



Gendered Language in Letters of Recommendation for Applicants to Pulmonary Critical Care Fellowships

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ABSTRACT

Background: Previous work has demonstrated letters of recommendation for women in academic medicine are shorter and emphasize communal traits over grindstone or agentic traits.

Objective: To determine if there are sex-based differences in letters of recommendation written for applicants applying to pulmonary critical care medicine fellowships and if the sex of the letter writer impacts these differences.

Methods: All fellowship applications submitted to a pulmonary critical care medicine fellowship program in 2020 were included in this study. The applicant demographics and self-reported accomplishments were extracted from their application. The sex of letter writers was identified through public online searches. Word count and language differences in the letters of recommendation were analyzed for each applicant using the Linguistic Inquiry and Word Count (LIWC2015) program. Multivariable linear regressions were performed controlling for applicant characteristics to identify if applicant sex was associated with total word counts and total agentic word counts.

Results: Of the 529 complete applications, 2,024 letters of recommendation were reviewed. A majority of the applicants (70%, $n = 370/530$) and letter writers (75%, $n = 1,515/2,024$) were male. When adjusting for applicant demographic and accomplishments, female applicants had longer letters of recommendation (30.91 words

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longer, 95% confidence interval [CI], 1.53–60.29; $P=0.04$) and more supportive letters (3.27 words longer, 95% CI, 1.59–4.95; $P<0.01$) as compared with male applicants. Female letter writers wrote longer and more supportive letters than male letter writers, and this difference was greatest for female applicants.

Conclusion: Female applicants received longer and more supportive letters of recommendation. Further work is needed to understand if this finding is the beginning of a change in the letters of recommendation for female applicants.

Keywords:

letters of recommendation; bias; sex; graduate medical education; pulmonary and critical care

Letters of recommendation are required for fellowship applications and are heavily weighed by fellowship selection committees (1). Prior work has shown that letters of recommendation for female applicants compared with male applicants were shorter, contain more communal adjectives, and are less likely to emphasize research accomplishments and ability (2–8). These subtle differences in the letters of recommendation continue to propagate systemic biases that can be detrimental to female applicants when compared with male applicants (6). Recommendations for language that should be used cautiously for female

applicants have, however, become broadly available and a subject of discussion (9).

In prior work, male mentors are reported to provide more sponsorship experiences (e.g., invitation to write an editorial, serve as a panelist at a national meeting/oral discussant, etc.) for female mentees as compared with female mentors (10). Mentorship and sponsorship often entail writing supportive letters of recommendation, and how sex concordance of the mentee/applicant and mentor/letter writer interacts has been an area of growing interest (11, 12). The results are conflicting whether female letter writers write different letters of recommendation than male letter

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writers (11, 12). How this translates to letter writers in pulmonary and critical care medicine (PCCM), a historically male-dominated field, is unknown.

In light of this gap and in conjunction with our division's diversity, equity, and inclusion efforts to minimize implicit bias in recruitment, we used a quality improvement lens to investigate if letters of recommendation for female PCCM applicants differed in length or language from letters for male applicants.

Furthermore, we evaluated if the sex of the letter writer contributed to these differences. We hypothesized that 1) female applicants would have shorter and more gendered letters of recommendation as compared with male applicants; and 2) male letter writers would write more supportive letters of recommendation for female applicants as compared with female letter writers.

METHODS

Study Population

All applicants to the University of Michigan PCCM fellowship in 2020 were included in the study. Applications were excluded if letters of recommendation were missing.

The applicants self-reported sex, race, accomplishments, publications, volunteer work, work experiences, chief medical resident status (CMR), and Alpha Omega Alpha (AOA) status were extracted into REDCap (Research Electronic Data Capture), a deidentified electronic database (13). REDCap is a secure web-based application designed to support data capture for research studies, providing 1) an intuitive interface for validated data entry; 2) audit trails for tracking data manipulation and export procedures; 3) automated export procedures for seamless data downloads to common statistical packages; and

4) procedures for importing data from external sources.

Applicants were defined as underrepresented in medicine (URiM) as per the definition used by the Association of American Medical Colleges as "any U.S. citizen or permanent resident who self-identified as one or more of the following race/ethnicity categories (alone or in combination with any other race/ethnicity category): American Indian or Alaska Native; Black or African American; Hispanic, Latino, or of Spanish origin; or Native Hawaiian or Other Pacific Islander" (14). International medical graduate applicants were not identified.

The sex for each letter writer was identified through internet searches. University, hospital, and professional websites (e.g., Doximity and Linked-In) were searched for the author's pronouns (15). If no pronouns were able to be identified, the author's sex was listed as unknown.

Data Dictionary

A custom data dictionary was built for use in the LIWC2015 program; Pennebaker Conglomerates, Inc.). This program is a word count-based text analysis program that quantifies language metrics. It has been previously used in multiple studies and fields to study the language used in letters of recommendation (3–6, 11, 16).

The data dictionary was created on the basis of prior literature to capture the different adjectives used in letters of recommendation, that encompass communal, grindstone, social-communal, positive and negative agentic, ability, standout, and research traits (5, 6, 9, 11) (Table 1). A composite outcome to measure the degree of support present in each letter was created by including all of the grindstone, positive agentic, research, ability, and standout words (Table E1 in the

Table 1. Abbreviated example of the terms used in linguistic inquiry and word count following linguistic inquiry and word count 2015 (LIWC2015) program

Communal	Grindstone	Social– Communal	Positive Agentic	Negative Agentic	Ability	Standout	Research
Affectionate	Assiduous	Babies	Able	Daring	Ability	Amazing	Abstract*
Agreeable	Busy	Brothers	Ambitious	Forceful	Accomplished	Best	Author*
Approachable	Careful	Children	Assertive	Outspoken	Adept	Excellent	Conference*
Calm	Conscientious	Colleagues	Bright	Provocative	Adroit	Exceptional	Contribution
Caring	Dedicated	Dad	Bright future	Reserved	Analytical	Extraordinary	Data
Cheerful	Dedication	Family	Capable		Aptitude	Extremely	Discover
Compassion*	Dependable	Gentleman	Clever		Beyond expected amount	Fabulous	Experiment

*The root words the LIWC program will search.

data supplement). The LIWC2015 program requires exact matching; therefore, modifications need to be added to the dictionary (e.g., aspirational and aspirat*). The dictionary was then applied to 50 randomly selected letters, and additional words were added to the dictionary in an iterative process until no new words were identified.

All the letters of recommendation were deidentified and cleaned using Adobe Acrobat Pro DC. Letterheads, salutations, dates, and signatures were removed from each letter before being processed by LIWC2015.

Statistical Analysis

We present applicant and letter writer characteristics as counts (percentages), means (standard deviations [SDs]), or medians (interquartile ranges [IQRs]) as appropriate. We used the applicant as the unit of analysis unless otherwise specified. We used two-sided significance testing and considered $P < 0.05$ to be statistically significant.

We performed multivariable linear regression analysis to identify if female applicants had shorter letters of recommendation compared with male applicants, adjusting for ethnicity, total number of publications, presentations, activities, and CMR and AOA status. When the sex of the author was unknown, those letters were dropped from the analysis.

We subsequently performed a multivariable linear regression analysis to identify if female applicants had less supportive letters of recommendation on the basis of the composite outcome as compared with male applicants adjusting for ethnicity, the total number of publications, presentations, activities, and CMR and AOA status.

Sensitivity Analysis

We subsequently performed a multivariable linear regression analysis to identify if URiM and Asian applicants had less supportive letters of recommendation on the basis of the total word count and composite outcome adjusting for total number of publications, presentations, activities, CMR status, AOA status, and sex of the letter writer. We conducted all statistical analyses with Stata software 15.1 (StataCorp).

RESULTS

Of the 530 applications received in 2020, 529 applications were included in the

study; one was excluded because there were no letters of recommendation submitted. The majority of the applicants were male (70%, $n = 369/529$) (Table 2). Letter writers were predominately male (75%, $n = 1,515/2,024$) (Table 2). However, female applicants, as compared with male applicants, were less likely to have male letter writers (unadjusted odds ratio, 0.72 [95% confidence interval (CI): 0.57–0.89]; P value = 0.02).

Female applicants received longer letters of recommendation (total word count: 528; SD, 319) as compared with male applicants (total word count: 491; SD, 298) (Table 2). Female applicants received longer letters of recommendation from

Table 2. Applicant demographics

Variable	Female Applicant, $n = 160$	Male Applicant, $n = 369$
Race, n (%)		
White	53 (33)	148 (40)
Asian	69 (43)	116 (31)
URiM	16 (10)	52 (14)
Other	22 (14)	53 (14)
Applicant total research activities, n (IQR)*	9 (5–16)	9 (5–14)
AOA, n (%)	12 (7.5)	23 (6.3)
CMR, n (%)	46 (28.9)	104 (28.3)
Letters of recommendation, mean (SD)	4 (0.4)	4 (0.4)
Word count per letter of recommendation, mean (SD)	528 (319)	491 (298)
Letter writers	609	1415
Female, n (%)	178 (29.2)	323 (22.8)
Male, n (%)	429 (70.4)	1086 (76.8)
Unknown, n (%)	2 (0.3)	6 (0.4)

Definition of abbreviations: AOA = alpha omega alpha; CMR = chief medical resident; IQR = interquartile range; SD = standard deviation; URiM = underrepresented in medicine defined as per Association of American Medical Colleges.

*Applicant research activities included peer-viewed abstracts, posters, oral presentations, book chapters, and online publications.

female and male letter writers as compared with male applicants, and their letters included more words in the following categories: grindstone,

social–communal, positive and negative agentic, ability, standout, and research (Table 3). Although male applicants received more communal words than

Table 3. Average word counts by the sex of applicant and letter writer

Variables (word count), mean (SD) Word count	Sex of Letter Writer	
	Male	Female
Male	467 (266)	570 (377)
Female	501 (285)	599 (384)
Communal words		
Male	3.32 (2.85)	4.26 (3.80)
Female	3.65 (3.20)	4.11 (3.70)
Grindstone words		
Male	4.03 (3.14)	5.00 (4.12)
Female	4.35 (3.44)	5.37 (4.51)
Social communal		
Male	0.67 (1.02)	0.80 (1.14)
Female	0.79 (1.05)	0.79 (1.17)
Positive agentic words		
Male	5.81 (4.68)	6.98 (5.38)
Female	6.60 (5.35)	7.78 (6.35)
Negative agentic words		
Male	0.01 (0.11)	0.02 (0.12)
Female	0.01 (0.17)	0.02 (0.15)
Ability words		
Male	4.66 (3.69)	5.40 (4.54)
Female	4.89 (3.89)	5.45 (4.92)
Standout words		
Male	4.09 (3.82)	4.74 (4.15)
Female	4.67 (4.30)	5.10 (4.45)
Research		
Male	3.98 (4.71)	5.05 (6.01)
Female	4.87 (5.46)	7.59 (8.28)

Definition of abbreviation: SD = standard deviation.

female applicants from female letter writers, this was not statistically significant ($P=0.13$).

When adjusting for applicant demographics and accomplishments, female applicants had longer letters of recommendation (30.9 words longer; 95% CI, 1.5–60.3; P value = 0.04) and more supportive letters (3.27 words longer; 95% CI, 1.59–4.95; P value < 0.01) as compared with male applicants (Table 4).

Although female applicants received longer and more positive letters from both male and female letter writers, it was more pronounced with female letter writers (Figure 1). In addition, applicants who self-identified as URiM and Asian received shorter letters of recommendation, and Asian applicants received less supportive letters of recommendation in the adjusted analysis (Table 4).

Table 4. Applicant demographics and accomplishments associated with a letter of recommendation length and the composite outcome

Variables	Total Words		Composite	
	Coefficient (95% CI)	P value	Coefficient (95% CI)	P value
Female applicant (compared with male)	30.91 (1.53 to 60.29)	0.04	3.27 (1.59 to 4.95)	<0.01
Total reported number of activities	0.72 (−1.04 to 2.49)	0.42	0.024 (−0.767 to 0.125)	0.639
Total number of publications	1.17 (−1.11 to 3.45)	0.31	0.169 (0.038 to 0.300)	0.01
Total number of presentations at conferences	2.89 (−0.86 to 6.65)	0.13	0.031 (−0.184 to 0.246)	0.779
Race (as compared with White)				
Asian	−63.10 (−94.92 to −31.28)	<0.01	−3.47 (−5.30 to −1.65)	<0.01
URiM	−55.71 (−98.85 to −12.56)	0.01	−2.02 (−4.49 to 0.45)	0.108
Other	−26.42 (−67.55 to 14.71)	0.21	−2.25 (−4.61 to 0.102)	0.061
AOA: yes (compared with no)	70.40 (16.44 to 124.35)	0.01	5.21 (2.12 to 8.30)	<0.01
CMR: yes (compared with no)	28.30 (−1.24 to 57.84)	0.06	0.46 (−1.23 to 2.14)	0.58
Male letter writer (compared with female)	−95.21 (−125.71 to −64.70)	<0.01	−4.66 (−6.41 to 2.91)	<0.01

Definition of abbreviations: AOA = alpha omega alpha; CI = confidence interval; CMR = chief medical resident; URiM = underrepresented in medicine.

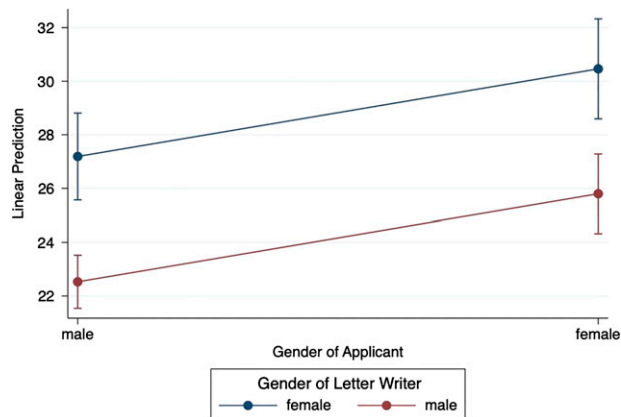


Figure 1. Composite word counts by sex.

In the sensitivity analysis of URiM applicants, male letter writers used fewer words than female letter writers (-113.22 words; 95% CI, -189.77 to -36.67 ; P value < 0.01) despite adjusting for sex, number of service activities, publications, presentation, and CMR status (Table E2A). In addition, URiM applicants with more publications had more composite words (0.43 words; 95% CI, 0.07 – 0.79 ; P value = 0.02) identified in their letters of recommendation when adjusting for sex, number of activities, presentations, CMR status, and sex of the letter writer (Table E2A).

In the sensitivity analysis of Asian applicants, male letter writers used fewer words as compared with female letter writers (-86.56 words; 95% CI, -139.79 to -33.33 ; P value < 0.01) despite adjusting for applicant sex, number of service activities, publications, presentations, and AOA and CMR status (Table E2B). In addition, Asian applicants received less supportive letters from male letter writers as compared with female letter writers (-4.78 words; 95% CI, -7.87 to -1.69 ; P value < 0.01) despite adjusting for applicant sex, number of service activities, publications,

presentations, and AOA and CMR status (Table E2B).

DISCUSSION

Key Findings

To our knowledge, this is the first quality improvement study of PCCM applicants to evaluate for sex bias in the letters of recommendation and to evaluate if the sex of the letter writer contributed to the differences. We found that female applicants not only had longer letters of recommendation but more supportive letters, reflected by the higher number of grindstone, positive agentic, research, ability, and outstanding adjectives used to describe them and their work. Notably, female applicants also received the longest and most supportive letters from female letter writers. URiM and Asian applicants received shorter letters of recommendation, and Asian applicants received less supportive letters even after adjusting for applicant accomplishments.

Relationship to Previous Studies

Over the past several years, multiple publications, professional societies, and the media have highlighted the implicit and explicit biases which exist in letters of recommendation for females in

academia, with specific attention focused on the length of the letters, the discussion of research, and the adjectives used to describe the applicants (2–6, 8, 11, 12, 16–20). However, more recent work evaluating letters of recommendation in radiation oncology and surgery has questioned these findings, suggesting that female applicants were not disadvantaged (17, 19). Our findings build on these more recent publications suggesting progress is being made in the letters of recommendation written on behalf of female applicants. Letters of recommendation for female applicants as compared with male applicants contained more grindstone, social–communal, positive and negative agentic, ability, stand-out, and research words.

Previous work also suggested that the sex of the letter writer may contribute to the words used in the letters of recommendation (12). Our results confirm these findings. Female letter writers wrote longer letters of recommendation as compared with male letter writers for both female and male applicants. However, unlike in prior work, female letter writers used more grindstone, ability, and outstanding adjectives and reflected on the applicant’s research, especially for female applicants. Although not statistically significant, it is interesting that female letter writers used less social–communal adjectives for female applicants as compared with male applicants. It is unclear if this is an intentional omission by female letter writers. In sum, this variability across studies, as well as the methods we report here, suggest a potentially feasible role for large-scale automated surveillance of gendering of language in letters of recommendation as part of a package of “public health surveillance” to evaluate the extent to which academic medicine is

moving toward its stated goals of sex and other equity.

Beyond sex-based differences, research aimed at diversity, equity, and inclusion must also focus on existing differences on the basis of race and ethnicity (21). Significant disparities have been reported in the PCCM pipeline when evaluating the number of URiM residents to the number of URiM fellows (22). Bias in the letters of recommendation may be contributing to this leaky pipeline. Our work suggests that URiM and Asian applicant letters of recommendation were shorter and Asian applicants also had less supportive letters of recommendation. These findings may partially explain the attrition in URiM individuals between application and acceptance to fellowship (22).

Study Implications

Our findings imply that change may be occurring in the letters of recommendation for female PCCM applicants. The authors of letters of recommendation may be attuned to the implicit biases and may be making an intentional effort to write letters that avoid gendered language.

Our findings also suggest that further work and attention are needed in the letters of recommendation for URiM and Asian applicants. To increase the number of URiM fellows to PCCM, it is important to address disparities in language, letter-writing, and evaluation in the fellowship application process (22). Although Asian applicants have historically not been thought of as being underrepresented in medicine, our cohort included many international medical graduates from the Middle East who identify as Asian. The disparities in language and degree of support found in the letters of

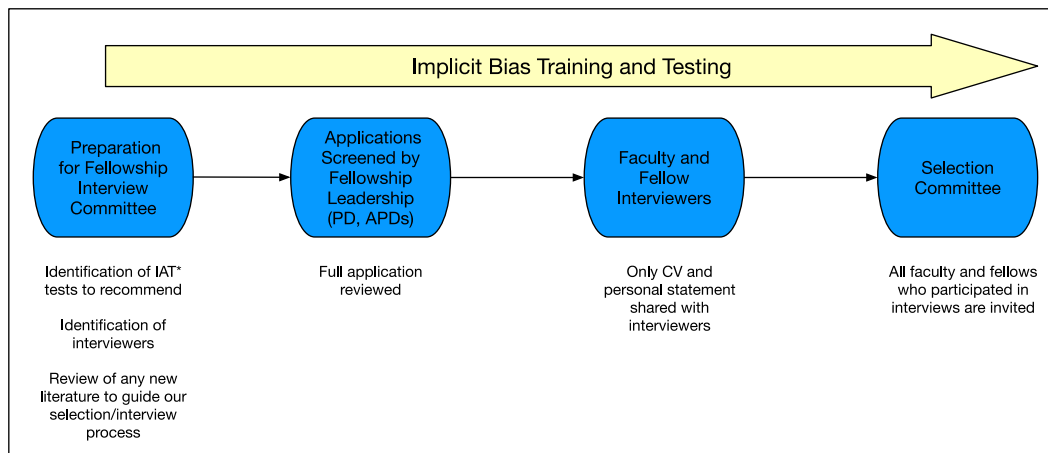


Figure 2. University of Michigan's pulmonary and critical care medicine fellowship recruitment process. APDs = associate program directors; CV = curriculum vitae; IAT = implicit bias testing; PD = program director.

recommendation for applicants from international medical schools have not been well studied but warrant further scrutiny.

Historically, in our program, letters of recommendation were reviewed not only by the fellowship leadership but shared with all faculty who interviewed the applicants. As recent work in other areas of medicine (8) and other training programs at the University of Michigan suggested that letters of recommendation were propagating systemic implicit biases, our division decided to stop sharing the letters of recommendation with faculty interviewers. We also actively worked to build a more diverse interviewer pool while encouraging all interviewers to participate in implicit bias training and testing (<https://implicit.harvard.edu/implicit/takeatest.html> and Figure 2).

Strength and Limitations

There are several limitations to our study. First, this is a single-center quality improvement study whose findings may not be reflective of the applicants who did not apply to our program. However,

there were over 2,000 letters evaluated from applicants across the entire country. Second, the applications evaluated were from the 2020 cohort and represent a single time point during the coronavirus disease (COVID-19) pandemic. Third, we do not know to what extent these measured differences accurately reflect differences within the population of applicants. Fourth, the context of how these words were used in the letters of recommendation is not measured by existing systems. Fifth, despite female applicants having statistically significantly longer letters of recommendation than male applicants, the practical significance is unknown. Sixth, our sample size for evaluating differences for URiM applicants was small, and further work is needed to validate our findings in a larger cohort. Finally, we did not exclude international medical graduate applicants from our analysis and could not identify them in our current study; thus, we could not determine if holding an international medical degree modifies the relationship between race and letter length and support.

Conclusion

Female applicants to PCCM received longer and more supportive letters of recommendation than male applicants. Further work is needed to understand if this finding is the beginning of a change and lays the foundation for future studies in PCCM exploring letters of recommendation of applicants not only by sex but race and ethnicity.

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