Gender Differences in Academic Productivity and Leadership Appointments of Physicians Throughout Academic Careers

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Abstract

Purpose

Because those selected for leadership in academic medicine often have a record of academic productivity, publication disparities may help explain the gender imbalance in leadership roles. The authors aimed to compare the publication records, academic promotions, and leadership appointments of women and men physicians longitudinally throughout academic careers.

Method

In 2007, the authors conducted a retrospective, longitudinal cohort study of all 25 women physicians then employed at Mayo Clinic with ≥20 years of service at Mayo and of 50 male physician controls, matched 2:1 by appointment date and career category, to women. The authors recorded peer-reviewed publications, timing of promotion, and leadership appointments throughout their careers.

Results

Women published fewer articles throughout their careers than men (mean [standard deviation] 29.5 [28.8] versus 75.8 [60.3], $P = .001$). However, after 27 years, women produced a mean of 1.57 more publications annually than men ($P < .001$). Thirty-three men (66%) achieved an academic rank of professor compared with seven women (28%) ($P = .01$). Throughout their careers, women held fewer leadership roles than men ($P < .001$). Nearly half (no. = 11; 44%) of women attained no leadership position, compared with 15 men (30%).

Conclusions

Women's publication rates increase and actually exceed those of men in the latter stages of careers, yet women hold fewer leadership positions than men overall, suggesting that academic productivity assessed midcareer may not be an appropriate measure of leadership skills and that factors other than publication record and academic rank should be considered in selecting leaders.

Despite increased attention to gender disparities in academic promotion over the past decade, women are still substantially underrepresented in the highest academic ranks.[1–3] Academic productivity is often used as a criterion for the selection of leaders, and therefore disparities in productivity may help explain why few women are in leadership roles.[1,4] As a result, few female academic physicians are available to provide gender-concordant role modeling and mentoring for more junior female colleagues.[5,6]

Gender disparities in academic productivity have been explained by observations that women are more likely than men (1) to work part-time,[7–10] (2) to dedicate a greater proportion of their professional effort to teaching and patient care as opposed to research,[11,12] (3) to shoulder a greater proportion of family responsibilities,[13–15] (4) to receive gender-discordant role modeling and mentoring,[5,6,16,17] (5) to perceive gender-related obstacles to academic advancement in the work environment,[17] and (6) to hold personal values incongruent with traditional measures of academic success.[12,18,19] However, most studies examining gender differences in academic productivity are cross-sectional and do not examine progress over the full span of academic careers. Whether disparities in academic productivity persist throughout careers is unknown.

Therefore, we aimed to compare the publication records, academic promotion, and leadership appointments of women and men academic physicians over the span of their entire careers using a longitudinal cohort design. These analyses will help determine whether disparities in academic productivity between genders persist throughout careers. On the basis of prior studies showing that women may prioritize family responsibilities over academic goals during the early phases of their careers,[13–15] we hypothesized that men would publish more than women early in their careers but that publication rates may be similar for both genders in the later stages of academic careers. Yet, on the basis of data demonstrating consistent gender disparities in leadership roles,[1,4] we hypothesized that a reduction in the gap in publication rates between genders would not attenuate inequity in leadership appointments.

Method

Study design

In 2007, we conducted a retrospective, longitudinal cohort study of the publication records, rates of academic promotion, and leadership appointments

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Acad Med. 2011;86:43–47.
First published online November 18, 2010
doi: 10.1097/ACM.0b013e3181ff9ff2

of women and men academic physicians at Mayo Clinic. The Mayo Clinic institutional review board approved this study.

Participants

We included all women scholarly clinicians who were, at the time, employees of Mayo Clinic with 20 or more years of service at Mayo Clinic. We defined scholarly clinicians as physicians who spend >25% of their professional effort directly providing patient care. We excluded clinician investigators and physician scientists, defined as physicians who dedicate ≥75% of their professional effort to research. We categorized physicians by career track based on their initial appointments. For each woman participant, we identified two male physicians, matched by appointment date and career track as scholarly clinicians, to serve as controls.

Mayo Clinic is a not-for-profit academic health center with a nontenured system. Continued employment and salary are disassociated from academic rank, and Mayo Clinic does not provide financial incentives for publishing, achieving academic promotion, or being selected for most leadership appointments.

Data collection

We identified physicians using an institutional database containing years of service of physicians. We used an institutional database containing physicians' curricula vitae to determine the following:

- the number and date (year) of peer-reviewed publications,
- the dates (years) of academic promotion to assistant professor, associate professor, and professor, and
- the total number of appointments to divisional, departmental, institutional, and national leadership roles for each participant.

Divisional and departmental leadership roles included division or department chair, vice chair, or associate chair. We did not include lesser roles such as head of a section within a division. We defined an institutional leadership position as dean, associate dean, or chair of a prominent institutional committee. We defined a national leadership role as president or chair of a national organization such as a scientific society or foundation.

Data analysis

We summarized continuous variables (years of service and total publications) using the mean and standard deviation (SD) for each group, and we made comparisons between groups using linear regression with a random effect for matched sets. In addition, we graphed the mean publications by years of service for men and women. We used a linear regression model to compare the publications per year, with a random effect for matched sets and repeated measures. This model included gender, years of service, an indicator variable for >27 years of service, and an interaction variable between gender and >27 years of service. We selected this model because the graph of mean publications by years of service seemed to show a reversal of the trend by gender after 27 years of service.

We summarized categorical variables (highest academic rank achieved and highest leadership position attained) using the number (percentage) in each group, and we made comparisons between groups with polytomous logistic regression with a random effect for matched sets and with robust standard errors. We summarized time-to-event data (years to assistant professor, associate professor, and full professor) using the mean and SD for those who achieved the academic rank; we made comparisons between groups using Cox regression with a random effect for matched sets. We also calculated Kaplan–Meier curves for time to associate and full professor. We compared the number of leadership positions held at the divisional, departmental, institutional, and national levels between men and women using a Poisson regression (for event data) with robust standard errors and a random effect for matched control. We adjusted the number of leadership positions held for the years of service by

Table 1

Publication Record, Academic Rank, and Leadership Positions of 25 Women and 50 Men Physicians With 20 or More Years of Service at Mayo Clinic, 2007

Measure	Men	Women	*P* value
Years of service, mean (SD)	**26.6 (3.2)**	**26.6 (4.2)**	**.83***
Total publications, mean (SD)	**75.8 (60.3)**	**29.5 (28.8)**	**.001***
Highest academic rank achieved			**.01†**
Instructor, no. (%)	1 (2)	2 (8)	
Assistant professor, no. (%)	11 (22)	13 (52)	
Associate professor, no. (%)	5 (10)	3 (12)	
Professor, no. (%)	33 (66)	7 (28)	
Years to assistant professor, mean (SD)	**2.8 (2.3)**	**3.6 (3.1)**	**.10‡**
Years to associate professor, mean (SD)	**9.3 (4.1)**	**10.1 (5.6)**	**.052‡**
Years to professor, mean (SD)	**16.3 (5.8)**	**19 (5.1)**	**.090‡**
Number of leadership positions held§			**<.001¶**
None, no. (%)	15 (30)	11 (44)	
Divisional, no. (%)	34 (68)	12 (48)	
Departmental, no. (%)	22 (44)	1 (4)	
Institutional, no. (%)	9 (18)	2 (8)	
National, no. (%)	15 (30)	7 (28)	

* Calculated using linear regression with a random effect for matched sets.
† Calculated using polytomous logistic regression with a random effect for matched sets and robust standard errors.
‡ Calculated using Cox regression with a random effect for matched sets.
§ Percentages do not total 100% because physicians may attain more than one leadership position at each level.
¶ Calculated using Poisson regression with a random effect for matched sets and robust standard errors.

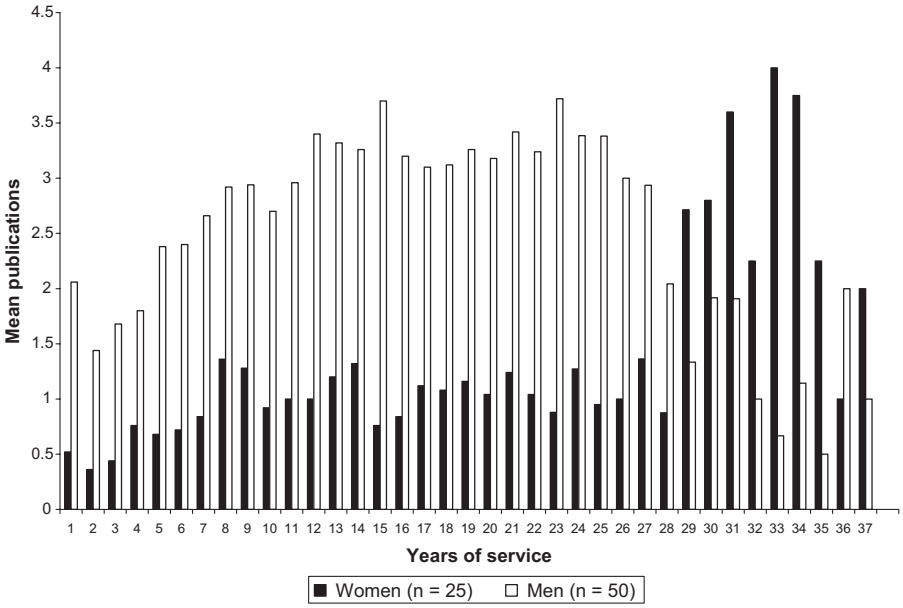

Figure 1 Mean number of publications for each year of service produced by 25 women and by 50 men matched 2:1 by years of service and career track (i.e., scholarly clinician) to women. Seven women and 13 men in the sample (from Mayo Clinic, 2007) had each, at the time of the study, provided more than 27 years of service.

including a natural log offset in those models. We considered a two-tailed $P < .05$ to be statistically significant for all analyses. We analyzed data using SAS 9.1 (SAS Institute, Cary, North Carolina).

Results

We included all 25 women physician scholars then employed at Mayo Clinic who had 20 or more years of experience at Mayo; we identified 50 men who, matched by appointment date and career track as scholarly clinicians, served as controls. Women physicians in this cohort practiced at Mayo Clinic a mean of 26.6 (SD: 4.2, range: 22–37) years, and men practiced at Mayo a mean of 26.6 (SD: 3.2, range 22–34) years. Seven women and 13 men had each, at the time of the study, provided more than 27 years of service at Mayo Clinic.

Academic productivity

The women in this cohort published a mean (SD) of 29.5 (28.8) and a median (interquartile range [IQR]) of 18 (8, 52) publications over the span of their careers compared with the men, who published a mean (SD) of 75.8 (60.3) and median (IQR) of 59 (26, 112) publications ($P = .001$) over the span of their careers (Table 1). The range of publications by individuals was 2 to 106 among women and 1 to 303 among men.

Figure 1 shows the mean publications for women and men according to years of service. In our study, women produced a mean of 1.94 fewer publications than men per year throughout the first 27 years of service ($P = .001$, Table 2). However, after 27 years of service, mean publications by women increased to 2.72 publications per year compared with a mean of 1.15 publications per year by men ($P = .03$), such that women produced a mean of 1.57 more publications per year than men in this time period (Table 2). The difference in the mean publications for women compared with men increased by 3.51 publications per year from −1.94 for ≤27 years of service to 1.57 for >27 years of service ($P < .001$ for the interaction between gender and more than 27 years of service, Table 2). Yet, women produced 1.74 fewer publications per year than men on average over their entire careers ($P < .001$). We found no associations between academic productivity and total career duration.

Academic rank

In our study, men achieved higher academic rank over the span of their careers compared with women ($P = .01$, Table 1). Throughout their entire careers, 38 men (76%) achieved the rank of associate professor and 33 men (66%) achieved the rank of professor compared with 10 (40%) and 7 (28%) women, respectively ($P = .01$). The mean (SD) years to promotion to associate professor was 10.1 (5.6) years for women and 9.3 (4.1) years for men ($P = .052$). Men achieved the academic rank of professor in a mean of 16.3 (5.8) years compared with 19 (5.1) years among women ($P = .090$). We compared the time required for women and men to attain the academic ranks of associate professor and professor using Kaplan–Meier curves (Figure 2).

Leadership appointments

Throughout the span of their academic careers, the women in this cohort held fewer total leadership roles than the men ($P < .001$, Figure 3). Nearly half (44%) of women physicians (no. = 11) did not attain a divisional, departmental, institutional, or national leadership position during the span of their careers, compared with 30% of men (no. = 15). Just one woman in the sample held a single departmental leadership position

Table 2

Mean Publications per Year by 25 Women and 50 Men Physicians Before and After 27 Years of Service at Mayo Clinic, 2007

No. of years of service	Mean publications per year		Mean difference*	*P* value†
	Women	Men		
≤27 years	1.54	3.48	−1.94	.001
>27 years	2.72	1.15	1.57	.03

* The difference in the mean publications per year for women versus men increased by 3.51 publications per year from −1.94 for ≤27 years of service to 1.57 for >27 years of service ($P < .001$ for interaction between gender and years of service). Values are relative differences from linear regression model. The exact number of predicted publications per year for a given number of years of service may be calculated by predicted mean publications = relative mean + 0.041 (years of service − 27).

† Calculated using linear regression with a random effect for matched sets.

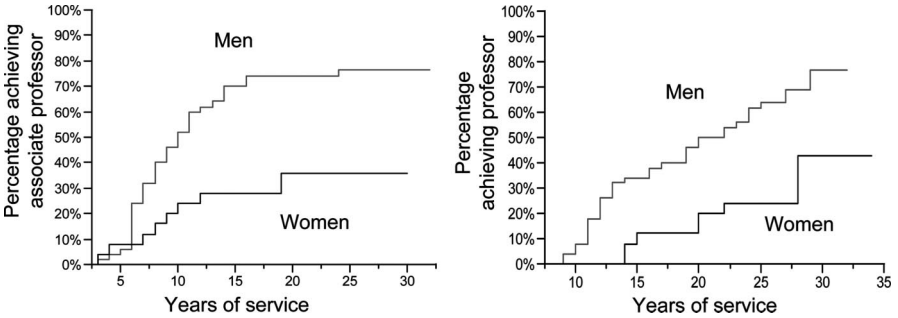

Figure 2 Kaplan–Meier curves comparing time in years to promotion between men and women physicians at Mayo Clinic in 2007. The left panel compares the 10 women and 38 men who became associate professors during the study ($P = .052$ after accounting for matching). The right panel compares the 7 women and 33 men who became full professors during the study ($P = .090$ after accounting for matching).

compared with 22 departmental positions held among 20 men. Seven national leadership positions were held among 5 women, compared with 15 national positions among 10 men.

Discussion

This retrospective, longitudinal cohort study examining the academic productivity, promotion, and leadership appointments of women and men academic physicians over the span of their careers demonstrates that women publish less, advance through academic ranks more slowly, and ultimately achieve lower academic rank and fewer leadership appointments compared with men. These findings align with previous cross-sectional studies indicating that publication productivity and academic promotion are lower among women.[1,2] These data are unique, however, in that the nontenured system of the Mayo Clinic allows examination of a longitudinal cohort that is not selected on the basis of academic productivity (unlike in systems in which academic productivity is often an important criterion for tenure).

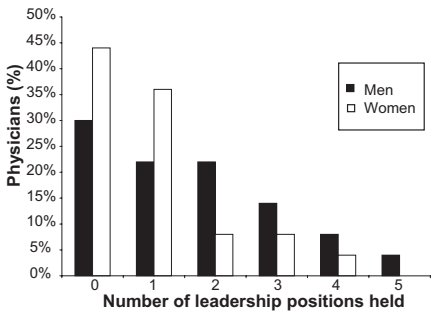

Figure 3 Number of leadership positions held among 25 women physicians and among 50 men physicians matched 2:1 by years of service and career track (i.e., scholarly clinician) to women ($P < .001$ for difference between women and men). These data are from Mayo Clinic, 2007.

Because Mayo Clinic is a nontenured academic health center where salary is dissociated from academic rank, all physicians in this cohort were equally likely to be retained regardless of academic productivity. Examination of this unique cohort across more than 20 years reveals that the publication productivity of women "catches up" to and even exceeds that of men in the latter stages of academic careers. To our knowledge, this finding has not been previously reported in the literature. Our findings have important implications: academic health centers with tenure systems that include financial incentives for academic rank may lose female physicians with less academic productivity early in their careers even though, as our findings suggest, these women may become more productive in the latter stages of their careers.

Despite increases in publication rates among women toward the ends of their careers, the women in our study did not achieve parity with men in attaining leadership positions. In this study, many leadership appointments occurred at 10 to 20 years of service, a period when, for this sample, the publication productivity of women was half that of men. Because academic productivity is often a criterion for the selection of leaders, otherwise qualified females may not be chosen on this basis. A paucity of qualified women in leadership positions both deprives organizations of the unique skills and perspectives women bring to such roles[20,21] and suggests that criteria other than publication record should be considered in the selection of leaders.

This study has several limitations. First, it occurred at a single institution; thus, the findings may not be generalizable to other academic health centers. Second, the duration of careers varied among physicians, so fewer participants represented the latter years of an academic career; however, we noted no association between career duration and productivity. Third, we did not examine other variables (e.g., marital status, number of children, personal values) that may explain discrepancies in academic productivity between genders. Fourth, although we matched physicians by career track (e.g., scholarly clinician) and excluded those who worked part-time, we did not examine the allocation of physicians' professional effort in patient care, teaching, and research, which fluctuates over the span of careers and cannot be accurately obtained retrospectively. Finally, we could not account for the possibility that physicians may have changed career tracks (e.g., from scholarly clinician to career scientist) over time.

These limitations notwithstanding, the findings from this longitudinal cohort study indicate that although the academic productivity of women lags behind men in the early and middle stages of careers, publication rates are similar between genders in the later stages of academic careers. Thus, academic productivity measured in midcareer may not be an appropriate measure of leadership skills, and factors other than publication record and academic rank should be considered in the selection of leaders. Academic health centers should recognize the disparate trends in scholarly productivity and promotion between men and women and develop new mechanisms to identify qualified female leaders.

Funding/Support: None.

Other disclosures: None.

Ethical approval: The Mayo Clinic institutional review board approved this study.

Previous presentations: This work was presented at the 31st Annual Meeting of the Society of General Internal Medicine.

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