

Socioeconomic Disparities in Research Participation: Bias in Plastic Surgery Residency Match

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Background: Integrated plastic surgery residency applicants have increased at a rate disproportionate to available positions. Research productivity has become a surrogate marker for competitiveness, and many applicants pursue it to distinguish themselves. To date, no study has investigated socioeconomic disparities in extended research experience (ERE) participation.

Methods: A 35-question cross-sectional survey was distributed to applicants to United States-based integrated plastic surgery residency programs during the 2019–2022 application cycles. Summary tables, student *t* test, and chi-square tests were used for statistical analysis.

Results: A total of 161 responses (response rate: 20.9%) were recorded. Fifty-nine (40.7%) respondents participated in an ERE. The most common reason for ERE participation was strengthening one's application. The most common reason against participation was avoiding delays in career progression. A greater percentage of respondents from Northeastern medical schools participated in EREs ($P = 0.019$). There were no significant differences in debt burden between those who did or did not participate in an ERE. A greater percentage of applicants whose parents had advanced degrees participated in EREs ($P = 0.053$).

Conclusions: There may be geographic and socioeconomic biases present in access to ERE for students interested in plastic surgery. The growing popularity of EREs may have unintended consequences for applicant diversity. As most plastic surgeons ultimately practice in nonacademic settings, applicants and plastic surgeons may consider the financial hardships and possible socioeconomic disparities in research opportunities before participating in or recommending them. (*Plast Reconstr Surg Glob Open* 2024; 12:e5565; doi: 10.1097/GOX.0000000000005565; Published online 2 February 2024.)

INTRODUCTION

Applications to integrated plastic surgery residencies have increased dramatically compared with the expansion in available positions.^{1–4} As a result,

applicants to integrated plastic surgery residency are consistently among the most competitive, often demonstrating the highest USMLE Step 1 and Step 2 CK scores as well as expansive research and volunteer experiences.^{4,5} With a 61% match rate,⁶ applicants are compelled to find opportunities that make them competitive. Research productivity has become an increasingly important measure of competitiveness with the average matched applicant reporting 28.4 abstracts, presentations, and publications in 2022.¹ To achieve this level of scholastic success, many applicants pursue an extended research experience (ERE): a research experience while not actively and concomitantly pursuing a medical degree. A recent study found that 25% of respondents participated in a research fellowship, 97% of whom matched, compared with an 81% match among respondents who did not complete an ERE.⁷ The counterpoint to pursuing an ERE is whether research development and achievement aligns with long-term career goals or the ERE serves mostly as a “resume booster.” Choosing to participate in an ERE comes with

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financial and professional sacrifices. In 2022, the average debt of graduating medical students was \$205,037.⁸ Participating in an ERE likely adds interest on loans and delays earning potential, and some participants support themselves out-of-pocket to participate. These aspects can deter applicants from more disadvantaged socioeconomic backgrounds. Zimmerman et al found that a majority of ERE applicants identified as White followed by Hispanic/Latino. American Indian/Alaskan Native and Black/African American applicants were the least reported.⁹ Selection bias in ERE candidates may exacerbate inequities of socioeconomic status and race seen within new trainees to plastic and reconstructive surgery. This study investigates how disparities in socioeconomic status among applicants to integrated plastic surgery residency influence participation in ERE.

MATERIALS AND METHODS

Under IRB exemption, we constructed a 35-question cross-sectional survey to assess applicant demographics, participation in and characteristics of an ERE—funding, relocation, satisfaction, research productivity—and integrated plastic surgery match outcomes. Demographics consisted of age, gender, race, ethnicity, and socioeconomic factors. Socioeconomic factors consisted of cumulative debt, debt before starting medical education, debt collected during medical education, and applicant and parents' greatest educational attainment. We defined an ERE as "a contiguous time period conducting research without concomitantly and actively pursuing a medical degree." For example, a third-year medical student takes a leave of absence after the conclusion of their third year to participate in a 12-month ERE at another medical institution. During this time, the student does not participate in any educational activities with their home institution that count toward graduation requirements.

We identified participants—US-based and international medical graduates—through emails for applicant from the 2019–2020, 2020–2021, and 2021–2022 application cycles to integrated plastic surgery residency programs at three medical institutions representing Northeast (private university-based), Midwest (public university-based), and West (public university-based). These institutions were selected because of geographic coverage, representative program characteristics (size, ranking, location), and faculty support. We cross-checked applicant email lists to eliminate duplicate entries. We then administered the survey via Qualtrics (Provo, Utah). All survey responses were anonymous. We emailed recruitment letters to applicants three times over two months. We removed invalid email addresses and respondents who requested to be removed from the study from the pool of potential participants. We used Association of American Medical Colleges (AAMC) Electronic Residency Application Service (ERAS) data for applicants to integrated plastic surgery residency from the corresponding application cycles to determine any sampling variance of the respondents.¹⁰ AAMC ERAS

Takeaways

Question: Plastic surgery applicants often participate in extended research experiences (ERE), which can come with financial hardships. How do socioeconomic factors affect ERE participation?

Findings: The most common reason to participate was strengthening one's application, and the most common reason against participation was avoiding career delays. There were geographic and socioeconomic disparities. Respondents whose parents held advanced degrees were more likely to participate than those with parents who had less formal education.

Meaning: There may be socioeconomic disparities present in ERE participation. Applicants and plastic surgeons involved in medical student education should be aware of this possible source of socioeconomic bias in the resident selection process.

data were selected as the benchmark, as all applicants to integrated plastic surgery residency must complete an ERAS application. We performed statistical analysis in IBM SPSS 26 (Philadelphia, Penn.). We compiled variables in summary tables and compared them using student *t* test or in crosstabs using Fisher exact test or Pearson chi-square test where applicable. We considered a *P* value less than 0.05 statistically significant. Our primary outcome was if any demographic or socioeconomic factors were associated with ERE participation or residency match success.

RESULTS

Demographics

Demographics are given in [Tables 1](#) and [2](#). We identified 861 subjects. Eighty-eight were removed for email nondelivery, and two requested removal from the study. We collected 161 (20.9% adjusted response rate) responses. Seventy-five respondents (46.6%) identified themselves as women. One hundred seven (66.5%) respondents identified as White, 17 (10.6%) as Black or African American, 20 (12.4%) as Asian, one (0.6%) as Alaska Native, and 14 (8.7%) as other. Eighteen (11.3%) identified as Hispanic or Latino. Compared with AAMC demographic data, there were differences in percentage of respondents identifying as White, Black, Asian, and other ($P = 0.01, 0.02, 0.02, \text{ and } 0.047$, respectively). There were a greater percentage of White respondents (study: 107, 67.3% versus AAMC: 583, 54.9%) and Black respondents (study: 17, 10.7% versus AAMC: 60, 5.7%), and a lower percentage of Asian respondents (study: 20, 12.6% versus AAMC: 212, 20.0%). There were also a greater percentage of respondents identifying as Hispanic/Latino (study: 18, 11.3% versus AAMC: 84, 7.8%). Respondents went to medical institutions in the southern United States (49, 30.8%), the Midwest (39, 24.5%), the Northeast (37, 23.3%), and the West (19, 11.9%). Neither gender nor race differed significantly between ERE participants and nonparticipants

Table 1. Respondent Demographics (n = 161) from an Online Survey Sent in 2023 to Previous Applicants from 2019 to 2022 of United States-based Integrated Plastic Surgery Residency Programs

Category		Total	ERE Participants	Non-ERE Participants	P
		n [%]	n [%]	n [%]	
Sex	Male	82 [50.9]	33 [47.1]	37 [52.9]	0.442
	Female	75 [46.6]	26 [36.6]	45 [63.4]	
Race	White	107 [66.5]	34 [36.6]	59 [63.4]	0.391
	Black or African American	17 [10.6]	8 [47.1]	9 [52.9]	
	Asian	20 [12.4]	9 [45.0]	11 [55.0]	
	Alaska Native	1 [0.6]	0 [0.0]	1 [100.0]	
	Other	14 [8.7]	8 [61.5]	5 [38.5]	
Ethnicity	Not Hispanic or Latino	141 [88.7]	54 [42.5]	73 [57.5]	0.302
	Hispanic or Latino	18 [11.3]	5 [29.4]	12 [70.6]	
Medical school region	Northeast	37 [23.3]	20 [58.8]	14 [41.2]	0.019
	Midwest	39 [24.5]	12 [31.6]	26 [68.4]	
	South	49 [30.8]	14 [30.4]	32 [69.6]	
	West	19 [11.9]	7 [38.9]	11 [61.1]	
Parents' highest educational attainment	High school diploma or GED	16 [11.0]	5 [31.3]	11 [68.8]	0.053
	Associate's degree	8 [5.5]	4 [50.0]	4 [50.0]	
	Bachelor's degree	34 [23.4]	10 [29.4]	24 [70.6]	
	Master's degree	30 [20.7]	9 [30.0]	21 [70.0]	
	Professional graduate	31 [21.4]	14 [45.2]	17 [54.8]	
	Doctorate	26 [17.9]	17 [65.4]	9 [34.6]	
Match outcomes	Matched	111 [78.2]	47 [85.5]	59 [73.8]	0.104

Table 2. A Comparison of Demographic Data between Survey Respondents (n = 161) and Applicants from 2019 to 2022 to United States-based Integrated Plastic Surgery Residency Programs as Reported by the AAMC (n = 1062)

Category		Total Respondents	AAMC Applicants	P
		n [%]	n [%]	
Sex	Male	82 [51.2]	592 [55.1]	0.497
	Female	75 [46.9]	482 [44.9]	
Race	White	107 [67.3]	583 [54.9]	0.006
	Black or African American	17 [10.7]	60 [5.7]	0.017
	Asian	20 [12.6]	212 [20.0]	0.023
	Alaska Native	1 [0.6]	7 [0.7]	1.000
	Other	14 [8.8]	52 [4.9]	0.047
Ethnicity	Not Hispanic or Latino	141 [88.7]	-	N/A
	Hispanic or Latino	18 [11.3]	84 [7.8]	

($P = 0.44$ and 0.39 , respectively). There was a significantly increased percentage of students from Northeast medical institutions (58.8%) who participated in EREs compared with other regions ($P = 0.02$).

Socioeconomic Factors

Socioeconomic factors are given in Table 1. A minority (31, 21.5%) of respondents held a master's degree. An even smaller minority (2, 1.4%) of respondents held a doctorate degree. For parents' greatest educational attainment, most respondents reported their parents earning bachelor's degree (34, 23.4%) followed closely by professional and master's degrees (professional: 31, 21.4%; master's: 30, 20.7%). Several reported a doctorate degree (26, 17.9%), and a minority reported a high school diploma or GED (16, 11.0%). When comparing parents' greatest educational attainment between ERE participants and nonparticipants, there was increased participation with parental advanced educational attainment ($P = 0.053$). The majority of respondents whose

parent(s) attained a doctorate degree participated in an ERE (17, 65.4%) compared with a minority of respondents whose parent(s) attained a bachelor's degree (10, 29.4%).

The majority of respondents (100, 83.4%) reported less than \$50,000 in debt before medical education. The majority (85, 77.3%) reported debt accrued during medical education of greater than \$100,000. Debt burden (cumulative, before medical education, or during medical education) did not vary between ERE participants and nonparticipants ($P = 0.73, 0.11, \text{ and } 0.98$, respectively) (Figs. 1–3).

Extended Research Experience Characteristics

See Table 3 for the ERE characteristics. Fifty-nine respondents (40.7%) participated in an ERE. Most respondents participated in an ERE between the third and fourth years of medical school (30, 52.6%). Forty respondents (70.2%) received funding. A majority participated in an ERE in the Northeast (23, 40.4%)

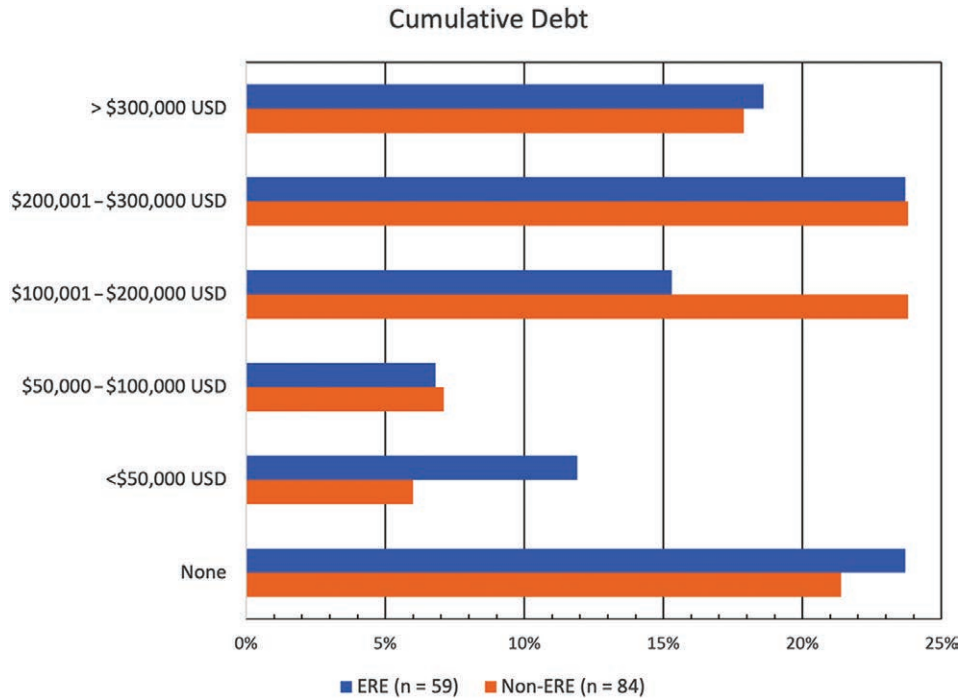


Fig. 1. Percentage of respondents with accrued cumulative debt (USD) at the time of submitting an integrated plastic surgery residency application stratified by participation in an extended research experience ($P = 0.73$).

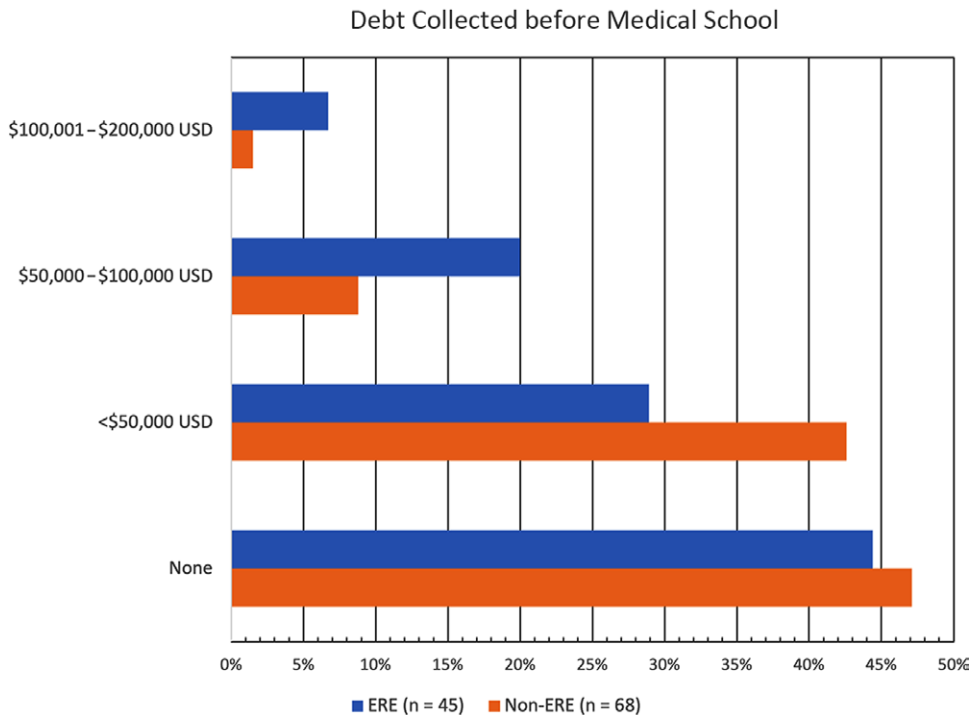


Fig. 2. Percentage of respondents with debt (USD) collected before medical school stratified by participation in an extended research experience ($P = 0.11$).

followed by the South (16, 28.1%) and the Midwest (9, 15.8%). The majority (50, 87.8%) reported being somewhat or extremely satisfied with their ERE. The

most frequently cited reason for participation was to strengthen their application for integrated plastic surgery residency (41, 69.5%). The second most frequently

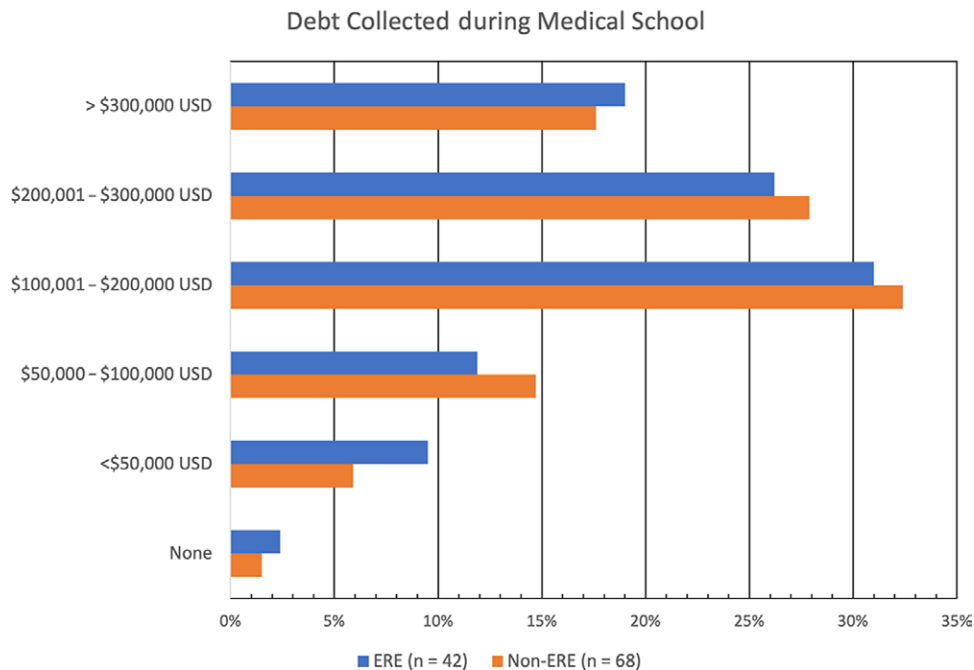


Fig. 3. Percentage of respondents with debt (USD) collected from the start of medical school until submitting an integrated plastic surgery residency application stratified by participation in an extended research experience ($P = 0.98$).

Table 3. Characteristics of Respondents’ ERE (n = 59) before Application to United States-based Integrated Plastic Surgery Residency

Category	n [%]	Median [IQR]
Participation	59 [40.7]	
Funding	40 [70.2]	
Relocation	29 [50.9]	
Duration (mo)		12 [12.0–18.0]
Timing of ERE	Before undergraduate medical education	9 [15.8]
	Between 3rd and 4th year of medical school	30 [52.6]
	Following medical school	11 [19.3]
Region of ERE	Northeast	23 [40.4]
	Midwest	9 [15.8]
	South	16 [28.1]
	West	6 [5.3]
Satisfaction	Somewhat to extremely satisfied	50 [87.8]
	Somewhat to extremely dissatisfied	5 [8.8]
Productivity	Published/accepted manuscripts	10 [5.0, 14.8]
	Submitted manuscripts	6 [3.5, 12.0]
	Oral presentations	5.5 [3.0, 10.0]

cited reason for participation was improving a research skillset (17, 28.8%) followed closely by studying a specific research interest (16, 27.1%). Of respondents who did not participate in an ERE, the most cited reasons against participating were the desire to avoid delays in career progression (30, 34.9%), followed by the lack of monetary support (27, 31.4%) (Figs. 4 and 5). For ERE participants, the median reported number of published and/or accepted manuscripts was 10 [IQR (5–14.75)]. The median number of submitted manuscripts was 6 [IQR (3.5–12.0)]. The median number of oral presentations was 5.5 [IQR (3–10)].

Match Outcomes

One-hundred eleven respondents (78.2%) matched into an integrated plastic surgery residency program. Match rates for respondents who participated in an ERE (47, 85.5%) were not significantly different than those who did not participate in an ERE (59, 73.8%, $P = 0.10$). Women matched at a greater rate than men (58, 84.1% compared with 53, 75.7%, $P = 0.03$). Hispanic or Latino applicants matched at a lower rate compared non-Hispanic applicants (8, 57.1% compared with 103, 81.7%, $P = 0.03$). Black applicants matched at a lower rate (11, 64.7%) compared with their Asian (16, 88.9%) and White

Reason for Extended Research Experience Participation (n = 59)

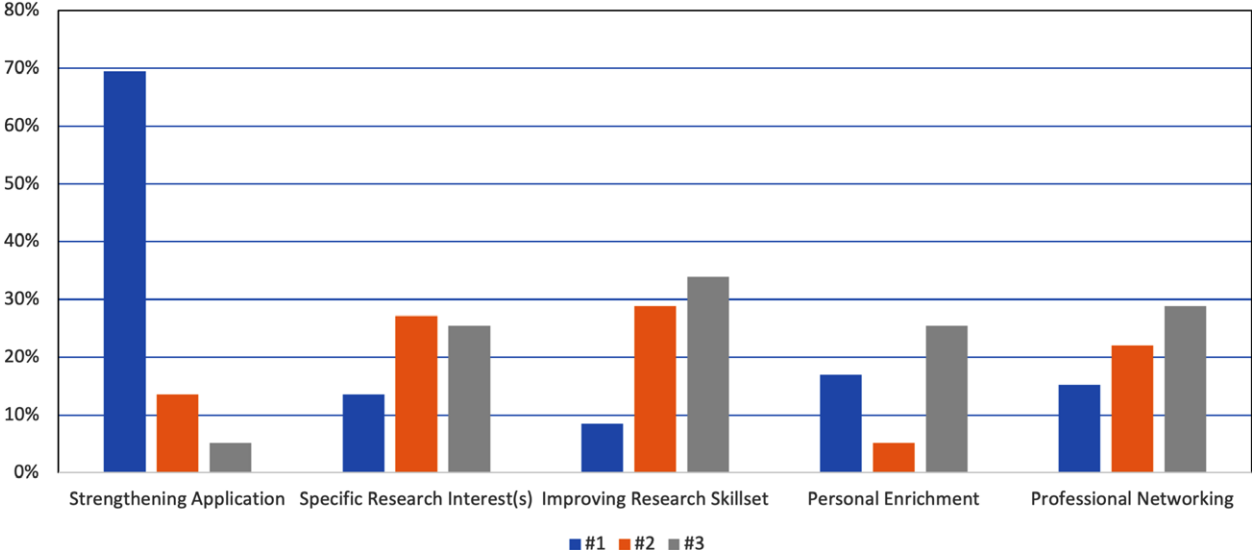


Fig. 4. Percentage of respondents' first, second, and third most-important reasons for participating in an extended research experience.

Reason Against Extended Research Experience Participation (n = 86)

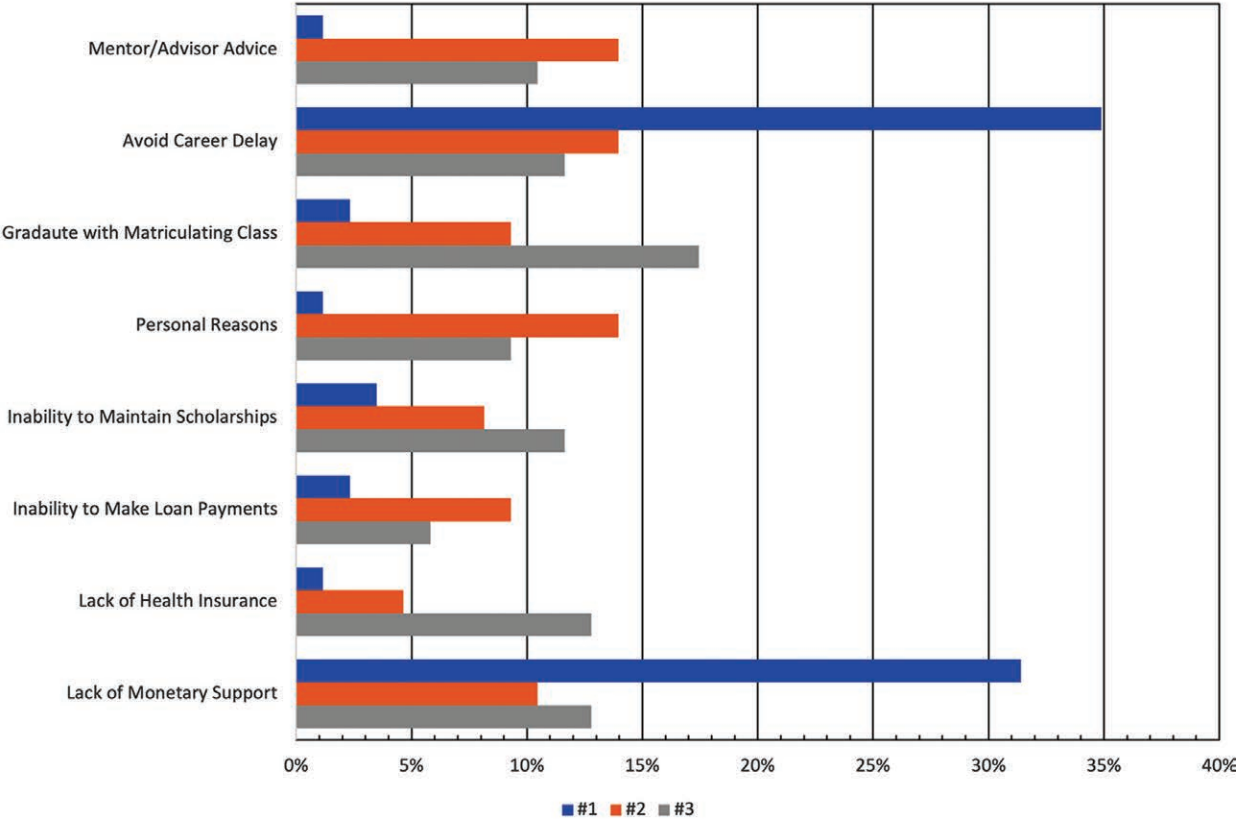


Fig. 5. Percentage of respondents' first, second, and third most-important reasons against participating in an extended research experience.

(73, 79.3%) counterparts, but this difference was not statistically significant ($P = 0.33$).

DISCUSSION

Integrated plastic surgery residency applicants are among the most competitive of all specialties, leading to scrutiny of objective and subjective markers for success.^{4,5} Applicants pursue opportunities that improve their match success, such as EREs. These experiences are fruitful opportunities for applicants to strengthen their application¹¹; however, EREs are not universally beneficial. Patel et al demonstrated no difference in match rate between plastic surgery re-applicants participating in an ERE compared with re-applicants participating in a preliminary surgery year.¹² Nevertheless, it is important that ERE access is open to all talented applicants regardless of race or socioeconomic background. This study is the first to report on socioeconomic differences in applicants who did or did not participate in EREs. We surveyed applicants to three United States-based integrated plastic surgery residency programs from 2019 to 2022. Our findings suggest there are a greater representation of students from Northeastern medical schools and applicants whose parent(s) earned more advanced degrees. A greater proportion of respondents whose parents achieved a professional or graduate/doctorate degree participated in EREs compared with respondents whose parents achieved a bachelor's degree or high school diploma/GED-equivalent. As plastic surgery training programs strive for a diverse and inclusive trainee population, it is important to consider how the emphasis on research productivity, the resultant growth of EREs, and the possible socioeconomic bias in ERE participation may negatively impact the recruitment of a diverse workforce of future plastic surgeons.

Robust research productivity is a current component of success in the integrated plastic surgery residency match. Now that United States Medical Licensing Examination (USMLE) Step 1 is scored as pass/fail, other factors such as Step 2 CK, scholastic productivity, applicants' medical school,¹³ reputation¹⁴ and location,¹⁵ program's familiarity with the applicant,¹⁶ and Alpha Omega Alpha status¹⁴ are more important factors in the application⁵ process. Studies highlight the importance of research publications to match into integrated plastic surgery residency,¹⁷⁻¹⁹ so many applicants are participating in EREs. For applicants who have lower rates of match—applicants without a home program,²⁰ DO graduates,¹ and international medical graduates^{1,21,22}—an ERE may be crucial. We demonstrated the most common reason for participating in an ERE was to strengthen the respondent's application.²³ Mehta et al found that applicants who had participated in an ERE matched at a greater rate than nonparticipants (97% compared with 81%).⁷ Currently, EREs are an increasingly popular tool to match in plastic surgery, and they will continue to be utilized as the plastic surgery match further emphasizes research productivity.

However, access to EREs may be a source of bias in the match process. Our findings indicate there may be geographic biases, with a greater proportion of students

from Northeastern medical schools ($P = 0.019$) participating in EREs. This finding could be due to geographic familiarity with applicants from Northeastern schools.^{24,25} Additionally, applicants whose parent(s) have more advanced degrees were more likely to participate in EREs compared with applicants whose parent(s) have less formal education. Parents' greatest educational attainment is a validated proxy for a person's socioeconomic status.²⁶⁻²⁹ Thus, there may be a positive bias toward applicants of higher socioeconomic status. This possible bias appears to extend beyond the integrated plastic surgery application process. Reghunathan et al discovered that all surgical residents at a public state-funded institution had a higher average childhood household income compared with nonsurgical residents.³⁰ Awad et al. investigated how neurosurgical research grants were awarded primarily to men (77.3% versus 22.7% women) resulting in a biased increase in neurosurgery match rates for men (58% match rate for male recipients versus 32% for female recipients).³¹ This bias has been reported in other countries as well. Rodriguez Santana describes how surgeons in the United Kingdom's NHS are more likely to be men, of British origin, and socioeconomically privileged compared with general practitioners.³² Kumwenda et al describe how UK medical students from less affluent backgrounds may opt out of medical electives abroad or research opportunities. These disadvantages can continue onward toward specialty selection and placement in coveted positions within NHS.³³ In the face of suspected demographic and socioeconomic biases in surgical residency selection, plastic surgeons can help build a more socially-diverse trainee population. Plastic surgeon diversity is positively associated with patient satisfaction.³⁴⁻³⁶ Unfortunately, the demographics of integrated plastic surgery residents are less diverse than the applicant pool.³⁷ To address this critical issue, plastic surgery must understand how diversity becomes restricted in the training/education pipeline. Academic plastic surgeons who interact with applicants can help promote equitable access to experiences that currently increase match success, such as subinternships, research fellowships, and mentorship.

Research productivity and EREs are associated with increased match rates in integrated plastic surgery residency, but it is important to discuss if the current emphasis on research is warranted. Since at least 2011, the mean number of abstracts, presentations, and publications for US allopathic medical graduates matching into integrated plastic surgery residency has increased year over year from 8.1 in 2011 to a staggering 28.4 in 2022.^{1,2,38-41} Despite this explosion in research productivity, the proportion of graduates entering academic plastic surgery, where scientific achievement is critical to promotion and/or compensation, remains steadily low. Mandel reports that 90% of graduates enter into private practice.⁴² Given that so few graduates enter academic practice, why is research productivity associated with increased match rates? It may be that research can be quantified and used to rank applicants similar to the USMLE Step 1 score. However, studies indicate that Step 1 scores have weak to no correlation with residency performance.⁴³⁻⁴⁵ Even research productivity

before residency has not been associated with sustained scholastic success as a junior academic plastic surgeon.⁴⁶ As academic research is unlikely to align with the majority of applicants' career goals, then ERE participation with the associated financial, professional, and personal sacrifices is difficult to justify for most applicants. In the face of possible socioeconomic bias in ERE participant selection, it is even more difficult to recommend ERE participation except for the rare applicant with a strong academic trajectory. There are innovative programs, such as PREPPED through the American Council of Academic Plastic Surgeons, aimed at addressing these socioeconomic, racial, and ethnic disparities in the plastic surgery match process.⁴⁷ Furthermore, implementation of equity-focused tools like holistic review^{48,49} in the residency application process will actively promote diverse and inclusive recruitment. For the select, motivated plastic surgery applicants who are pursuing an academic career, EREs remain an exceptional way to develop a research skillset and pursue a topic of interest. However, promoting research and ERE participation must be cautiously weighed in the setting of financial hardships to applicants, the socioeconomic diversity bias, and the lack of alignment with career trajectory.

There are several limitations in this study that should be discussed. First, recall bias may have influenced our results, as respondents were asked to recall certain aspects of their application that occurred up to three years ago. However, it is unlikely that our results would be dramatically different, as the inaccuracies are likely to be small. Second, it is possible that not all applicants to United States-based integrated plastic surgery residency programs from 2019 to 2022 were captured as possible respondents. We attempted to address this through a multi-institutional study of three programs representing three different geographic regions. However, not all possible applicants may have applied to one of three geographically-diverse programs. Additionally, the sample population may introduce sampling bias that have not been accounted for. Third, our selected socioeconomic proxies may not be an accurate representation of a respondent's socioeconomic status. Debt⁵⁰ and parental greatest academic achievement^{26–29} are two well-proven proxies for socioeconomic status. Additionally, multiple proxies are better able to distinguish between socioeconomic groups.⁵¹ Though we could have selected more than two socioeconomic status proxies, increasing survey length would likely have a detrimental effect on response rate.^{52,53} Lastly, our response rate (20.9%) may not accurately represent a cross-section of the larger applicant pool. Compared with Association of American Medical Colleges (AAMC) demographic data from the same application cycles, our cohort consisted of a greater percentage of White respondents. However, our cohort also consisted of a greater percentage of Black and Hispanic/Latino respondents as well as a lower rate of Asian respondents compared with AAMC data.^{10,54,55} Our cohort may over-represent generally under-represented minorities within plastic surgery. While our results may not reflect the opinions of the applicant pool as a whole, our results may more likely reflect the thoughts and experiences of under-represented minorities within plastic surgery.

CONCLUSIONS

Integrated plastic surgery residency is an increasingly competitive match where candidates are participating in EREs at greater rates to distinguish their application. EREs may improve match success, but there is a possible bias towards ERE participation in applicants whose parents have higher educational achievement, a marker of higher socioeconomic status. This study contributes awareness to a possible bias: disproportionate selection of applicants from a higher socioeconomic status for coveted EREs. The majority of plastic surgeons ultimately practice outside of academic institutions where research productivity is a priority. Thus, applicants may consider if scientific achievement aligns with their career goals before pursuing an ERE. Lastly, plastic surgeons interacting with and mentoring applicants can help ensure equitable access to all career-advancing opportunities such as research experiences.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

ETHICAL APPROVAL

Ethical approval has been waived for this study, #2022E0573, involving human subjects by the Office of Responsible Research Practices of the Ohio State University.

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