

# Racial and Sex Disparities in Resident Attrition Among Surgical Subspecialties

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**IMPORTANCE** Racial and sex disparities are prevalent in surgical trainees. Although retrospective studies on resident attrition have been conducted for individual specialties, this study analyzes racial and sex differences in resident attrition among all surgical subspecialties over an 18-year period.

**OBJECTIVE** To evaluate the racial and sex differences in resident attrition among surgical specialties over an 18-year period.

**DESIGN, SETTING, AND PARTICIPANTS** This was a large, cross-sectional, database study that analyzed program-reported resident censuses (program information, resident demographics, and attrition status) obtained by the Association of American Medical Colleges from 2001 to 2018 for trainees in surgical residency programs. Data were analyzed from March 20, 2021, to June 8, 2022.

**MAIN OUTCOMES AND MEASURES** Demographic trends (including race and ethnicity and sex) for all surgical subspecialty training programs over an 18-year period. Resident attrition includes all-cause withdrawals, dismissals, and transfers to another specialty. Unintended attrition encompasses all withdrawals, dismissals, and transfers except for changing career plans.

**RESULTS** This study included 407 461 program-reported resident years collected from 112 205 individual surgical residents (67 351 male individuals [60.0%]). The mean percentage of female trainees was 40.0% (44 835) and increased over the study period. Sex disparity remained greatest in orthopedic surgery. Residents who were underrepresented in medicine (URiM) comprised 14.9% (16 695) of all surgical trainees but demonstrated a 2.1% decrease over the study period. Overall attrition rate among all specialties was 6.9% (7759), with an unintended attrition rate of 2.3% (2556). Female residents had a significantly higher relative risk (RR) of attrition (RR, 1.16; 95% CI, 1.11-1.22;  $P < .001$ ) and unintended attrition (RR, 1.17; 95% CI, 1.08-1.26;  $P < .001$ ) compared with their male counterparts. URiM residents were at significantly higher RR for attrition (RR, 1.40; 95% CI, 1.32-1.48;  $P < .001$ ) and unintended attrition (RR, 1.92; 95% CI, 1.75-2.11;  $P < .001$ ) compared with non-URiM residents. The highest attrition (10.6% [746 of 7043]) and unintended attrition (5.2% [367 of 7043]) rates were in Black/African American residents. The lowest attrition and unintended attrition rates were seen in White residents at 6.2% (4300 of 69 323) and 1.8% (1234 of 69 323), respectively. Black/African American residents were at disproportionate risk for attrition (RR, 1.66; 95% CI, 1.53-1.80;  $P < .001$ ) and unintended attrition (RR, 2.59; 95% CI, 2.31-2.90;  $P < .001$ ) compared with all other residents. Orthopedic surgery had the highest attrition (RR, 3.80; 95% CI, 2.84-5.09;  $P < .001$ ) and unintended attrition (RR, 7.20; 95% CI, 4.84-10.71;  $P < .001$ ) for Black/African American residents.

**CONCLUSIONS AND RELEVANCE** Results of this cross-sectional study suggest that the percentage of female residents in surgical specialties has improved over the last 18 years, and the percentage of URiM residents has remained relatively unchanged. Risk for attrition and unintended attrition was significantly elevated for female and URiM residents, specifically Black/African Americans. These results highlight current racial and sex disparities in resident attrition and demonstrate the importance of developing strategies to recruit, retain, and support residents.

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**S**urgical residency involves significant physical, emotional, and mental challenges over many years. Retaining residents in such a demanding environment requires extensive social and academic support from residency programs. Previous single-specialty studies of attrition have demonstrated attrition rates of 1.2% annually in otolaryngology, 3.0% in plastic surgery, 14.2% in neurosurgery, 1.0% in orthopedics, and as high as 20.8% in general surgery.<sup>1-5</sup> Prior research has also suggested that female residents and individuals from underrepresented minoritized backgrounds are at increased risk for attrition during their surgical residency training.<sup>3-6</sup>

Well-documented sex and racial and ethnic discrepancies exist among the surgical fields, although the percentage of female individuals and minoritized groups pursuing medicine has started to slowly increase. According to the Association of American Medical Colleges (AAMC) in 2019, the percentage of female individuals who matriculate to medical school is 50.5%.<sup>7</sup> Similarly, the proportion of minority applicants and matriculates has also been rising.<sup>8</sup> However, many surgical subspecialty residencies, such as neurosurgery and orthopedics, continue to trail in sex and racial and ethnic diversity despite the trend observed in matriculated medical students.<sup>9,10</sup>

The primary aims of this study were to (1) characterize demographic composition and trends across all surgical subspecialties from 2001 to 2018 and (2) determine the rate of resident attrition for each subspecialty during this period while identifying any specific disparities or risk factors.

## Methods

### Data Source

This cross-sectional study was exempt from institutional review board review because it included the analysis of deidentified participant information. In addition, the need for participant informed consent was also waived for this reason. Resident data maintained and collected by the AAMC via the Graduate Medical Education (GME) Track National Census were obtained from 2001 to 2018 for the following surgical specialties: general surgery, neurosurgery, obstetrics and gynecology (OB-GYN), ophthalmology, orthopedic surgery, otolaryngology, plastic surgery (integrated plastic surgery included), thoracic surgery (integrated thoracic surgery included), urology, and vascular surgery (integrated). Integrated programs, such as vascular surgery and thoracic surgery, are relatively newer training routes and first submitted survey responses to the AAMC in 2007 to 2008. This study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines.

Resident training status was collected and confirmed by participating programs to GME Track. Trainee statuses were verified for each resident in a program annually by the participating training program (this data set will be referenced throughout the article unless otherwise indicated). For example, residents in a 5-year training program would be confirmed for 5 years (or more if additional years were pursued).

## Key Points

**Question** What is the trend in racial and sex disparities in resident attrition among surgical specialties over the past 18 years?

**Findings** In this large cross-sectional study analyzing 407 461 program-reported resident years collected from 112 205 individual surgical residents over 18 years, the mean percentage of female residents increased whereas the mean percentage of residents underrepresented in medicine (URiM) remained relatively unchanged. Significantly higher attrition rates were observed for URiM and female residents compared with White and male residents, respectively.

**Meaning** Results suggest that female and URiM residents were at significantly higher risk for attrition and unintended attrition.

Residents who experienced attrition before the end of a 5-year program will have had confirmed only the participated years of training.

The GME Track data included the year of completion, a unique resident identification code, program identification code, medical school(s) of affiliation, surgical subspecialty, age category/range at the start of training, reported race and ethnicity, and sex. The starting and ending dates of training for residents were also recorded. Only primarily allopathic training programs accredited by the Accreditation Council for Graduate Medical Education (ACGME) were included; however, not all ACGME-accredited programs participate in GME Track (response rates estimated to be 80%-95% of all programs).

### Race and Ethnicity Data

Race and ethnicity data were obtained from both self-reported resident responses (eg, the Electronic Residency Application Service, or Medical College Admission Test registration) and nonself-reported sources such as institutional student records or the GME Track system. During the study period, the AAMC noted several changes in the collection of race and ethnicity data. Before the 2002 to 2003 academic year, an individual could identify with a singular race or ethnicity category. From 2003 until 2013, the AAMC collected race and ethnicity data in 2 questions: the first inquired about the race or races with which an individual identified, and the second asked about Hispanic origin. Since the start of the 2013 academic year, the AAMC has collected race and ethnicity data in a single question that allows an individual to select any combination of races and Hispanic origin.

For purposes of this study, race and ethnicity information was gathered from the first reported response of the individual resident and organized into the following categories: American Indian/Alaska Native, Asian, Black/African American, Hispanic, multirace or multiethnicity, Native Hawaiian/Pacific Islander, White, other (not otherwise specified), and unknown. Underrepresented in medicine (URiM) is defined as American Indian/Native American, Black/African American, Hispanic, multirace or multiethnicity (identifies with 1 or more racial and ethnic categories), or Native Hawaiian/Pacific Islander.

### Attrition Data

Data on resident attrition were obtained from the AAMC for the 2001 to 2018 academic year in conjunction with the demographic data that were available from the 2001 to 2018 calendar year. Attrition was reported on an individual basis for each resident. Two categories were used to describe attrition including (1) withdrawal and dismissal, which encompassed all the following: changing careers (leaving medicine), health/family reasons, leaving country/visa issues, military obligations, other/unknown, and some unknown quantity of involuntary dismissal or termination (not formally tracked by AAMC) and (2) transfer to another specialty. Transfers within the same specialty to another program were not reported. Unintended attrition is a category defined by the authors that encompasses all withdrawals, dismissals, and transfers except for changing career.

Attrition data were presented using the individual resident as the observation unit for frequency counts and analysis. This unit of observation was achieved by collapsing all responses provided by the individual, yielding a binary (yes/no) summary of attrition/dismissal events for the individual resident. For example, a resident who underwent attrition during the third year of residency would represent 3 annual responses but only 1 attrition event. A resident who successfully completed residency in a 5-year program would have up to 5 responses with no attrition event. For an individual with more than 1 event (eg, transferring specialties then later choosing to leave medicine entirely), only the first-ever attrition event was counted for that individual.

Surgical specialty assignment was determined by the first (and only) recorded response for residents who participated in only 1 year of training. For residents who participated in more than 1 year of residency, the second-year response was used for specialty assignment as residents in surgical fields often complete a general surgery or preliminary year as part of their programs or before matriculation into desired subspecialties.

### Statistical Analysis

Data processing and statistical analyses were performed with SAS, version 9.4 (SAS Institute) and Stata, version 13.0/SE (StataCorp). Two-sided *P* values at an  $\alpha$  level of .05 were defined as the limits for statistical significance, and 95% CIs were reported. Descriptive analysis and bivariate tables with relative risk (RR) were computed (SAS, Stata) using the individual resident as the unit of observation. Data were analyzed from March 20, 2021, to June 8, 2022.

## Results

### General Demographic Analysis

Over the course of 2001 to 2018, surgical training programs reported on 407 461 resident training statuses representing 112 205 unique residents (most prevalent age group: 25-27 years, 57 300 of 112 205 participants [51.1%]; 44 835 female individuals [40.0%]; 67 351 male individuals [60.0%]). Residents identified with the following race and ethnicity groups: 323 (0.3%) American Indian/Alaska Native, 22 359 (19.9%)

Asian, 7043 (6.3%) Black/African American, 4385 (3.9%) Hispanic, 6619 (5.9%) multirace or multiethnicity, 133 (0.1%) Native Hawaiian/Pacific Islander, 69 323 (61.8%) White, 1690 (1.5%) other (not otherwise specified), and 330 (0.3%) unknown. Asian and White proportions remained relatively stable, whereas the mean percentage of Black/African American residents in all surgical specialties steadily declined from 7.2% (1476 of 20 450) in 2001 to 4.9% (1283 of 26 230) in 2018. The mean percentage of Hispanic trainees initially declined from 2001 to 2010 but gradually increased over the past 10 years with a resultant minor net percentage loss from 5.4% in 2001 to 4.9% in 2018. Residents identifying as multiracial or multiethnicity increased from a mean of 1.6% (324 of 20 450) to 7.3% (1904 of 26 230) over our study interval; however this phenomenon may be attributed to changes in data collection methods, specifically the more recent ability to identify as multiracial or multiethnicity. The overall composition of racial and ethnic diversity in all surgical residency programs over the study interval is depicted in **Figure 1** and eFigure 1 in **Supplement 1**.

### Sex Diversity

Overall, the number of female trainees increased from 31.5% (6429 of 169 263) in 2001 to 43.1% (11 293 of 169 263) in 2018. Sex disparity was greatest in orthopedic surgery and neurosurgery, with female trainees composing 12.9% (1963 of 15 215) and 15.0% (663 of 4434) of residents, respectively, over the study period. Notably, both specialties approximately doubled their proportion of female residents from 2001 (orthopedics 8.8% [265 of 3022], neurosurgery 10.4% [86 of 829]) to 2018 (orthopedics 15.5% [611 of 3931], neurosurgery 17.3% [258 of 1488]). The percentage of female trainees over the study period was highest in OB-GYN (78.7% [21 018 of 26 725]), followed by ophthalmology (39.8% [3566 of 8961]). An overview of the mean percentage of female residents in surgical training programs by specialty is depicted in **Table 1**.

### Racial and Ethnic Diversity

Orthopedic surgery had the highest proportion of White trainees across our study period (74.5% [11 333 of 15 215]) and was the least demographically diverse field (**Figure 1**; eFigure 1 in **Supplement 1**). Integrated vascular surgery was the most demographically diverse field with the following race and ethnicity groups among 487 residents: 2 (0.4%) American Indian/Native American, 124 (25.5%) Asian, 22 (4.5%) Black/African American, 15 (3.1%) Hispanic, 37 (7.6%) multirace or multiethnicity, and 18 (3.7%) other or unknown. URiM residents comprised a mean of 14.9% (16 695 of 112 205) of all surgical trainees from 2001 to 2018 but demonstrated a 2.1% decrease over the study period. Ophthalmology and otolaryngology had the lowest mean percentage of URiM residents at 8.8% (792 of 8961) and 8.8% (560 of 6397), respectively over the study period, whereas OB-GYN had the highest (21.0% [5615 of 26 725]). OB-GYN and general surgery were the only specialties that had an above mean percentage (>14.9%) of URiM trainees.

OB-GYN had the highest percentage of Black/African American residents (10.9% [2902 of 26 725]) and Hispanic residents (4.8% [1288 of 26 725]). Otolaryngology had the lowest

Figure 1. Demographic Composition by Specialty (2001-2018)

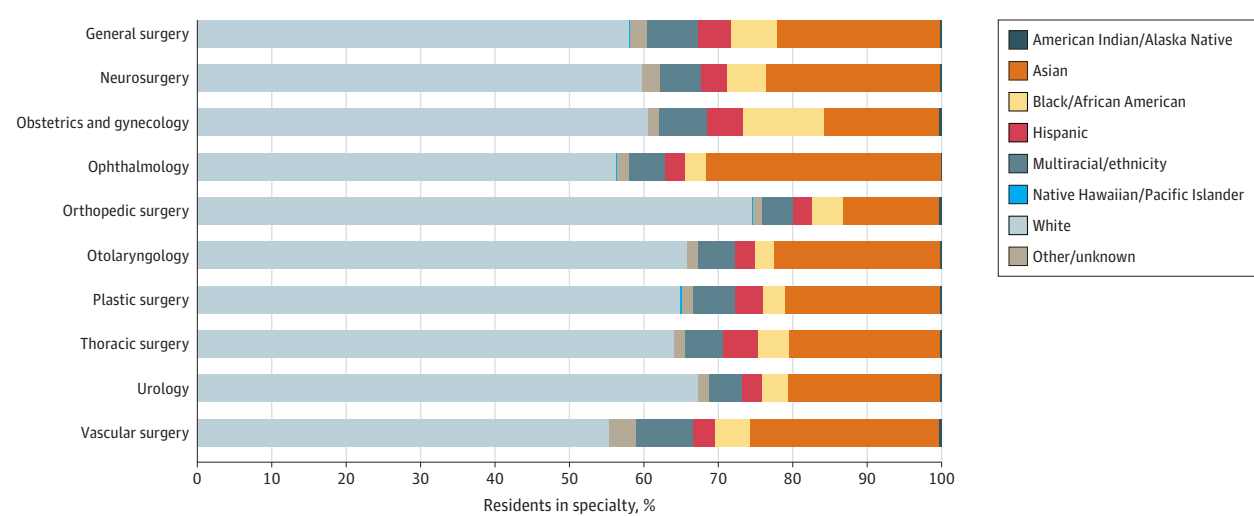


Table 1. Female and URiM Demographic Composition and Relative Risk Attrition Data by Specialty (2001-2018)

Specialty	Female				URiM							
	All attrition		Unintended attrition		No./total No. (%)		All attrition		Unintended attrition		No./total No. (%)	
	RR (95% CI)	P value	RR (95% CI)	P value	Residents	Attrition composition	RR (95% CI)	P value	RR (95% CI)	P value	Residents	Attrition composition
General surgery	1.33 (1.24-1.42)	<sup>a</sup>	1.31 (1.17-1.47)	<sup>a</sup>	13 546/41 569 (32.6)	1602/4170 (38.4)	1.13 (1.04-1.23)	<sup>b</sup>	1.54 (1.35-1.76)	<sup>a</sup>	6684/41 569 (16.1)	736/4170 (17.7)
Neurosurgery	1.62 (1.28-2.06) <sup>a</sup>		1.70 (1.18-2.44) <sup>b</sup>		663/4434 (15.0)	98/462 (21.2)	1.39 (1.00-1.94)	<sup>c</sup>	2.72 (1.94-3.84)	<sup>b</sup>	573/4434 (12.9)	82/462 (17.8)
Obstetrics and gynecology	0.61 (0.55-0.68)	<sup>a</sup>	0.63 (0.53-0.75)	<sup>a</sup>	21 018/26 725 (78.7)	1215/1737 (70.0)	1.40 (1.26-1.57)	<sup>a</sup>	1.83 (1.54-2.18)	<sup>a</sup>	5615/26 725 (21.0)	464/1737 (26.7)
Ophthalmology	1.38 (1.02-1.85)	<sup>c</sup>	1.38 (0.89-2.13)	.15	3566/8961 (39.8)	84/177 (47.5)	1.48 (0.94-2.32)	.10	1.78 (0.96-3.30)	.07	792/8961 (8.8)	22/177 (12.4)
Orthopedic surgery	2.21 (1.78-2.73)	<sup>a</sup>	2.09 (1.47-2.97)	<sup>a</sup>	1963/15 215 (12.9)	117/487 (24.0)	2.22 (1.76-2.79)	<sup>a</sup>	3.42 (2.45-4.79)	<sup>a</sup>	1542/15 215 (10.1)	95/487 (19.5)
Otolaryngology	1.34 (1.03-1.74)	<sup>c</sup>	1.08 (0.66-1.77)	.71	1912/6397 (29.9)	89/247 (36.0)	1.58 (1.08-2.32)	<sup>c</sup>	2.07 (1.11-3.87)	<sup>c</sup>	560/6397 (8.8)	32/247 (13.0)
Plastic surgery	1.12 (0.79-1.60)	.52	1.15 (0.61-2.17)	.66	790/1693 (31.8)	50/146 (34.3)	1.32 (0.81-2.15)	.27	1.08 (0.42-2.76)	.88	271/2484 (10.9)	20/146 (13.7)
Thoracic surgery	2.87 (1.61-5.13)	<sup>a</sup>	1.71 (0.67-4.35)	.26	128/717 (15.2)	19/60 (31.7)	1.40 (0.69-2.86)	.35	2.11 (0.83-5.37)	.12	108/845 (12.8)	10/60 (16.7)
Urology	1.79 (1.35-2.37)	<sup>a</sup>	2.02 (1.18-3.45)	<sup>c</sup>	1078/5088 (21.2)	75/236 (31.8)	1.46 (0.99-2.16)	.06	1.25 (0.57-2.77)	.58	486/5088 (9.6)	31/236 (13.1)
Vascular surgery	1.00 (0.50-2.02)	.99	None recorded		171/487 (35.1)	13/37 (35.1)	1.05 (0.40-2.82)	.91	4.04 (1.15-14.21)	<sup>c</sup>	63/487 (12.9)	5/37 (13.5)
Combined (all specialties)	1.16 (1.11-1.22)	<sup>a</sup>	1.17 (1.08-1.26)	<sup>a</sup>	44 835/112 205 (40.0)	3362/7759 (43.3)	1.40 (1.32-1.48)	<sup>a</sup>	1.92 (1.75-2.11)	<sup>a</sup>	16 695/112 205 (14.9)	1497/7759 (19.3)

Abbreviations: RR, relative risk; URiM, underrepresented in medicine.

<sup>b</sup> P < .01.

<sup>a</sup> P < .001.

<sup>c</sup> P < .05.

percentage of Black/African American residents (2.5% [158 of 6397]), and orthopedic surgery had the lowest percentage of Hispanic residents (2.5% [384 of 15 215]). Native Hawaiian/Pacific Islander and American Indian/Alaska Native residents made up very small percentages in all surgical specialties. Table 1 lists the mean percentage of URiM trainees in each surgical specialty. URiM trainees among all surgical specialties had a 2.1% decrease over the study period. Otolaryngology had the highest percentage increase in URiM trainees (33.2%). Representation of URiM female residents increased over the study

period for all specialties except OB-GYN. URiM female trainees comprised a mean of 1.6% (242 of 15 215) of orthopedic residents over the past 2 decades and 1.5% (13 of 845) of thoracic surgery residents.

**Attrition Analysis**

The overall attrition rate among all specialties and races and ethnicities was 6.9% (7759 of 112 205) with an unintended attrition rate of 2.3% (2556 of 112 205) (Table 2). Neurosurgery had the highest rate of resident attrition (10.4% [462]) and un-

Table 2. Resident Attrition Rates by Specialty and Race and Ethnicity (2001 to 2018)

Characteristic	No. (% of total in category)		Total No. of residents (% of total)	% Change, 2001-2018	% Change in URiM, 2001-2018
	All attrition	Unintended attrition			
<b>Sex</b>					
Female	3362 (7.50)	1116 (2.49)	44 835 (39.96)	+36.88	
Male	4397 (6.53)	1440 (2.14)	67 351 (60)	-16.94	NA
Unknown	0	0	19 (0.02)	NA	
<b>Specialty</b>					
General surgery	4170 (10.03)	1292 (3.11)	41 569 (37.05)		2.79
Neurosurgery	462 (10.42)	177 (3.99)	4434 (3.95)		11.50
Obstetrics and gynecology	1737 (6.50)	617 (2.31)	26 725 (23.82)		-17.51
Ophthalmology	177 (1.98)	82 (0.92)	8961 (7.98)		0.22
Orthopedic surgery	487 (3.20)	175 (1.15)	15 215 (13.56)		19.28
Otolaryngology	247 (3.86)	73 (1.14)	6397 (5.7)	NA	33.20
Plastic surgery	146 (5.88)	43 (1.73)	2484 (2.21)		11.13
Thoracic surgery	60 (5.13)	26 (2.67)	845 (0.75)		-4.75
Urology	236 (4.64)	60 (1.18)	5088 (4.54)		23.25
Vascular surgery, integrated	37 (7.60)	11 (2.26)	487 (0.43)		26.19
<b>Race and ethnicity</b>					
American Indian/Alaska Native	31 (9.60)	15 (4.64)	323 (0.29)	-74.00	
Asian	1682 (7.52)	583 (2.61)	22 359 (19.93)	-3.32	
Black/African American	746 (10.59)	367 (5.21)	7043 (6.28)	-32.27	
Hispanic	307 (7.00)	92 (2.10)	4385 (3.91)	-9.83	
Multiracial/ethnicity	513 (7.75)	187 (2.83)	6619 (5.90)	359.49	NA
Native Hawaiian/Pacific Islander	10 (7.52)	3 (2.26)	133 (0.12)	-78.26	
Other/unknown	170 (8.42)	75 (3.71)	2020 (1.80)	622.2	
White	4300 (6.20)	1234 (1.78)	69 323 (61.78)	-5.90	
Combined total	7759 (6.92)	2556 (2.28)	112 205	NA	

Abbreviations: NA, not applicable; URiM, underrepresented in medicine.

intended attrition (4.0% [177]) over the study period. Ophthalmology had the lowest rate of resident attrition (2.0% [177]) and unintended attrition (0.9% [82]). The attrition rate across all specialties for our study period improved from a mean percentage of 5.9% (1198 of 20 450) in 2001 to 1.7% (106 of 6081) in 2018.

Of the 112 205 residents in the study, 3362 female residents (7.5%) underwent attrition, and 1116 (2.5%) underwent unintended attrition. Conversely, 4397 male residents (6.5%) experienced attrition, and 1440 (2.1%) experienced unintended attrition. The RR of attrition for female residents was 1.16 when compared with male residents (95% CI, 1.11-1.22;  $P < .001$ ). Female residents were 1.17 times more likely to experience unintended attrition than their male counterparts (95% CI, 1.08-1.26;  $P < .001$ ).

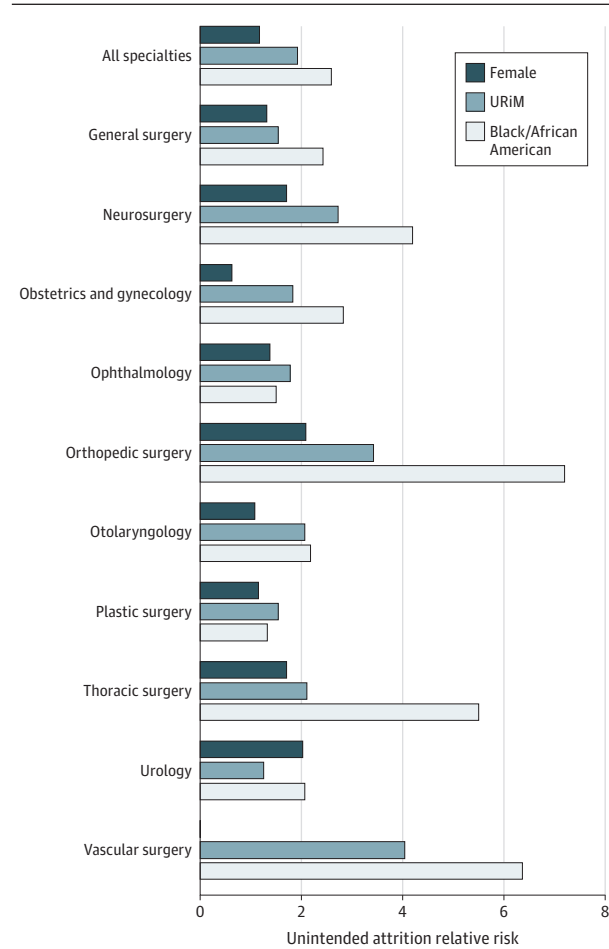
The RR for attrition in female residents compared with male residents was highest in thoracic surgery at 2.87 (95% CI, 1.61-5.13,  $P < .001$ ). Female residents in orthopedic surgery had the highest RR for unintended attrition compared with male colleagues at 2.09 (95% CI, 1.47-2.97;  $P < .001$ ). OB-GYN had the lowest RR for female attrition and unintended attrition at 0.61 (95% CI, 0.55-0.68;  $P < .001$ ) and 0.63 (95% CI, 0.53-0.75;  $P < .001$ ), respectively. A summary of all specialties is provided in Table 1. Demographically, orthopedic surgery and neu-

rosurgery had the lowest percentages of female residents and OB-GYN had the highest. The RR for female attrition and unintended attrition decreased as the proportion of female residents increased across all surgical specialties (Table 1) ( $R^2 = 0.94$  for attrition;  $R^2 = 0.51$  for unintended attrition).

The rate of attrition for residents from URiM backgrounds among all surgical specialties was 9.0% (1497 of 16 695) compared with 6.6% (6262 of 95 510) in the non-URiM group over the entire study period ( $P < .001$ ). The unintended attrition rate in the URiM group was 3.8% (634 of 16 695) compared with 2.0% (1922 of 95 510) in non-URiM group ( $P < .001$ ). The RR for attrition and unintended attrition in the URiM group compared with the non-URiM group was significantly elevated at 1.40 (95% CI, 1.32-1.48;  $P < .001$ ) and 1.92 (95% CI, 1.75-2.11;  $P < .001$ ), respectively. Across all specialties, as the proportion of URiM residents increased, the RR for URiM attrition and unintended attrition decreased (Table 1) ( $R^2 = 0.70$  for attrition;  $R^2 = 0.38$  for unintended attrition).

The highest attrition (10.6% [746 of 7043]) and unintended attrition (5.2% [367 of 7043]) rates were in Black/African American residents. The lowest attrition and unintended attritions rates were seen in White residents at 6.2% (4300 of 69 323) and 1.8% (1234 of 69 323), respectively. The RR for Black/African American residents to experience attri-

**Figure 2. Relative Risk for Unintended Attrition by Specialty—Female Individuals, Residents Underrepresented in Medicine (URiM), and Black/African American Residents (2001-2018)**



The comparison group for female residents was male residents. For URiM residents, the comparison group was residents who are not underrepresented. For Black and African American residents, comparison groups were White residents.

tion and unintended attrition compared with all other races was 1.66 (95% CI, 1.53-1.80;  $P < .001$ ) and 2.59 (95% CI, 2.31-2.90;  $P < .001$ ), respectively. Orthopedic surgery had the highest RR for attrition and unintended attrition in Black/African American residents when compared with White residents at 3.80 (95% CI, 2.84-5.09;  $P < .001$ ) and 7.20 (95% CI, 4.84-10.71;  $P < .001$ ), respectively. Across all specialties, Hispanic residents did not have a significantly elevated RR of attrition and unintended attrition. However, an RR of 2.58 (95% CI, 1.38-4.83;  $P < .004$ ) for unintended attrition was observed in Hispanic neurosurgery residents compared with White residents. A comparison of RR of unintended attrition for female residents, URiM residents, and Black/African American residents by specialty is illustrated in Figure 2 and eFigure 2 in Supplement 1.

Examination of racial and ethnic group attrition in each specialty was especially notable in orthopedic surgery as Black/African American residents accounted for 4.1% (616 of 15 215)

of total residents but 12.1% (59 of 487) of the residents experiencing attrition and 20.0% (35 of 175) of the residents experiencing unintended attrition (Figure 3; eFigure 3 in Supplement 1). Conversely, White residents accounted for 74.5% (11 333 of 15 215) of total orthopedic residents but only 63.0% (307 of 487) of those experiencing attrition and 53.8% (94 of 175) of those experiencing unintentional attrition. This same disparity was observed in other specialties and is detailed in Figure 3 and eFigure 3 in Supplement 1.

## Discussion

In this cross-sectional study, we identified an attrition rate among all surgical specialties of 6.9% with an unintended attrition rate of 2.3%. This attrition rate decreased from 5.9% in 2001 to 1.7% in 2018, which may be due to changes in work hour restrictions. We also found a disproportionate rate of attrition and unintended attrition among female and URiM residents, particularly Black/African American residents.

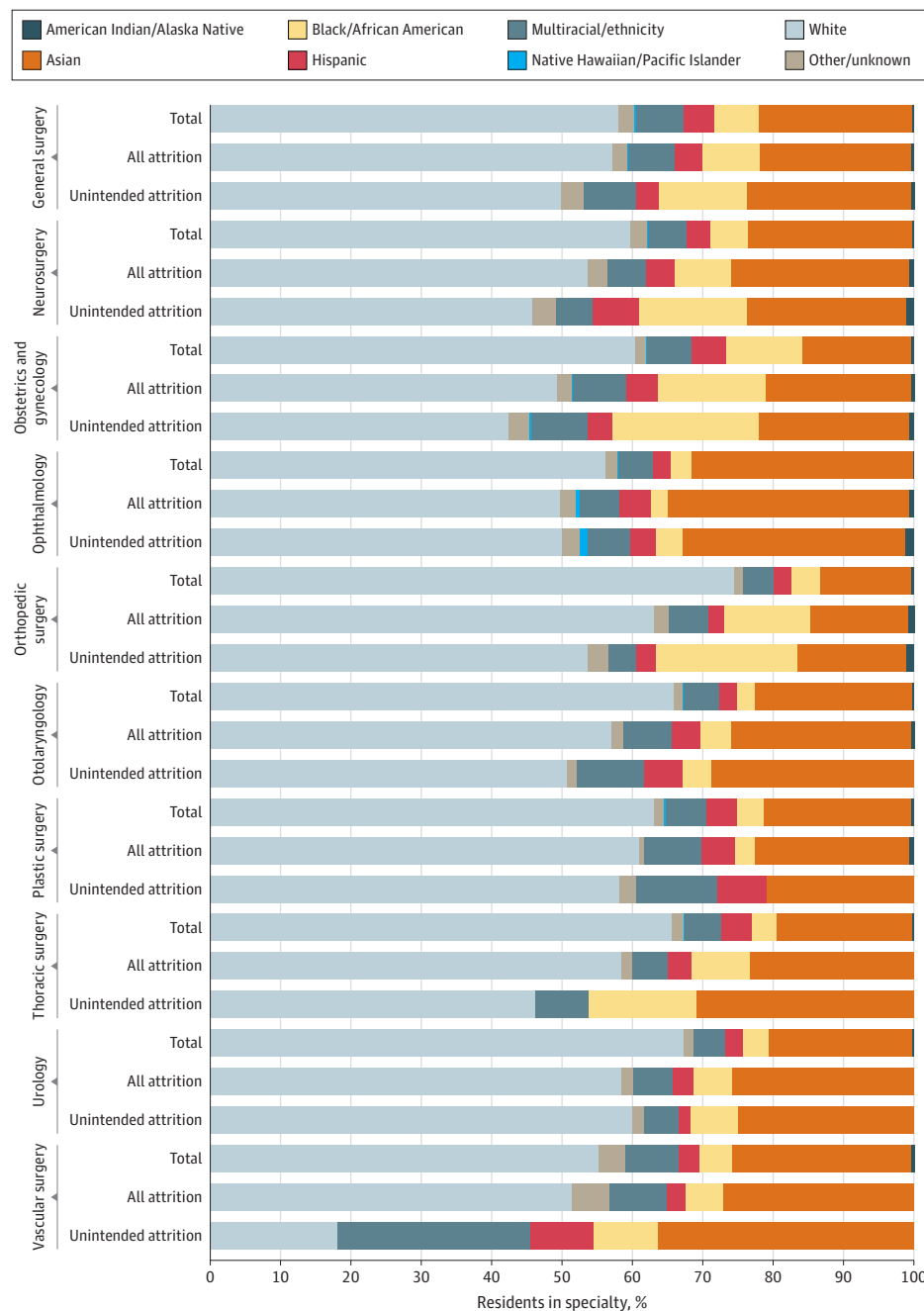
Previously published specialty specific studies have reported an attrition rate of up to 20.8% in general surgery,<sup>11,12</sup> 11.0% in neurosurgery,<sup>3</sup> and between 3% and 21% in OB-GYN.<sup>6,13</sup> Outlier specialties with respect to absolute attrition rates should be carefully examined for issues that may exist in the selection process, resident support structure, and overall culture of the training programs.

There is conflicting literature regarding whether female residents are more likely to undergo attrition compared with male residents. Our aggregate data suggest that female residents have an approximately 16% increased risk of undergoing attrition compared with their male counterparts. Yeo et al<sup>11</sup> reported that female residents were equally as likely as male residents to undergo attrition during their internship year but were more likely to experience attrition in subsequent years of training. Agarwal et al<sup>3</sup> also observed that female individuals in neurosurgery residencies had a significantly higher attrition rate than male individuals. We did find that an increased proportion of female residents in a given subspecialty helped to mitigate disparity with respect to female attrition; however, further in-depth analysis of this trend is warranted.

Although the recent US Census estimates that female individuals represent 50.8% of the national population and more than one-half of all medical school matriculants, surgical subspecialties do not reflect this reality.<sup>14</sup> Orthopedic surgery has historically had the lowest female presence, which was similarly confirmed in our findings.<sup>15-18</sup> Overall, we did observe an increase in the number of female residents over the past 2 decades; urology, integrated vascular surgery, otolaryngology, and thoracic surgery all had percentage increases greater than 100%.

Previous studies have also identified residents from racial and ethnic minoritized groups to have a higher attrition rate.<sup>11,19</sup> A study by Keshinoro et al<sup>19</sup> demonstrated that URiM residents have significantly higher attrition rates (3.6%) when compared with White residents (2.6%) and Asian residents (2.9%). Our data found both a higher attrition rate (9.0%) and unintended attrition rate (3.8%) for residents from URiM back-

Figure 3. Total Resident Population and Attrition Demographic Comparison by Specialty (2001-2018)



grounds compared with the non-URiM group (6.6% and 2.0%, respectively). These higher rates appear to be predominantly driven by Black/African American residents who have the highest attrition rate (10.6%) and unintended attrition rates (3.8%) of all URiM residents. During our study period, Black/African American residents accounted for 6.3% of all surgical residents but were 9.6% of all residents experiencing attrition and 14.4% of those dismissed. This magnitude of disparity raises significant concern about the training environment of surgical residencies and what factors are contributing to this disproportionate rate.

One contributing factor could be the lack of social support or inclusivity within a residency program. According to a cross-sectional national survey administered to 4339 general surgery residents in 2008, Black/African American, Asian, and other residents from minoritized groups were less likely to feel a sense of community and fit within their programs compared with their White counterparts and were more likely to report feeling unable to count on peers for help.<sup>20</sup> In another survey by Sullivan et al,<sup>21</sup> both younger and female residents were less likely to report collegial relationships with faculty, with decreased socialization highly related to dissatisfaction with the program.

Although race and ethnicity and sex are just one component of the issue, the historic lack of diversity in many surgical subspecialties has created an absence of peers, mentors, or identifiable figures for URiM individuals. In addition to the lack of mentors and role models, program leadership mattered significantly as well. In a study of 21 general surgery residencies comparing high attrition and low attrition rate programs, there was no difference in the pass rates on the General Surgery Qualifying or Certifying Examination. However, differences were found in the use and perception of remedial vs redirection (to another field) interventions between of program directors at low vs high attrition programs, respectively.<sup>22</sup>

### Insights

This study highlights the issue of limited diversity and attritional disparities in surgical residency training programs. The rates presented herein are fundamental and actionable. Developing an enhanced understanding of these findings will allow potential solutions, informed decision-making, and direct avenues for change. Increasing diversity in surgical specialties is vital in providing quality care, improving trust in physicians, and increasing satisfaction of patient care.<sup>23</sup> Physicians of minoritized groups are also more likely to practice in underserved communities.<sup>24</sup> To better serve our patients, the need to recruit and retain underrepresented minorities and women is paramount.

Future directions of study include a detailed look at the effects of intersectionality, possible trends involving year of training, and incorporation of faculty and institutional data to further examine the influence of training environment on attrition rates and risk factors. In addition, we plan to take an in-depth look at our own specialty, orthopedics, to further characterize and understand the racial and ethnic and sex disparities that exist not only in resident demographic composition but also attrition. Ultimately, critical and honest evaluation of these issues can inform the design of feasible programmatic and institutional guidelines and initiatives to address the potential barriers to more inclusive, diverse, and supportive surgical training programs.

### Limitations

Limitations of this study include those inherent with a large, partially self-reported and census-based data set of information. These data were collected each year yet are not specifi-

cally continuous and longitudinal for each individual resident. For example, at analysis start year (2001) a resident may have already completed some years of residency whereas at end year (2018), a resident may just be beginning residency; therefore, a specific longitudinal cohort of individuals (followed from their start year to completion) was not identified.

Another limitation is the race and ethnic allocation of residents. Residents with more than 1 reported race were considered multiracial for the purposes of this study. Allocating individuals to multiracial categories may decrease the number of underrepresented residents. However, the authors believe that this is preferred to attempting to assign multiracial individuals to a single most representative race.

The authors also wish to acknowledge the evolving and more contemporary definition of underrepresented in medicine, as defined by the AAMC Executive Committee in 2004, to include “those racial and ethnic populations that are underrepresented in the medical profession relative to their numbers in the general population.”<sup>25</sup> Similarly, although the previously described evolution of AAMC data collection practices serves to encompass a more inclusive and wholistic approach to race and ethnicity self-identification, we do acknowledge the potential for variation in data reporting by the resident over our study period.

Finally, by nature, the data set was limited in scope of reported demographics, often failing to adequately represent or capture all individuals, for example trainees in the lesbian, gay, bisexual, transgender, and queer or questioning community. We also acknowledge the effect and importance of intersectionality and would advocate for future data collection methods and studies that are sufficiently inclusive and representative.

## Conclusions

Results of this cross-sectional study suggest that the percentage of female residents in surgical specialties has improved over the last 18 years, and the percentage of URiM residents has remained relatively unchanged. Risk for attrition and unintended attrition was significantly elevated for female and URiM residents, specifically Black/African Americans. These results highlight current racial and sex disparities in resident attrition and demonstrate the importance of developing strategies to recruit, retain, and support residents.

### ARTICLE INFORMATION

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**Author Contributions:** Dr Haruno had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

**Concept and design:** Haruno, Metzger, Lin, Little, Poon.

**Acquisition, analysis, or interpretation of data:** Haruno, Chen, Metzger, Little, Kanim, Poon.

**Drafting of the manuscript:** Haruno, Chen, Metzger, Lin, Little, Poon.

**Critical revision of the manuscript for important intellectual content:** All authors.

**Statistical analysis:** Haruno, Chen, Kanim.

**Obtained funding:** Haruno, Metzger, Lin, Little, Poon.

**Administrative, technical, or material support:** Haruno, Metzger.

**Supervision:** Haruno, Lin, Little, Poon.

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the submitted work. Dr Lin reported receiving grants from OREF and the J. Robert Gladden Orthopedic Society for statistical support during the conduct of the study. Dr Little reported receiving grants from OREF and the J. Robert Gladden Orthopedic Society and consultant fees from Depuy Synthes, Restor3D, and Globus Medical outside the submitted work. Dr Poon reported receiving grants from OREF, the J. Robert Gladden Orthopedic Society, and Pediatric Orthopedic Society of North America and personal fees from Medtronic Spine and Depuy Synthes outside the submitted work. No other disclosures were reported.



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**Disclaimer:** The views expressed herein are those of the authors and do not necessarily reflect the position or policy of the Association of American Medical Colleges.

**Data Sharing Statement:** See Supplement 2.

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**Additional Information:** This material is based upon data provided by the Association of American Medical Colleges.

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## Supplementary Online Content

Haruno LS, Chen X, Metzger M, et al. Racial and sex disparities in resident attrition among surgical subspecialties. *JAMA Surg*. Published online February 8, 2023. doi:10.1001/jamasurg.2022.7640

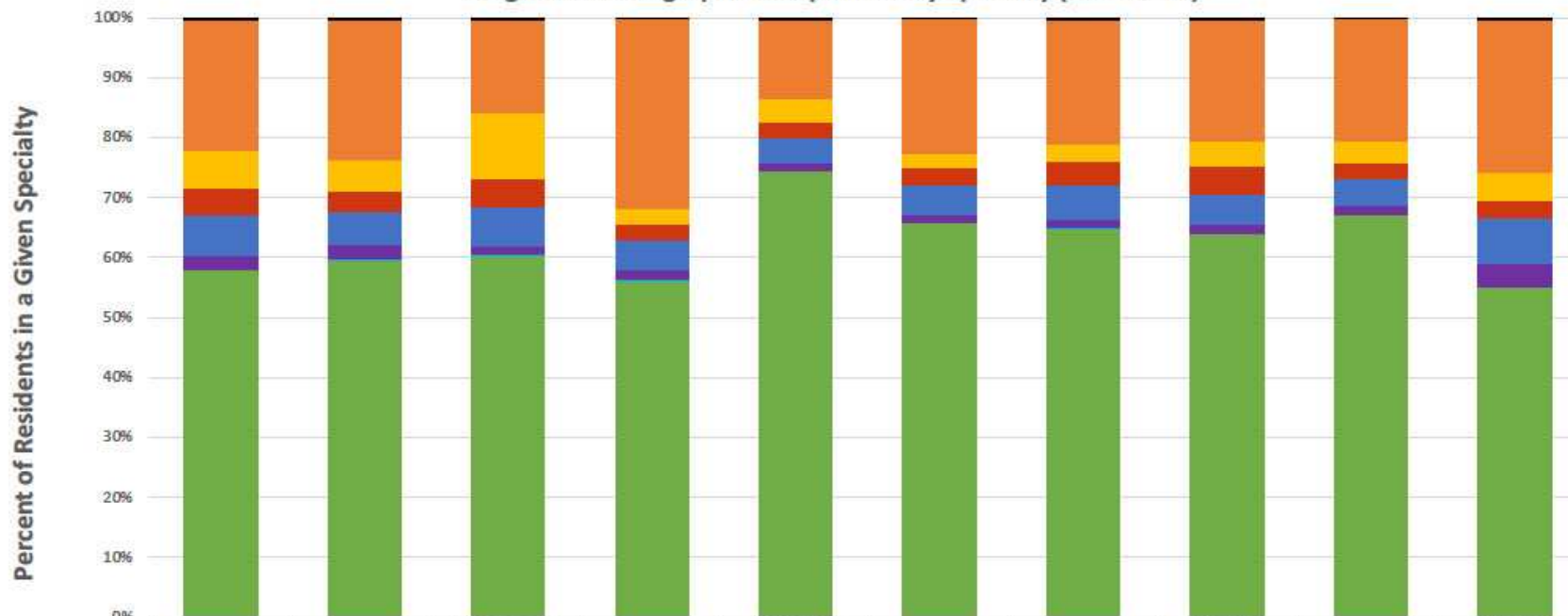
**eFigure 1.** Demographic Composition by Specialty (2001-2018)

**eFigure 2.** Relative Risk for Unintended Attrition by Specialty—Females, URiM, and Black/African American Residents (2001-2018)

**eFigure 3.** Total Resident Population and Attrition Demographic Comparison by Specialty (2001-2018)

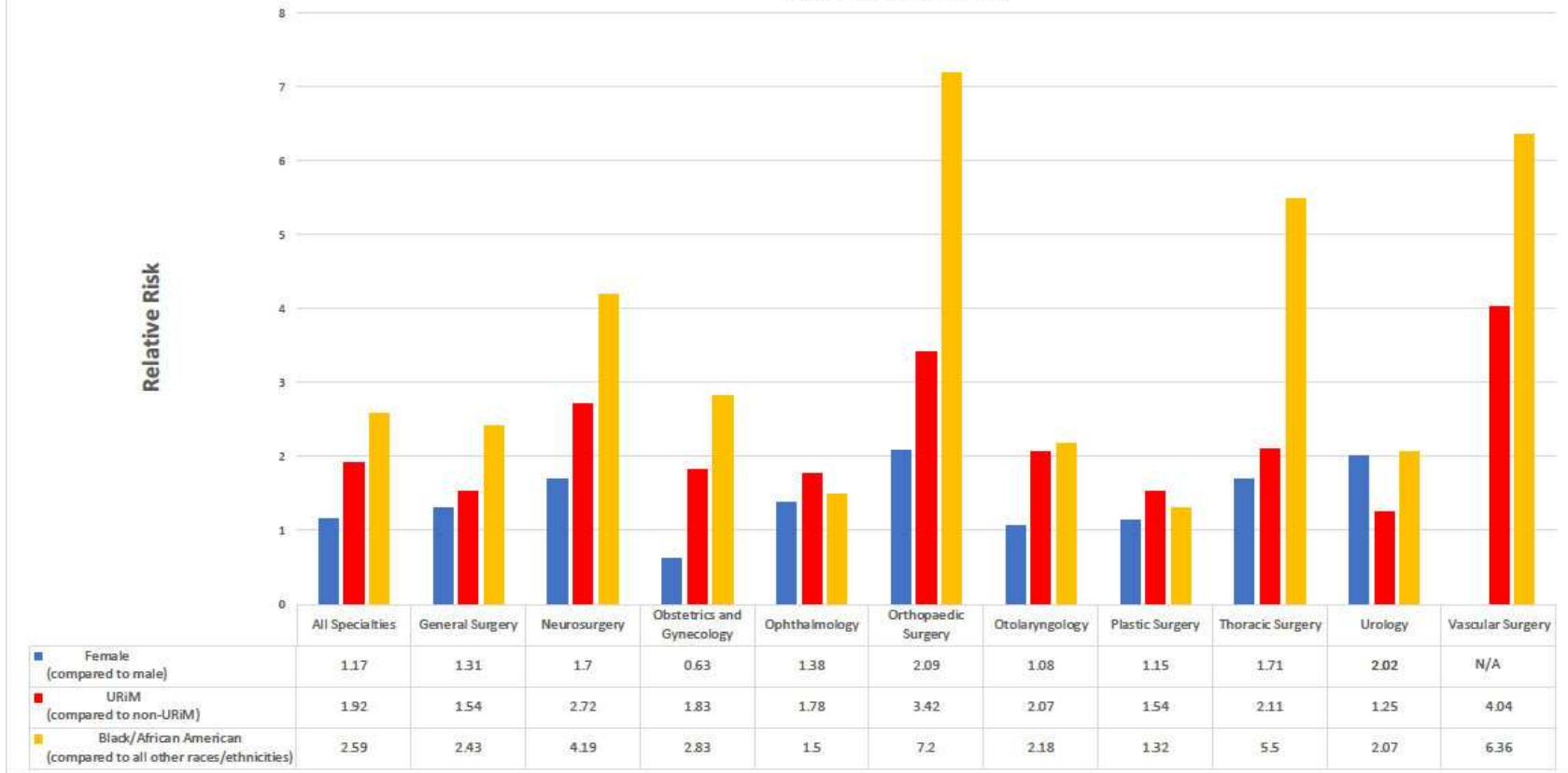
This supplementary material has been provided by the authors to give readers additional information about their work.

eFigure 1. Demographic Composition by Specialty (2001-2018)

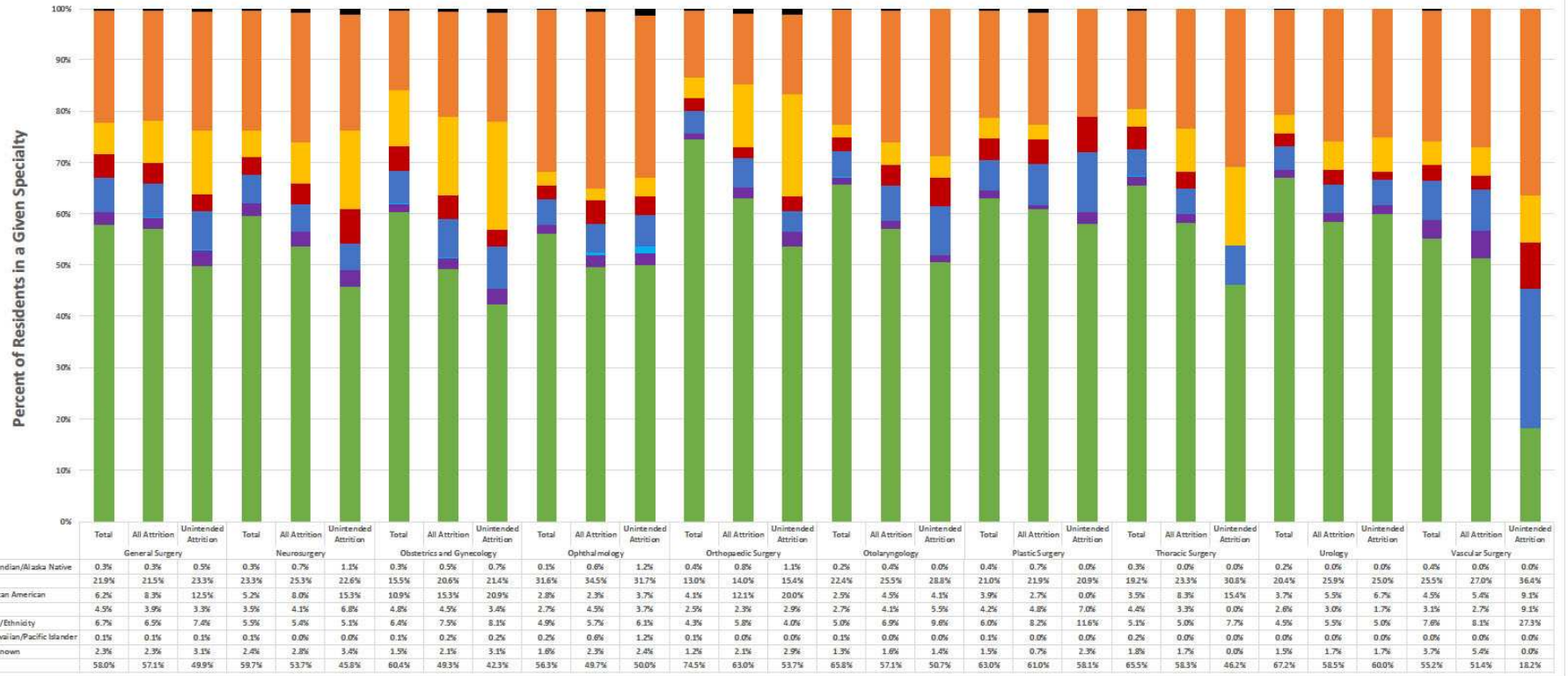


	General Surgery	Neurosurgery	Obstetrics and Gynecology	Ophthalmology	Orthopaedic Surgery	Otolaryngology	Plastic Surgery	Thoracic Surgery	Urology	Vascular Surgery
American Indian/Alaska Native	0.3%	0.3%	0.3%	0.1%	0.4%	0.2%	0.3%	0.2%	0.2%	0.4%
Asian	21.9%	23.3%	15.5%	31.6%	13.0%	22.4%	20.9%	20.2%	20.4%	25.5%
Black/African American	6.2%	5.2%	10.9%	2.8%	4.1%	2.5%	2.9%	4.3%	3.7%	4.5%
Hispanic	4.5%	3.5%	4.8%	2.7%	2.5%	2.7%	3.9%	4.7%	2.6%	3.1%
Multiracial/ethnicity	6.7%	5.5%	6.4%	4.9%	4.3%	5.0%	5.6%	5.0%	4.5%	7.6%
Other/Unknown	2.3%	2.4%	1.5%	1.6%	1.2%	1.3%	1.4%	1.5%	1.5%	3.7%
Native Hawaiian/Pacific Islander	0.1%	0.1%	0.1%	0.2%	0.1%	0.1%	0.2%	0.1%	0.0%	0.0%
White	58.0%	59.7%	60.4%	56.3%	74.5%	65.8%	64.9%	63.9%	67.2%	55.2%

**eFigure 2. Relative Risk for Unintended Attrition by Specialty - Females, URiM, and Black/African American Residents (2001-2018)**



eFigure 3. Total Resident Population and Attrition Demographic Comparison by Specialty (2001-2018)



## Data Sharing Statement

Haruno. Racial and Sex Disparities in Resident Attrition Among Surgical Subspecialties. *JAMA Surg*. Published February 08, 2023. doi:10.1001/jamasurg.2022.7640

### Data

**Data available:** No

### Additional Information

**Explanation for why data not available:** Data will not be made available per the data use/licensing agreement between the authors and the Association of American Medical Colleges