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Geographic Mobility in the Emergency Medicine Residency Match and the Influence of Gender

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Short running title: Geographic Mobility by Gender

Geographic Mobility by Gender in the Emergency Medicine Residency Match

Objectives: Women are underrepresented in Emergency Medicine (EM) leadership. Some evidence suggests geographic mobility improves career advancement. We compared movement between medical school and residency by gender. Our hypothesis was that women move a shorter distance than men.

Methods: We collected National Residency Matching Program (NRMP) lists of ranked applicants from 8 EM residency programs from the 2020 Main Residency Match. We added the gender expressed in interviews and left the Association of American Medical Colleges (AAMC) number as the unique identifier. Applicant data for matched osteopathic and allopathic seniors in the continental United States was included. We obtained street addresses for medical schools from an AAMC database and residency program addresses from the ACGME website. We performed geospatial analysis using ArcGIS Pro and compared results by gender. NRMP approved the data use and our IRB granted exempt status.

Results: 881 of 944 unique applicants met inclusion criteria and included 48.5% (830/1713) of matched allopaths and 37% of all matched seniors; 48% (420) were female. There was no significant difference between genders for distance moved (p=0.31). Women moved a mean 619 miles (SD=698, median 341, range 0-2679); men a mean 641 miles (SD=717, median 315, range 0-2671). Further analysis of applicants travelling less than 50 miles (49 women, 51 men) and by census division showed no significant frequency differences.

Conclusion: Women and men travel similar distances for EM residency with the majority staying within geographic proximity to their medical school. This suggests that professional mobility at this stage is not a constraint. Our study findings are limited because we do not know which personal and professional factors inform relocation decisions. Gender is not associated with a difference in distance moved by students for residency. This finding may have implications for resident selection and career development.

Introduction

Women have comprised half of all medical students for almost two decades, yet remain underrepresented in higher-ranking positions in medical schools such as full professor, chair, and dean.[1] Differential career progression between genders can be demonstrated from the earliest academic ranks, and women are disproportionately underrepresented in medical school leadership positions.[1,2] The

specialty of emergency medicine (EM) is not immune to this: the number of female academic EM physicians remains low at approximately 27%, and representation in academic departmental leadership positions even more rare.[3,6] While women as less represented in EM as a whole,[4,5] this small percentage of female leaders signifies a discrepancy in academic progress by gender.

In business, voluntary geographic relocation for job opportunities has a strong correlation with markers of career success and job satisfaction.[7-9] These include higher salaries, advanced leadership roles, and increased autonomy. Within medicine, an analysis of participants in the Executive Leadership in Academic Medicine program (a professional development program for female physician leaders) demonstrated that geographic moves of more than 50 miles, within their cohort, correlated with career advancement.[10]

Literature describing residency selection consistently cites the geographic location of residency programs as a major factor in applicant decision-making.[11,12] An Otolaryngology study demonstrated a tendency for students to match in the same geographic region as their medical school.[13] Similarly, anesthesiology trainees were more likely to match to their home state, and a multispecialty study in 2016 reaffirmed the regionality of match results.[14,15] While gender-specific data are sparse, a retrospective single site study from the surgery department at the University of Cincinnati demonstrated that most of their applicants matched at a program within 640 miles of their medical school, and did not find any gender differences in distance between medical school and training site.[16] It remains unclear whether geographic preferences signal personal or professional motivations.

Given the established gender inequity in academic emergency medicine and the evidence that relocation can be associated with career advancement, we sought to determine whether there are gender differences in geographic mobility during EM residency selection. We hypothesized that women would be less likely than men to move significant geographic distances for their residency training.

Methods

Study Design

We used a multicenter, retrospective, cross-sectional study design to conduct a geospatial analysis of EM residency program applicants in the 2020 NRMP Main Residency Match (Match). We assessed trends by gender for distance moved between an applicant's medical school and their newly matched residency program.

Study Population

EM applicants who were ranked by any of the 8 EM residency programs included in the study during the 2020 Match were included. Residency programs represented a diversity of locations, training environments including community settings, city sizes, and program lengths to provide a broad representation of EM applicants. These programs are geographically distributed in the Northeast, Midwest, South, and West regions of the United States with half in the PGY 1-4 format. Applicants were excluded if they went unmatched or matched in another specialty besides EM, if their expressed gender was unknown or recorded differently between program lists, if they were an International Medical Graduate (IMG), or if they graduated from medical school in Hawaii. IMGs were excluded due to the significant challenges they face in the Match and the concern that they may be forced to travel any distance to secure a residency spot, while Hawaiian medical school graduates were excluded as they were subject to forced travel due to the lack of any EM residency programs in their state. NRMP applicant data for all matched osteopathic and allopathic seniors in the continental United States was included for analysis.[17]

Research Approval

The NRMP approved the deidentified use of the NRMP List of Ranked Candidates. Our study was granted exempt status by the Institutional Review Board of the principal investigator.

Study Protocol

We contacted residency program directors via email for site recruitment shortly after the 2020 Match results were released. Program directors 1) downloaded a Microsoft Excel® (Microsoft, Seattle, Washington, USA) spreadsheet of their 2020 NRMP List of Ranked Candidates; 2) added expressed gender (Male/Female/Unknown) during the interview; 3) deleted applicant names; 4) sorted the list by the unique identifier of the AAMC ID, thus randomizing the rank list positions of the applicants. We combined the 8 sites into a single dataset utilizing the AAMC ID as the unique identifier and eliminated duplicate entries.

For the geospatial analysis, we obtained street addresses for medical schools from the Association of American Medical Colleges (AAMC) List of Member Medical Schools, American Osteopathic Association (AOA) Osteopathic Medical Schools, and residency program addresses from the Accreditation Council

for Graduate Medical Education (ACGME) website.[18-20] We used medical school or residency program websites to obtain the rare address missing in these sources.

Key Outcomes

The primary outcome studied was the comparison of distance traveled between origin programs (i.e. medical school) and destination programs (i.e. residency program) by gender. Secondary outcomes included the percent of applicants staying at the same program (defined as distance < 1 mile), and within a distance felt to not require a relocation of home address (defined as distance < 50 miles). Finally, we analyzed departure from a nine-division region of origin as defined by the U.S. Census.

Data Analysis

We used descriptive statistics to describe the demographics of the cohort. We utilized ESRI ArcGIS Pro to geospatially map origin (i.e. medical school) and destination (i.e. residency program) and performed an analysis by gender in differences in mobility. Distance traveled was presented in miles with mean, standard deviation, median, and range of each group. Statistical analysis was performed using Excel® (Microsoft 365 MSO, Version 2104).

The analysis of the student data was completed using ESRI ArcGIS Pro (version 2.8.0). The ArcGIS World Geocoding Service (ESRI, run on October 12, 2020) was used to generate two sets of geocoded points from the prepared database of residents; one set for the origin medical school and one for the destination residency program. Then, using the Select by Attributes tool, the medical school points and residency points were both split by gender. The XY to Line tool created line features showing the distance each student traveled from medical school to residency. All the datasets were reprojected to the Albers Equal Area Conic projection. Then, a new field was created in each attribute table using the Calculate Geometry function to determine the length of each line in miles, thereby calculating the distance between each pair of points and how far each resident traveled. The datasets for each gender were further subdivided to those who traveled less than 50 miles.

Additionally, analysis of the geocoded points was conducted with census divisions (9 regions) using freely available US Census data (US Census Bureau, 2018; accessed 2021). The sets of points (medical schools and residencies, each split by gender) were spatially joined to polygons of census divisions, then

a Python script was run to compare their attribute tables and determine if each person left their division or not between medical school and residency.

Results

From the 2020 NRMP match, a total of 1,398 ranked applicants were collected from 8 EM programs, representing 944 unique applicants. Of these unique applicants, 881 (93.3%) met inclusion criteria and were included for analysis. Exclusions are noted in **Figure 1**. Allopathic applicants made up 94.2% (830/881) of our sample and osteopathic applicants represented 5.8% (51/881). Thus, our sample represented 48.5% (830/1713) of all matched allopaths and 37% of all matched allopathic and osteopathic graduates (881/ 2396) that year. Women represented 48% (420/881) of the cohort.

There was no significant difference between gender for distance moved (p=0.31). **Figure 2** Women moved a mean 619 miles (SD=698, median 341, range 0-2679), while men a mean 641 miles (SD=717, median 315, range 0-2671). Further analysis of applicants traveling less than one mile (Total n= 36 women, 40 men) and those traveling less than 50 miles (Total n= 49 women, 51 men) showed no significant differences. McNemar's Chi-squared test for binary outcomes showed there was no significant difference (ρ=0.16. OR 0.87 (CI 0.72-1.06) between the 45.6% (192/421) of women and 43.2% (200/463) of men remaining within their local geographic division.

Discussion

Women and men travel similar distances for EM residency training, with almost half of students of both genders staying within the same geographic region as their medical school. These findings correspond with work by Shappell and Dhar showing strong regional preferences across specialties.[15,16] The consistency of these findings has two important implications for residency selection practices. First, the presumption that women won't travel as far as men for residency is not supported by this study. Program directors should be empowered to offer interviews to the most qualified candidates, not those presumed most likely to match based on past or biased assumptions of the influence of gender. Second, our findings reinforce the challenge for program directors aiming to recruit a geographically diverse group of trainees. This may also disadvantage applicants who wish to move across regions.

Data from 1998 showed even less student mobility within emergency medicine. At that time, 55% of applicants remained within the same state as their medical school, and an astounding 43% within the same city.[21] More recent literature provides some insights about student decision making regarding residency program selection. Within EM, Love *et al.* demonstrated that three-quarters of respondents utilized geographic location of residency programs as the most important factor in program selection, followed by proximity to family and community characteristics.[12] That study showed no significant difference of geographic priority by gender; however, men prioritized university-based programs more than women. Though geographic location remains the predominant factor for student selection of residency, the exact meaning of this outcome is not clearly defined and may be subject to many influences. For example, students may be more familiar with the programs in their region and therefore feel more comfortable with their decision to remain close to their medical school, or they may simply want to be closer to home.

Program features that improve the willingness of students – particularly women -to relocate have been elucidated in the literature. In a multi-specialty study that excluded EM, Jagsi *et al* identified that female applicants tend to select training programs with a higher proportion of female trainees.[22] Interestingly, they did not necessarily seek locations with higher proportions of female faculty or female chairs. While mentorship programs have been developed to help support the advancement of women in their careers, it is unclear if the lack of women in leadership has a downstream impact on recruitment into the overall field of EM or to a given program.[23] A 2019 study found that female applicants placed more emphasis on the gender diversity of a program than geography in prioritizing their program selection.[24] Studies from internal medicine and surgery show similar findings.[25,26] A narrative review by Edmunds *et al.* affirms the importance of role-models, mentorship, and a supportive environment in influencing women to pursue an academic career.[27] Considering the demonstrated difference in time spent on family-centered activities, we can speculate that women may thrive in an environment that allows flexibility and support of personal and family aspirations as well as career aspirations.[28] Aagaard *et al*. also identified significant factors of “location of residency program near spouse” or “spouse’s job” as more important for female applicants.[25] A recent survey of women faculty in EM found that senior faculty are much more likely to relocate to advance their careers than junior faculty; this age difference -- closer to childbearing and childrearing years -- may extend to medical students in the Match.[29]

Business literature informs our understanding of one's willingness to relocate for a new job. Across disciplines, there is clearly an observable phenomenon of people moving preferentially toward geographical destinations perceived as desirable.[30] The influence of gender with willingness to relocate is less clear and hindered by the dated nature of much of the work. A 2006 study by Baldridge *et al.* of individuals in management positions showed women were less willing to relocate for their career than men. [31] This effect persisted even when controlling for factors known to influence relocation decisions, including spousal contribution to family income, presence of preschool-aged children at home, and the strength of community ties. While performed in an exclusively male subject population in Israel, Sagie identified that individuals willing to relocate tended to be younger, possess strong family support for the relocation, and intended to remain with their new organization over the long-term.[32] These factors may also influence decisions in the residency match.

Finally, research evaluating new business school graduates, who may be analogous to new medical school graduates, failed to show a difference in willingness to relocate based on gender or family status, but did show an increased likelihood based on personal psychological characteristics related to resilience and risk-taking.[33] These findings parallel those of a German study that elucidated that personality factors, such as higher levels of tolerance of uncertainty, individualism, and openness to new experiences, were stronger predictors of willingness to relocate than demographics.[34] Personality traits that negatively predicted relocation included higher levels of anxiety and social integration.

Limitations

Our study includes a number of important limitations. Our data represents only a single application cycle and a portion of the total application pool. We also acknowledge that trends may be dynamic and vary year-to-year (the ongoing COVID-19 experience being a prime example). In addition, examination of motivating factors for geographic location of training programs was beyond the scope of this work.

This geographically dispersed convenience sample is comparable but not identical to national characteristics; this skew of data may be a reflection of the applicant pools of the participating residency programs and could have affected our outcomes. Our sample included 48% female students, which is higher than the 37% proportion of women matching in EM during the 2020 match.[4] Our cohort is predominantly allopathic seniors and with such a small sample of osteopaths, our data may not be generalizable to this population. We do not believe the sample is confounded by significant selection

bias, thus we feel that our chance of Type I error is minimized. We cannot exclude the possibility of a Type II error given the constraints of our data set.

We did not investigate other factors applicants consider when creating their rank list, such as hometown, partner opinion or career, impact of a couple's match or cost of living. Thus, there may be important effects unaccounted for by our study. These items may serve as important factors for future research along with elements identified in the business literature.

Gender identity is not recorded in the source NRMP data set. Therefore, we based our data on the binary designation in the ERAS demographics and coded this based on candidates' gender expression or self-identification during interviews. We acknowledge that gender identity is broader than a binary choice, and the lack of accurate gender information may affect our data. We identified a small number of cases (7) with discrepant or unknown identity and removed those from analysis, and we acknowledge the possibility of inaccurate gender assignment based on program director assignment.

Lastly, two study design decisions about geography may also limit interpretation of our outcomes. First, we chose to compare distance between medical school and residency program, rather than permanent address and residency program. Although ERAS applications do ask for a permanent address, we did not feel this would confidently represent the applicant's true "hometown" Applicants may simply list their current address in this field or may no longer have a family address in the area they consider "home." Second, while we chose 50 miles as the cut point to represent an applicant staying in the same city or region, mileage may not transfer across regions of the country in terms of travel time (i.e. 50 miles in the Northeast may not be weighed equally as in the Midwest).

Conclusions

In emergency medicine, women and men travel similar distances for residency training, and a large number of applicants choose residency programs in their geographic regions of the United States. The combination of opportunity for mobility at a critical career junction coupled with personality characteristics may account for the lack of gender differences seen in our study population. Our study findings should be augmented by future work investigating the influence of factors such as consideration of family structure, hometown, partner/spousal preference and the nature of these on

geographic mobility. These findings may have implications for resident selection and career development.

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Figure 1: CONSORT diagram for subject inclusion criteria

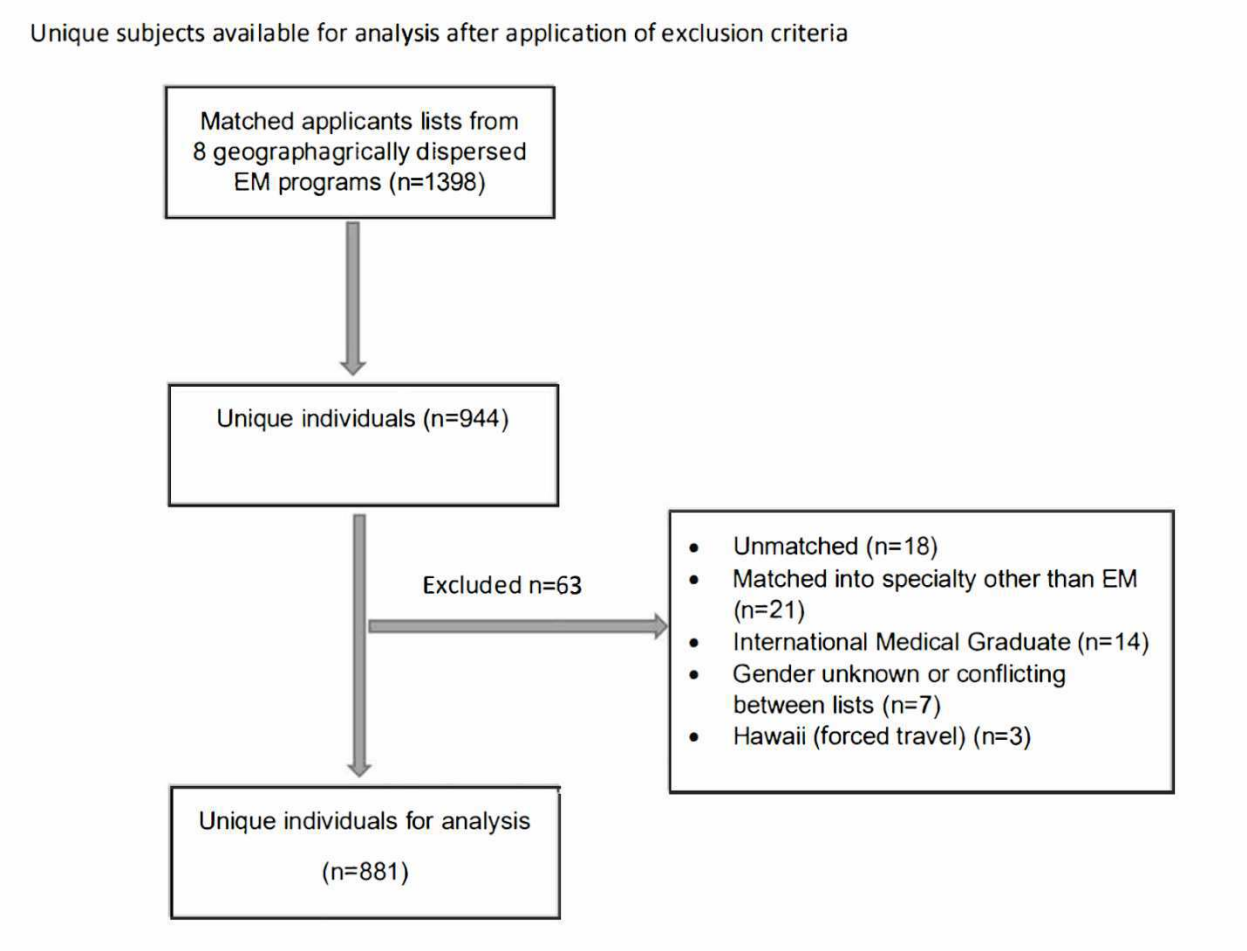

Figure 2: Graphical representation of numbers of matched applicants by gender and the distance travelled between their origin medical school and destination residency program. There is no significant difference by gender.