Geographic Trends in the Orthopedic Surgery Residency Match

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ABSTRACT

Background Residency program location may be an important factor for orthopedic surgery residency applicants. More than half of residents locate their practice near the site of their training, and surgical specialties (eg, otolaryngology, plastic surgery, and general surgery) have shown geographic patterns in their residency matches.

Objective We analyzed geographic trends in the orthopedic surgery Match.

Methods Hometown, undergraduate institution, and medical school "preresidency locations" of all allopathic, nonmilitary, orthopedic surgery residents were recorded from program websites for the 2015–2016 academic year. Program and preresidency locations were coded according to state and US census division. Statistical analysis was used to investigate associations between residency program locations and preresidency locations.

Results Of 2662 residents in the study, 1220 of 2614 (47%), 536 of 1329 (40%), and 308 of 744 (41%) matched into the same division as their medical school, undergraduate institution, and hometown, respectively. There were significant differences among divisions ($P < .001$). Also, 817 of 2662 (31%), 319 of 1329 (24%), and 200 of 770 (26%) residents matched in the same state as their medical school, undergraduate institution, and hometown, respectively, with significant differences between states for medical school ($P < .0001$) and undergraduate institution ($P < .0001$), but not hometown ($P = .22$). Overall, 21% of residents (538 of 2612) matched at the program affiliated with their medical school.

Conclusions There is an association among hometown, undergraduate institution, and medical school for the training program location in which orthopedic surgery residents match, with variability in locations matched at state and census division levels.

Introduction

The location of a residency program is an important influence on where medical students choose to apply, interview, and rank programs.[1–4] It also is an important predictor of their practice location, with data showing that more than half of physicians locate their practice in the same state in which they completed their graduate medical education.[5] To our knowledge, no previous studies have focused on investigating geographic trends in the orthopedic surgery residency Match. A study evaluating geographic trends in the otolaryngology residency Match showed that 58% of residents matched into a program in the same US census region as their medical school,[6] and a study of the surgery residency Match found that 24.6% of residents matched at the program affiliated with their medical school.[7] Given these trends, the geographic history of orthopedic residency applicants may be associated with the location of the program into which they match.

The purpose of this study was to determine whether applicants tended to match into residencies located in close proximity to where they had previously lived and studied. We hypothesized that the percentage of orthopedic residents who matched at a program in 1 of their preresidency locations would vary depending on the state and US census division.

Methods

The methodology for this study was adapted from an otolaryngology residency analysis.[6] The American Medical Association (AMA) FREIDA Residency Database was used to identify allopathic orthopedic surgery residency programs in the United States for the 2015–2016 academic year. Residents were included if they had an online profile that contained their medical school, undergraduate institution, or hometown. If any of the residents' preresidency locations were missing, that resident was excluded from that portion of the analysis. Each residency program and each preresidency location were paired with codes

DOI: http://dx.doi.org/10.4300/JGME-D-17-00633.1

Editor's Note: The online version of this article contains a table showing residents with residency program, medical school, undergraduate institute, and hometown in the same US census division.

representing the state as well as the US census division in which it was located.[8]

This study was declared exempt by the Brown University Institutional Review Board given that all data utilized were publicly available.

Statistical analyses were performed with SAS version 9.4 (SAS Institute Inc, Cary, NC). We used generalized linear models for binary outcomes (PROC GLIMMIX, SAS) to model the proportion of residents currently in orthopedic surgery programs for each of the preresidency geographic locations. Separate models were constructed for each combination of preresidency location and level of aggregation (eg, US census division, state, residency program). The rates of matching were compared among US census divisions and states. Familywise α was maintained at 0.05 with the Holm adjustment.

What was known and gap
The factors that affect resident decisions on training location are important as they may affect the location of their initial practice.

What is new
Hometown, undergraduate institution, and medical school were predictors of the location of orthopedic surgery residents' training program.

Limitations
Analysis limited to data available from websites, with the potential for reporting bias.

Bottom line
Trainees' hometown, undergraduate institution, and medical school influence the location of the residency program at which they match.

Results

Overview

At the time of data collection, the AMA FREIDA Residency Database included 156 allopathic orthopedic programs, 8 (5%) of which were affiliated with the US military and were subsequently excluded. The categorical breakdown of these programs by US census division is shown in TABLE 1. Of the 148 residency programs, 128 (86%) had an online resident roster, 106 (72%) included residents' medical schools, 60 (41%) included residents' undergraduate institutions, and 33 (22%) listed residents' hometowns.

Geographic Trends by US Census Division

Overall, 47% of residents (1220 of 2614) had matched within the same US census division as their medical school (FIGURE 1), 40% (536 of 1329) in the same division as their undergraduate institution, and 41% (308 of 744) in the same division as their hometown (TABLE 1). There were significant differences for each preresidency location among the divisions. The Pacific division had the highest percentage of residents who matched in the same division as their medical school (60%, 177 of 295), whereas the Middle Atlantic division had the highest percentage of residents who matched into the same division as their undergraduate institution (57%, 120 of 209) and hometown (62%, 76 of 123). The Mountain division had the smallest percentage of residents matching in the same division as their medical school (13%, 9 of 69), undergraduate school (14%, 6 of 42), and hometown (12%, 3 of 25). The percentage of residents remaining in the same US census division for all 4 educational periods is provided as online supplemental material. The Middle Atlantic division (10%, 50 of 502; 95% confidence interval [CI] 7.6–12.9) had the highest percentage of residents remaining in 1 division, and the New England division (0.5%, 1 of 220; 95% CI 0.1–3.2) had the lowest percentage.

TABLE 1
Percentage of Residents in Same Census Division as Their Preresidency Locations

US Census Division	Residency Programs, No. (%)	Medical School,[a] No. (%)	Undergraduate,[a] No. (%)	Hometown,[a] No. (%)
New England	9 (6)	67 (33)	32 (22)	25 (31)
Middle Atlantic	33 (22)	237 (52)	120 (57)	76 (62)
East North Central	26 (18)	274 (52)	114 (46)	30 (41)
West North Central	10 (7)	89 (40)	18 (30)	14 (21)
South Atlantic	25 (17)	190 (45)	112 (44)	53 (42)
East South Central	8 (5)	62 (37)	43 (39)	35 (46)
West South Central	16 (11)	115 (49)	57 (45)	38 (40)
Mountain	6 (4)	9 (13)	6 (14)	3 (12)
Pacific	15 (10)	177 (60)	34 (31)	34 (41)
Overall	148	1220 (47)	536 (40)	308 (41)

[a] The difference in percentages are statistically significant ($P < .0001$).

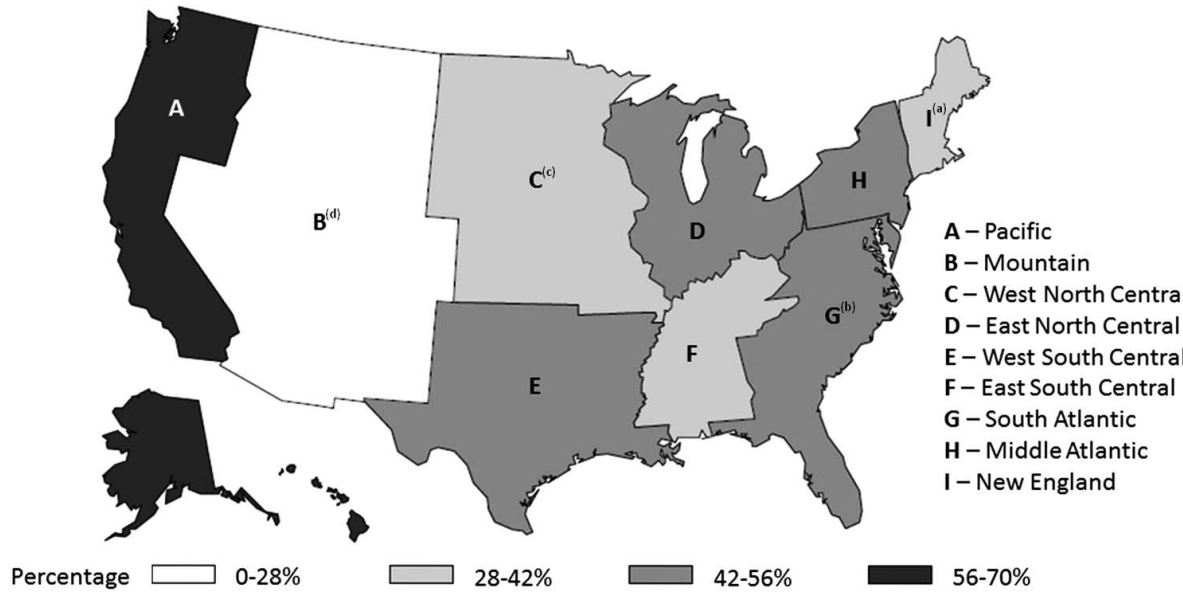

FIGURE 1
Percentage of Residents in Same US Census Division as Their Medical School

[a] 1 of 6 programs did not have a resident roster.

[b] 1 of 8 programs did not have a resident roster.

[c] 2 of 8 programs did not have a resident roster.

[d] 5 of 8 programs did not have a resident roster.

Note: Shaded regions on the US map represent the US census divisions (letters correspond to division name). The percentage of orthopedic surgery residents within a division who matched into a residency program in the same division as their medical school is represented by the darkness of the shade (legend below the Figure).

Geographic Trends by State

Eleven of 50 states (22%) did not have an established orthopedic residency with an online resident roster that included geographical information (FIGURE 2). Overall, 31% of residents (817 of 2662) had matched in the same state as their medical school, 24% (319 of 1329) in the same state as their undergraduate institution, and 26% (200 of 770) in the same state as their hometown (FIGURE 2). There were significant differences in the percentages of residents who had matched in the same state as their medical school or undergraduate school but not for residents who had matched in the same state as their hometown. Residents in programs in California, Michigan, and Mississippi were most likely to have completed medical school in the same state (61% [156 of 255], 51% [84 of 165], and 50% [10 of 20], respectively). Residents in programs in Mississippi, Texas, and Ohio were most likely to have completed their undergraduate education in the same state (55% [11 of 20], 47% [61 of 129], and 45% [77 of 171], respectively).

Resident Characteristics in Orthopedic Programs Affiliated With Their Medical Schools

Overall, 538 of 2612 (21%) of orthopedic surgery residents matched into the residency program affiliated with their medical school. TABLE 2 shows no statistically significant difference between the percentages of residents who matched at the program affiliated with their medical school among the 5 consecutive postgraduate year (PGY) levels. However, significant differences among the 9 US census divisions were seen for the percentages of residents matching with the program affiliated with their medical school: the West South Central division had the highest (30%, 71 of 236), and the Mountain division had the lowest (6%, 4 of 69; $P = .001$; TABLE 3).

Discussion

This study of allopathic orthopedic surgery residency programs found that, for programs listing resident geographic information, there was a strong association between where the resident previously lived and went to school and the state in which they matched for residency training. This was most pronounced for the Pacific and Middle Atlantic US census divisions. Additionally, 21% of residents matched at the orthopedic surgery residency program affiliated with their medical school.

There appear to be similar trends in geographic relationships in plastic surgery and general surgery residencies. Silvestre et al[9] showed that, in the plastic

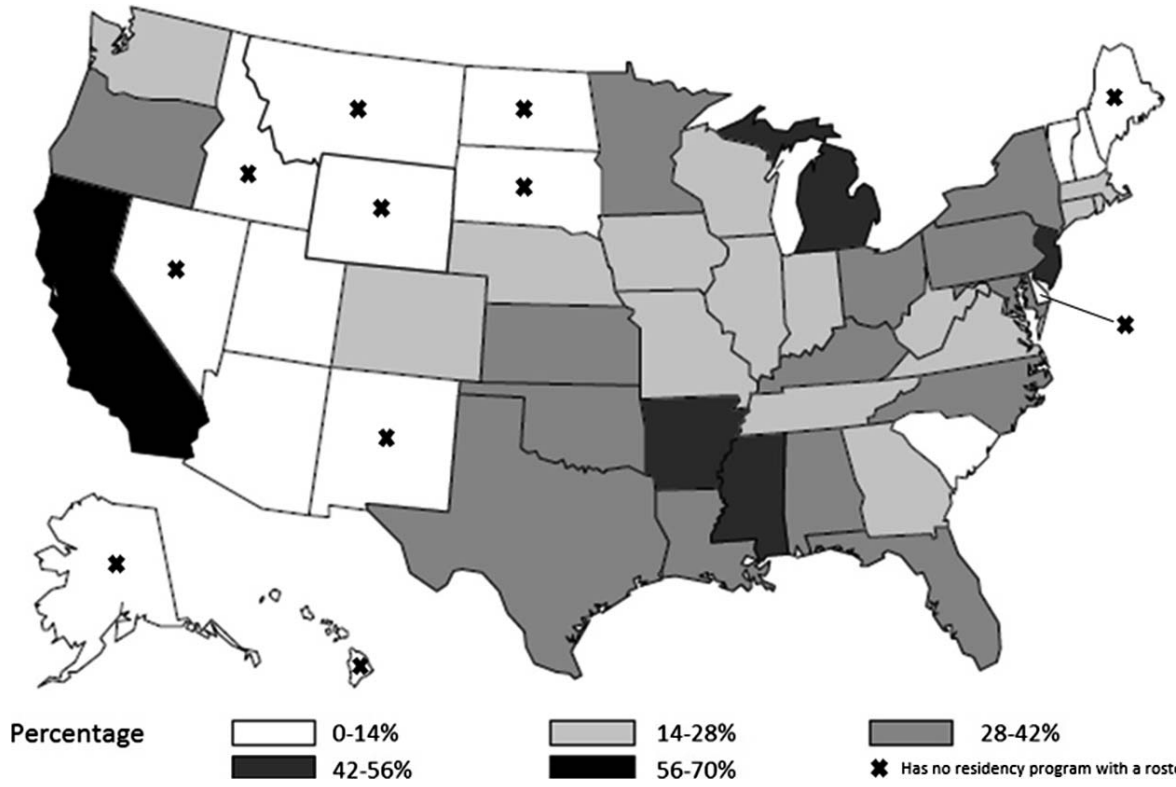

FIGURE 2
Percentage of Residents in the Same State as Their Medical School[a]

[a] Shaded regions on the US map represent the individual states. The percentage of orthopedic surgery residents within a state who matched into a residency program in the same state as their medical school is represented by the darkness of the shade (legend below the Figure).

surgery residency Match, approximately 15.5% of residents were in the residency program affiliated with their medical school. Given that 21% of all orthopedic residents had matched at the program affiliated with their medical school (approximately half of the residents who had attended a medical school within their respective divisions), it seems that a main explanation supporting divisional retention of medical students is that medical students often Match into their "home programs." A study of surgery residents found that states with fewer medical schools typically have more "home program graduates" in surgery residencies, which they attributed to stronger educational relationships in geographically isolated programs, in which fewer visiting medical students may complete subinternships.[7] Although we did not look at the number of medical schools within each state, we noted that the census divisions with the fewest orthopedic surgery residency programs (New England, East South Central, and Mountain divisions)

TABLE 2
Residents at a Program Affiliated With Their Medical School by Postgraduate Year

Postgraduate Year	Matched at Affiliated Program[a], No. %
1	95 (21)
2	104 (19)
3	106 (19)
4	109 (20)
5	118 (22)
Overall	532 (21)

[a] $P = .76$.

TABLE 3
Residents at Program Affiliated With Their Medical School by US Census Division

US Census Division	Residents[a], No. (%)
New England	30 (14)
Middle Atlantic	108 (24)
East North Central	94 (18)
West North Central	46 (20)
South Atlantic	85 (20)
East South Central	40 (24)
West South Central	71 (30)
Mountain	4 (6)
Pacific	60 (20)
Overall	538 (21)

[a] $P = .001$.

had the lowest percentages of residents who matched into the same division in which they attended medical school.

In addition, orthopedic surgery residency programs have published scoring rubrics, which include some intangible factors, such as "likelihood of coming" to the program.[10] Some programs also may consider the likelihood that residents will remain in a particular state or region for clinical practice after graduation. A study of approximately 2612 physicians across 10 specialties demonstrated that more than 40% of residents began practicing within 10 miles of their residency program, and more than 50% began practicing within 75 miles.[11] Our findings suggest that geographic location plays a role in applicant rankings of residency programs.

This study has limitations, including that the data used depended on what was available on the orthopedic residency program websites. While the majority of programs had resident rosters and medical school attended for their residents, fewer programs included undergraduate institutions or hometowns. There was also intrainstitutional variability, with some details missing from resident profiles in the same program. Conclusions about geographic factors and applicant rankings of programs should also take into account the influence of fourth-year orthopedic "away" rotations, the selection of which also may be related to geographic factors.[12,13] Data on away rotations were not available, so we were not able to investigate that relationship. Assessing changes over 5 PGY levels in a single academic year may be insufficient to accurately assess variations in Match trends.

Future research may need to include qualitative data to better understand how medical students are influenced by geographic factors in choosing orthopedic surgery residency programs as well as how the "likelihood of coming" and geographic factors influence program directors' ranking decisions. Greater understanding of the decision-making process may help reduce the excessive number of applications currently observed.[14]

Conclusion

This study demonstrated that there is an association between orthopedic surgery residents' preresidency locations and the US census division and state of their residency programs.

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Funding: The authors report no external funding source for this study.

Conflict of interest: The authors declare they have no competing interests.

This study was presented as an e-poster at the American Orthopaedic Association Annual Leadership Meeting, Charlotte, North Carolina, June 20–24, 2017.

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Received August 30, 2017; revisions received February 6, 2018, and April 13, 2018; accepted April 18, 2018.