# AOA Critical Issues in Education

# Current Orthopaedic Residency Letters of Recommendation Are Not Biased by Gender of Applicant

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**Background:** Letters of recommendation (LORs) are highly influential in the residency selection process. Differences in language and length of LORs by gender have been demonstrated for applicants applying to surgical residencies and fellowships. This had yet to be studied in orthopaedic surgery. Given the gender disparity in the field, we sought to investigate the impact of gender on orthopaedic residency applicant LORs. We hypothesized that differences in length and language would be present for women applicants as compared to men.

**Methods:** LORs for 2019 to 2020 applicants who applied to a single academic institution were selected for review. Female and male applicants were matched by medical school attended and United States Medical Licensing Examination Step 1 score. LORs were analyzed using both qualitative and quantitative analyses. Letters were evaluated for their word count, presence of language terms, and frequency of language terms. A similar subgroup language analysis was performed for standardized LORs (SLORs).

**Results:** Six hundred fifty-six applicants met the initial screening criteria—126 women and 530 men. After matching, 71 female applicants were paired with 111 male applicants. Word count was, on average, longer for female applicants. LORs for female applicants were more likely to contain language terms that characterized their ability, achievement, participation in athletics, awards received, fit, leadership, and personality traits. Of these terms, ability and participation in athletics were also found more frequently in LORs written for women. In addition, language characterizing technical skills was found more frequently in LORs of female applicants. Similar codes were found to be statistically significant in the SLOR subgroup analysis.

**Conclusion:** This study highlights that current orthopaedic surgery residency LORs do not appear to be biased by applicant gender. LORs were longer for female applicants and described them more positively. Future female orthopaedic residency applicants should be assured that current female candidates are applying with at least similar if not greater subjective qualifications to their male counterparts based on the findings of this study.

L etters of recommendation (LORs) are highly influential in the residency selection process because they are ranked by surgery program directors to be the second most important factor used to select applicants for interviews— United States Medical Licensing Examination (USMLE) scores are first[1]. Therefore, of the subjective (e.g., Dean's letter and

LORs) and relatively objective (e.g., USMLE scores and clerkship grades) components of the Electronic Residency Application Service (ERAS), LORs are the most highly weighted subjective piece of the application. Because of the subjective nature of LORs, the presence of gender bias is a real possibility and should be of concern. Studies in academic medicine have drawn on the social role theory of sex differences to evaluate gender bias in LORs[2-5]. This theory highlights how men are generally described in agentic terms (i.e., descriptions of assertiveness, independence, and self-confidence) and women in communal terms (i.e., descriptions of sympathy, sensitivity, and nurturance). Previous work has shown that communal characteristics have a negative relationship with hiring decisions[4]. In addition to language differences by gender, studies have also revealed difference in letter length, which is relevant because longer letters have been associated with higher favorability in the trainee review process[6,7]. Differences in language and length by gender have been demonstrated for applicants applying to surgical residencies and fellowships—general surgery, otolaryngology, and transplant surgery—outside the field of orthopaedic surgery[2,3,6,8,9].

The lack of gender diversity in orthopaedic surgery has been an increasing topic of discussion among the profession. With women comprising nearly 50% of medical students in the recent years[10], orthopaedic surgery remains the medical specialty with the lowest proportion of female residents at around 14%[11]. Over the years, the percentage of women in orthopaedics has increased, yet this percentage increase has lagged behind other male-dominated specialties[11]. Barriers to improvements in gender diversity in the field are multifactorial but are thought to be related to the lack of female mentors in academic orthopaedic surgery and a lack of early exposure in the field[12,13]. There is also the possibility that gender bias plays a role in widening the gender gap.

In this context, the purpose of this study was to evaluate LOR differences in length and language by gender for orthopaedic surgery residency applicants. Based on previous literature, we hypothesized that differences in length and language would be present for women applicants as compared to men.

## Methods

We performed this study using data from the ERAS for the 2019 to 2020 application cycle. Candidates applying through ERAS to a single academic institution during the 2019 to 2020 application cycle were screened for their eligibility to be included in the study. Applicants were included if they were first-time applicants to orthopaedic surgery residency through ERAS, received a USMLE Step 1 score of 200 or greater, and were enrolled in a US medical school. Those who did not meet these criteria were excluded. ERAS provides 2 gender choices (male or female) for applicants; therefore, gender was considered a dichotomous variable in this study. After the initial screening, female applicants were matched with male applicants by medical school and USMLE Step 1 scores within 5 points. If there were several male applicants who attended the same medical school as a female applicant with a Step 1 score in the required range, they all were added to the analysis.

The letters from these matched applicants were downloaded from ERAS in portable document format (pdf) and then converted to Microsoft Word documents to remove applicant names, letter writer names, Association of American Medical Colleges numbers, and ERAS numbers from the LORs. Removal of applicant and letter writer information also included the removal of salutation and signature components from the letters. After the removal, LOR word count was determined using Microsoft Word's Word Count function. Letters were reviewed and corrected for any conversion errors. Deidentified documents were imported into Dedoose version 8.3.17—web application for managing, analyzing, and presenting qualitative and mixed method research data (Los Angeles, CA: SocioCultural Research Consultants, LLC www.dedoose.com, 2020).

The following categories of language terms (codes) were selected a priori based on literature review and entered into Dedoose: ability[2,14,15], academic background[2], achievement[2,15], agency[2,4], authority established[2], awards[2], career choice[2], clinical skills[2,7], communal[2,4], community service[2], doubt raisers[2,6], family[2], fit[2], fund of knowledge[2,7], future promise[2], grindstone adjectives[2,14,15], hardship[2], initiative[2], judgment[2,7], leadership[2], legacy[2], personality traits[2,7], physical description[2], personal but general terms[2], presentations[2], receptive to feedback[2], recruitment[2], research[2,14,15], scholarship[2], standout adjectives[2,14,15]/superlatives[2], teaching[2,14,15]/mentoring[2], teamwork[2], technical skills[2,7], and work habits[2,7]/work ethic[2]. Qualitative codes were refined while reading through the LORs, and the codes that emerged were the following: athletics, strong support, top student, and ranked highly were added to the recruitment category. Codes are defined in Appendix 1.

Letters were evaluated for their presence of code use (dichotomous variable) and frequency of code use (continuous variable). They were reviewed and coded by 2 researchers (S.A.L. and N.E.G). Discussion and review of 10% of cases allowed for consensus in coding—a similar process to what has been described in other published studies on this topic[2]. An identical language subgroup analysis was performed on letters associated with SLORs.

Descriptive statistics was used to evaluate letter writer factors. *T*-test was used for parametric data, and Wilcoxon rank sum test was used for nonparametric data. Chi-square test was performed for dichotomous outcomes. Stata Software (StataCorp. 2019. *Stata Statistical Software: Release 16*. College Station, TX: StataCorp LLC) was used to perform all statistical analysis. The study was determined to not require Institutional Review Board (IRB) approval after submitting it for internal IRB review.

## Results

### Applicants

Six hundred fifty-six applicants met the initial screening criteria—126 women and 530 men. After matching by medical school and USMLE Step 1 scores, 71 female applicants were paired with 111 male applicants. Statistical analysis showed no difference between mean USMLE Step 1 scores for

men and women, 249.85 and 249.93, respectively (p-value 0.37). The number of scholarly studies was similar between the 2 groups. These included counts of peer-reviewed journal articles/abstracts, poster/podium presentations, and the composite of these scholarly studies (p-values 0.14, 0.13, and 0.12, respectively).

*Letter Writers*
There were 650 LORs from 51 institutions that were written in support of these applicants. Two hundred forty-six letters were written for female applicants and 404 for male applicants. For faculty, 73 (11.23%) letters were written by female faculty, 525 (80.77%) letters were written by male faculty, and 52 (8%) letters were written by a group. The breakdown of letter writers by faculty rank and role can be found in Table I. Of the 650 LORs, 458 (70.46%) are associated with a standard letter of recommendation (SLOR)—178 of these letters were written for women and 280 for men.

*Letters*
The average number of LORs for men and women was similar at 3.70 and 3.74, respectively (p-value 0.83). Average word count was significantly longer for female applicants than their male counterparts—a mean of 316.83 for women and 288.45 for men (p-value 0.04).

Certain differences in language were found when comparing LORs for male and female applicants (Tables II–V). When looking at language codes for all LORs from a dichotomous standpoint (presence vs absence in a letter), ability, achievement, participation in athletics, awards, fit, leadership, personality traits, and presentations were more likely to be mentioned in LORs for female applicants than male applicants (Table II). In addition, ability, athletics, leadership, and technical skills were mentioned more frequently for female applicants (Table III).

When comparing the subgroup of letters associated with SLORs for male and female applicants, achievement, participation in athletics, awards, fit, personality traits, and presentations were more likely to be mentioned in SLORs (Table IV). In addition, achievement, participation in athletics, leadership, and technical skills were found to be mentioned more frequently for female applicants (Table V). All other language terms were not significantly different in their gender distribution.

## Discussion

LORs are highly influential in the orthopaedic residency selection process[1]. Studies in academic medicine have shown differences in language and length by gender[2-4,6,8,9]. There have been no studies in the field of orthopaedic surgery that have evaluated the impact of applicant gender on LORs; therefore, we sought to evaluate the influence of applicant gender on residency LOR length and language.

In our study, we found the LOR word count to be longer for female applicants. We also found significant differences in the language used to characterize male and female applicants. LORs for female applicants were more likely to contain language terms that characterized their ability, achievement, participation in athletics, awards received, fit, leadership, and personality traits. Of these terms, ability and participation in athletics were also found more frequently in LORs written for women. In addition, language characterizing technical skills was found more frequently in LORs of female applicants. When looking at these language terms in the SLOR subgroup analysis, many of the same codes were found to be significant in both presence and frequency.

The SLOR subgroup analysis was performed to determine if there were meaningful differences when the SLOR was evaluated outside of traditional LORs. SLORs were recommended for orthopaedic surgery applications by the American Orthopaedic Association Council of Orthopaedic Residency Directors in 2017 in an effort to standardize the assessment and allow for a more meaningful comparison of orthopaedic applicants. Given their recent introduction into the application process, there have been few studies evaluating their effectiveness[8]. There has yet to be any comparison between traditional LORs and SLORs in the orthopaedic literature. A study in the otolaryngology head and neck surgery literature compared SLORs with traditional LORs for language and gender, and they found that female applicants were less likely to be described as "bright" and more likely to have their appearance mentioned in traditional letters than SLORs[8]. For these reasons, we performed a subgroup analysis, which resulted in very similar findings to that of LORs as a composite (Tables IV and V).

| TABLE I Number of LORs by Faculty Gender, Role, and Rank | |
| --- | --- |
|  | No. of Letters (n = 650) |
| Letters written by female faculty by rank/role | n = 73 (11.23%) |
| Rank | |
| Professor | 20 (27.40%) |
| Associate professor | 25 (34.25%) |
| Assistant professor | 27 (36.99%) |
| No specified faculty rank | 1 (1.37%) |
| Role | |
| Chair | 3 (4.11%) |
| Program director | 10 (13.70%) |
| Letters written by male faculty by rank/role | n = 525 (80.77%) |
| Rank | |
| Professor | 216 (41.14%) |
| Associate professor | 167 (31.81%) |
| Assistant professor | 125 (23.81%) |
| No specified faculty rank | 17 (3.24%) |
| Role | |
| Chair | 118 (22.48%) |
| Program director | 68 (12.95%) |
| Group letters | n = 52 (8.00%) |

| Code | Total Frequency Count | Applicant | | p |
| --- | --- | --- | --- | --- |
| | | Female Frequency Count (n = 178) | Male Frequency Count (n = 280) | |
| Ability | 403 | 188 | 215 | 0.04 |
| Academic background | 135 | 60 | 75 | 0.10 |
| Achievement | 189 | 84 | 105 | 0.04 |
| Agency | 174 | 77 | 97 | 0.32 |
| Athletics | 98 | 54 | 44 | <0.001 |
| Authority established | 31 | 11 | 20 | 0.69 |
| Awards | 142 | 72 | 70 | 0.03 |
| Career choice | 6 | 4 | 2 | 0.33 |
| Clinical skills | 284 | 127 | 157 | 0.16 |
| Communal | 193 | 92 | 101 | 0.10 |
| Community service | 80 | 28 | 52 | 0.64 |
| Doubt raiser | 28 | 11 | 17 | 0.89 |
| Family | 2 | 1 | 1 | 0.75 |
| Fit | 46 | 26 | 20 | 0.04 |
| Fund of knowledge | 198 | 78 | 120 | 0.79 |
| Future promise | 380 | 160 | 220 | 0.37 |
| Grindstone | 439 | 190 | 249 | 0.12 |
| Hardship | 13 | 7 | 6 | 0.28 |
| Initiative | 129 | 62 | 67 | 0.07 |
| Judgment | 5 | 2 | 3 | 0.96 |
| Leadership | 150 | 71 | 79 | 0.04 |
| Legacy | 10 | 4 | 6 | 0.73 |
| Personality traits | 231 | 110 | 121 | 0.04 |
| Physical description | 7 | 2 | 5 | 0.57 |
| Positive but general | 380 | 157 | 223 | 0.42 |
| Presentations | 131 | 65 | 66 | 0.008 |
| Receptive to feedback | 39 | 20 | 19 | 0.18 |
| Recruitment/ranked highly | 239 | 108 | 131 | 0.22 |
| Research | 326 | 125 | 201 | 0.64 |
| Scholarship | 147 | 56 | 91 | 0.46 |
| Standout adjectives/superlatives | 387 | 178 | 209 | 0.11 |
| Strong support | 236 | 94 | 142 | 0.96 |
| Teaching/mentoring | 55 | 20 | 35 | 0.64 |
| Teamwork | 164 | 71 | 93 | 0.41 |
| Technical skills | 130 | 65 | 65 | 0.10 |
| Top student | 156 | 72 | 84 | 0.24 |
| Work habits/ethic | 213 | 80 | 133 | 0.66 |

**TABLE II Codes Counted in All LORs by Applicant Gender Listed by Presence of Code**

Regarding language, the results of our study show some similarities and notable differences when compared with related studies in academic medicine[2-4,6,8,9]. A study by Madera et al. evaluated the differences between LORs for junior faculty members applying to a single institution[4]. This study drew from the social role theory of sex differences in that men are generally described in agentic terms and women in communal terms. Their study supported their hypothesis and found that women were more described as communal and less agentic than men and that communal characteristics had a negative relationship with hiring decisions in academia[4]. In the current literature evaluating trainee LORs written for applicants to

| TABLE III Codes Counted in All LORs by Applicant Gender Listed by Frequency | | | | |
| --- | --- | --- | --- | --- |
| | | Applicant | | |
| Code | Total Frequency Count | Female Frequency Count (n = 246) | Male Frequency Count (n = 404) | p |
| Ability | 641 | 283 | 358 | 0.03 |
| Academic background | 216 | 87 | 129 | 0.44 |
| Achievement | 295 | 126 | 169 | 0.05 |
| Agency | 237 | 107 | 130 | 0.09 |
| Athletics | 142 | 78 | 64 | <0.001 |
| Authority established | 49 | 19 | 30 | 0.89 |
| Awards | 221 | 105 | 116 | 0.05 |
| Career choice | 10 | 5 | 5 | 0.78 |
| Clinical skills | 400 | 177 | 223 | 0.06 |
| Communal | 269 | 122 | 147 | 0.15 |
| Community service | 113 | 40 | 73 | 0.79 |
| Doubt raiser | 36 | 15 | 21 | 0.91 |
| Family | 2 | 1 | 1 | 0.72 |
| Fit | 63 | 31 | 32 | 0.09 |
| Fund of knowledge | 278 | 109 | 169 | 0.86 |
| Future promise | 577 | 233 | 344 | 0.56 |
| Grindstone | 646 | 267 | 379 | 0.16 |
| Hardship | 21 | 13 | 8 | 0.07 |
| Initiative | 193 | 88 | 105 | 0.07 |
| Judgment | 8 | 4 | 4 | 0.78 |
| Leadership | 209 | 98 | 111 | 0.04 |
| Legacy | 15 | 6 | 9 | 0.47 |
| Personality traits | 338 | 150 | 188 | 0.11 |
| Physical description | 7 | 2 | 5 | 0.61 |
| Positive but general | 571 | 235 | 336 | 0.23 |
| Presentations | 205 | 93 | 112 | 0.05 |
| Receptive to feedback | 48 | 25 | 23 | 0.07 |
| Recruitment/ranked highly | 341 | 152 | 189 | 0.08 |
| Research | 486 | 185 | 301 | 0.78 |
| Scholarship | 238 | 89 | 149 | 0.26 |
| Standout adjectives/superlatives | 582 | 260 | 322 | 0.06 |
| Strong support | 369 | 139 | 230 | 0.94 |
| Teaching/mentoring | 93 | 41 | 52 | 0.34 |
| Teamwork | 223 | 95 | 128 | 0.26 |
| Technical skills | 180 | 92 | 88 | 0.007 |
| Top student | 220 | 97 | 123 | 0.26 |
| Work habits/ethic | 321 | 116 | 205 | 0.54 |

various surgical specialties, most studies have found no differences in the use of agentic or communal terms based on gender[2,16]. Similarly, our study found no difference in the use of these terms. In addition, the intent to recruit an applicant to stay at the writer's institution for residency—viewed as one of the most positive factors in surgical LOR[7]—appeared equally in letters for men and women. This finding was similar to a study by Turrentine et al. who compared general surgery applicant LORs and gender[2].

Unlike most studies evaluating surgical trainee LORs and gender, our study found differences in language that overall characterized women positively for ability, achievement,

| TABLE IV Codes Counted in SLORs by Applicant Gender Listed by Presence of Code | | | |
| --- | --- | --- | --- |
| | Applicant | | |
| Code | Female Letter Count (n = 178) | Male Letter Count (n = 280) | p |
| Ability | 102 | 146 | 0.28 |
| Academic background | 60 | 74 | 0.10 |
| Achievement | 67 | 78 | 0.03 |
| Agency | 59 | 80 | 0.30 |
| Athletics | 50 | 39 | <0.001 |
| Authority established | 11 | 20 | 0.69 |
| Awards | 46 | 49 | 0.03 |
| Career choice | 3 | 2 | 0.33 |
| Clinical skills | 94 | 133 | 0.27 |
| Communal | 64 | 83 | 0.16 |
| Community service | 27 | 47 | 0.65 |
| Doubt raiser | 9 | 15 | 0.89 |
| Family | 1 | 1 | 0.75 |
| Fit | 23 | 20 | 0.04 |
| Fund of knowledge | 64 | 106 | 0.68 |
| Future promise | 116 | 172 | 0.42 |
| Grindstone | 113 | 153 | 0.06 |
| Hardship | 6 | 5 | 0.28 |
| Initiative | 51 | 61 | 0.10 |
| Judgment | 2 | 3 | 0.96 |
| Leadership | 52 | 59 | 0.05 |
| Legacy | 3 | 6 | 0.73 |
| Personality traits | 80 | 99 | 0.04 |
| Physical description | 2 | 5 | 0.57 |
| Positive but general | 99 | 142 | 0.31 |
| Presentations | 57 | 58 | 0.007 |
| Receptive to feedback | 16 | 16 | 0.18 |
| Recruitment/ranked highly | 87 | 125 | 0.38 |
| Research | 104 | 169 | 0.68 |
| Scholarship | 36 | 66 | 0.40 |
| Standout adjectives/superlatives | 93 | 131 | 0.25 |
| Strong support | 76 | 119 | 0.97 |
| Teaching/mentoring | 20 | 27 | 0.58 |
| Teamwork | 57 | 80 | 0.43 |
| Technical skills | 54 | 66 | 0.11 |
| Top student | 54 | 72 | 0.28 |
| Work habits/ethic | 69 | 111 | 0.85 |

awards received, and leadership. This contrasts with the study by Turrentine et al. who found that male applicants were more likely to be described by these terms. The same study also found that women were more likely to be described by their physical description. There have been several other studies in the surgical literature, showing that female applicants are more likely to be described by their physical characteristics than male applicants[2,8,9]. To the contrary, we found no difference between the 2 groups regarding physical description.

Importantly, descriptions of a good fit were more likely to be mentioned in letters for female than male applicants although overall counts were similar. This may be of particular

| | Applicant | | |
| TABLE V Codes Counted in SLORs by Applicant Gender Listed by Frequency | | | |
| Code | Female Letter Count (n = 246) | Male Letter Count (n = 404) | p |
|---|---|---|---|
| Ability | 149 | 221 | 0.14 |
| Academic background | 86 | 129 | 0.43 |
| Achievement | 96 | 126 | 0.04 |
| Agency | 81 | 107 | 0.08 |
| Athletics | 71 | 60 | <0.001 |
| Authority established | 19 | 30 | 0.89 |
| Awards | 64 | 79 | 0.05 |
| Career choice | 3 | 6 | 0.78 |
| Clinical skills | 129 | 185 | 0.10 |
| Communal | 87 | 126 | 0.27 |
| Community service | 39 | 67 | 0.81 |
| Doubt raiser | 12 | 19 | 0.92 |
| Family | 1 | 1 | 0.72 |
| Fit | 28 | 30 | 0.09 |
| Fund of knowledge | 91 | 149 | 0.98 |
| Future promise | 166 | 261 | 0.45 |
| Grindstone | 153 | 232 | 0.23 |
| Hardship | 10 | 7 | 0.07 |
| Initiative | 70 | 92 | 0.10 |
| Judgment | 3 | 4 | 0.78 |
| Leadership | 70 | 86 | 0.04 |
| Legacy | 4 | 10 | 0.47 |
| Personality traits | 107 | 151 | 0.12 |
| Physical description | 2 | 5 | 0.61 |
| Positive but general | 145 | 219 | 0.24 |
| Presentations | 81 | 105 | 0.06 |
| Receptive to feedback | 21 | 20 | 0.07 |
| Recruitment/ranked highly | 122 | 178 | 0.17 |
| Research | 150 | 255 | 0.58 |
| Scholarship | 53 | 106 | 0.18 |
| Standout adjectives/superlatives | 135 | 199 | 0.16 |
| Strong support | 114 | 185 | 0.90 |
| Teaching/mentoring | 33 | 44 | 0.33 |
| Teamwork | 76 | 109 | 0.28 |
| Technical skills | 77 | 89 | 0.009 |
| Top student | 73 | 105 | 0.31 |
| Work habits/ethic | 94 | 161 | 0.68 |

importance given the current times where medical students will be participating less in away rotations for the foreseeable future secondary to the global pandemic. The literature on orthopaedic away rotations has highlighted that program directors value away rotations for finding a "good fit"[17]. In times like these, where personal interactions are limited, descriptions of fit in LORs could become more important—particularly when an applicant does not represent the majority, making assumptions of good fit less likely to be made.

For letter length, our study found that residency LORs for women were longer. Turrentine et al. observed that general surgery residency LORs were on average longer for men,

whereas French et al. found no difference[2,15]. Previous work has associated longer letter with higher favorability in the review process[6,7].

Although the reason behind longer letters and more positive language used to describe female candidates during this application cycle is beyond the scope of this study, this may either accurately reflect the applicant pool or represent more attention being paid to equity for female applicants. In relation to the former, it is very plausible that imposter syndrome plays a role for female applicants applying into orthopaedic surgery. This phenomenon is when an individual doubts his/her competence and has persistent fear of being exposed as a fraud despite objective evidence that he/she is capable of. In particular, for women, the literature has shown that women are less likely to view themselves as qualified despite being similarly qualified to their male counterparts[18,19]. In this sense, the orthopaedic applicant pool could be affected by imposter syndrome.

In addition to the inability to identify reasons for language differences, this study has several other limitations. We analyzed LORs from a single application cycle to a single academic institution and matched the candidates, which does exclude some applicants. Despite this, we do feel that our sample was relatively representative of the applicant pool. We used a low threshold for our initial screen (USMLE Step 1 score of 200) to try to minimize the exclusion of applicants. Matching was used to limit confounding although we do realize that this could also lead to selection bias. There were several factors that could have been chosen for matching applicants, but we specifically chose medical school and USMLE Step 1 score because these are more objective factors than clerkship grades, Alpha Omega Alpha status, and the Medical School Performance Evaluation, which have all been suggested to be influenced by bias[15,20-22]. We did not control for scholarly endeavors, such as publications or presentations, a priori; nevertheless, these were found to be similar between the 2 groups in our analysis. Pronouns were not removed from the letters, so coder bias is a also consideration; however, this does not appear to be the case, as the letters were reviewed by 2 female authors, and the findings are actually contrary to what the authors hypothesized based on previous literature. The authors also recognize that there are individuals who do not identify with the binary gender system of male and female participants. The binary approach to gender was used in this study given that ERAS only provides these 2 gender choices for applicants and letter writers.

For future direction, a study evaluating the perceived qualifications to apply into orthopaedic surgery and differences in this perception based on gender could be conducted. This study would be interesting to compare with the general body of literature on gender and job applications. In addition, an analysis of the impact of gender on LORs over several years would be interesting for the evaluation of trends in language and word count.

## Conclusion

This study highlights that current orthopaedic surgery residency LORs do not appear to be biased by applicant gender. LORs were longer for women and described female applicants positively for their abilities, achievements, leadership, and good fit in orthopaedic surgery, to name a few. This is unlike previous studies in academic medicine that have shown female applicants to be characterized by communal terms[3,4] and their physical characteristics[2,8,9]. Future female applicants to orthopaedic surgery residency should be assured that current female candidates are applying with at least similar subjective qualifications to their male counterparts based on the findings of this study.

## 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/A274). This content was not copy-edited or verified by JBJS. ∎

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## References

1. Main residency match data and reports. The Match, National Resident Matching Program. Available at: http://www.nrmp.org/main-residency-match-data/. Accessed December 26, 2019.

2. Turrentine FE, Dreisbach CN, St Ivany AR, Hanks JB, Schroen AT. Influence of gender on surgical residency applicants' recommendation letters. J Am Coll Surg. 2019;228(4):356-65.e3.

**3.** Hoffman A, Grant W, McCormick M, Jezewski E, Matemavi P, Langnas A. Gendered differences in letters of recommendation for transplant surgery fellowship applicants. J Surg Education. 2019;76(2):427-32.

**4.** Madera JM, Hebl MR, Martin RC. Gender and letters of recommendation for academia: agentic and communal differences. J Appl Psychol. 2009;94(6):1591-9.

**5.** Grimm LJ, Redmond RA, Campbell JC, Rosette AS. Gender and racial bias in radiology residency letters of recommendation. J Am Coll Radiol. 2020;17(1 pt A):64-71.

**6.** Trix F, Psenka C. Exploring the color of glass: letters of recommendation for female and male medical faculty. Discourse Soc. 2003;14(2):191-220.

**7.** Greenburg AG, Doyle J, McClure DK. Letters of recommendation for surgical residencies: what they say and what they mean. J Surg Res. 1994;56(2):192-8.

**8.** Friedman R, Fang CH, Hasbun J, Han H, Mady LJ, Eloy JA, Kalyoussef E. Use of standardized letters of recommendation for otolaryngology head and neck surgery residency and the impact of gender. The Laryngoscope. 2017;127(12):2738-45.

**9.** Messner AH, Shimahara E. Letters of recommendation to an otolaryngology/head and neck surgery residency program: their function and the role of gender. The Laryngoscope. 2008;118(8):1335-44.

**10.** 2019 Facts: enrollment, graduates, and MD-PhD data. AAMC. https://www.aamc.org/data-reports/students-residents/interactive-data/2019-facts-enrollment-graduates-and-md-phd-data. Accessed December 25, 2019.

**11.** Chambers CC, Ihnow SB, Monroe EJ, Suleiman LI. Women in orthopaedic surgery: population trends in trainees and practicing surgeons. J Bone Jt Surg Am. 2018;100(17):e116.

**12.** Hill JF, Yule A, Zurakowski D, Day CS. Residents' perceptions of sex diversity in orthopaedic surgery. J Bone Jt Surg Am. 2013;95(19):e1441-1446.

**13.** Van Heest AE, Fishman F, Agel J. A 5-year update on the uneven distribution of women in orthopaedic surgery residency training programs in the United States. J Bone Jt Surg Am. 2016;98(15):e64.

**14.** Schmader T, Whitehead J, Wysocki VH. A linguistic comparison of letters of recommendation for male and female chemistry and biochemistry job applicants. Sex Roles. 2007;57(7):509-14.

**15.** Isaac C, Chertoff J, Lee B, Carnes M. Do students' and authors' genders affect evaluations? A linguistic analysis of Medical Student Performance Evaluations. Acad Med. 2011;86(1):59-66.

**16.** French JC, Zolin SJ, Lampert E, et alet al. Gender and letters of recommendation: a linguistic comparison of the impact of gender on general surgery residency Applicants☆. J Surg Education. 2019;76(4):899-905.

**17.** O'Donnell SW, Drolet BC, Brower JP, LaPorte D, Eberson CP. Orthopaedic surgery residency: perspectives of applicants and program directors on medical student away rotations. J Am Acad Orthop Surg. 2017;25(1):61-8.

**18.** Exley CL, Kessler JB. The gender gap in self-promotion. 2019. https://www.hbs.edu/faculty/Pages/item.aspx?num=57092. Accessed June 16, 2020.

**19.** Mohr TS. Why women don't apply for jobs unless They're 100% qualified. Harvard Business Review. 2014. https://hbr.org/2014/08/why-women-dont-apply-for-jobs-unless-theyre-100-qualified. Accessed June 16, 2020.

**20.** Boatright D, Ross D, O'Connor P, Moore E, Nunez-Smith M. Racial disparities in medical student membership in the Alpha Omega Alpha Honor society. JAMA Intern Med. 2017;177(5):659-65.

**21.** Teherani A, Hauer KE, Fernandez A, King TE, Lucey C. How small differences in assessed clinical performance amplify to large differences in grades and awards: a cascade with serious consequences for students underrepresented in medicine. Acad Med. 2018;93(9):1286-92.

**22.** Low D, Pollack SW, Liao ZC, et alet al. Racial/ethnic disparities in clinical grading in medical school. Teach Learn Med. 2019;31(5):487-96.