



# Single Ophthalmology Program Trends in Resident Surgical and Research Productivity by Gender, Underrepresented Minority Status, and Welcoming a Child

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## Abstract

**Objective** The aim of the study is to identify differences for cataract surgery, total procedural volume, and publication rates between residents by gender, underrepresented minority (URM) status, and welcoming a child during ophthalmology residency.

**Design** This is a retrospective, cross-sectional study.

**Participants** A total of 89 residents graduating from 2002 to 2020 at a single program were included.

**Methods** A multiple linear regression model was created to determine factors predictive of the number of cataract surgeries performed as the primary surgeon, total procedural volume, number of publications, or first author publications. Independent variables included resident gender, URM status, PhD degree, welcoming a child during residency, and graduation year.

**Results** Of the 89 graduating residents included in this study, identifying as female (45 women, 50.6%) and as URM (eight identifying as URM, 9.0%) was not associated with a difference in surgical or research volume. Female residents performed a mean (SD) of 240.1 (55.1) cataract surgeries while male residents performed 210.6 (46.1) cataract surgeries. Residents identifying as URM completed 228.1 (41.9), while non-URM residents completed 234.8 (51.9) cataract surgeries. Since 2008, eight female residents (22.2%) and two male residents (6.9%) added children to their families. Welcoming a child to the family was also not associated with decreased surgical or publication volume. Number of cataract surgeries, total procedures, and number of publications did increase over time ( $p < 0.001$ ), as each graduation year was associated with 5.4 (95% CI: 3.9, 7.1) more cataract surgeries and 30.5 (95% CI: 25.7, 36.9) more procedures. Each year was also associated with 0.24 (95% CI: 0.09, 0.38) more publications and 0.18 (95% CI: 0.08, 0.28) more first author publications.

## Keywords

- ▶ ophthalmology
- ▶ surgical volume
- ▶ cataract surgery
- ▶ publication rate
- ▶ gender
- ▶ underrepresented minority

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**Conclusion** Surgical and research productivity has increased, and female residents and residents who identify as URM did not have fewer cataract surgeries or procedures. Welcoming a child also did not correlate with differences in surgical or procedural volume. Programs should continue to promote equitable surgery and procedural distributions as well as identify more targeted strategies to encourage and recruit underrepresented medical students into ophthalmology.

The goal of any ophthalmology residency program is to train outstanding clinicians and surgeons, the latter of which requires residents to perform a significant volume of surgical cases to gain competency. A recent multi-program study has demonstrated that female residents performed fewer surgeries and procedures than their male counterparts, and this gap widened over time for procedural volume.<sup>1</sup> Female vitreoretinal surgery fellows were also found to have performed fewer procedures than male fellows.<sup>2</sup> While gender has been examined, there have not been any studies comparing differences between resident-performed surgical volume based on underrepresented minority (URM) identity, which can be defined as Black, Hispanic, American Indian, Alaskan Native, Native Hawaiian, and Pacific Islander.<sup>3</sup> While there has been an increase in medical students identifying as URM, these groups remain underrepresented in ophthalmology faculty and residents.<sup>4</sup>

In addition to surgical case volume, the number of publications may reflect academic and research engagement, which many residency programs also strive to achieve. However, there have been limited studies evaluating the effect of gender and URM status on publication rate. This study examined how resident identity such as gender and URM status impacted procedural and surgical case volume, as well as publication rate for ophthalmology residents at the University of California, San Francisco (UCSF).

## Methods

This is a retrospective, cross-sectional study approved by the UCSF Institutional Review Board. This study analyzed case logs obtained from Accreditation Council for Graduate Medical Education (ACGME) records for residents graduating from 2002 to 2020. Data collected included total procedural volume as the primary surgeon/proceduralist, number of primary surgeon cataract procedures, gender, URM status, PhD degree, and graduation year. URM status was defined as Black, Hispanic, American Indian, Alaskan Native, Native Hawaiian, and Pacific Islander as defined by the Association of American Medical Colleges.<sup>3</sup> Additionally, from 2008 onward, we identified residents who welcomed a child (either the resident or their partner gave birth, or they adopted a child) to their family.

We recorded the number of publications and first author publications by searching for papers on Web of Science using the authorship function. We counted any published paper from July of the year they started residency at UCSF to the

July two years after their graduation year. In addition, we only counted projects started during residency. We also recorded Heed Fellow status.

A multiple linear regression model was used to determine the factors predictive of the total procedural cases or cataract surgeries performed as the primary surgeon. Variables included in the model were gender, URM status, having a child during residency, and PhD status. A multiple regression model with the same variables was repeated to determine the predictive factors for number of total publications and first author publications. Finally, a multiple regression model compared the relationship of the number of total publications with the number of total procedures as well as number of cataract surgeries performed as the primary surgeon. This was followed by adjusting for graduation year. Values are presented with 95% confidence intervals. Data analyses were performed with R version 4.0.4 (R Foundation for Statistical Computing, Vienna, Austria).

## Results

There were 89 graduating residents between 2002 and 2020. Of these, 45 (50.6%) were female, and eight (9.0%) had completed a PhD degree prior to starting their residency. A total of eight (9.0%) residents were identified as URM. During residency, residents published an average of  $4.1 \pm 3.9$  (range: 0–23) publications with  $2.4 \pm 2.8$  (range: 0–16) first author publications. A total of 32 residents (36.0%) were awarded Heed Fellowships at the end of their training. From 2008 onward, eight female residents (22.2%) and two male residents (6.9%) added children to their families while in training.

The average number of procedures for residents is shown in **Table 1**. In a multivariate analysis, female residents had 5.0 (–56.1, 66.1) more procedures and 8.0 (–10.8, 24.8) more cataract surgeries, but these differences were not significant. Having a child born during residency (73.3 procedures, CI: –26.7, 173.2; 9.6 cataract surgeries, CI: –19.6, 38.7), URM status (–0.8 procedures, CI: –105.5, 103.9; –6.0 cataract surgeries, CI: –36.5, 24.6), and PhD degree status (–9.7 procedures, CI: –114.7, 95.4; –20.2 cataract surgeries, CI: –50.8, 10.5) were also not significantly correlated with surgical numbers ( $p > 0.05$ ). Recent graduates were significantly more likely to have higher procedure numbers and cataract surgeries, as each year was associated with an increase of 30.5 (25.7, 36.9) procedures and 5.4 (3.9, 7.1) cataract surgeries (**Fig. 1A and B**).

**Table 1** Average number of procedures and cataract surgeries for graduated residents, grouped by gender, URM status, welcoming a child during residency, and PhD status

Group	N	Mean procedural volume (SD)	Mean cataract surgery volume (SD)
Total	89	691.7 (218.1)	234.3 (50.9)
Female	45	711.7 (225.7)	240.1 (55.1)
Male	44	671.3 (228.3)	210.6 (46.1)
URM	8	684.4 (275.1)	228.1 (41.9)
Non-URM	81	692.5 (213.7)	234.8 (51.9)
Females welcoming a child during residency <sup>a</sup>	8	763.3 (133.3)	250.3 (38.6)
Females not welcoming a child during residency <sup>a</sup>	28	756.9 (233.4)	249.3 (55.8)
Males welcoming a child during residency <sup>a</sup>	2	880.5 (147.8)	258.5 (51.6)
Males not welcoming a child during residency <sup>a</sup>	27	761.2 (167.2)	242.5 (38.6)
PhD Degree	8	641.4 (301.4)	209.5 (78.0)
No PhD Degree	81	696.7 (209.6)	236.7 (47.5)

Abbreviation: URM, underrepresented minority.

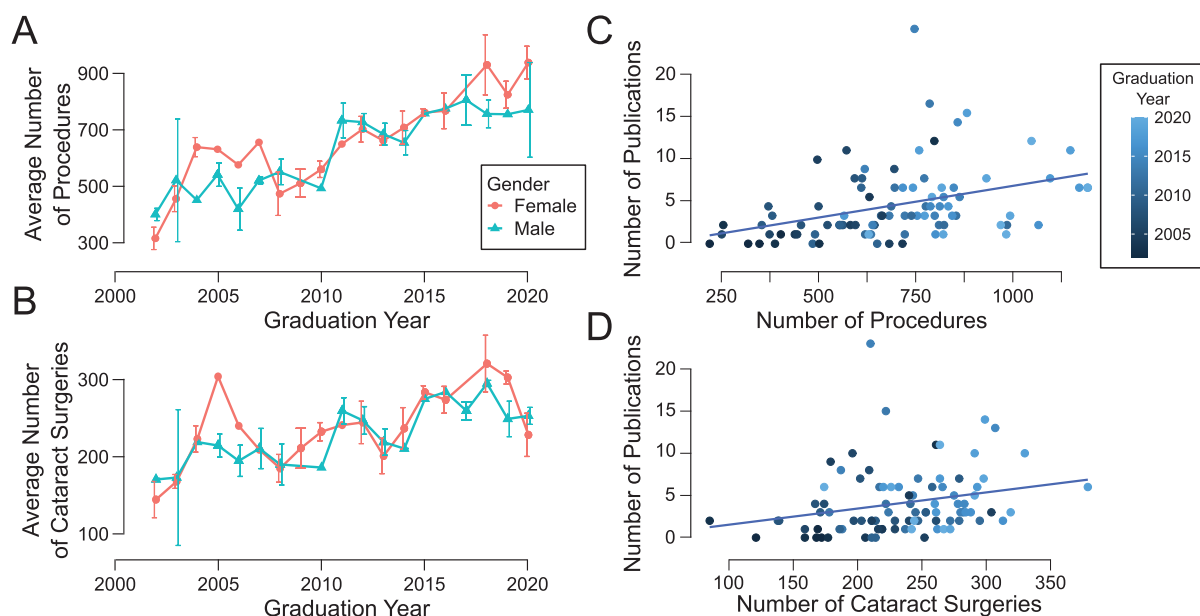
<sup>a</sup>Graduates from 2008 and onward when there is data for welcoming a child during residency.

In a linear regression model, the number of publications published from residency also significantly correlated with the number of procedures ( $p < 0.001$ ) and cataract surgeries ( $p = 0.02$ ), respectively (—Fig. 1C and D). Adjusting for graduation year attenuates this correlation ( $p = 0.04$  for procedures and  $p = 0.45$  for cataract surgeries). A multivariate analysis including PhD degree, gender, URM identity, welcoming a child, and graduation year showed that the only graduation year correlated with publication volume

( $p < 0.001$ ), where each subsequent year is associated with an additional 0.24 (0.09, 0.38) publications and 0.18 (0.08, 0.28) first author publications.

## Discussion

Our findings demonstrated that for the studied residency program, gender was not a significant predictor for cataract surgery and total procedural volume. This is in contrast to



**Fig. 1** Resident surgical and research productivity. Over time, number of procedures (A) and cataract surgeries (B) have increased. There was also not significant difference between procedural and surgical volume based on gender. Standard error bars, representing the standard error of the mean, are included when there was more than one resident of that gender. The total number of publications plotted against the number of total procedures (C) and cataract surgeries (D) are performed by residents. The points are shaded for the graduation year, and over time, residents have increased their research productivity as well as their surgical numbers.

national data that suggests women are likely to have performed fewer procedures than men.<sup>1,2</sup> However, the smaller sample size and the variability from an increasing number of procedures over time may be driving the large confidence intervals identified in this study, which suggests that one possible explanation for the differing results compared with previous studies is chance. Although we did not observe a difference, it is critical to continue to promote equitable distribution of surgeries as studies have noted that female ophthalmologists in practice perform fewer surgeries than their male counterparts.<sup>5,6</sup> Although these studies do not take into account surgeon practice preferences, it is possible that disparities during residency training may contribute in the imbalance of cases post-training. We also found that female residents had similar surgical numbers regardless of welcoming a child, similar to Gong et al.<sup>1</sup> This is crucial because in a recent survey, residency program directors perceived parental leave negatively, in particular for child-bearing parents.<sup>7</sup> Nevertheless, our results suggest that residents are able to maintain their surgical excellence regardless of child status.

We also found that residents were increasing their research productivity in concordance with increasing procedural volume. This finding demonstrates that increasing procedural numbers has not impacted research productivity. Factors that may contribute to this robust publication rate may include dedicated research time for residents during their second and third year of the residency program, and dedicated research time has been associated with increased research completion and satisfaction.<sup>8</sup>

This study is also notable for incorporating URM status into our data analysis model. While we did not observe a significant correlation between URM status and surgical volume, only 9.8% of the residents identified as URM, suggesting that our study may be under powered to make any meaningful conclusions regarding URM status. This, however, does highlight the need to diversify residency programs and to identify ways to recruit medical students identifying as URM into ophthalmology. Currently, individuals identifying as URM remain significantly underrepresented in ophthalmology,<sup>4</sup> and this underrepresentation has increased from 1990 to 2016.<sup>9</sup> In addition, there has not been an increase in URM applicants and matriculants in a variety of surgical subspecialties from 2010 to 2016.<sup>10</sup> Critical steps that can be taken require identifying possible systemic biases that begin even before residency training such as recognizing the implicit bias in the narrative language used in student evaluations.<sup>11</sup> Additionally, residency programs can work to identify what factors women and URM trainees desire from a program to create a better support system to recruit such students.<sup>12</sup>

Limitations of this study include this being a single institutional study. This resulted in a smaller sample size and our findings had wide confidence intervals, which limits our ability to make definitive conclusions and to generalize our findings at other programs. A single institution may also not clearly illustrate a disparity in surgical data given that there are minimum surgical requirements established by the

American Board of Ophthalmology for certification. Furthermore, we did not have leave of absence time for parental status, which we used as a proxy for leave status. Consequently, our interpretation could be skewed if residents who welcomed a child did not take time off following welcoming a child. Moreover, we used Web of Science to quantify publications, which may not have identified all published papers during residency.

In conclusion, a close examination of the available surgical data showed that residents have increased their surgical and research productivity. We did not identify disparities in surgical or research metrics by gender, URM status, or welcoming a child. Our smaller sample sizes regarding URM and parental status make it difficult to draw a definitive conclusion and warrant further investigation to determine how this trend may change over time and how it may differ at other institutions. Furthermore, the small number of URM residents continues to highlight the need to diversify residents and faculty to promote equity and to create a workforce that resembles the population it serves.

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#### Conflict of Interest

None declared.

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