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AOA Critical Issues in Education

Where Do Orthopaedic Surgery Applicants Match on Their Rank Lists? A Survey of Incoming Residents

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Background: The National Resident Matching Program reports match results by rank list position for all specialties in aggregate, but these data have not been previously reported for orthopaedic surgery specifically. The purpose of this study was to determine where orthopaedic applicants match on their rank lists in comparison to the national average for all specialties and to evaluate which factors may influence match results.

Methods: This was a cross-sectional survey study distributed to all applicants to a single institution's orthopaedic surgery residency program. Metrics such as match result, USMLE scores, Alpha Omega Alpha (AOA) status, and research productivity, in addition to other applicant-specific traits were captured. Results were stratified by match status and rank list position, with subgroup analyses completed for applicants matching at highly ranked programs (1-3) vs. lower ranked programs (≥ 4).

Results: The survey was distributed to 698 applicants with a response rate of 32% (n = 224), with a match rate of 85% (n = 191). Thirty-four percent of respondents matched at their top choice program, 15.2% at their second choice, 9.9% at their third, and 40.8% at their fourth or lower. When comparing the matched to unmatched applicant cohorts, there was a significant difference in number of programs ranked, AOA status, and sex. When comparing applicants who matched at highly ranked (1-3) vs. lower ranked (≥ 4) programs, there was a significant difference in USMLE board scores.

Conclusions: Orthopaedic surgery residency applicants are significantly less likely to match at their first choice or within their top 3 choices when compared to the national average for all specialties. Number of contiguous ranks, AOA status, and female sex were found to be associated with successfully obtaining an orthopaedic residency position, whereas USMLE board scores were associated with matching higher on one's rank list, thus resulting in greater match satisfaction.

Level of Evidence: III.

Introduction

Orthopaedic surgery is historically one of the most competitive specialties for medical students to obtain a residency position in, and it continues to get more selective each year[1]. In 2021, 92.8% of US allopathic medical school (MD) seniors matched to postgraduate year 1 (PGY-1) positions across all specialties, which fell within the historical overall match rate of 92% to 95%[2]. In comparison, the 2021 match rate

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for orthopaedic surgery among this same cohort was only 78.3%. The surplus of applicants per available orthopaedic residency spots in the United States has continually driven the competitiveness of the field upward, with 1.34 applicants per available position in 2021[2]. The average orthopaedic surgery applicant has US Medical Licensing Examination (USMLE) board scores, medical school grades, and research productivity that are markedly higher than those of the average matched applicant for all specialties as a whole[3,4]. Although the metrics for orthopaedic surgery applicants vary from the norm, it is unknown whether orthopaedic applicants match in similar positions on their rank lists relative to the national average for all specialties. In 2021, 46.4% of matched US allopathic medical school seniors matched at their first-choice residency program, whereas 15.7% matched at their second choice, 10.2% at their third, and 27.7% at their fourth or further[2].

It is theorized that orthopaedic surgery applicants may attempt to extrapolate match information from the average data reported for all specialties; however, it is unknown whether orthopaedics significantly differs from the average in this regard. Thus, there may be utility in reporting these match data for orthopaedic surgery, specifically including both where orthopaedic surgery applicants match on their rank lists and which factors may influence how applicants match.

The purpose of this study was therefore to determine where orthopaedic applicants match on their rank lists in comparison to the national average for all specialties. In addition, this study aimed to examine any existing correlations between match results and USMLE board scores, research productivity, Alpha Omega Alpha (AOA) status, and other applicant-specific characteristics such as sex and ethnicity. Given the competitive nature of the field, it was hypothesized that significantly fewer orthopaedic surgery applicants would match at one of their top 3 ranked programs compared with the national data for all specialties.

Methods

This was a cross-sectional survey of orthopaedic surgery residency applicants. All applicants to a single institution's orthopaedic surgery residency program in the 2021 to 2022 application cycle were surveyed in accordance with guidelines set forth by the National Resident Matching Program (NRMP). All applicant emails were acquired from the Electronic Residency Application Service. An anonymous survey was created with the intention of capturing the information as outlined in the supplemental appendix, http://links.lww.com/JBJSOA/A452. The supplemental appendix includes the entire survey as it was sent out to participants. Residency match results were released on March 18, 2022. To minimize respondent bias, the survey was distributed through email to all applicants on March 23, 2022. An email reminder was sent to applicants who had not yet completed the survey 1 week after the initial email. The survey was closed on April 8, 2022, and no further responses were collected.

Survey responses were collected using Research Electronic Data Capture and analyzed using R Statistical Software (R Core Team, 2017). Continuous data were reported as mean and SD, and categorical data were reported as percent of total group. Categorical Likert style response data were assigned numerical values (from 1 to 10) and reported as averages. The student t test and χ^2 test were used for statistical analysis of continuous and categorical variables, respectively. Separate bivariate analyses were performed to compare study measures by board scores, AOA status, research items, sex, and ethnicity for applicants who matched at highly ranked programs (ranks 1-3) vs. lower ranked programs (≥ 4). Significance was established at a p value of < 0.05.

Results

The survey was distributed to a total of 698 applicant email addresses. Two hundred twenty-four applicants (32.1%) completed the survey. Of these, 191 (85.3%) obtained a residency position in orthopaedics and 33 (14.7%) went unmatched. Of the 191 matched orthopaedic surgery applicants, 34% (n = 65) matched at their top choice program, 15.2% (n = 29) matched at their second choice, 9.9% (n = 19) at their third, and 40.8% (n = 78) at their fourth or lower. Figures 1 and Figures 2 depict match position results for orthopaedic surgery applicants and for applicants to all specialties, respectively. The percentage of orthopaedic surgery applicants who matched at their first choice is significantly different than the value for all specialties reported by the NRMP, which is 46.4% (8,553/18,435) ($p < 0.001$). A significantly greater proportion of orthopaedic surgery applicants also match at their fourth or further rank, falling out of their top 3 choices, relative to the data reported by the NRMP for all specialties ($p < 0.001$) (Table I).

Applicants who responded to the survey were a mean of 27.6 ± 2.4 years old, with 69.6% (n = 156) identifying as male and 28.6% (n = 65) identifying as female. 0.4% (n = 1) chose not to report their sex, and 0.9% (n = 2) reported their sex as other (Fig. 3). Sixty-one percent (n = 137) of respondents identified as White, 6% (n = 13) as Hispanic, 7% (n = 16) as African American, 15% (n = 34) as Asian, 5% (n = 11) as other, and 6% (n = 13) chose not to report their ethnicity (Fig. 4). The geographic distribution of responding applicants was 38.8%

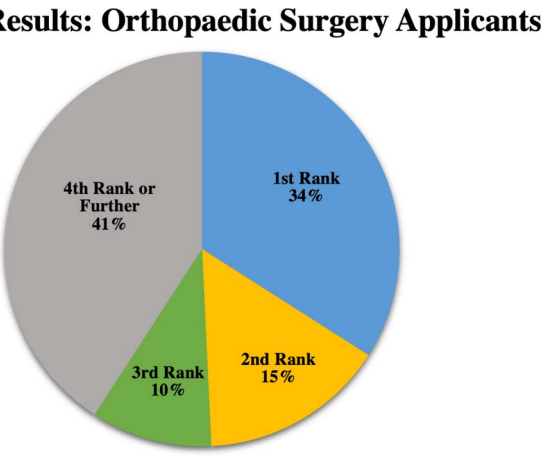


Fig. 1
Match results of orthopaedic surgery applicants by rank list position.

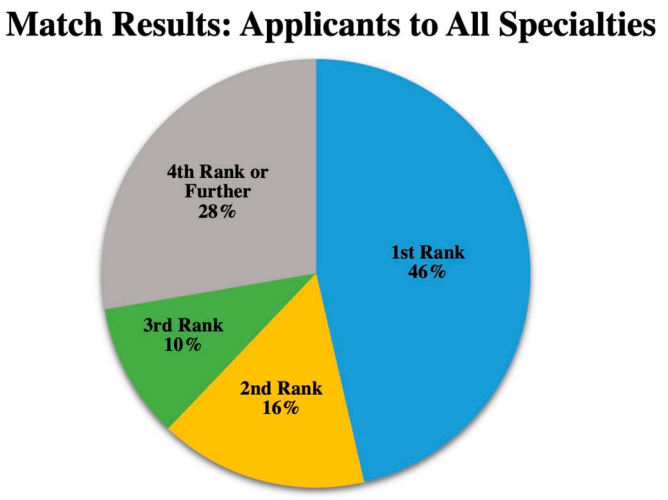


Fig. 2
Match results of applicants to all specialties by rank list position.

(n = 87) Northeast, 24.1% (n = 54) Southeast, 27.2% (n = 61) Midwest, 1.8% (n = 4) Northwest, and 8.0% (n = 18) Southwest (Fig. 5). There was found to be a significant difference in the proportion of female applicants between matched (32% women, n = 61) and unmatched (9% women, n = 3) groups (p = 0.013). There were no significant differences found based on age, ethnicity, or geographic region between matched and unmatched applicants or those matched to high ranks vs. low ranks.

The mean number of programs applied to per applicant was 108.5 ± 31. The mean number of interviews was 12.3 ± 9.4, with the mean number of program ranks being 11.9 ± 6.1. The mean USMLE Step 1 and 2 scores of all applicants were 243.5 ± 21.6. and 254.2 ± 21.1, respectively. The mean number of individual research items listed per applicant was 14.6 ± 13.1. Of all respondents, 21.5% reported taking at least 1 year off during medical school for dedicated research. 34.4% of applicants were members of AOA honor society (Table II).

When comparing matched vs. unmatched applicants, matched applicants had a significantly greater number of programs ranked (12.9 ± 5.9) relative to those who went unmatched (5.9 ± 3.1) (p < 0.001). In addition, a greater proportion of matched applicants were AOA members (39.8%) relative to those who went unmatched (9.1%) (p = 0.002) (Table III). There was a significant difference in USMLE Step 1 (246.8 ± 11.9 vs. 240.4 ± 17.1) and Step 2 scores (256.5 ± 9.6 vs. 252.5 ± 15.1), as well as satisfaction with match results (9.4 ± 1.2 vs. 5.8 ± 2.6) in favor of applicants matching at one of their top 3 choices (p < 0.001) (Table III). There was found to be no significant differences in applicant age, ethnicity, number of research items, reapplicant status, or dedicated research year between matched and unmatched applicants, or those matched to high ranks vs. low ranks.

TABLE I Rank List Match Positions of Matched Orthopaedic Surgery Applicants vs. Applicants for All Specialties

Rank List Match Position	NRMP All Specialties (n = 16,058)	Orthopaedic Surgery (n = 191)
1st	46.4%	34.0%*
2nd	15.7%	15.2%
3rd	10.2%	9.9%
>4th	27.7%	40.8%*

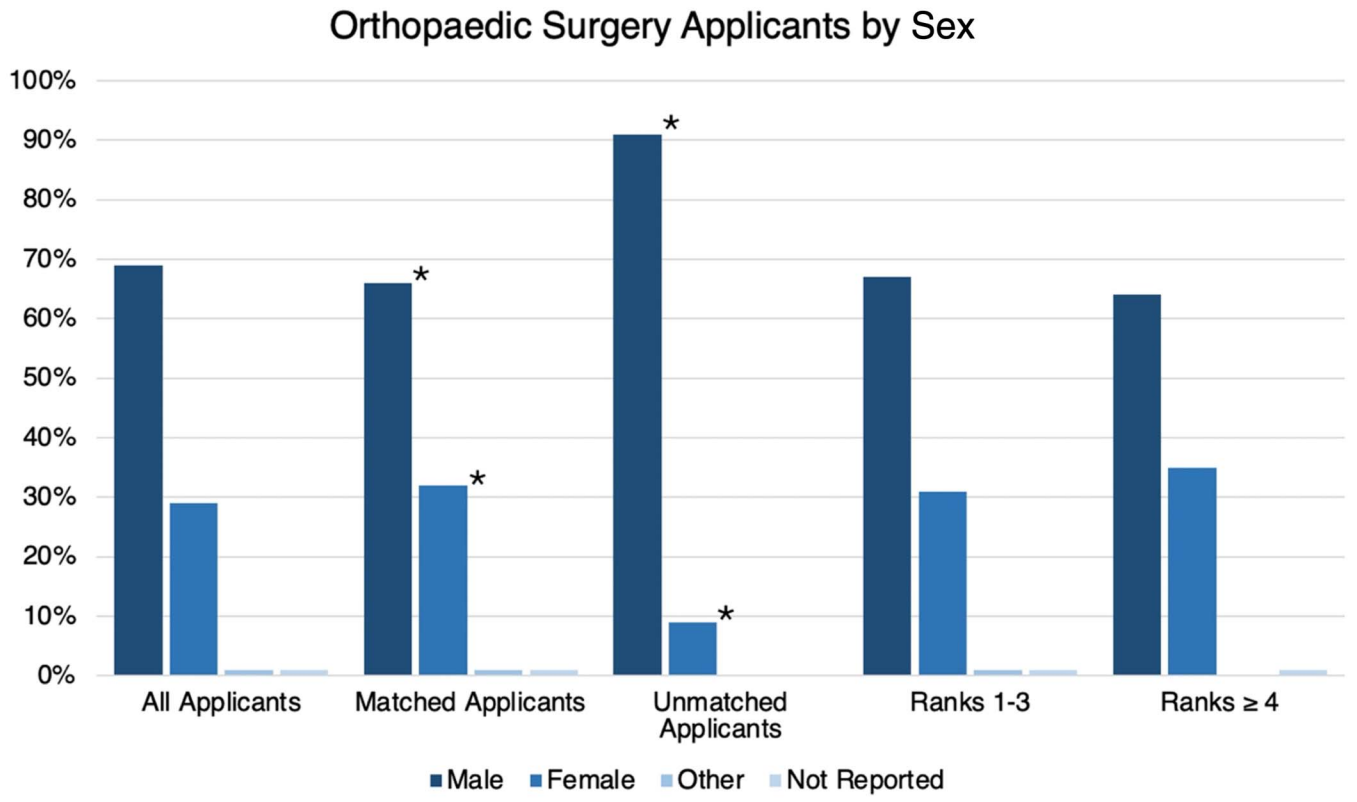
*Indicates p < 0.05 between all applicants and orthopaedic surgery applicants.

Discussion

Orthopaedic surgery has consistently been one of the most competitive specialties to obtain a residency position in, and there has been much speculation regarding how orthopaedic applicants fare in the match relative to all other specialties. This survey study found that not only do applicants match into orthopaedic surgery at a lower rate but also the percentage of orthopaedic surgery applicants matching at their top choice programs is lower than the national average for all specialties, and there are differences in the applications between those who match at higher or lower ranked programs.

Thirty-four percent of matched orthopaedic surgery applicants matched at their first choice in this study, and 59.2% matched within their top 3 choices. These values differed significantly from the national average for all specialties reported by the NRMP, where the values are 46.4% and 72.3%, respectively. Ophthalmology, another competitive surgical subspecialty, has demonstrated that their average matched applicant has board scores, grades, and research output greater than those of the average matched applicant in all specialties[3,5]. As ophthalmology uses the San Francisco Match rather than the NRMP, the match rates by rank list position have been reported annually for this subspecialty. In 2021, 38% of applicants matched at their first-choice program, whereas 19% matched at their second choice, 10% at their third, 33% at their fourth or further[5]. Similarly to orthopaedics, this subspecialty also deviates from the NRMP data reported for all applicants; however, a greater proportion of ophthalmology applicants still match at highly ranked programs on their rank list (67% match in their top 3) compared with the orthopaedic applicants in this study.

In 2020, the average orthopaedic surgery residency program received 603 applications, with an average of 4 offered PGY-1 positions. Therefore, 150.8 applications were received per individual spot[6]. In 2021, there were 868 available PGY-1 orthopaedic surgery residency spots, with a total of 1,163 applicants, equating to 1.34 applicants per spot[2]. The excess of applicants per spot is presumably the driving force behind the competitive nature of matching into an orthopaedic surgery residency. The surplus of highly qualified applicants may be one of the underlying reasons for orthopaedic applicants to fall further down their rank list than the average for all specialties.



*Indicates $p < 0.05$ between proportion of male and female applicants in matched versus unmatched groups

Fig. 3

Summary of orthopaedic surgery residency applicant results by sex.

Among the study participants, when comparing matched with unmatched applicants, there was found to be a significant difference in number of programs ranked (12.9 matched and 5.9 unmatched), despite having applied to a similar number of programs, which was approximately 110. Thus, applicants should maximize the number of programs they are able to rank to optimize their match chances, which may be achieved by constructing a strong, well-rounded application. The data also showed that while 39.8% of matched applicants were members of AOA, only 9.8% of those who went unmatched held this same distinction. This study cohort falls in line with the national average of percentage of applicants with AOA status matching into an orthopaedic surgery residency at 40.3%[3]. The criteria for nomination to AOA as a medical student varies at the university level; however, it typically necessitates exceptional clinical grades and USMLE board scores, research productivity, and involvement in leadership positions. Thus, AOA status is likely a reflection of a well-rounded and competitive application. An NRMP survey of orthopaedic surgery residency program directors (PDs) found that AOA status plays a highly important role in inviting applicants for interviews and in the applicant ranking process[6]. However, it should be noted that not all medical schools designate AOA to their high-performing students, and this may potentially be detrimental to those students at schools that do not offer AOA distinction.

In addition to AOA status, it has been reported that orthopaedic survey PDs place great emphasis on USMLE board scores when interviewing and ranking applicants, which is consistent with the results of the current study. When comparing applicants who matched at highly ranked programs (1-3) vs. those who matched at lower ranked programs (≥4), there was found to be a significant difference in USMLE Step 1 and 2 scores in favor of those with higher scores matching higher on their list. However, with USMLE Step 1 scores becoming binary (pass/fail), more emphasis may be placed on additional factors in the coming years.

It should be noted that there was a significant difference in match result satisfaction on a ten-point scale between those who matched at highly ranked vs. lower ranked programs (9.4 for ranks 1-3 and 5.8 for ranks ≥4), which would seemingly be expected.

A significant difference in the proportion of women in the matched (32% women) and unmatched cohorts (9% women) was found. Female applicants may be less likely to go unmatched when compared to their male counterparts. The

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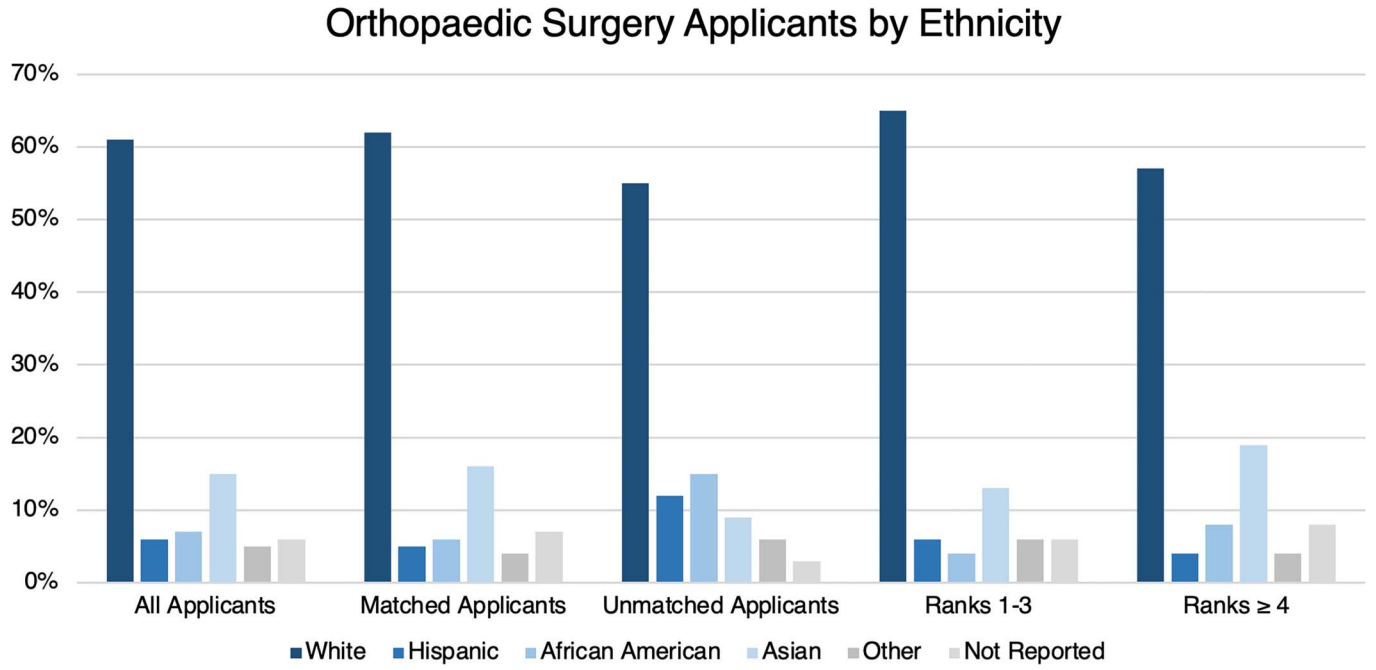

Fig. 4
Summary of orthopaedic surgery residency applicant results by ethnicity.

NRMP does not report application information or match results by sex; however, previous survey-based studies or orthopaedic applicants have found a similar proportion of female orthopaedic applicants to the proportion in this study. Tawfik et al., in a 2021 survey study of orthopaedic applicant perspectives during the COVID-19 pandemic, reported that 30% of orthopaedic applicants identified as female, which was similar to the data in the current study's 29% female respondents[7]. Given the

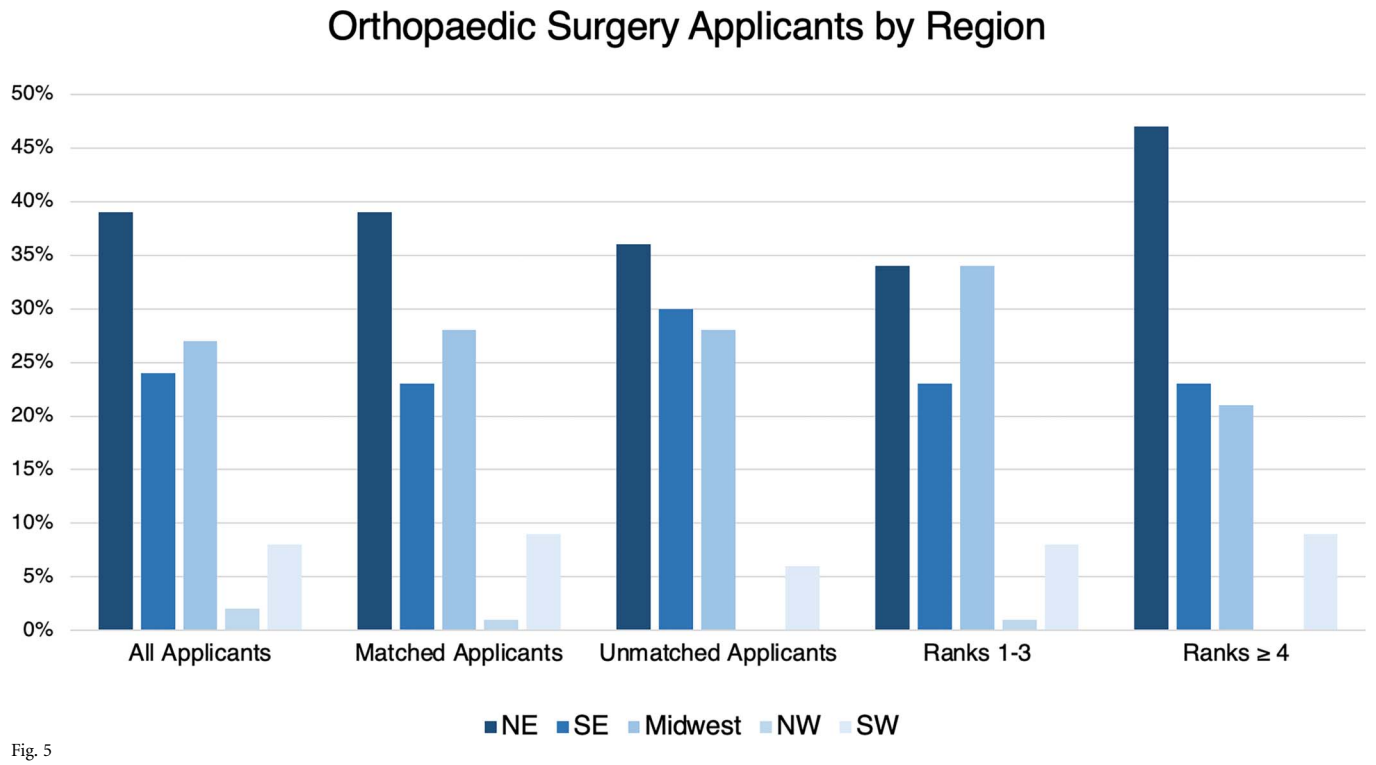

Fig. 5
Summary of orthopaedic surgery residency applicant results by geographic region.

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TABLE II Comparison of Metrics between Matched Applicants in Orthopaedic Surgery vs. All Specialties*

	NRMP Data: Matched Applicants in All Specialties (n = 16,058)†	NRMP Data: Orthopaedic Surgery Matched Applicants (n = 645)†	Study Cohort: Orthopaedic Surgery Matched Applicants (n = 191)
Mean USMLE step 1 score (SD)	234	248	244.2 (22.8)
Mean USMLE step 2 score (SD)	247	255	254.9 (22.2)
Mean no. research items (SD)	6.9	14.3	15.2 (13.3)
AOA membership	16.7%	40.3%	39.8%
Mean no. of programs Ranked (SD)	12.5	12.3	12.9 (5.9)
Mean no. of Applications (SD)	33	77	107.3 (31.3)

*SD not reported for NRMP data. †Data from NRMP charting outcomes in the Match 2020. ‡Data from NRMP 2021 applicant survey 2021.

historical lack of sexual diversity in the field of orthopaedics, there has been an emphasis on improving diversity and attracting qualified female applicants in recent years, which may explain this finding related to match rates. Orthopaedic surgery has also historically been a field which is predominantly White, as was reflected in the current study[8]. Sixty-one percent of respondents identified as White, while 6% identified as Hispanic and 7% as African American. Continued diversity initiatives are required to improve the racial/ethnic disparities in orthopaedics. In this study, there was no significant difference in the proportion of minority applicants in matched (11%, 21/191) or unmatched (27.3%, 9/33) groups; however, this may have become a significant finding with a larger sample size. Conclusions regarding the impact of sex and ethnicity on match rates among orthopaedic applicants should however be drawn with caution given the limited sample size. A larger study of all orthopaedic applicants nationwide may reveal differences that did not reach significance in this study.

This study was not without limitations. The data were self-reported through anonymous survey, and there would be no way to feasibly determine the accuracy of the applicant responses. In addition, the study participants were limited to those who applied to a single orthopaedic surgery residency program, and this may not be representative of the applicant pool as a whole. In this study, the highest percentage of applicants came from the Northeast, followed by the Southeast. The region of the institution whose applicants were surveyed may be relevant in sex and diversity metrics, as some parts of the country may be more intentional about efforts to diversify the field. In addition, the survey yielded a suboptimal response rate (32%). However, it should be noted that this is on par with previous survey-based studies of orthopaedic surgery residency applicants[7,9]. The metrics of the study cohort (USMLE scores or AOA status) are similar to those reported by the NRMP and the study match rate of 85.3% is not significantly different than the NRMP match rate of 78.3%, indicating that this is more likely a representative

TABLE III Metrics of Orthopaedic Surgery Residency Applicants by Match Status and Results

	All Orthopaedic Applicants (n = 224)	Orthopaedic Applicants Matched at Ranks 1-3 (n = 113)	Orthopaedic Applicants Matched at Ranks ≥4 (n = 78)	Orthopaedic Applicants Matched (n = 191)	Orthopaedic Applicants Unmatched (n = 33)
Mean no. of applications (SD)	108.5 (31)	108.2 (32.1)	105.9 (30.4)	107.3 (31.3)	115.4 (28.5)
Mean no. of programs ranked (SD)	11.9 (6.1)	12.5 (5.9)	13.7 (5.8)	12.9 (5.9)†	5.9 (3.1)†
Mean USMLE step 1 score (SD)	243.5 (21.6)	246.8 (11.9)*	240.4 (17.1)*	244.2 (22.8)	239.7 (12.6)
Mean USMLE step 2 score (SD)	254.3 (21.1)	256.5 (9.6)*	252.5 (15.1)*	254.9 (22.2)	250.4 (12.7)
Mean no. research items (SD)	14.6 (13.1)	15.4 (13.2)	14.9 (13.3)	15.2 (13.3)	11 (11.3)
Satisfaction with match result	6.9 (3.4)	9.4 (1.2)*	5.8 (2.6)*	7.9 (2.6)†	1.1 (0.5)†
Mean age (SD)	27.7 (2.4)	27.5 (2.1)	27.8 (2.6)	27.6 (2.3)	28.1 (2.6)
First time applicant	84.3%	84.1%	84.6%	84.3%	84.8%
Dedicated research yr	21.4%	22.1%	24.3%	23%	12.1%
AOA membership	34.3%	41.6%	34.6%	39.8%†	9.1%†

*Indicates $p < 0.05$ between applicants matched at ranks 1 to 3 vs. ≥ 4. †Indicates $p < 0.05$ between matched and unmatched applicants.

cohort. Finally, the study only explored specific applicant traits and was unable to quantify more subjective aspects such as residency interview performance and interpersonal skills, which have been demonstrated to be important to orthopaedic surgery PDs[6].

Conclusion

Orthopaedic surgery residency applicants are significantly less likely to match at their first choice or within their top 3 choices when compared to the national average. Number of contiguous ranks, AOA status, and female sex were associated with successfully obtaining an orthopaedic residency position. Matching higher on ones' rank list was associated with higher USMLE board scores and greater match satisfaction. It should be noted that these data were limited to a single institution, and further research is warranted with a larger and more geographically diverse sample to draw definitive conclusions.

Appendix

eA Supporting material provided by the authors is posted with the online version of this article as a data supplement at jbjs.org (http://links.lww.com/JBJSOA/A452). This content was not copyedited or verified by JBJS. ■

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