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Race and Gender in Ophthalmology: A National Analysis of Medical Students with Intention to Pursue the Field

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Abstract

Purpose The field of ophthalmology must become more reflective of the increasingly diverse U.S. population. This study characterizes students intending to pursue ophthalmology and practice in an underserved area versus other surgical and nonsurgical fields.

Subjects Deidentified responses from 92,080 U.S. MD students who matriculated in the academic years beginning from 2007 to 2011 were obtained from the Association of American Medical Colleges (AAMC) Graduation Questionnaires.

Methods Study participants were those who fully completed the AAMC Graduation Questionnaire. Chi-squared and multivariate logistical regressions were used for analyses.

Results Ophthalmology intending graduates (OIG; $n = 1,177$) compared with other surgical intending graduates ($n = 7,955$) were more likely to be female (adjusted odds ratio [aOR]: 1.46; 95% confidence interval [CI]: 1.28–1.66), Asian (1.71 [1.46–2.01]), and have conducted a research project with a faculty member (1.58 [1.26–1.98]). OIG compared with nonsurgery intending graduates ($n = 35,865$) were more likely to have completed a research project with a faculty member (4.78 [3.86–5.92]), to be Asian (1.4 [1.21–1.62]), and have received scholarships (1.18 [1.04–1.34]). OIG were less likely to be female (0.64 [0.57–0.73]) and Black/African American (0.5 [0.33–0.74]). Among OIG, Black/African American students and multiracial students were more likely than non-Hispanic (NH) White students to report intention to practice in underserved areas (IPUA; 14.29 [1.82–111.88] and 2.5 [1.06–5.92]), respectively. OIG with global health experience were more likely to report IPUA (1.64 [1.2–2.25]).

Keywords
- diversity
- underrepresented minorities
- medically underserved areas

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Conclusion Females and underrepresented in medicine (URM), respectively, were more likely to be nonsurgery intending graduates than OIG, which, if not addressed, may lead to a persistent underrepresentation of these groups in the field. In addition, URM students, including African American students, were more likely to report IPUA, which further emphasizes the importance of more URM students entering the field to address these growing gaps in medical care. Finally, we recommend increased mentorship to help address these disparities.

In 2011, a geographic maldistribution of ophthalmologists was identified, with 61% of U.S. counties lacking ophthalmologists and 24% of U.S. counties lacking both ophthalmologists and optometrists.[1] Medically underserved areas (MUAs) contribute to the societal burden of preventable and treatable eye diseases.[2] Moreover, disparities in eye care tend to disproportionately affect underrepresented minorities. Recent evidence demonstrates that non-Hispanic (NH) Black/African Americans suffer from visual impairment due to glaucoma and diabetic retinopathy at 2.35 and 1.34 times the rate of NH White people, respectively.[3,4] It is imperative that we address disparate outcomes in eye health in an aging and increasingly diverse U.S. population.

According to the census data in 2020, the U.S. population was 60.1% NH White, 18.5% Hispanic/Latino, 13.4% Black/African American, 5.9% Asian, 1.3% Native American, 0.2% Pacific Islander, and 2.8% multiracial.[5] This unfortunately is not reflected in the ophthalmology workforce. In 2019, the racial and ethnic composition of ophthalmology faculty members at U.S. medical schools was 60.3% NH White, 27.6% NH Asian, 2.3% NH Black/African American, 2.3% Hispanic/Latino, 0.03% Native American, and 0.07% Pacific Islander.[6] These demographics were also inconsistent with the demographics of ophthalmology residency programs from 2011 to 2019, which, despite increasing ethnoracial diversity, still lag in comparison to other specialties as well as the U.S. population.[7] Research indicates that ophthalmologists from racial and ethnic populations that are underrepresented in the medical profession relative to their numbers in the general population groups, abbreviated as underrepresented in medicine (URM), are more likely to practice in MUAs and bring the clinical benefits that include similar demographics and language, which improve patient/physician concordance.[8,9]

Exploring the intention to practice ophthalmology in underserved areas (IPUA) has important ramifications for visual health outcomes across the nation. Additional factors that motivate graduating medical students to practice ophthalmology in MUAs remain to be investigated. For example, cultural competency, community service, mentorship, and lower debt burden tend to influence medical students' perceptions of MUAs.[10,11] Few studies have implied that underrepresented clusters of the ophthalmology workforce, including female and osteopathic (DO) ophthalmologists, may have strong intentions to serve diverse patient populations.[12,13]

The primary objective of our study was to examine the characteristics of ophthalmology intending graduates (OIG) stratified by racial and gender demographics, age at matriculation, debt burden, elective medical school experiences, and several other factors, such as degree programs and scholarships awarded. The second objective was to determine whether these characteristics among students pursuing ophthalmology correlated with an intention to practice in underserved areas. Finally, we hypothesized that OIG compared with nonsurgical specialties were less likely to be female or URM. In contrast, we hypothesized that OIG compared with other surgical specialties were more likely to be female. In addition, we hypothesized that URM would be more likely to report IPUA.

Methods

The study sample consists of a national cohort of 92,080 U.S. medical students who matriculated between academic years of 2007–2008 and 2011–2012. Individual deidentified data were obtained from the Association of American Medical Colleges (AAMC) Student Record System (SRS) and the AAMC Graduation Questionnaire (GQ). The following data were obtained for analysis: planned practice area, sex, race/ethnicity, age at matriculation, total debt at graduation, degree program, parental level of education, intention to practice in underserved areas, scholarship awarded during medical school, and participation in electives during medical school. These records were merged across survey years before analysis. All data were confidential and anonymous. The study has received approval by the institutional review board.

Students who reported intention for ophthalmology specialty were categorized as OIG. Students who reported intention for general surgery, colorectal surgery, neurosurgery, orthopaedic surgery, otolaryngology, plastic surgery, vascular surgery, thoracic surgery, and urology were categorized as other surgical specialty intending students. Students who reported intentions for other specialties not forementioned were categorized as nonsurgical specialty intending students. Age at matriculation was used to create a binary variable to identify students who were $\geq$23 years during matriculation. Race/ethnicity was self-reported by students and categorized into the following eight ethno-racial groups: NH White, NH Black/African American, NH Asian, Native American/Alaska Native, Hawaiian Native/Other Pacific

Islander, Hispanic, multiracial, and unknown/other. Students who reported more than one race were categorized as multiracial. Total debt at matriculation was categorized into four levels: no debt, $1 to $149,000, $150,000 to $249,999, and greater than $250,000. Degree program was categorized into four levels: MD, BA/BS-MD, MD-PhD, and other dual degrees that included MD-MPH and MD-MBA. Parental level of education was used to create the binary variable of generation status. First-generation status was assigned to those who reported "some college" or less for both parents. Continuing-generation status was assigned to those who reported "college degree" or higher for either parent. Those with education data for only one parent were categorized as first-generation if "some college" or less was reported.

All statistical analyses were conducted on STATA 16.1 (StataCorp, College Station, TX). Descriptive statistics were generated to report frequencies and percentages. Chi-squared analysis was performed to assess the difference between students with intention for ophthalmology and those with intention for other surgical and nonsurgical specialties. Binary logistical regression models were conducted to estimate the adjusted odds ratio (aOR) for the effect of covariates (e.g., sex, race/ethnicity, total debt at graduation) on the two primary outcomes: intention for ophthalmology and intention to practice in underserved areas among students interested in ophthalmology. Statistics were reported as aOR and the 95% confidence interval (CI).

Results

Of the 92,080 U.S. medical students who matriculated in the academic years 2007–2008 through 2011–2012, 88,059 (95.7%) matriculants graduated by 2017. Of these, 43,820 (49.8%) fully completed the AAMC GQ and were included in the final study sample (►**Fig. 1**). In all, 1,177 (2.7%) students were OIG, 7,955 (18.2%) graduates reported intention for other surgical specialties, and 34,688 (79.2%) graduates reported intentions for nonsurgical specialties (as shown in ►**Table 1**. Among OIG, 222 (18.9%) reported intention to practice in underserved areas, compared with 17.7% of other surgery students and 29.6% of nonsurgery students ($p < 0.001$). A lower percentage of OIG were NH Black/African American (2.2%) when compared with other surgery intending (4.1%) and nonsurgery intending (5.4%) students ($p < 0.001$). A higher proportion of females were OIG than intending for surgical and nonsurgical specialties (41.4 vs. 31.3 vs. 52.0%; $p < 0.001$). Students with a total debt at graduation greater than $250,000 were less likely to intend for ophthalmology than for other surgical and nonsurgical specialties (13.8 vs. 21.2 vs. 18.8%, $p < 0.001$). OIG (18.9%) were more likely than other surgical intending students (17.7%) to report intention to practice in underserved areas but were less likely than nonsurgical intending students (29.7%) to report intention to practice in underserved areas ($p < 0.001$).

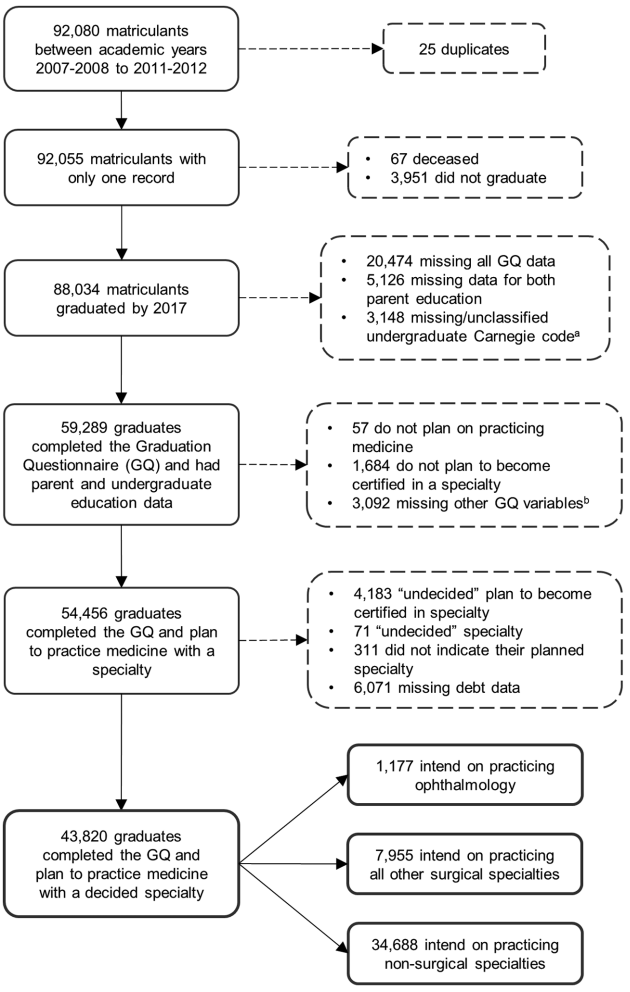

Fig. 1 Final study sample size flow chart ($N = 43,820$).
[a]3,145 missing; 3 unclassified.
[b]This includes those who did not respond when asked about (1) elective/volunteer medical school activities ($n = 1$); (2) intention to practice in underserved areas ($n = 84$); (3) scholarships, stipends, or grants ($n = 83$); or (4) a combination thereof ($n = 2,924$).
Note that the 20,474 records excluded in the previous step were missing every GQ response, and it is assumed these participants did not take the GQ.

Intention to Practice Ophthalmology

Adjusted logistic regression analysis of ethno-racial groups indicated that NH Black/African American students were less likely than NH White students to intend for ophthalmology than for other surgical specialties (0.59 [0.39–0.89]) and nonsurgical specialties (0.5 [0.33–0.74]) as shown in ►**Table 2**. When compared with nonsurgical specialties, females were less likely to intend to practice ophthalmology (0.64 [0.57–0.73]). In addition, OIG were less likely to be first generation compared with nonsurgical specialties (0.84 [0.69–1.03]). In comparison to traditional MD students, students in a combined MD/PhD dual degree program were less likely to intend for ophthalmology than for nonsurgical specialties (0.63 [0.46–0.87]).

Table 1 Characteristics of graduates who matriculated in academic years 2007–2008 through 2011–2012 by specialty choice at graduation (ophthalmology vs. all other specialties)

Characteristics	Total, *N* (%)	Nonsurgical specialties, *N* (%)	All other surgical specialties, *N* (%)	Ophthalmology, *N* (%)	*p* value[a]
	N = 43,820	*N* = 34,688	*N* = 7,955	*N* = 1,177	
Sex					
Male	22,799 (52.0%)	16,647 (48.0%)	5,462 (68.7%)	690 (58.6%)	<0.001
Female	21,021 (48.0%)	18,041 (52.0%)	2,493 (31.3%)	487 (41.4%)	
Race/ethnicity					
Non-Hispanic White	27,665 (63.1%)	21,692 (62.5%)	5,299 (66.6%)	674 (57.3%)	<0.001
Non-Hispanic Asian	7,630 (17.4%)	6,059 (17.5%)	1,254 (15.8%)	317 (26.9%)	
Hispanic	3,119 (7.1%)	2,549 (7.3%)	507 (6.4%)	63 (5.4%)	
Non-Hispanic Black/African American	2,222 (5.1%)	1,869 (5.4%)	327 (4.1%)	26 (2.2%)	
Multiracial	1,531 (3.5%)	1,208 (3.5%)	279 (3.5%)	44 (3.7%)	
Native American/Alaska Native	83 (0.2%)	65 (0.2%)	16 (0.2%)	2 (0.2%)	
Native Hawaiian/other Pacific Islander	56 (0.1%)	46 (0.1%)	8 (0.1%)	2 (0.2%)	
Other/unknown	1,514 (3.5%)	1,200 (3.5%)	265 (3.3%)	49 (4.2%)	
Age at matriculation ≥ 23 y	24,566 (56.1%)	19,570 (56.4%)	4,414 (55.5%)	582 (49.4%)	<0.001
Generation of college graduate					
Continuing generation	38,125 (87.0%)	30,057 (86.6%)	7,005 (88.1%)	1,063 (90.3%)	<0.001
First generation	5,695 (13.0%)	4,631 (13.4%)	950 (11.9%)	114 (9.7%)	
Total educational debt at graduation (USD)					
No debt	6,891 (15.7%)	5,414 (15.6%)	1,235 (15.5%)	242 (20.6%)	<0.001
$1–149,999	12,660 (28.9%)	10,051 (29.0%)	2,201 (27.7%)	408 (34.7%)	
$150,000–249,999	15,898 (36.3%)	12,703 (36.6%)	2,830 (35.6%)	365 (31.0%)	
≥$250,000	8,371 (19.1%)	6,520 (18.8%)	1,689 (21.2%)	162 (13.8%)	
Received scholarships, stipends, or grants for medical school					
No	16,427 (37.5%)	13,045 (37.6%)	2,967 (37.3%)	415 (35.3%)	0.240
Yes	27,393 (62.5%)	21,643 (62.4%)	4,988 (62.7%)	762 (64.7%)	
Type of undergraduate institution					
Research universities (very high research activity)	27,379 (62.5%)	21,518 (62.0%)	5,087 (63.9%)	774 (65.8%)	<0.001
Doctoral/research universities (high research activity)	6,144 (14.0%)	4,835 (13.9%)	1,142 (14.4%)	167 (14.2%)	
Master's colleges and universities	4,407 (10.1%)	3,612 (10.4%)	701 (8.8%)	94 (8.0%)	
Baccalaureate colleges (arts & sciences)	5,247 (12.0%)	4,191 (12.1%)	926 (11.6%)	130 (11.0%)	
All other undergraduate institutions	643 (1.5%)	532 (1.5%)	99 (1.2%)	12 (1.0%)	
Medical degree program					
MD program	40,020 (91.3%)	31,594 (91.1%)	7,373 (92.7%)	1,053 (89.5%)	<0.001
Combined BA/MD, BS/MD	999 (2.3%)	781 (2.3%)	175 (2.2%)	43 (3.7%)	
Combined MD/PhD	1,437 (3.3%)	1,212 (3.5%)	180 (2.3%)	45 (3.8%)	
Other combined advanced-degree programs (e.g., MD/MPH, MD/MBA)	1,364 (3.1%)	1,101 (3.2%)	227 (2.9%)	36 (3.1%)	

(*Continued*)

Table 1 (*Continued*)

Characteristics	Total, *N* (%)	Nonsurgical specialties, *N* (%)	All other surgical specialties, *N* (%)	Ophthalmology, *N* (%)	*p* value[a]
	N = 43,820	*N* = 34,688	*N* = 7,955	*N* = 1,177	
Intention to practice in underserved areas (IPUA)					
No	11,203 (25.6%)	8,055 (23.2%)	2,812 (35.3%)	336 (28.5%)	<0.001
Yes	11,925 (27.2%)	10,293 (29.7%)	1,410 (17.7%)	222 (18.9%)	
Undecided	20,692 (47.2%)	16,340 (47.1%)	3,733 (46.9%)	619 (52.6%)	
Elective/volunteer medical school activities					
Field experience in providing health education in the community (e.g., adult/child protective services, family violence program, rape crisis hotline)	17,369 (39.6%)	13,697 (39.5%)	3,193 (40.1%)	479 (40.7%)	0.420
Community-based research project	12,226 (27.9%)	9,757 (28.1%)	2,109 (26.5%)	360 (30.6%)	0.002
Experience related to cultural awareness and cultural competence	30,334 (69.2%)	24,141 (69.6%)	5,353 (67.3%)	840 (71.4%)	<0.001
Educating elementary, high school, or college students about careers in health professions or biological sciences	20,202 (46.1%)	15,872 (45.8%)	3,792 (47.7%)	538 (45.7%)	0.008
Experience with a free clinic for the underserved population	32,736 (74.7%)	25,946 (74.8%)	5,867 (73.8%)	923 (78.4%)	0.002
Experience related to health disparities	30,345 (69.2%)	24,205 (69.8%)	5,308 (66.7%)	832 (70.7%)	<0.001
Providing health education (e.g., HIV/AIDS education, breast cancer awareness, smoking cessation, obesity)	26,351 (60.1%)	21,026 (60.6%)	4,606 (57.9%)	719 (61.1%)	<0.001
Field experience in home care	14,473 (33.0%)	11,513 (33.2%)	2,570 (32.3%)	390 (33.1%)	0.320
Independent study project for credit	18,161 (41.4%)	13,989 (40.3%)	3,588 (45.1%)	584 (49.6%)	<0.001
Global health experience	13,388 (30.6%)	10,793 (31.1%)	2,211 (27.8%)	384 (32.6%)	< 0.001
Learned the proper use of the interpreter when needed	32,696 (74.6%)	25,965 (74.9%)	5,855 (73.6%)	876 (74.4%)	0.068
Learned another language to improve communication with patients	10,699 (24.4%)	8,558 (24.7%)	1,814 (22.8%)	327 (27.8%)	< 0.001
Field experience in nursing home care	13,857 (31.6%)	11,052 (31.9%)	2,477 (31.1%)	328 (27.9%)	0.009
Research project with faculty member	31,459 (71.8%)	23,479 (67.7%)	6,899 (86.7%)	1,081 (91.8%)	< 0.001
Other elective/volunteer medical school activities	1,302 (3.0%)	1,083 (3.1%)	200 (2.5%)	19 (1.6%)	< 0.001

[a]*p* values reported for chi-square tests.

Table 2 Graduates who intend to practice ophthalmology versus graduates who intend to practice nonophthalmology specialties

Characteristics	Ophthalmology versus nonsurgical specialties	*p* value[a]	Ophthalmology versus all other surgical specialties	*p* value[a]
	Adjusted odds ratio (95% confidence interval)		Adjusted odds ratio (95% confidence interval)	
	N = 35,865		*N* = 9,132	
Sex				
Male	(reference)		(reference)	
Female	0.64 (0.57–0.73)	<.001	1.46 (1.28–1.66)	0.000
Race/ethnicity				
Non-Hispanic White	(reference)		(reference)	
Non-Hispanic Asian	1.40 (1.21–1.62)	<.001	1.71 (1.46–2.01)	0.000
Hispanic	0.80 (0.61–1.04)	0.099	0.92 (0.70–1.22)	0.561
Non-Hispanic Black/African American	0.50 (0.33–0.74)	<.001	0.59 (0.39–0.89)	0.012
Multiracial	1.10 (0.80–1.51)	0.552	1.10 (0.79–1.54)	0.569
Native American/Pacific Islander	1.31 (0.48–3.60)	0.601	1.23 (0.42–3.60)	0.707
Other/unknown	1.12 (0.83–1.51)	0.465	1.26 (0.91–1.73)	0.163
Age at matriculation ≥ 23 y	0.92 (0.89–0.95)	<.001	0.97 (0.94–1)	0.058
Generation of college graduate				
Continuing generation	(reference)		(reference)	
First generation	0.84 (0.69–1.03)	0.089	0.91 (0.73–1.12)	0.368
Total educational debt at graduation (USD)				
No debt	(reference)		(reference)	
$1–149,999	0.90 (0.76–1.07)	0.248	0.94 (0.78–1.12)	0.488
$150,000–249,999	0.71 (0.59–0.85)	<.001	0.72 (0.60–0.87)	0.001
≥$250,000	0.68 (0.55–0.84)	<.001	0.55 (0.44–0.69)	0.000
Received scholarships, stipends, or grants for medical school				
No	(reference)		(reference)	
Yes	1.18 (1.04–1.34)	0.011	1.10 (0.96–1.26)	0.170
Type of premed institution				
Research universities (very high research activity)	(reference)		(reference)	
Doctoral/research universities (high research activity)	1.11 (0.93–1.32)	0.250	1.13 (0.94–1.36)	0.202
Master's colleges and universities	0.97 (0.77–1.21)	0.767	1.10 (0.87–1.39)	0.428
Baccalaureate colleges (arts & sciences)	1.03 (0.85–1.25)	0.766	1.04 (0.85–1.27)	0.712
All other undergraduate institutions	0.84 (0.47–1.50)	0.547	1.18 (0.64–2.19)	0.590
Medical degree program				
MD program	(reference)		(reference)	
Combined BA/MD, BS/MD	1.15 (0.83–1.59)	0.414	1.21 (0.84–1.73)	0.299
Combined MD/PhD	0.63 (0.46–0.87)	0.005	1.38 (0.97–1.96)	0.070
Other combined degree programs (e.g., MD/MPH, MD/MBA)	0.77 (0.55–1.09)	0.139	1.00 (0.69–1.44)	0.979

(*Continued*)

Table 2 (*Continued*)

Characteristics	Ophthalmology versus nonsurgical specialties	*p* value[a]	Ophthalmology versus all other surgical specialties	*p* value[a]
	Adjusted odds ratio (95% confidence interval)		Adjusted odds ratio (95% confidence interval)	
	N = 35,865		*N* = 9,132	
Elective/volunteer medical school activities				
Field experience in providing health education in the community (e.g., adult/child protective services, family violence program, rape crisis hotline)	1.03 (0.90–1.17)	0.658	0.93 (0.81–1.07)	0.327
Community-based research project	1.04 (0.91–1.19)	0.570	1.18 (1.02–1.36)	0.029
Experience related to cultural awareness and cultural competence	1.05 (0.88–1.25)	0.599	1.11 (0.92–1.34)	0.260
Educating elementary, high school or college students about careers in health professions or biological sciences	1.02 (0.90–1.16)	0.748	0.85 (0.74–0.97)	0.016
Experience with a free clinic for the underserved population	1.21 (1.03–1.41)	0.017	1.22 (1.03–1.44)	0.020
Experience related to health disparities	0.97 (0.81–1.15)	0.688	1.08 (0.9–1.30)	0.404
Providing health education (e.g., HIV/AIDS education, breast cancer awareness, smoking cessation, obesity)	1.00 (0.87–1.14)	0.964	1.06 (0.92–1.23)	0.412
Field experience in home care	1.04 (0.90–1.20)	0.614	1.12 (0.96–1.30)	0.159
Independent study project for credit	1.21 (1.07–1.36)	0.002	1.12 (0.98–1.27)	0.099
Global health experience	1.08 (0.94–1.23)	0.268	1.11 (0.97–1.28)	0.141
Learned the proper use of the interpreter when needed	0.83 (0.71–0.97)	0.019	0.84 (0.71–0.99)	0.038
Learned another language to improve communication with patients	1.10 (0.96–1.27)	0.159	1.16 (1.00–1.34)	0.052
Field experience in nursing home care	0.78 (0.67–0.90)	0.001	0.78 (0.67–0.92)	0.002
Research project with faculty member	4.78 (3.86–5.92)	0.000	1.58 (1.26–1.98)	0.000
Other elective/volunteer medical school activities	0.55 (0.35–0.87)	0.011	0.68 (0.42–1.09)	0.112

[a]*p* values reported for binary logistical regression.

Multivariable analysis revealed elective medical school experiences that were associated with students' intention to pursue ophthalmology. OIG were more likely than both other surgical intending students and nonsurgery students to have participated in a research project with a faculty member (1.58 [1.26–1.98] and 4.78 [3.86–5.92]). Compared with other surgery intending students, OIG were more likely to have participated in a community-based research project (1.18 [1.02–1.36]).

Intention to Practice in Underserved Areas

NH Black/African American OIG were more likely than NH White OIG to report intention to practice in underserved areas (14.29 [1.82–111.88]; ►**Table 3**). Similarly, multiracial

Table 3 Intention to practice in underserved areas among ophthalmology intending graduates

Characteristics	Adjusted odds ratio (95% confidence interval) ($N = 1,177$)	*p* value[a]
Sex		
Male	(reference)[b]	
Female	1.03 (0.77–1.38)	0.830
Race/ethnicity		
Non-Hispanic White	(reference)	
Non-Hispanic Asian	1.28 (0.91–1.80)	0.150
Hispanic	1.54 (0.78–3.02)	0.211
Non-Hispanic Black/African American	14.29 (1.82–111.88)	0.011
Multiracial	2.50 (1.06–5.92)	0.037
Native American/Pacific Islander	1.44 (0.14–14.74)	0.756
Other/unknown	1.41 (0.72–2.80)	0.318
Age at matriculation $\geq$ 23	0.99 (0.92–1.07)	0.877
Generation of college graduate		
Continuing generation	(reference)	
First generation	1.14 (0.7–1.86)	0.590
Total educational debt at graduation (USD)		
No debt	(reference)	
$1–149,999	1.06 (0.72–1.55)	0.779
$150,000–249,999	1.41 (0.94–2.11)	0.099
$\geq$$250,000	1.14 (0.70–1.85)	0.609
Received scholarships, stipends, or grants for medical school		
No	(reference)	
Yes	1.12 (0.84–1.49)	0.452
Type of premed institution		
Research universities (very high research activity)	(reference)	
Doctoral/research universities (high research activity)	0.97 (0.65–1.45)	0.891
Master's colleges and universities	1.19 (0.71–1.99)	0.509
Baccalaureate colleges (arts & sciences)	1.62 (1.02–2.58)	0.040
All other undergraduate institutions	2.08 (0.36–11.88)	0.409
Medical degree program		
MD program	(reference)	
Combined BA/MD, BS/MD	1.46 (0.66–3.24)	0.350
Combined MD/PhD	0.39 (0.20–0.77)	0.007
Other combined degree programs (e.g., MD/MPH, MD/MBA)	1.03 (0.47–2.25)	0.940
Elective/volunteer medical school activities		
Field experience in providing health education in the community (e.g., adult/child protective services, family violence program, rape crisis hotline)	1.06 (0.79–1.43)	0.698
Community-based research project	1.45 (1.05–2.02)	0.026
Experience related to cultural awareness and cultural competence	0.74 (0.50–1.11)	0.151
Educating elementary, high school, or college students about careers in health professions or biological sciences	1.05 (0.79–1.40)	0.737
Experience with a free clinic for the underserved population	1.07 (0.75–1.52)	0.714

(*Continued*)

Table 3 (*Continued*)

Characteristics	Adjusted odds ratio (95% confidence interval)	*p* value[a]
	(*N* = 1,177)	
Experience related to health disparities	1.70 (1.14–2.54)	0.009
Providing health education (e.g., HIV/AIDS education, breast cancer awareness, smoking cessation, obesity)	1.59 (1.17–2.16)	0.003
Field experience in home care	0.80 (0.58–1.12)	0.197
Independent study project for credit	0.80 (0.60–1.05)	0.113
Global health experience	1.64 (1.20–2.25)	0.002
Learned the proper use of the interpreter when needed	0.67 (0.47–0.96)	0.031
Learned another language to improve communication with patients	1.10 (0.80–1.52)	0.555
Field experience in nursing home care	1.05 (0.74–1.48)	0.777
Research project with faculty member	0.77 (0.46–1.30)	0.333
Other elective/volunteer medical school activities	2.84 (0.78–10.41)	0.114

[a]*p* values reported for binary logistical regression.
[b]Reference refers to the reference group to which all groups are compared for the adjusted odds ratio.

OIG were also more likely than NH White OIG to report intention to practice in underserved areas (2.5 [1.06–5.92]). Among ophthalmology intending students, those with experience in community-based research projects (1.45 [1.05–2.02]), global health experience (1.64 [1.20–2.25]), experience related to health disparities (1.7 [1.14–2.54]), and providing health education (1.59 [1.17–2.16]) were more likely to report intention to practice in underserved areas.

Discussion

To our knowledge, this is the first study to characterize graduating medical students with the intention of ophthalmology and their intent to practice in underserved areas. Our findings highlight the salient characteristics, contextualize them in the current literature, and show students intending to practice ophthalmology in underserved areas are significantly more likely to participate in experiences related to health disparities, including providing health education, global health, and community-based research projects.

OIG were more likely to have worked on a research project with a faculty member than their counterparts interested in other surgical and nonsurgical specialties. Given how competitive the field is, it may be inferred that research has a significant impact on matching into ophthalmology, thus leading students to pursue scholarly activity. However, in evaluating the inequalities in research, we found female physicians have a lower h-index, a measure of research productivity, compared with their male counterparts, and URM physicians have significantly fewer peer-reviewed publications than their white counterparts.[14,15] Female and URM students should be encouraged to participate in ophthalmology research to receive mentorship benefits and increase their h-index, which can affect their academic promotion.[16] Female and URM students should be encouraged to participate in ophthalmology research to receive mentorship benefits and increase their h-index, which can affect their academic promotion.

From 2005 to 2015, the proportion of female ophthalmology residents and faculty members significantly increased, but women are still underrepresented in the field overall.[8] Our study similarly found females to be less likely than their male counterparts to intend to match into ophthalmology versus nonsurgical fields, but interestingly more likely to intend to match into ophthalmology than other surgical fields. According to the AAMC, women represent 50.5% of all medical students in the country but only 37.9% of active ophthalmology residents and only 26.7% of actively practicing ophthalmologists.[17–19] Female medical students may be less interested in the field compared with nonsurgical fields than their male counterparts due to "real and perceived gender discrimination" and fewer female ophthalmologist role models.[20–22]

Studies have shown that racially concordant physician–patient relationships can improve patient satisfaction and trust because of increased perceived racial similarity between a provider and a patient.[23] In our study, NH Black/African American students were significantly less likely to show intention for ophthalmology versus nonsurgical fields and surgical fields in comparison to their NH White counterparts. In addition, NH Black/African American and multiracial students intending for ophthalmology were the only two racial/ethnic groups that were significantly more likely to intend to practice in underserved areas in comparison to their NH White counterparts. Walker et al similarly found that NH African American as well as Latin and Pacific Islander physicians were more likely to practice in primary care and across diverse surgical and nonsurgical specialties than their NH white counterparts to practice in MUAs in California.[24] Therefore, increasing diversity in the ophthalmology workforce is a substantial way to reduce inequities in eye care. Encouraging a diversity of students to have

intention for the field is an important means to achieve that diversity.

Lack of exposure represents one of the most significant barriers for URM students' entry into ophthalmology. In recent decades, ophthalmology's curricular time has decreased to the point where students are primarily exposed to ophthalmology during their preclinical years and from extracurricular activities.[22] Because of this, considering ophthalmology as a career costs additional time and effort when compared with other fields. These differences are even greater if a student's home institution does not have a program.[25] Data show that URMs face greater financial challenges than other racial/ethnic groups, as they are more likely to have lower socioeconomic status (SES).[26] Our data show OIG were less likely to graduate with debts greater than $150,000 compared with nonophthalmology specialties, suggesting they are students with adequate resources to seek exposure to ophthalmology. Higher socioeconomic status is associated with both financial support and social capital, which translates into an advantage in finding not only initial exposure to ophthalmology but also other opportunities including networking, receiving shadowing opportunities, and obtaining letters of recommendation.

The experiences we found significantly associated with IPUA involved significant interactions with the underserved population, including global health experience, experience related to health disparities, and experience completing a community-based research project. Since these factors were associated with IPUA, increased emphasis should be placed on them in the residency application process. Further initiatives to advance global health opportunities in medical school are a potential strategy to expose students to the field of ophthalmology and raise interest in practicing in underserved areas. Our findings coincide with Slifko et al's study, which found that medical students completing a global health elective had a 22% greater prevalence of working with underserved populations after graduation.[27] Global health experiences would teach students to practice medicine resourcefully while demonstrating the significance of ophthalmologists within underserved communities.[28] Completing community-based research projects is one of the best ways to understand health disparities in low-income communities.[29] Awareness of these issues may encourage medical students to tackle those disparities and therefore demonstrate IPUA, as seen in our study.

Limitations

First, this study explores the intention to pursue ophthalmology and does not look at actual matriculation rates. IPUA was analyzed to understand which characteristics and experiences within OIG were associated with ultimately practicing in underserved areas. While we do not know the correlation between the GQ survey results and the actual career paths of OIG, roughly half of graduating medical students reporting IPUA continued to practice in underserved areas 7 to 10 years later, as shown in a prior study indicating the truthfulness of reported intentions.[30] Next, our data are collected from a self-reported survey, so variations in survey responses, including the truthfulness of answers, may have affected data collection. Next, the included ethno-racial groups are aggregates of many ethnic groups with differential representations and experiences in the medical field that cannot all be accounted for in this study.

Finally, the last matriculating class in this study would have graduated in 2015, making these data older. However, the problems addressed in this manuscript are still prevalent today, namely that women and URM remain underrepresented in ophthalmology residency nationwide. For example, the 2021 AAMC active resident statistics show a decrease in active female ophthalmology residents from 2021 compared to 2018 (39.4% vs 41.2%), which is considerably lower than the proportion of males in 2021 and 2018, 55.8% and 58.8% respectively. These figures include International Medical Graduates (IMGs), Doctors of Osteopathic Medicine (DOs), and Doctors of Medicine (MDs), down from 41.2% in 2018, which is much lower than the 55.8% that are males in 58.8% in 2018. Similarly, URM, which includes American Indian or Alaska Native, Black or African American, Hispanic/Latino, Native Hawaiian, or Other Pacific Islander, in total makes up 10.6%, which is less than the percent of just Hispanic/Latino individuals and Black/African American individuals in the United States alone (at 18.5 and 13.5%, respectively).[31,32]

Next Steps

The AAMC projected a shortage of ophthalmologists by 2025.[31] Moreover, it is critical that we improve provider coverage in MUAs. We must encourage diversity within OIG to address these needs.

Mentorship for URM is critical to increase diversity in the field. Recent initiatives, such as the Minority Ophthalmology Mentoring (MOM) Program and the Diversity, Equity and Inclusion Initiative by the University of Michigan Kellogg Eye Center, provide mentorship as well as hands-on experience for first-year medical students who are URM.[33] The MOM program is new with the inaugural class of students in 2018 but seems promising given participant feedback and the extent of topics covered in the program.[34] Another initiative is the Rabb-Venable Excellence in Ophthalmology Program, which was started in 2000. The program provides the opportunity for URM students to present original work at the National Medical Association Ophthalmology Section meeting. The program participants also get mentorship in areas ranging from how to create a strong ophthalmology residency application to interview prep.[35] Targeting first-year students is important to give students the tools they need to become successful applicants their fourth year. Students should be made aware of the national programs that they may participate in, and individual medical schools should foster the development of school-specific programs that may be more easily accessible for students and perhaps a stepping stone to national organization involvement. Mentorship for URM at all steps of the educational ladder from medical students to junior faculty is important to increase diversity in the field as a whole and that is why programs like the Harvard Ophthalmology Mentoring Program are equally

important. The program is aimed at assisting in the promotion of junior faculty who are URM through mentorship by senior faculty.[36] Programs like this, whether large or small, should be created at all medical schools and can have a large influence indirectly and directly on medical students who look up to URM faculty as resources and role models.

Strategies to encourage female medical students to pursue ophthalmology can help eliminate gender disparities. National societies, such as Women in Ophthalmology (WIO), represent a crucial step in the right direction for addressing the disparity and may help account for our additional finding that females were more likely than their male counterparts to pursue ophthalmology versus other surgical specialties. However, since females are still underrepresented compared with nonsurgical specialties, we recommend that early in their medical student journey they be made aware of groups like the WIO and its equivalents in other specialties to help encourage female students to pursue surgical specialties overall.

Community-engaged projects are crucial strategies for addressing health disparities in ophthalmology. In 2002, Anderson et al demonstrated that using culturally specific interventions significantly increased follow-up care in patients not receiving adequate screening and/or treatment for sight-threatening eye problems.[32] We propose creating additional community-engaged projects aimed at practicing the culturally specific interventions to improve health disparities at home and abroad. One example is Sight Savers America's collaboration with the government of Nigeria, which increased cataract surgery coverage from 7.1 to 62%.[37] We also recommend medical students investigate to find projects or programs that prioritize building trust and relationships through community engagement. Participants should also continue to interrogate the intentionality of programs and the long-term impact on the communities they serve.

Scholarships are another important avenue to support students who are unrepresented in the field, an example of which is the David K. McDonogh, MD Scholarship in Ophthalmology/Otolaryngology for students who identify as African American, Afro-Latino(a), or Native American.[38] The scholarship can be used by students at their own discretion toward any part of the application or interview process, additionally empowering them to make the best decision for their own application journey.[38]

Diversifying our recruitment of medical students to ophthalmology may address ethno-racial, socioeconomic, and geographic disparities in eye care. The ophthalmology workforce must be prepared to evolve and meet the needs of an increasingly aging and diverse U.S. population.

Conflict of Interest
None declared.

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