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Abstract: (in progress word count: 254, 250 word limit)

Background: Given more emphasis on training primary care physicians for underserved areas, we hypothesized that students self-identifying as “disadvantaged” would be less likely to pursue surgical training.

Methods: We retrospectively reviewed medical school data on students graduating 2005-2014. Students were stratified into “disadvantaged” and “non-disadvantaged”. Data were recorded on age, science GPA, MCAT score, gender, surgery clerkship grade, USMLE step 1 score, and residency match into a surgical field. A comparison of the proportion of students matching into a surgical field was assessed with X^2 test. Multivariate logistic regression was performed to assess factors that predict the choice of general surgery versus another surgical field.

Results: Of the 1140 students who graduated during the study period, 219 (19.2%) students self-identified as “disadvantaged”. One hundred fifty-eight (13.9%) of all students chose a surgical field. The disadvantaged group was older at entry, and had lower GPA and total MCAT scores. Twenty-seven (12.3%) disadvantaged students chose a surgical residency versus 130 (14.1%) non-disadvantaged students (p=0.56). On multivariate logistic regression, female gender (OR 3.9 (1.9-8.3), p <0.01), disadvantaged status (OR 2.8 (1.1-7.1), p=0.03), and USMLE step 1 score ≥ 227 (OR 0.43 (0.21-0.88), p=0.02) were significantly associated with matching into general surgery versus another surgical specialty.

Discussion: While the disadvantaged cohort was older and had lower undergraduate GPAs and MCAT scores, the proportion of disadvantaged students matching into a surgical residency was not statistically different. In order to address the future shortage of general surgeons in underserved areas, increasing enrollment of “disadvantaged” students may alleviate the “surgical desert”.

Introduction

Prior studies have demonstrated that physicians from underserved backgrounds are more likely to practice in an underserved area.[1-3] The majority of the work done regarding improving physicians participation in underserved areas has involved primary care, most notably the disciplines of family medicine, pediatrics and internal medicine. To date, there has been minimal attention to addressing the shortage of surgeons needed to partner in the treatment of these same communities. Numerous reports predict a significant future shortage of general surgeons, primarily constituted by a lack of service in smaller communities and rural areas.[4-12] Surgeons serving these areas typically have an extended scope of practice and in many ways function as a primary care surgeon.

On the American Medical College Application Services (AMCAS) application, there is a specific section for applicants to designate whether they self-identify as “disadvantaged”. The application webpage offers guidelines for what might constitute being disadvantaged, including growing up in a medically underserved area, parental educational and/or occupational background, and/or enrollment in state or federal assistance programs.[13] Additionally, the applicant is given space to describe the extent of their circumstances. This designation is intended to identify those individuals who may not have had the same educational advantages as other applicants, and who have demonstrated perseverance and resilience in

pursuit of a career in medicine. This designation may also be a marker to identify those students more likely to devote themselves to ameliorating healthcare disparities.

Given the tendency for students who come from disadvantaged backgrounds to be more likely to return to practice in these areas, we questioned the relationship between AMCAS “disadvantaged” status and choice of surgical careers. Due to the emphasis on training more primary care physicians for underserved areas, we hypothesized that students who indicate themselves as “disadvantaged” on their AMCAS application are less likely to pursue surgical training.

Methods

After Institutional Review Board (IRB) approval, we performed a retrospective review of a University of California, San Diego School of Medicine Admissions database of students matriculating from 2001-2010 and graduating between 2005-2014. Data were extracted on age at entry, undergraduate science (including biology, chemistry, physics, mathematics) GPA, total MCAT score, gender, disadvantaged status on application and residency match into a surgical field at graduation. An applicant's self-assessment as "disadvantaged" is routinely checked against AMCAS and the school's criteria, and only those students whose self-description matches those descriptors are included within that group. A surgical residency, requiring a minimum of 5 clinical training years, included one of the following residencies: general surgery, orthopedic surgery, neurosurgery, otolaryngology (ENT), urology, plastic surgery, cardiothoracic surgery, and vascular surgery. Race and ethnicity reporting was not required on the application, not available on all subjects and therefore, excluded from our analysis.

For our initial analysis, students were stratified into "disadvantaged" and "non-disadvantaged" groups. Admissions data were assessed with ANOVA for continuous variables or chi-square/Fisher's exact test for categorical data. The proportion of students from "disadvantaged" backgrounds matching into surgery versus non-disadvantaged was assessed

with a chi-square test. Multivariate logistic regression modeling was used to assess “disadvantaged” status and other admissions data on the odds of matching into a surgical residency.

Our secondary analysis focused on the students who matched into a surgical field. The outcome of interest was choice of general surgery versus another surgical residency. For this analysis, additional student data extracted included USMLE step 1 test scores and third-year core surgical clerkship grades. USMLE step 1 scores were dichotomized into scores (<226 and scores >=227) based on the average USMLE step 1 score for US matched applicants into general surgery from the available 2011 NRMP match data.[14] Clerkship grade was either “honors” or “pass”. Univariate logistic regression was performed to assess the association between admissions and medical school performance factors and matching into general surgery versus another surgical field. Factors with a p-value <0.10 on univariate analysis were included in a final multivariate logistic regression. Data analysis was performed in R Software v3.14. A p-value <0.05 was used for statistical significance.

Results

A total of 1140 students enrolled, graduated and matched into an ACGME-approved residency during the study period. Of the 1140 students, 219 (19.2%) reported “disadvantaged” on their medical school application and were confirmed as meeting socioeconomic disadvantaged criteria. Overall, 158 (13.9%) of students chose a surgical field.

Disadvantage vs. non-disadvantage

Students from the disadvantage group were older at entry (24.4 years vs. 23.2 years ($p<0.001$)), and had lower science GPA (3.59 vs. 3.75 ($p<0.001$) and total MCAT scores (30.1 vs. 33.7 ($p<0.001$)). There was no statistically significant difference in gender distribution between the two groups. Twenty-seven (12.3%) of the 219 disadvantaged students chose a surgical career versus 130 (14.1%) of the 921 non-disadvantaged students ($p=0.56$). Student characteristics between the disadvantaged and non-disadvantaged group are reported in Table 1.

In our multivariate logistic model, disadvantaged status (Odds ratio (OR) 0.90, $p= 0.69$) was not significantly associated with choice of surgical career. Males (OR 2.1, $p < 0.001$) were nearly twice as likely to enter surgical residency compared with females. Age at entry, GPA and total MCAT score were not associated with choosing a surgical residency. See Table 2 for final model.

General surgery versus another surgical residency

Amongst the surgical specialties chosen, general surgery was selected by 57 (36.3%), orthopedic surgery by 54 (34.4%), ENT by 14 (8.9%), urology by 14 (8.9%), neurosurgery by 11 (7.0%), plastic surgery by 6 (3.8%) and vascular surgery by 1 (0.6%) of the students (see Table 3). Univariate significant predictors at $p < 0.10$ of choosing general surgery vs. another surgical specialty were female gender, disadvantaged status, and USMLE step 1 score>= 227. Surgical clerkship grade, age, GPA or MCAT scores were not significant (see Table 4) On final multivariate logistic model, female gender (OR 3.9 (1.9-8.3), $p <0.01$), disadvantaged status (OR 2.8 (1.1-7.1), $p=0.03$), and USMLE step 1 score >=227 (OR 0.43 (0.21-0.88), $p=0.02$) were significantly associated with choosing general surgery versus another surgical specialty (see Table 5).

Discussion

The percentage of students who pursue surgical specialties from our institution is similar to percentages previously reported.[15] While the disadvantaged cohort at our institution was older and had lower undergraduate GPAs and MCAT scores, the proportion of disadvantaged students matching into a surgical specialty was not statistically different than the non-disadvantaged group. Additionally, it appears that the performance on the surgical clerkship is similar to their peers. However, when controlling for USMLE step 1 scores in the surgical cohort, women and disadvantaged students were significantly more likely to enter general surgery versus another surgical subspecialty. Based purely on objective competitiveness data from the National Residency Matching Program (NMRP)[16], it appears at our institution women and disadvantaged students are pursuing the least competitive of the surgical residencies. Whether this is the result of overall less competitiveness of objective measures or intent to go into a field with opportunities to serve the underserved or rural communities remains unclear. Previous data has shown that students from underserved areas are more likely to return to underserved areas,[1] and thus perhaps this is a manifestation of students who felt they could help treat patients best as a surgeon finding a path to do this. Further study is needed to better identify if this is in fact the case.

Gender disparity in surgical training has been improving with increasing numbers of women pursuing general surgery and surgical specialties. However, as is the case at our institution, despite women choosing careers in general surgery, they are still under-represented in surgical specialties.[17] More attention and actions to rectify these differences is needed.

Numerous factors may contribute to both the looming surgeon shortage and the disparity in the geographic distribution of surgeons. General surgery and other surgical specialties require a minimum of five years of postgraduate training, longer than primary care based specialties. Further, surgical training delays time to actualizing one's career and future compensation. Moreover, most general surgery graduates pursue subspecialty training, ultimately leading to careers centered in around tertiary referral medical systems.[18-22] The trend of 70-80% of general surgery trainees pursuing advanced fellowships has been stable for some time and has resulted in a minority choosing traditional general surgery practice, with even fewer choosing to practice in underserved or rural communities.[18, 23-29]

Given the shortage of surgeons in the underserved areas, solutions are needed to increase availability to surgeons willing to practice in the underserved and rural settings. One study from Oregon Health and Sciences University found that a dedicated year of general surgery training in a rural setting was associated with increased likelihood of practicing general surgery

in a small town.[30] Another study from the same institution found that medical students participating in a nonmetropolitan surgical clerkship away from the main teaching hospital significantly increased interest and match into a general surgery residency.[31] This suggests that by allowing students and residents appropriate opportunities, it could translate later in to a potentially increased supply of surgeons practicing in underserved areas.

The American College of Surgeons (ACS) has increased its involvement with promoting surgical careers in rural settings. However, the ACS webpage currently lists only 11 general surgery residencies with an approved rural surgery training component.[32] Recently, the ACS instituted the Transition to Practice program, a fellowship, for newly graduated general surgeons to improve their skills for independent practice in a underserved/rural setting.[33] Since its inception in 2014, the program has expanded, but early reports of the experience have not been published. This program represents an important opportunity for trainees in the later part of their training, however more exposure to underserved/rural surgical experiences are needed in medical school and during surgical training.

If there is chance at increasing the future workforce of surgeons who will serve our underserved populations where shortages are going to become increasingly more problematic, we need to engage students early and more often. A study at our institution showed that students applying to our medical school from underrepresented minorities and disadvantaged

backgrounds were more likely to express interest in a curriculum that is designed to train them to work in underserved communities.[34] Al-Heeti et al. has shown previously that medical student trajectory to a surgical career is set in the pre-clinical years.[35] Reid et al. showed that students participating in surgical apprenticeship had more positive views of surgeons and a surgical career than those not participating.[36] Students need opportunities that will provide exposure to rural surgery and general surgery in under-represented areas. One possible solution is to develop curricula that allow junior medical students an opportunity to work with a surgeon mentor from an underserved or rural region. It should not be overlooked that post-graduate trainees need also be offered the same exposure. Surgeons must initiate positive influences earlier in students' careers, perhaps even during the premedical years.

There are limitations to our investigation. Firstly, disadvantaged status describes a heterogeneous group of students depending on criteria utilized. However, we were only able to analyze the students as one group. Regarding residency selection, our analysis does not take into account student preferences or if they attempted to match into a different specialty besides their ultimate training program. Additionally, we do not have any data regarding residency attrition or final practice location. We are tracking whether those completing their training are practicing in health professional shortage areas (HPSAs) or medically underserved areas (MUAs) but due to

the duration of training, have not yet accrued enough data to analyze. These will clearly be important data to track over time.

Conclusion

It is reassuring to see that disadvantaged status does not preclude choice of a surgical career. While many programs exist with the goal to improve healthcare disparity and increase physicians in underserved areas, these programs focus mainly on primary care or family medicine. General surgery is a critical component to any successful under-served medical program and more surgeons are needed. General surgery may be considered the “primary care of surgery” by some, and programs are needed to address surgical workforce shortages that are centered in rural and underserved communities. If appropriate exposure to surgery in these areas is implemented into medical school and residency curriculums, more students may be interested in choosing to serve the underserved as a surgeon.

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Tables

Table 1: Medical School Admissions Data

Variable	Disadvantaged	Non-Disadvantaged	p-value
n	219 (19.2%)	921 (80.8%)	
Age at entry (years)	24.4 (3.4)	23.2 (2.8)	<0.001
Gender			
Male	100 (45.7%)	480 (52.1%)	0.10
Female	119 (54.3%)	441 (47.9%)	
GPA	3.59 (.3)	3.75 (.2)	<0.001
MCAT	30.1 (3.7)	33.7 (3.2)	<0.001

GPA: Undergraduate Science Grade Point Average, MCAT: Medical College Admissions Test

Table 2: Multivariate Logistic Model for Choice of Surgical Residency

Variable	Odds Ratio	95% CI	p-value	
Age at entry (years)	0.98	(0.92 - 1.04)	0.57	
Male	2.12	(1.47-3.10)	<0.001	
Disadvantaged	0.90	(0.54-1.47)	0.69	
GPA	1.00	(0.99-1.01)	0.83	
MCAT	1.00	(0.95-1.06)	0.9	

GPA: Undergraduate Science Grade Point Average, MCAT: Medical College Admissions Test

Table 3: Students Matching Into Surgical Residency Stratified By Disdvantaged

Variable	Disadvantaged	Non-Disadvantaged	p-value
n	27	130	
Age at entry	24.7 (3.7)	23.1 (2.4)	0.03
Male	15 (55.6%)	91 (70%)	0.22
Female	12 (44.4%)	39 (30%)	
GPA	3.59 (.3)	3.75 (.2)	0.01
MCAT	31.1 (2.9)	33.8 (2.9)	<0.001
USMLE Step 1	229 (15)	235 (17)	0.049
Clerkship Grade			
Honors	9 (33.3%)	48 (36.9%)	0.83
Pass	18 (66.7%)	82 (63.1%)	
Specialty Choice			
General Surgery	16 (59.3%)	41 (31.5%)	0.012
Surgical Subspecialties	11	89	
Orthopedic	6	48	
ENT	2	12	
Plastics	0	6	
Urology	2	12	
Neurosurgery	1	10	
Vascular	0	1	

GPA: Undergraduate Science Grade Point Average, MCAT: Medical College Admissions Test, USMLE: United States Medical Licensing Exam Step 1

Table 4: Univariate Factors Associated With Matching Into General Surgery versus another Surgical Specialty

Variable	Odds Ratio	95% Confidence Interval	
Female	4.2	2.1	8.6
Age at entry (years)	1.1	1.0	1.2
Disadvantage	3.2	1.4	7.6
step 1 ≥ 227	0.4	0.21	0.79
Honors Grade	1.5	0.8	2.9
MCAT	1.0	0.9	1.1
GPA	1.0	1.0	1.0

GPA: Undergraduate Science Grade Point Average, MCAT: Medical College Admissions Test, USMLE: United States Medical Licensing Exam Step 1

Table 5: Final Multivariate Model Factors Associated With Matching Into General Surgery versus another Surgical Specialty

Variable	Odds Ratio	95% Confidence Interval		p-value
Female	3.93	1.9	8.34	< 0.01
Disadvantage	2.78	1.11	7.12	
step 1 ≥ 227	0.43	0.21	0.88	