Gender Disparities in Prosthodontics: Authorship and Leadership, 13 Years of Observation

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Abstract

Purpose: The purpose of this study was to examine gender disparities in prosthodontics by reviewing the trend of female authorship in prosthodontic journals and exploring the role of female leadership in prosthodontic organizations and Advanced Education in Prosthodontic (AEP) programs.
Materials and Methods: Three journals representing the prosthodontic specialty were selected to analyze the percentage of female dentist first and last (senior) authors for the years 1995, 2000, 2005, and 2008. Article inclusion criteria were restricted to the first or last authors who held at least a DMD/DDS/BDS degree and were from U.S. institutions. Data on female leadership in prosthodontic organizations and advanced education programs were collected, and the trends were studied. Descriptive statistics were used to analyze the data. A linear regression analysis was performed to investigate the proportion of female authorship compared to male in the dental literature. A Fisher's Exact Test was performed to contrast differences of female first and last authorship in the selected journals between years 1995 and 2008.
Results: Overall, there was no statistically significant linear increase in the proportion of either first or last female authorship compared to male authorship over time. With respect to each journal, the linear regression analysis showed that the increase of first female authorship was statistically significant ($p = 0.016$) compared to male authorship only in the *Journal of Prosthetic Dentistry*. The percentage of female presidents of prosthodontic organizations has been very limited. A similar trend was also observed in AEP program director positions.
Conclusions: Over the past 13 years, female dentists' participation in prosthodontics literature authorship has not increased significantly in the United States. Furthermore, female involvement in prosthodontics leadership has been limited over the past decades.

Participation of women in medicine has increased dramatically over the past eight decades.[1] The percentage of female faculty in academic medicine has increased steadily from 27% in 1999 to 30% in 2002 to 33% in 2007;[2-4] however, women have not achieved parity with men in academic ranks or appointment status. In 2007–2008, women made up 17% of full professors, 29% of associate professors, and 40% of assistant professors for all medical school faculties.[4] In the same year, 13% of female professors had tenure, compared to 26% of their male counterparts. Female deanship in U.S. colleges of medicine increased from 5% in 1999 to 11% in 2008.[4,5]

The roles of women in dentistry historically were limited to the auxiliary fields of dental hygiene and dental assisting, rather than main providers such as general dentists and specialists.[6] Nevertheless, the enrollment of female students in dental schools has increased steadily over time as has their

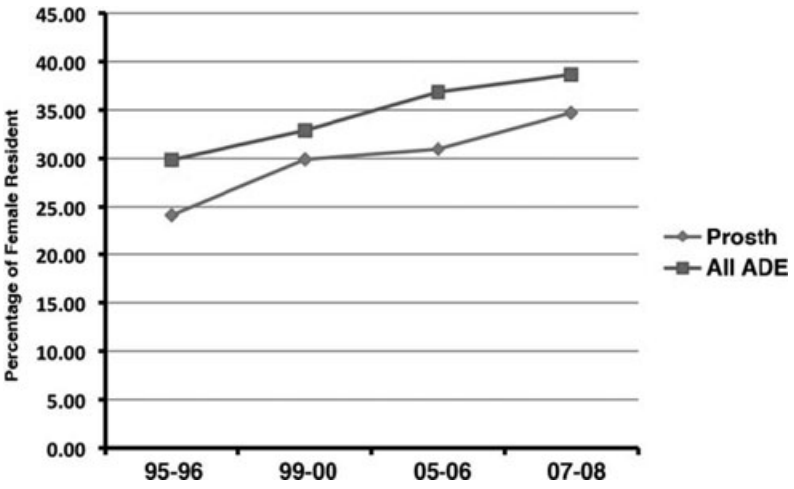

Figure 1 Percentage of female residents in prosthodontic programs and all ADE programs from 1995 to 2008. Data retrieved from the ADA.

role as main providers.[7] The percentage of professionally active female dentists and active female practitioners increased by about 50% between 1998 and 2006, whereas the number of males stayed nearly the same.[8]

The enrollment of female residents in Advanced Dental Education (ADE) programs has also continuously increased over the past 13 years. A similar trend has been observed in Advanced Education in Prosthodontics (AEP) programs (Fig 1). The most recent data have shown that female participation in AEP programs is almost the same as in orthodontics and periodontics, and is expected to increase further in the future (Fig 2).

The influx of women into dentistry and their roles in dental academics have been a topic of interest for many years. One recent study examined the gender differences in career and practice patterns of postgraduate general dentistry (PGD) trained dentists.[9] They showed female PGD-trained dentists tend to choose career paths in government, hospital care, or dental education rather than private practice.[9] In addition, women were more likely to pursue a career in academics.[10] Conversely, one recent study reported that gender was not associated with practice pattern and academic preparation in various disciplines.[11]

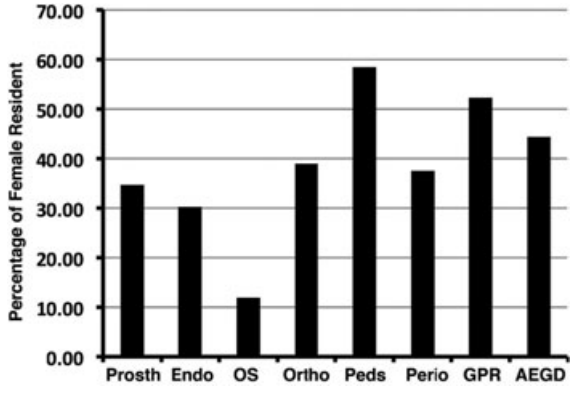

Figure 2 Percentage of female residents in each ADE program in 2007–2008. Data retrieved from the ADA.

Advancement in the academic environment is measured by one's scholarly activity, including outstanding performance in the areas of teaching, research, and service. Publication in peer-reviewed journals is deemed to be an objective assessment of academic productivity, whereas participation in administration is judged to demonstrate leadership in the profession. Many studies have evaluated the gender gap in regards to the number of publications, but most are from the medical literature.[1,12-17] As for female leadership, there was a ninefold increase in the percentage of female deanship in U.S. dental schools from 1985–1986 to 2005–2006;[18,19] however, female involvement is still underrepresented in dentistry. There has been no published study evaluating the gender gap in ADE programs, especially in the prosthodontic discipline. With increasing numbers of female students entering AEP programs, female prosthodontists may have greater impact in academic prosthodontics in the future.

The purpose of this study was to examine the gender disparities in prosthodontics by (1) reviewing the trend of female authorship in the prosthodontic journals, including the types of articles written, their academic degrees and ranks, and sources of funding, and (2) exploring the role of female leadership in prosthodontic organizations and as program directors for AEP programs. In this study, we hypothesize that female participation in prosthodontic literature authorship has increased over time compared to male participation.

Materials and methods

Data collection

Authorship: The methodology of the study was adopted from Jagsi et al[1] with some modification. The journals selected in the study were based on published impact factors, organization's journal, and those represented most by the prosthodontic specialty. One inclusion factor was that the degree of the authors had to be listed in the publications. Three journals were selected for this study: *Journal of Prosthetic Dentistry* (*JPD*), *International Journal of Prosthodontics* (*IJP*), and *Journal of Prosthodontics* (*JOPR*). Trends in authorship were studied using 1995, 2000, 2005, and 2008 as representative years.

Article inclusion criteria were restricted to the first or last (senior) authors who held at least DMD/DDS/BDS degree and were from U.S. institutions. For each of these articles, the gender of first and last authors was recorded. The gender of the author was initially determined by inspection of the first name. In situations where the gender of the first name was uncertain, efforts were made to identify the author's gender by performing an Internet search or by visiting the affiliated institutional website. When the gender could not be determined, it was coded as "Unidentified." Female authors' degree, affiliation, and academic rank were recorded, whereas for male authors, only who held both DMD/DDS/BDS and PhD degrees were recorded. The articles with either first or last female author were categorized, and sources of funding were reported. The institutional affiliation categories included university; government/military/National Institutes of Health (NIH)/Center for Diseases Control and Prevention (CDC); private organizations/American Dental Association (ADA)/private practice; or other/unidentified. The categories of the degrees were DMD/DDS/BDS only; DMD/DDS/BDS and MS; DMD/DDS/BDS and PhD; or DMD/DDS/BDS and other. The articles were categorized as review, original research article, clinical report, technique, or other. The sources of funding were classified as private/company, university, government (NIH), not mentioned, or other.

Leadership: The list of past and present female presidents in prosthodontic organizations, such as American College of Prosthodontists (ACP), American Board of Prosthodontics (ABP), American Academy of Fixed Prosthodontics (AAFP), and Academy of Prosthodontics (AP) were identified by communicating with the contact person listed from each organization's website. The proportion of the female presidents in each organization was then calculated and analyzed. Data on leadership of female prosthodontists as AEP program directors were retrieved from the ADA survey center, central office. The percentage of female program directors was determined and the trends were studied.

Statistical analysis

Data were entered into Microsoft Excel 2003 (Microsoft, Seattle, WA). The frequency of female first and last authors as a percentage of total number of authors was calculated to determine the gender distribution for each journal over time. Descriptive statistics were used to analyze the data. A linear regression analysis was performed using statistical software (SPSS v16.0; SPSS Inc, Chicago, IL) to investigate the proportion of female authorship compared to male authorship in the dental literature. A Fisher's Exact Test was performed to contrast differences of female first and last authorship in the selected journals between years 1995 and 2008. A significance level of 0.05 was used for all tests.

Results

Demographic characteristics of female authors in prosthodontic journals

A total of 1202 articles met the inclusion criteria from the three selected journals for the years studied. This represented 774 total authors, of whom 451 were first authors and 323 were last authors. Overall, 16% of first authors and 8% of last authors were female. The majority of the authors held DDS/DMD/BDS and Master's degree (59%), followed by DMD/DDS/BDS only (37%). Only 1% of female authors held a combination of DMD/DDS/BDS and PhD, compared to 12% of male authors. Most female authors were affiliated with a university (84%), followed by private (7%) and government-related institutions (6%). The total distribution of female first and last authors were 35% and 26% assistant professors, 18% and 13% associate professors, 13% and 13% professors, 12% and 13% residents, 1% and 9% instructors, respectively. Academic rank was not listed for 21% of first and 26% of last female authors. The types of article written were mostly original articles (52%), followed by technique articles (23%), case reports (17%), and reviews (4%). From 93 articles written by female authors, 4% were funded by government, 4% by university, and 8% by private companies or organizations.

Authorship role in prosthodontic journals

Collectively, the percentage of female first authorship increased from 12% in 1995 to 23% in 2000. In 2005 and 2008, the proportion of female first authors dropped to 15% (Table 1). Similar observations were made in female last authorship, which increased from 8% in 1995 to 12% in 2000. In 2005, the percentage of female last authorship decreased to 5% and increased again to 6% in 2008. In general, women made up a smaller percentage of senior authors throughout the study. Overall, there was no statistically significant linear increase in the proportion of either first or last female authorship compared to male authorship over time ($p = 0.6$ and $p = 0.2$, respectively).

With respect to each journal, the percentage of female first authorship in the *JPD* was 5% in 1995 and increased to 21% in 2000; however, the percentage of female first authorship dropped to 19% in 2005 and again to 17% in 2008. The linear regression analysis showed that the increase of first female authorship in the *JPD* was statistically significant ($p = 0.016$) compared to male authorship. The proportion of female first authors in the *JPD* was significantly higher in 2008 than in 1995 ($p = 0.021$). In contrast, a nonsignificant decrease of female last authorship was noted over time (Table 1).

In the *JOPR*, the percentage of female first authorship was 31% in 1995. In 2000, it dropped to 24% and again to 5% in 2005. It increased again in 2008 to 12%. A significant linear decrease over time in the proportion of women as first author compared to men was observed ($p = 0.017$). For the percentage of female last authorship, it was 10% in 1995 and increased to 27% in 2000. There was no female last authorship in 2005, and it was only 7% in 2008 (Table 1).

In the *IJP*, the percentage of female first authorship was 19% in 1995 and increased to 50% in 2000. There was no female first authorship in 2005 and 2008. There was no female last authorship presented from 1995 to 2008 (Table 1).

Leadership role of female prosthodontists

The percentage of female presidents of prosthodontic organizations has been very limited (Table 2). The ACP and AAFP recently had their first female presidents. A similar trend was

Table 1 Representation of female first and senior authors in three prosthodontic journals (analysis restricted to authors from U.S. institutions holding a DMD/DDS/BDS degree for whom gender could be determined)

Female /total (%)	1995	2000	2005	2008	*p*-value
Overall					
First author	18/153 (12%)	25/111 (23%)	14/92 (15%)	14/95 (15%)	0.596
Last author	8/99 (8%)	9/77 (12%)	3/64 (5%)	5/83 (6%)	0.201
JPD					
First author	5/103 (5%)	18/84 (21%)	13/68 (19%)	10/58 (17%)	0.016[a]
Last author	6/63 (10%)	5/62 (8%)	3/52 (6%)	3/53 (6%)	0.534
JOPR					
First author	9/29 (31%)	6/25 (24%)	1/22 (5%)	4/33 (12%)	0.017[b]
Last author	2/21 (10%)	4/15 (27%)	0/9 (0%)	2/26 (7%)	0.205
IJP					
First author	4/21 (19%)	1/2 (50%)	0/2 (0%)	0/4 (0%)	0.375
Last author	0/15 (0.0%)	0/0 (0.0%)	0/3 (0.0%)	0/2 (0.0%)	0.678

[a]Linear regression showing increase over time in the proportion of women compared to men.

[b]Linear regression showing decrease over time in the proportion of women compared to men.

also observed in AEP program director positions. The number of female AEP program directors has never been more than 5% in the last 13 years (Table 3).

Discussion

The results of this study did not demonstrate an increasing trend of female authorship in the selected journals. This differs from the finding of recent studies in the medical field.[1,12–15,20,21] Those studies demonstrated a significant trend toward increased female authorship. One possible explanation for the noted gender trends in the authorship is related to family responsibility. Research and manuscript preparation requires time and effort. According to a 1995 ADA survey, female dentists spent about twice the amount of time in childcare and housework compared to their male colleagues,[22] adding a substantial time commitment outside of work.[23] Women were also more likely than men to take a leave of absence from work for childrearing, and the leave was longer in duration.[22] Explanations for the lack of increased trend of female authorship from the selected journals could not be offered, as this study did not explore the reasons for this gender gap. More research is warranted in the future to explore this topic.

This study showed an interesting pattern in female authorship, both in individual journals and overall. Collectively, female first and last authorship peaked in 2000, and the same trend was observed in first authorship in the *JPD* and the *IJP*, and last authorship in the *JOPR*. It has been speculated that first authors are usually the residents or junior faculty at the assistant professor level, whereas last authors are usually the principle investigators (associate professor and professor) with more experience in the field. In this study, we noted that most of the first and last authors were assistant professors, which may indicate a high desire for female junior faculty for promotion; however, the provided information may also suggest a low number of female professors in prosthodontics, which is paralleled by a low number of female professors in general.[21]

The higher influx of female prosthodontic residents entering programs from 1995 to 2000 may also reflect increased female first authorship in the prosthodontics literature (Fig 1). One noteworthy observation is that there was no last female author from 1995 to 2008 in the *IJP*. One may attribute this to the stringent selection criteria of this study; only authors who held at least DMD/DDS/BDS degrees and were from U.S. institutions were included. *IJP* is an international journal and accepts articles from all over the world. Therefore, fewer female authors, especially last authors who fit the criteria of the study, were observed in the *IJP*.

The majority of the female authors observed in the study held both DDS/DMD/BDS and Master's Degrees. One possible explanation could be the publication of the master's research. The percentage of female authors who held both DDS/DMD/BDS and PhD was only 1%. This finding is different from the medical discipline.[1] Jagsi et al[1] reported 20% and 9% of female

Table 2 Number of female presidents of prosthodontics organizations (%). Data retrieved from the ABP, ACP, AAFP, and AP

Presidents of	Male	Female
American Board of Prosthodontics (ABP)	58 (100%)	0 (0%)
American College of Prosthodontists (ACP)	37 (97%)	1 (3%)
American Academy of Fixed Prosthodontics (AAFP)	57 (98%)	1 (2%)
Academy of Prosthodontics (AP)	86 (99%)	1 (1%)

Table 3 Number of prosthodontics program directors based on gender. Data retrieved from the ADA

Year	Male	Female
1995	50 (98%)	1 (2%)
2000	52 (96%)	2 (4%)
2005	45 (100%)	0 (0%)
2008	41 (95%)	2 (4%)

first and last authors holding MD and PhD degrees in 2004, respectively. The need to have female prothodontist-scientists is important for the growth of the specialty in the future.

Most of the female authors were affiliated with academic institutions. This finding is similar to a previous study.[24] This result was expected, as the academic setting provides better resources and support for research. Furthermore, research and publication are highly encouraged in the academic environment from the advancement perspective.[25] The analysis showed that most financial and material support to female authors was from private funding. It can be speculated that the complexity of the support from university or government sources may be more stringent, hence, more difficult to obtain. On the contrary, another study evaluated grant support, and showed there were no statistical differences in available grant support between genders.[21]

This study revealed that the most frequently published articles by female authors were original research articles, followed by technique articles, clinical reports, and a few reviews. These data are promising, as original articles may have a higher impact on the specialty. On the other hand, an elevated number of techniques and clinical report articles were noted. This may indicate that a significant number of female authors were clinicians and may not have a strong research background. In addition, one study showed that female faculty members were less likely to be sought for collaborative research efforts that are important in performing original research.[21] All these factors may contribute to the types of articles women have published in the dental literature.

Female participation in AEP programs was similar to orthodontics and periodontics, but less than pedodontics. A recent ADA report showed there were 38% more female practicing prosthodontists in 2006 compared to 1998.[7] This supports findings from a recent study[8] concluding gender did not affect the probability of applying to postgraduate programs. It suggested that mentoring and faculty encouragement may play an important role in students' selection of post-graduate education. This could serve as valuable information for the prosthodontic specialty to address gender differences in resident participation, and to help the specialty attract more female residents in AEP programs.

Female participation in scholarly service activity in the prosthodontic specialty has remained low, based on this study. This is similar to findings from previous studies, in which gender disparity still existed in the administrative domain.[12,26] Wright et al[27] reported that though women and men had the same aspirations and perceptions on leadership positions, women were more likely to be ignored for their leadership ability. There has been only one female president of the ACP and AAFP organizations. Five female prosthodontists have served as AEP program directors to date. More female faculty members should be encouraged to apply for higher administrative positions. Several programs have been implemented to support advancement for women in academic dentistry.[20] The Commission on Graduate Medical Education (COGME) report stressed the importance of having women in leadership positions for decision making.[28] With this, a more diverse approach in healthcare may be established and be beneficial to the profession as a whole. With these efforts, female administrative involvement and contribution will hopefully reach parity with men in the near future.

An attempt was made to analyze and evaluate the distribution of academic rank and departmental chairmanship between genders in the dental discipline. Unfortunately, this kind of information was not available in the dental workforce database. Though the ADA and ADEA have made great efforts to conduct surveys and analyze statistics, the dental profession should strive to achieve the same level as its medical counterpart for obtaining and organizing this critical information. Such a database could present an opportunity for the profession to critically evaluate the historical and present status, and also provide an opportunity to appreciate dynamic ongoing changes.

This study has several limitations. First, the gender of only the first and last authors of the articles was examined, as opposed to all authors. There could be more female authors participating in the research, but not included in this study. Second, our study was not based on a random sample of prosthodontic journals, which may limit the generalization of the results. Further, our study did not look at all prosthodontic organizations, which may limit the information. Lastly, the assumption that the selected female authors were prosthodontists was made for analysis purposes. This may not be necessarily true, as this study did not explore the specific educational training of the individual authors.

Conclusion

Within the limitations of this study, it can be concluded that female dentists' participation in prosthodontic literature authorship has not increased significantly over time. Furthermore, female involvement in prosthodontic leadership has been limited over the past decades.

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References

1. Jagsi R, Guancial EA, Worobey CC, et al: The "gender gap" in authorship of academic medical literature—a 35-year perspective. N Engl J Med 2006;355:281-287
2. Bickel J: Women in academic medicine. J Am Med Womens Assoc 2000;55:10-12
3. Simpson BM: Trends in women among medical school faculty. JAMA 2002;288:1067-1072
4. Women in U.S. Academic Medicine: Statistics and Medical School Benchmarking 2007–2008. Washington, DC, Association of American Medical College, 2008: Table 11
5. Women in U.S. Academic Medicine: Statistics and Medical School Benchmarking 2004–2005. Washington, DC, Association of American Medical Colleges, 2005
6. Campbell JE: Women dentists. An untapped resource. J Am Coll Dent 1970;37:265-269
7. Scarbecz M, Ross JA: The relationship between gender and postgraduate aspirations among first- and fourth-year students at public dental schools: a longitudinal analysis. J Dent Educ 2007;71:797-809

8. American Dental Association, Distribution of Dentists in the US, Historical report, from 1998 to 2006: Chicago, IL, ADA, 2009
9. Atchison KA, Bibb CA, Lefever KA, et al: Gender differences in career and practice patterns of PGD-trained dentists. J Dent Educ 2002;66:1358-1367
10. Wilson LD, Flynn DF, Haffty BG: Radiation oncology career decision variables for graduating trainees seeking positions in 2003–2004. Int J Radiat Oncol Biol Phys 2005;62: 519-525
11. Kelsey WP III, Kimme NS, Williams DE, et al: Gender-based differences in satisfaction with academic preparation and practice experiences. J Dent Educ 2009;73:464-470
12. Dewan P, Gupta P, Choudhury P: Gender gap and Indian academy of pediatrics: still a long way to go. Indian Pediatr 2007;44:598-600.
13. Feramisco JD, Leitenberger JJ, Redfern SI, et al: A gender gap in the dermatology literature? Cross-sectional analysis of manuscript authorship trends in dermatology journals during 3 decades. J Am Acad Dermatol 2009;60:63-69
14. Li SF, Latib N, Kwong A, et al: Gender trends in emergency medicine publications. Acad Emerg Med 2007;14: 1194-1196
15. Stinson S: Participation of women in human biology, 1975–2001. Am J Hum Biol 2003;15:440-445
16. Kurichi JE, Kelz RR, Sonnad SS: Women authors of surgical research. Arch Surg 2005;140:1074-1077
17. Bhattacharyya N, Shapiro NL: Increased female authorship in otolaryngology over the past three decades. Laryngoscope 2000;110:358-361
18. American Dental Association. 1985–86 Survey of predoctoral dental education: Academic Program, Enrollment and Graduate. Chicago, American Dental Association, 1987
19. American Dental Association: 2005–2006 Survey of Predoctoral Dental Education: Academic Program, Enrollment and Graduate. Chicago, IL, ADA, 2007
20. Sinkford JC, Valachovic RW, Harrison S: Advancement of women in dental education: trends and strategies. J Dent Educ 2003;67:79-83
21. Nesbitt PE, Inglehart MR, Sinkford JC: Work environment perceptions of full-time dental educators: does gender matter? J Dent Educ 2003;67:916-924
22. American Dental Association: 1995 Survey of Dentists: A Comparison of Male and Female Dentists—Personal and Family Issues. Chicago, American Dental Association, 1997
23. Hochschild AR, Machung A: The Second Shift. New York, Penguin, 2003
24. Bailey CE, Pryce J, Walsh F: Trends in author characteristics and diversity issues in the Journal of Marital and Family Therapy from 1990 to 2000. J Marital Fam Ther 2002;28:479-486
25. Boyer E: Scholarship Revisited: Priorities of the Professoriate. New York, Carnegie Foundation, 1990
26. Scarbecz M, Ross JA: Gender differences in first-year dental students' motivation to attend dental school. J Dent Educ 2002;66:952-961
27. Wright AL, Schwindt LA, Bassford TL, et al: Gender differences in academic advancement: patterns, causes, and potential solutions in one US College of Medicine. Acad Med 2003;78:500-508
28. Council on Graduate Medical Education: Fifth Report: Women and Medicine. Bethesda, MD, Department of Health and Human Services, 1995