Published in final edited form as:

Laryngoscope. 2017 May ; 127(5): 1052–1057. doi:10.1002/lary.26236.

Applicant Characteristics Associated with Successful Matching into Otolaryngology

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Abstract

Objective—To identify resident applicant characteristics that increase the odds of matching to Otolaryngology residency.

Study Design—Cross-sectional analysis.

Methods—Residency applications to our institution from 2009 through 2013 were reviewed. The available data represented 81.1% of applicants to Otolaryngology programs nationwide. Online public records were searched to determine whether an applicant matched to an Otolaryngology residency position. Factors that were significantly associated with the odds of matching were determined using logistic regression.

Results—A total of 1,479 unique applications were analyzed. On univariate analysis, 27 demographic, academic, personal, medical school, prior training, and application-specific factors were associated with the odds of matching into Otolaryngology. On multivariate analysis, indicators of academic achievement, including AOA status, whether applicant received awards, and publications were significantly associated with the odds of matching (OR 2.03, 1.39, 1.66, respectively). The odds of matching increased with increasing Step 1 scores ($p < 0.001$). Attending a medical school ranked by the US News & World Report and being a US citizen born in the US significantly increased odds of matching (OR 1.55 and 2.04, respectively), while being a non-US Senior significantly decreased the odds of matching (OR 0.33).

Conclusion—Multiple factors are associated with successfully matching into an Otolaryngology residency. While this information allows medical students to determine the strength of their application, these criteria have not been correlated with resident success. We urge selection

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All authors report no conflicts of interest.

All authors report no financial disclosures.

Presented at Triological Society Combined Sections Meeting, January 22–24, 2015, Coronado Island, California, USA

Level of Evidence: N/A

committees to begin identifying applicant selection methods that reflect the values we want to cultivate in our future colleagues.

Keywords

Match; Residency; Education; Otolaryngology

Introduction

Matching into an allopathic otolaryngology residency program has become increasingly more competitive over the past few years. In 2009, the match rate to Otolaryngology through the main residency match for US Senior medical students was 80%, compared to a 91% match rate for US Seniors in all specialties¹. In 2013, the match rates were even lower within Otolaryngology, at 66% of all applicants and 71% of US Seniors, compared to a 74% and 94% match rates for all applicants and US Seniors to all specialties, respectively². Otolaryngology had the highest number of unmatched applicants applying to a single specialty at 21.3%². Similarly, the average USMLE Step 1 score of applicants matching into Otolaryngology has steadily risen over the past 20 years from 224 in 1998 to 243 in 2011³. Based on the 2014 Charting Outcomes in the Match, only Dermatology and Plastic Surgery exhibited similar scores on the USMLE Step 1 scores among matched applicants⁴.

Only one prior study has evaluated the characteristics that determine the likelihood of matching among Otolaryngology residency applicants⁵. Rinard et. al. found that higher USMLE Step 1 and 2 scores, AOA membership, and graduation from a top 40 NIH-funded medical school had a positive impact on matching success; however, this study only evaluated a limited number of variables and was not specific to Otolaryngology, as it included a variety of other surgical subspecialties⁵. Another study reviewed applicants to General Surgery residency programs and found that high USMLE Step 1 and 2 scores, AOA membership, Asian race, and research publications were more common among the 20 highest ranked applicants at the most competitive programs⁶. A similar study in Ophthalmology found that top medical schools ranked by US News and World Report and an allopathic degree were predictors of successful matching, in addition to USMLE scores and AOA membership⁷. A thorough evaluation of applicant characteristics has not been completed in Otolaryngology.

Given the competitiveness of the field, the ability to predict which characteristics lead to a successful match into Otolaryngology residency would help selection committees focus on specific applicants while also allowing medical students to have a more concrete idea of whether their application is strong or weak. The objective of this study is to determine what characteristics increase the chance that a resident applicant will match into an Otolaryngology residency.

Methods

This cross-sectional study was approved by the Colorado Multiple Institution Review Board (COMIRB Protocol # 13-2105). Residency application data to our institution from 2009 through 2013 was analyzed. This encompassed 81.1% of the total applicants to allopathic

Otolaryngology programs nationwide. All data was collected through the Electronic Residency Application Service (ERAS) system. All applicant data was de-identified and secured in a password-protected database. Online public records were searched to determine whether an applicant matched. The member search tool of the Otolaryngology Academy website and individual Otolaryngology residency program websites were used most frequently. Additionally, NPI numbers, hospital affiliations, and other training program websites were also searched. A total of 1,627 applications were identified from 2009 to 2013. Matching data for 13 applicants was not able to be determined and these applicants were excluded from analysis. Only unique applications were considered for the analysis. If an applicant applied multiple years, only the first year of application was included in the analysis to prevent confounding (N=88). One applicant was excluded for incomplete demographic data. Only one applicant who failed Step 1 matched as well as one applicant who received a DO degree. As these factors were an almost perfect indicator for not matching, applicants who failed the Step 1 exam (N=16) or received a DO degree (N=30) were excluded.

Demographic characteristics included age, gender, race, birth country, and citizenship. Race was categorized as white, non-white and unknown. A three level categorization was made for birth country and citizenship: non-US citizen born outside the US, US citizen born outside the US, and US citizen born within the US. Measurements of academic achievement included whether applicants had evidence of awards, publications and research, as well as whether they were members of AOA. USMLE Step 1 scores were also used to measure academic achievement. Step 1 scores were categorized into four quartiles. The 1st quartile included scores less than 231; 2nd quartile scores were greater than or equal to 231 but less than 242; 3rd quartile scores greater than or equal to 242 but less than 251, while 4th quartile scores were greater than or equal to 251. Personal factors included participation in the couples match, additional degrees, volunteer experience, and whether applicants had interrupted their medical school education for research or other reasons. Medical school characteristics included whether an applicant's medical school was public or private, medical school location (within or outside the United States), whether the medical school has an Otolaryngology residency, and whether the medical school has a US News & World Report top 50 rank for that application year. Top 40 NIH-funded medical schools were also considered, however, nearly all schools were captured in the US News & World Report rankings, so the latter was used for analysis. We attempted to identify applicants who were not US Seniors at the time of their application. Previous participation in a residency program was identified via the listing of current or prior training in the application and was used as a marker for non-US Senior status. Since there are other pathways besides residency training (such as research, foreign medical training, and additional degrees) for non-US Seniors prior to application, we wanted to capture this group as well. Additional variables including ACLS, Board Certification, DEA license, prior medical license, and PALS certification were determined as likely to indicate that an applicant was not a US Senior. If two or more of these criteria were present within an application, the application was marked as non-US Senior status. Application specific variables included number of letters of recommendation, whether the applicant delayed graduation from medical school, and application submission

date. Submission date was categorized into three groups: submitted on day one, in the first week (day 2 to day 8) and beyond the first week (greater than day 8).

Data analysis was done using R version 3.1.2 (2014-10-31)⁸. Univariate logistic regression was performed for variables considered to be potential factors associated with whether an applicant matched. Odds ratios (OR) with corresponding 95% confidence intervals and p-values were calculated. Multivariable logistic regression was used to determine what factors are independently associated with the odds of matching. The following model building approach was used. We first created groupings of the variables by common themes. These included demographics, academic achievement, personal factors, medical school factors, previous residency, and application content. For each theme, variables that were most associated with matching in the univariate models ($p < 0.25$) were included in a multivariable theme model. Then using a backwards selection approach, variables were removed one-by-one until only variables with $p < 0.15$ remained in the model. To assess whether the different themes were independently associated the theme models were combined and variables were removed one-by-one until only variables with a $p < 0.15$ remained in the model.

Results

A total of 1,479 applications were included in the analysis (Table). The average age of applicants was 27 years old. Most were male (66.3%), and the mean USMLE Step 1 score among match applicants was 240, which is similar to the published NRMP data. Most of the factors considered in the single variable analysis were significantly associated with matching into an Otolaryngology residency program (Figure 1). Of the 27 variables found to be significantly associated with matching into Otolaryngology, 21 were significant with a p-value of < 0.001 (Figure 1). Variables that were not significantly associated with matching included gender, couples match participation, whether medical education was interrupted, and public versus private medical school status.

The final multivariable logistic regression model (variables with adjusted within group p-values of less than 0.15) included age, gender, birth country and citizenship, AOA status, awards, publications, research, USMLE Step 1 score, couples match participation, volunteer activities, medical school US News rank, non-US Senior status, number of letters of recommendation, graduation date (on time versus delayed), and submission date (Figure 2). Younger applicants and US citizens born in the US were more likely to match [OR 0.94 CI (0.89, 1) $p = 0.041$ and OR 2.04 CI (1.04, 3.89) $p = 0.033$, respectively]. Indicators of academic achievement, including AOA status, whether applicant received awards, and publications were significantly associated with the odds of matching [OR 2.03 CI (1.43, 2.92) $p < 0.001$, OR 1.39 CI (1.04, 1.85) $p = 0.028$, OR 1.66 CI (1.15, 2.39) $p = 0.001$, respectively]. Participating in research trended towards increasing the odds of matching, but was not statistically significant [OR 2.11 CI (0.99, 4.48) $p = 0.052$]. The odds of matching increased with increasing Step 1 scores (Figure 3). Attending a medical school ranked by the US News & World Report significantly increased odds of matching [OR 1.55 CI (1.17, 2.05) $p = 0.003$]. Non US Seniors were significantly less likely to match [OR 0.33 CI (0.14, 0.75) $p = 0.01$]. Submitting 4 letters of recommendation significantly increased the odds of

matching, while submitting less than 3 significant decreased the odds of matching [OR 1.44 CI (1.08, 1.93) $p=0.01$ and OR 0.21 CI(0.04, 0.89) $p=0.04$, respectively]. The odds of matching increased with increasing Step 1 scores ($p<0.001$). Applicants with scores 231–242, 242–251, and 251 (2nd, 3rd, and 4th quartiles, respectively) were significantly more likely to match than those with scores <231 (1st quartile), all with a p value of <0.001 . Applicants in the 4th quartile (≥ 251) were significantly more likely to match than those in the 2nd (231–242) ($p = 0.03$), but not compared to the 3rd quartile (242–251) ($p = 0.11$). Applicants in the 3rd quartile (242–251) were more likely to match than those in the 2nd (231–242) ($p = 0.03$). Variables that were not significantly associated with matching included gender, couples match participation, whether medical education was interrupted, volunteer experience, attending a medical school with an otolaryngology program, on time graduation, and application submission date.

Discussion

Multiple factors are highly associated with matching into an otolaryngology residency. On univariate analysis, the only factors analyzed that had no correlation with matching status were gender, couples match participation, whether medical education was interrupted, having an additional degree, and attending public versus private medical school. When multivariate analysis was performed, Step 1 score, AOA status, medical school awards, publications, medical school ranking in US News, completing a prior residency, number of letters of recommendation, age, and birth country or citizenship were found to be associated with matching. Although some of these factors have been cited previously, this is the first study to comprehensively evaluate applicant characteristics that are significant predictors of matching into Otolaryngology.

Many studies have shown that higher USMLE scores increases an applicant's chances of matching into surgical specialties^{5,6,9} and surveys of applicants and program directors in Otolaryngology have also shown that both parties believe USMLE scores are one of the most important criteria used by residency programs when ranking applicants¹⁰. We similarly found that Step 1 scores had an impact on matching. Applicants with Step 1 scores greater than 231 were significantly more likely to match than those with scores below. A study of applicants from 1998–2007 similarly found the average Step 1 score for matched applicants to be 233 while the average for unmatched applicants was 215⁹. The odds of matching increased with increasing scores, but we found no difference in the odds of matching when comparing scores between 242 to 251 to scores greater than 251. Therefore, our data suggests that there may not be any added benefit for those with scores higher than 242 (Figure 3). It is likely that application review committees use the Step 1 score as a screening tool to narrow down the initial large applicant pool. Although not all programs use this strategy and there is no consensus between programs on what the cutoff score should be, this may explain the limited benefit seen with increasing board scores above 242.

Being a member in AOA, receiving a medical school award, and having publications significantly increased odds of matching. This corresponds with previous studies that also demonstrated that AOA membership is associated with an increased likelihood of matching^{5,6,11}. Rinard, et. al. showed that AOA members were 6 times more likely to match

into Otolaryngology⁵. In our cohort, controlling for all other variables, the odds of matching for AOA members was twice that seen for non-members. Regardless of the effect size, it is clear that AOA membership indicates high academic performance and is associated with an increased chance of matching into Otolaryngology.

Numbers of research experiences and publications have been shown to be higher among matched applicants in the integrative plastic surgery program versus unmatched applicants¹². Though research experience is considered by many to be an integral factor to matching in otolaryngology, no prior studies have shown that medical student research increases the odds of matching in the field. In fact, it was previously shown to not be a significant factor in Otolaryngology⁵. This change may reflect an increased emphasis on research productivity among applicants as the Otolaryngology match becomes more competitive. Interestingly, our data show that having publications increase the odds of matching, but not necessarily research experience in general. We therefore recommend advising medical students to try to focus on productive research projects that will result in publications.

Medical school characteristics also have an impact on matching success in Otolaryngology. Medical school rankings by US News and World Report rankings are widely considered to be a marker of medical school quality. Students who attend a medical school ranked in the US News and World Report Top 50 Medical Schools for their application year had 55% increased odds of matching. A top rated medical school has previously been shown to be an important factor for a successful Otolaryngology match and in other specialties^{5,7}. Medical students who attend a school with an Otolaryngology residency program likely have an advantage since they have increased exposure to the field, access to research opportunities, ability to obtain letters of recommendation, and access to more personalized mentorship and advisement throughout the residency application process. On univariate analysis, we found that applicants from medical schools with an Otolaryngology residency program were more likely to match than those without. In the group model, however, this was no longer significant. A review of applicants to plastic surgery programs similarly showed a trend towards favoring students with home plastic surgery programs, but it was not significant¹³. We recommend that medical students consider attending a highly ranked medical school or one with an Otolaryngology residency program if there is any interest in pursuing Otolaryngology when applying for medical school.

Attending medical school outside the US and indicators of previous residency program attendance were the strongest predictors of an unsuccessful match. This accounted for about 6% of our cohort. International medical graduates (IMG) make up 23.5% of residents and 27.6% of practicing physicians in the United States¹⁴ and accounted for 36.8% of applicants in the 2013 residency match². These applicants tend to have lower USMLE scores and may require multiple attempts prior to passing the test, making matching successfully into residency positions more difficult¹⁴. Cabrera-Muffly et al. noted that IMG and prior US graduates are filling an increasing number of residency spots in many other specialties, but US senior graduates continue to make up about 94% of the matched applicants despite increasing numbers of residency positions available³. We similarly found that applicants graduating from a foreign medical school, non-US citizens, and those born outside the US were significantly less likely to match.

Interestingly, we found an increased likelihood of matching for applicants submitting 4 letters of recommendation versus the 3 that are required for application submission. Although many studies have cited quality of letters of recommendation or personal knowledge of letter writer as factors in ranking applicants highly^{15,16,17}, the number of submitted letters has not previously been reported as a significant factor. Obtaining more than the required number of letters of recommendation may indicate a student who is more motivated and willing to put in extra work or an outgoing student with good social skills, characteristics which many programs look for in selecting residents.

Our study had several potential limitations. Since individual matching results are not recorded and stored, determinations of matching status was based on public records. Although it is possible that a small number of applicants were characterized incorrectly, this would be unlikely to be significant in such a large database. Any applicant without convincing evidence of a successful or unsuccessful match into otolaryngology was removed from analysis. Because there are only a limited number of Otolaryngology residencies, the majority of applicants apply to most programs. Our results are limited to those who applied to our institution, but this comprised 81.1% of the total applicants to Otolaryngology residency from 2009–2013. Given our very large sample size, we feel that our results can be extrapolated to the entire applicant pool. We chose to not include Osteopathic programs given the heterogeneity of these programs and applicants. There are 20 DO programs encompassing 119 total residents¹⁸. Application to DO programs is mostly managed through ERAS, but through a different match than the main allopathic residency match with unique requirements and admission considerations. Board licensing exams are administered through the NBOME (National Board of Osteopathic Medical Examiners), with an option take the USMLE licensing exams based on personal preference. Many programs seem to only consider applicants who have rotated at the program and often do not accept applicants each year¹⁸. Given these differences and that only one osteopathic applicant matched into an allopathic program in our cohort, we feel that our results are likely only generalizable to other allopathic programs and would likely not have been altered if osteopathic programs and applicants were included.

When advising applicants to Otolaryngology residency, it is important to keep in mind which application factors are modifiable and which are not. Two factors that were highly associated with matching status on multivariate analysis were age and birth country or citizenship. These characteristics are not modifiable for applicants at the time of their application. This is still valuable information, however, because applicants who are a standard deviation older the mean age or are non-US citizens need to be counseled that they are at a disadvantage compared to the rest of the applicant pool, and will need to excel in multiple other characteristics if they want to match successfully.

This study describes which type of applicants are currently the most competitive when applying for allopathic Otolaryngology programs. Residency programs choose applicants who they believe will be successful residents. “Success” as a resident is a complex outcome, however, with both subjective and objective measures including considerations for knowledge base, professionalism, patient interactions, empathy, and surgical skills. Studies evaluating predictors of residency performance have been conflicting. One study noted

higher USMLE scores and AOA membership were correlated with in-service exam scores, higher faculty ranking, and increased likelihood of pursuing an academic career¹⁹, but another found no correlation between these factors and faculty rating of performance²⁰. Both studies did suggest that higher interview scores may be predictive of performance during residency. Our data shows that these more traditional measures of academic achievement in medical school predict a higher likelihood of matching into Otolaryngology, but it remains unclear whether applicants should be selected based on these factors, as many may not be indicators of resident performance. Given that each year, the majority of applicants are US seniors from allopathic medical schools with awards, publications, and excellent letters of recommendation with Step 1 scores above 241, and the fact that we cannot correlate these factors with resident success, we urge selection committees to begin to identify other methods of applicant selection. We may consider, for example, interviewing a candidate who displays perseverance in their personal statement, since this has been shown to lead to long term success²¹. The increase in demand for our specialties' residency positions presents an opportunity to redefine our values regarding successful professionals and how we judge our applicants to align with those values.

Conclusion

Otolaryngology continues to be one of the most competitive specialties for medical students to apply to, with high Step 1 scores and a large percentage of unmatched applicants. This large cohort of applicants shows that indicators of academic achievement (including AOA membership, USMLE Step 1 scores, medical school awards, research publications, US citizenship, attending a top medical school in the US, and submitting 4 letters of recommendation) all significantly improved the odds of matching into an Otolaryngology residency program. Given the increasing competitiveness of the field, the ability to predict which characteristics lead to a successful match into Otolaryngology residency allows medical students to have a more concrete idea of the strength of their application based on current selection criteria. At the same time, these methods have not been correlated with resident success, and we urge selection committees to begin identifying methods of applicant selection that reflect the values we want to cultivate in our future colleagues.

Acknowledgments

Source of Financial Support or Funding: Supported by NIH/NCATS Colorado CTSI Grant Number UL1 TR001082. Contents are the authors' sole responsibility and do not necessarily represent official NIH views.

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Figure 1.

Odds of Matching into Otolaryngology, univariate analysis. Log10 scale of Odds Ratio with 95% confidence intervals (CI). OR greater than 1 indicate increased odds of matching, while OR less than 1 indicate decreased odds of matching.

Figure 2.

Odds of Matching into Otolaryngology, multivariate analysis. Log10 scale of Odds Ratio with 95% confidence intervals (CI). Top panel includes variables that were significantly associated with matching, while the bottom panel shows those variables that did not reach statistical significance. OR greater than 1 indicate increased odds of matching, while OR less than 1 indicate decreased odds of matching.

Figure 3.

Percent of applicants matching based on Step 1 scores. Error bars indicate 95% confidence intervals. * indicates comparison with the 1st quartile. Applicants with scores in the 2nd, 3rd, and 4th quartiles were significantly more likely to match than those with scores in the 1st, all with a p value of <0.0001. Applicants in the 4th quartile were significantly more likely to match than those in the 2nd ($p = 0.03$), but not compared to the 3rd quartile ($p = 0.11$). Applicants in the 3rd quartile were more likely to match than those in the 2nd ($p = 0.03$).

Table

Demographics

Application	N	Percent
2009	281	19.0%
2010	270	18.3%
2011	284	19.2%
2012	291	19.7%
2013	353	23.9%
Total	1479	
Gender	Mean	Percent
Male	980	66.3%
Female	499	33.7%
Age	Mean	SD
	27	3
USMLE Step 1	Mean	SD
	240	16