Gender Trends in Dental Leadership and Academics: A Twenty-Two-Year Observation

Judy Chia-Chun Yuan, D.D.S., M.S.; Damian J. Lee, D.D.S.; Suchada Kongkiatkamon, D.D.S.; Sasha Ross, D.M.D.; Soni Prasad, B.D.S., M.S.; Anne Koerber, D.D.S., Ph.D.; Cortino Sukotjo, D.D.S., Ph.D., M.M.Sc.

Abstract: The purpose of this study was to examine gender disparities in dental leadership and academics in the United States. Nine journals that represent the dental specialties and high published impact factors were selected to analyze the percentage of female dentists' first and senior authorship for the years 1986, 1990, 1995, 2000, 2005, and 2008. Data on appointment status and female deanship were collected from the American Dental Association (ADA) survey, and the trends were studied. The proportion of female presidents in ADA-recognized specialty organizations was also calculated. Overall, the increase in first female authorship was not statistically significant, but the increase of last female authorship was statistically significant in a linear trend over the years. The percentage of tenured female faculty members and female deans in U.S. dental schools increased by factors of 1.7 and 9, respectively, during the study period. However, female involvement in professional organizations was limited. Findings from this study indicate that female participation in authorship and leadership has increased over time. Nevertheless, females are still a minority in dental academics and leadership.

Dr. Yuan is Clinical Assistant Professor, Department of Restorative Dentistry, University of Illinois at Chicago, College of Dentistry; Dr. Lee is Clinical Assistant Professor, Department of Restorative Dentistry, University of Illinois at Chicago, College of Dentistry; Dr. Kongkiatkamon is a Resident and Research Fellow in Advanced Education in Prosthodontics, Department of Restorative Dentistry, University of Illinois at Chicago, College of Dentistry; Dr. Ross is a Resident and Research Fellow in Advanced Education in Periodontics, Department of Periodontics, University of Illinois at Chicago, College of Dentistry; Dr. Prasad is Assistant Professor, Department of Prosthodontics, University of Texas Health Science Center at Houston Dental Branch; Dr. Koerber is Associate Professor and Director of Behavioral Science, Department of Pediatric Dentistry, University of Illinois at Chicago, College of Dentistry; and Dr. Sukotjo is Assistant Professor, Department of Restorative Dentistry, University of Illinois at Chicago, College of Dentistry. Direct correspondence and requests for reprints to Dr. Cortino Sukotjo, Department of Restorative Dentistry, University of Illinois at Chicago, College of Dentistry (MC 555), 801 South Paulina Street, Room 365B, Chicago, IL 60612-7211; 312-355-0360 phone; 312-996-3535 fax; csukotjo@uic.edu.

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The dental community has traditionally been dominated by men both in the academic and private workforces.[1-7] Progress toward gender parity has been observed with increased participation by women in dentistry over the past twenty years.[4,5,8,9] Data from the American Dental Association (ADA) indicate that the percentage of women enrolled in dental schools and in advanced dental education (ADE) programs increased from 25 percent in 1985 to 44 percent in 2005 and from 30 percent in 1995 to 39 percent in 2007, respectively (Figure 1).[8-11] Although women are more likely than men to choose academic careers[12,13] and to remain in dental education for the long term,[14] women in academic dentistry do not progress in status as men do,[5] and women dentists still remain underrepresented in the academic workforce.[15]

Advancement in the academic environment is measured by one's scholarly activity. The definition of scholarship differs among institutions. Based on Boyer's definition, there are four areas of scholarship: discovery, integration, application, and teaching.[16] Although Peterson[17] has suggested that outstanding performance on all aspects of teaching, research, and service is essential for academic advancement, others have stated that research, publication, and grants are the main factors considered for faculty promotion and tenure.[18-20] This has important implications for women seeking promotion and tenure.

Numerous studies have attempted to explore the gender bias in academic advancement.[6,21-32] Even though grant support[26] and time spent on research[33] were similar by gender, female faculty members have still reported experiencing gender bias in professional advancement.[21-23,27,28,30,31,33] Other studies have reported that despite similar scholarly production by gender, male faculty members were more likely to be at higher academic rank, have higher promotion rates, and enjoy higher salaries than their female colleagues.[24,27,28,30,31,34]

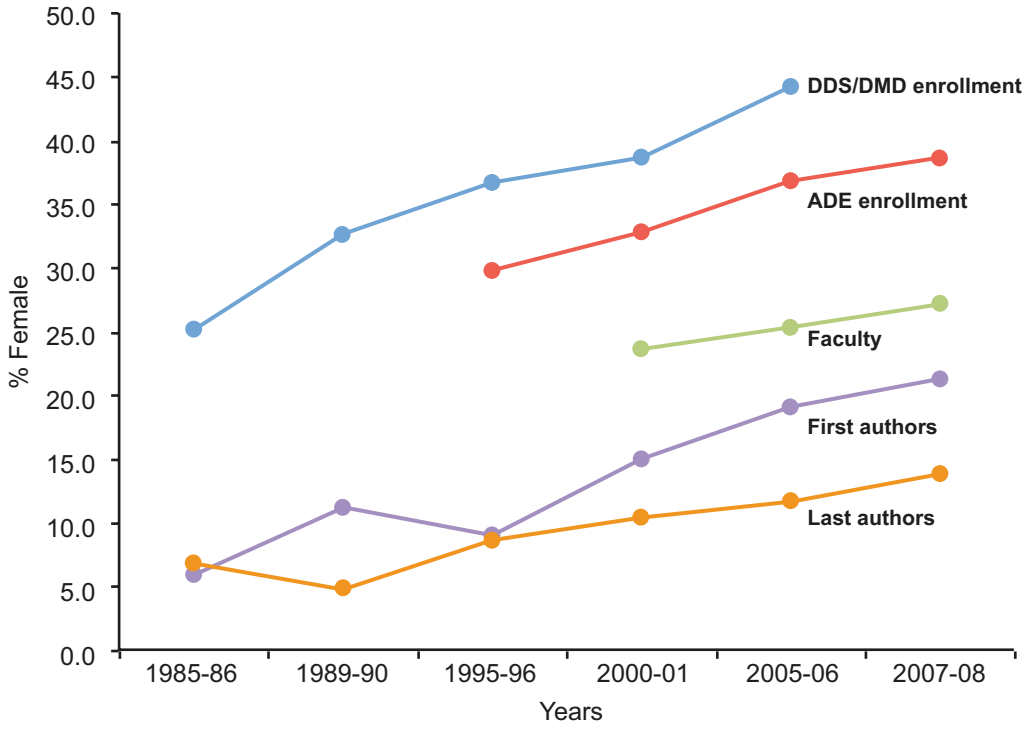

Figure 1. Distribution of female dental students' enrollment, advanced dental education residents' enrollment, full-time faculty, and first and last authors in selected journals, 1986–2008

Note: Data are from the American Dental Association. Data on advanced dental education enrollment for years of 1985–86 and 1989–90 and for female faculty for years of 1985–86, 1989–90, and 1995–96 were not available.

In addition to research, scholarly service activity may come from professional service or service to the community and institutional citizenship.[16,35] Participation in the administrative domain such as deanship in dental schools and presidential positions in American Dental Association (ADA)-recognized organizations is judged to demonstrate leadership in the community.

Publication in peer-reviewed journals is an objective measure of academic productivity. Many studies have evaluated the gender gap in the medical field.[36-42] These studies found considerable increase in the proportion of female authors in prestigious medical journals over the past thirty years. However, female authors were still in the minority in the academic literature. The topic of a gender gap in authorship in dental publication has not been as widely investigated.[33]

The purpose of this study was to examine gender disparities in dental leadership and the dental academic environment. The study sought to evaluate progress toward gender parity in those areas by 1) analyzing the trend of female first and last authorship in selected dental literature, 2) observing the trend of female academic appointment position, and 3) exploring the trends of female leadership in professional organizations over the past two decades. In this study, we also hypothesized that female participation in authorship in dental research literature has increased over time. Identifying such trends is important to address gender gaps, if any, in academic dentistry.

Materials and Methods

Authorship

The methodology in this portion of the study was adopted from that of Jagsi et al.[38] in the *New England Journal of Medicine*. The journals selected

for our study were based on published impact factors and official journals of the specialty organizations. In addition, the journals represented most of the recognized dental specialties. One inclusion factor was that the degree of the authors had to be listed in the publications. Nine journals were selected for this study: *Journal of Prosthetic Dentistry (JPD)*, *Journal of Endodontics (JOE)*, *American Journal of Orthodontics and Dentofacial Orthopedics (AJO-DO)*, *Journal of American Dental Association (JADA)*, *Journal of Dental Education (JDE)*, *Journal of Public Health Dentistry (JPHD)*, *International Journal of Periodontics & Restorative Dentistry (IJPRD)*, *Journal of Oral and Maxillofacial Surgery (JOMS)*, and *Pediatric Dentistry (PD)*. Trends in authorship were studied using 1986, 1990, 1995, 2000, 2005, and 2008 as representative years.

Article inclusion criteria were restricted to the first or last (senior) authors who held at least the D.M.D./D.D.S./B.D.S. degree and were from U.S. institutions when the study was performed. 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 in which 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." The number of male and female authors holding both D.M.D./D.D.S./B.D.S. and Ph.D. degrees were also recorded.

Academic Position

Data on appointment status from the ADA survey of academic years 1995–96, 2000–01, 2005–06, and 2007–08 were collected to examine the trends in full-time academic performance of females.

Leadership

The ADA-recognized specialty organizations are American Academy of Public Health Dentistry (AAPHD), American Association of Endodontists (AAE), American Academy of Oral and Maxillofacial Pathology (AAOMP), American Academy of Oral and Maxillofacial Radiology (AAOMR), American Academy of Oral and Maxillofacial Surgery (AAOMS), American Association of Orthodontists (AAO), American Academy of Pediatric Dentistry (AAPD), American Academy of Periodontology (AAP), and American College of Prosthodontists (ACP). The past and current female presidents of all nine specialty organizations 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.

The deanship of U.S. dental schools based on gender from 1985–86 to 2005–06 was also acquired from the ADA Survey Center's central office. The percentage of female deanship was determined, and the trends were studied.

Descriptive statistics including the frequencies and percentages of female first and last authors, female tenure status, deanship, and leadership in specialty organizations were initially calculated. Then, statistical software (Statistical Package for the Social Sciences, version 16.0; SPSS Inc., Chicago, IL) was used for the statistical analysis. A linear regression analysis was performed to investigate the trend of female participation in authorship in the dental literature. A chi-square test was used to determine significant differences of overall percentage of female first and last authorship between the years 1986 and 2008. A significance level of 0.05 was used for all tests.

Results

A total of 7,104 articles were reviewed from the nine selected journals for the years studied. Among all these articles, 5,773 authors met the inclusion criteria, of whom 3,556 were first authors and 2,217 were last authors. Overall, 13 percent of first authors and 9 percent of last authors were female, and 2 percent of the authors were unidentified. Collectively, the percentage of first female authorship increased from 6 percent in 1986 to 11 percent in 1990. In 1995, the proportion of first female authors dropped to 9 percent. It increased to 15 percent in 2000 and again to 21 percent in 2008 (Figure 1, Table 1). Overall, the increase in first female authorship was not statistically significant (p=0.633) as a linear trend, but the proportion of female first authors was significantly higher in 2008 than in 1986 (p<0.001). Similar trends were observed in last female authorship, where the percentage decreased from 7 percent in 1986 to 5 percent in 1990, and then a continuous increase to 14 percent in 2008. In general, women made up a smaller percentage of senior authors throughout the study. However, the increase of last female authorship was statistically significant (p=0.034) in a linear trend, and

Table 1. Female first and last (senior) authors from U.S. institutions in nine dental journals, by number/total number and percentage

	1986	1990	1995	2000	2005	2008	*p*-value
Overall							
First author	39/655 (6%)	76/671 (11%)	56/615 (9%)	85/563 (15%)	100/521 (19%)	113/531 (21%)	0.633
Last author	25/364 (7%)	19/391 (5%)	32/367 (9%)	36/343 (11%)	42/356 (12%)	55/396 (14%)	**0.034**
JADA							
First author	11/110 (10%)	7/103 (7%)	13/113 (12%)	10/109 (9%)	18/105 (17%)	20/107 (19%)	0.392
Last author	6/65 (9%)	5/54 (9%)	5/52 (10%)	7/45 (16%)	7/42 (17%)	14/57 (25%)	**0.015**
IJPRD							
First author	1/20 (5%)	2/19 (11%)	2/23 (9%)	0/21 (0)	0/13 (0)	0/13 (0)	0.250
Last author	0/12 (0)	1/11 (9%)	0/18 (0)	2/16 (13%)	0/16 (0)	2/12 (17%)	0.266
JPHD							
First author	1/16 (6%)	7/25 (28%)	3/20 (15%)	8/27 (30%)	8/17 (47%)	6/16 (38%)	0.182
Last author	2/7 (29%)	0/13 (0)	1/12 (8%)	0/15 (0)	1/14 (7%)	5/12 (42%)	**0.018**
AJO-DO							
First author	0/16 (0)	12/61 (20%)	5/58 (9%)	5/53 (9%)	9/44 (21%)	9/37 (24%)	0.436
Last author	4/12 (33%)	4/36 (11%)	2/35 (6%)	0/43 (0)	7/32 (22%)	3/27 (11%)	0.614
JDE							
First author	5/64 (8%)	9/55 (16%)	3/46 (7%)	4/21 (19%)	12/46 (26%)	25/66 (38%)	**0.049**
Last author	2/22 (9%)	1/21 (5%)	5/18 (28%)	3/22 (14%)	6/28 (21%)	10/43 (23%)	0.142
JPD							
First author	14/218 (6%)	17/150 (11%)	5/103 (5%)	18/84 (21%)	13/68 (19%)	10/58 (17%)	0.844
Last author	8/104 (8%)	1/78 (1%)	6/63 (10%)	5/62 (8%)	3/52 (6%)	3/53 (6%)	0.908
JOMS							
First author	3/114 (3%)	6/155 (4%)	7/155 (5%)	10/144 (7%)	16/129 (12%)	13/121 (11%)	**0.021**
Last author	0/78 (0)	1/104 (1%)	8/90 (9%)	6/72 (8%)	11/97 (11%)	7/104 (7%)	0.075
JOE							
First author	1/62 (2%)	7/68 (10%)	6/59 (10%)	4/52 (8%)	11/67 (16%)	14/75 (19%)	**0.016**
Last author	0/41 (0)	0/49 (0)	1/48 (2%)	4/36 (11%)	3/58 (5%)	3/67 (5%)	**0.001**
PD							
First author	3/35 (9%)	9/35 (26%)	12/38 (32%)	26/52 (50%)	13/32 (41%)	16/38 (42%)	0.264
Last author	3/23 (13%)	6/25 (24%)	4/31 (13%)	9/32 (28%)	4/17 (24%)	8/21 (39%)	0.344

Note: The analysis was restricted to authors from U.S. institutions holding a D.M.D./D.D.S./B.D.S. degree for whom gender could be determined. *P*-values are linear regression of the number of female authors on year of publication, controlling for the number of male authors. Significant values are noted in bold.

JADA=Journal of American Dental Association; IJPRD= International Journal of Periodontics & Restorative Dentistry; JPHD=Journal of Public Health Dentistry; AJO-DO=American Journal of Orthodontics and Dentofacial Orthopedics; JDE=Journal of Dental Education; JPD=Journal of Prosthetic Dentistry; JOMS=Journal of Oral and Maxillofacial Surgery; JOE=Journal of Endodontics; PD=Pediatric Dentistry

the differences over time were significantly higher in 2008 than in 1986 (p=0.047). With respect to each individual journal, significant trends of increased female first authorship were evident in a linear way in the *JDE* (p=0.049), *JOMS* (p=0.021), and *JOE* (p=0.016); significant trends of increased female last authorships were observed in the *JADA* (p=0.015), *JPHD* (p=0.018), and *JOE* (p=0.001).

Of all included authors, 670 (12 percent) male authors and seventy-seven (1 percent) female authors held both D.M.D./D.D.S./B.D.S. and Ph.D. degrees.

The tenure status of female full-time dental/clinical science faculty members is shown in Table 2. The percentage of tenured female faculty members increased from 10 percent in 1995–96 to 17 percent in 2007–08. The proportion of female faculty members in tenure-track positions also showed a steady increase from 24 percent to 31 percent for the same years.

The proportion of females serving as dental school deans were 2 percent, 5 percent, 2 percent, 7 percent, and 18 percent for 1985–86, 1990–91,

1995–96, 2000–01, and 2005–06, respectively (Table 3). From 1985–86 to 2005–06, there was a ninefold increase in the percentage of female deans in U.S. dental schools.

The percentage of female presidents in ADA-recognized specialty organizations from the past to present is shown in Table 4. From the total of nine organizations, three (AAOMS, AAO, AAPD) have never had a female president. The AAPHD had the highest proportion of past and current female presidents (14 percent).

Table 2. Tenure status of female full-time dental/clinical science faculty members, by percentage of total

Year	Tenured	On Tenure Track	Not Eligible for Tenure
1985–86	NI	NI	NI
1990–91	NI	NI	NI
1995–96	10	24	26
2000–01	14	26	30
2005–06	17	32	34
2007–08	17	31	34

NI=no information

Note: Data were acquired from the American Dental Asso-cia-tion (data were not available for years of 1985–86 and 1990–91).

Table 3. Deanships of U.S. dental schools by gender, by number and percentage of total

Year	Male	Female	Total (%)
1985–86	57	1	58 (2%)
1990–91	52	3	55 (5%)
1995–96	53	1	54 (2%)
2000–01	52	4	56 (7%)
2005–06	46	10	56 (18%)
2007–08	NI	NI	NI

NI=no information

Note: Data were acquired from the American Dental Association (data were not available for year of 2007–08).

Discussion

The frequency of women who are first and last authors on dental research papers has increased during the last twenty-two years, especially in the last authorship position in the selected journals (Table 1). This is comparable with findings from recent studies in the medical fields.[6,33,36-40]

The studies of medical literature found that the increasing trends of female authorship roughly paralleled increased female participants in their field;[37,39,40] however, female authorships were still considered to be a minority.[36,38,41,42] In our study, the overall proportion of female authorship in the selected journals did not reflect the increasing numbers of women entering the dental education workforce and academia. Despite making up 39 percent of enrolled residents in ADE programs and 31 percent of full-time faculty in 2007–08, only 21 percent and 14 percent of first and last authors were female in the dental literature.[9] Nevertheless, it is promising that female authorships had increased almost threefold and twofold for overall first and last authorship, respectively, from 1986 to 2008. The general lower overall percentage of female last authors compared to first authors is noted. One explanation could be that the first authors are usually the residents or junior faculty members in the discipline, whereas the last authors are usually the principal investigators with more experience in the field. One could also speculate that those authors who held both D.M.D./D.D.S./B.D.S. and Ph.D. degrees are more likely to be the principal investigators.

Table 4. Female presidents in American Dental Association-recognized specialty organizations, by number and percentage of total

Organization	Years	Number of Presidents	Number of Female Presidents (%)
American Academy of Public Health Dentistry	1937–2009	71	10 (14%)
American Association of Endodontists	1943–2009	66	1 (1%)
American Academy of Oral and Maxillofacial Pathology	1946–2009	63	1 (1%)
American Academy of Oral and Maxillofacial Radiology	1949–2009	50	3 (6%)
American Association of Oral and Maxillofacial Surgery	1918–2009	90	0 (0)
American Association of Orthodontists	1901–2009	107	0 (0)
American Academy of Pediatric Dentistry	1948–2009	60	0 (0)
American Academy of Periodontology	1914–2009	63	4 (6%)
American College of Prosthodontists	1970–2008	38	1 (3%)

Further, studies have reported fewer women holding higher faculty ranks of professor and associate professor.[5,27,28,30] This may suggest that the proportion of female senior mentors is insufficient to provide guidance for junior female faculty members. Future analysis of the trends in author characteristics, sources of funding, and types of articles published is warranted.

There was a higher proportion of both female first and last authorship contributions in the pediatric dentistry publication than the other dental journals studied. One may attribute this to the consistently high female enrollment in pediatric dentistry specialty programs from 1995–96 (63 percent) to 2007–08 (59 percent).[8,9] However, female first and last authorship contributions to the pediatric dentistry publication did not change significantly from 1986 to 2008. Explanations for the lack of increased female authorship could not be offered as this study did not explore the reasons for this gender gap. More research is warranted to explore this topic. One interesting observation from the study is that the female first authorship in pediatric dentistry peaked (50 percent) in 2000, reaching parity with male authors, then dropped almost 10 percent in 2005. Despite being considered a female-dominated specialty, there had never been a female president of the AAPD.

In contrast, females made up a smaller percentage enrollment in the endodontic specialty programs (20 percent in 1995–96, 30 percent in 2007–08),[8,9] but showed a significant increase in both first and last female authorship in the *JOE* from 1986 to 2008. One may attribute this to the extremely low absolute number of female authors in the *JOE* in the initial years studied. Subsequently, any increase would show a steady progress on the proportion of female authorship participation.

This study found that female participation in scholarly service activity in the dental profession remained low. This is similar to findings from previous studies, in which gender disparity still existed in the administrative domain.[5,19,36,43] Wright et al.[21] reported that though women and men had the same aspirations and perceptions of leadership positions, women were more likely to be ignored for their leadership ability. Most of the ADA-recognized specialty organizations had a low representation of female presidents, except the AAPHD, which had 14 percent of its presidents. Another important observation is the significant increase of female senior authorship in the *JPH*. It is promising that more women are involved in higher responsibility endeavors.

As for deanship, there was a sharp increase in the number of female deans in dental schools. Female deanship increased ninefold from 1985–86 (2 percent) to 2005–06 (18 percent). It should be noted that there were very few female deans in 1985–86. Although still underrepresented, this finding suggests that there is potential for women to be more involved in administration. More female faculty members should be encouraged to apply for higher administrative positions. Several programs have been implemented by the American Dental Education Association (ADEA) to support women's advancement in academic dentistry.[6] The Women Liaison Officers program was established in 1992 to improve the academic environment for female faculty, staff, and students. The ADEA/Johnson & Johnson Healthcare Products Enid A. Neidle Scholar-in-Residence Program was instituted in 1994 to sponsor female faculty members to work on gender-related issues in the central office. Furthermore, the ADEA International Women's Leadership Conference was launched to provide an opportunity to mentor, educate, and network with women in the profession around the world. The Hedwig van Ameringen Executive Leadership in Academic Medicine (ELAM) Program for Women was expanded in 1995 to include women dental faculty members in this national leadership program.[44] The Council on Graduate Medical Education (COGME) report stressed the importance of having women in leadership positions for decision making.[45] It is hoped that female faculty members will take advantage of these programs and advance into leadership positions. In that way, a more gender-balanced approach to health care and curricular and organizational change may be achieved, which may benefit the profession as a whole.

In 2007–08, women were still underrepresented among the appointments of tenured faculty members of academic dental institutions. Seventeen percent of female full-time faculty members were tenured in 2007–08, and 31 percent were on a tenure track. Unfortunately, statistics on academic rank based on gender by dental discipline were not available for this study. According to a 2001 ADEA survey, a small percentage of respondents were female professors.[33] Among the female respondents, 15 percent were full professors, 47 percent were associate professors, 34 percent were assistant professors, and 4 percent were instructors. For their male counterparts, 43 percent were full professors, 39 percent were associate professors, 16 percent were assistant professors, and 1 percent were instructors. Several explanations have

been proposed to explain gender disparity in the workforce, which may result in early departure before reaching tenured status. Despite being one-third of the full-time faculty, most females were clustered in a junior rank position. One study reported that women took longer to attain an associate professor rank than men,[19] whereas other studies have found that women felt they were less likely to be promoted.[21,27-31] Some studies have suggested that women exhibited lower research productivity and research funding,[27,46] and others indicated that women faced greater career obstacles.[21,22,47] Another study, however, found equal production in research publications for both women and men.[24] Nevertheless, women faculty members have reported experiencing more obstacles to career success and less satisfaction in their work environment.[21,48,49] It has been found that young faculty members in lower rank positions have a higher tendency to leave academia.[13] In addition, it has been found that more male faculty members had defined their career goals more clearly,[47] which may lead to increased success in promotion. Addressing gender bias and providing necessary support are important for female faculty recruitment and retention. It is essential to have female role models and mentors to guide junior faculty members, demonstrate leadership, and promote advancement in the academic environment.

When comparing these data with those in medicine, some similarities were observed. The academic medical and dental professions have comparable percentages of females who are tenured. Most of the medical data were acquired from the section on women in U.S. academic medicine of the Association of American Medical Colleges website (www.aamc.org). Although we wanted to evaluate the academic rank position distribution between genders in dentistry, the necessary data were not available at the present time. In addition, information on gender-based faculty demographics in academic dentistry is not yet available in the dental workforce databases. Though the ADA and ADEA have made great efforts to conduct surveys and analyze the statistics, dentistry should strive to achieve the same level its medical counterparts have in obtaining and organizing this critical information. The specialty organizations and individual institutions could collaborate with the ADA or ADEA to collect such data. The availability of this data would not only provide an opportunity to critically evaluate the historical and present status of women in the profession, but also would provide an opportunity to understand dynamic changes in the data.

This study has several limitations. First, the gender of only the first and last coauthors of articles was examined, as opposed to all coauthors. There could be more female authors participating in research than were included in this study because of being credited as middle authors. Secondly, some high impact factor journals were excluded, such as the *Journal of Dental Research* and *Journal of Periodontology*. This was because these journals do not include their authors' degrees or they include only authors' first initials and last names on published articles, rendering gender identification difficult. Therefore, our results may not be representative of all the journals in the dental field. Lastly, the most recent information (year of 2007–08) for deanships and historical statistics regarding academic rank were not available at the time of this study. These omissions made it difficult to perform direct comparison between the journals studied and the data retrieved at the representative years.

Conclusions

The findings from this study demonstrate that the percentage of female authors has increased in the journals studied over the past twenty-two years. The percentage of female faculty members in higher-level academic appointments and academic and professional leadership positions has also increased over time. However, despite these essential gains, females are still underrepresented in the top levels of the dental profession. Hopefully, the information reported from this study will stimulate more mentoring, role modeling, and attention to the particular challenges faced by female dental faculty members in recruitment, promotion, and tenure processes. Such developments could make academic dentistry a more welcoming and supportive field for female faculty members and help female dentists, wherever they work and/or practice, one day reach parity with men.

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