



Gender Differences in Publication Productivity Among Academic Urologists in the United States

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OBJECTIVE	To describe the publication productivity of academic urologists in the United States by gender.
MATERIALS AND METHODS	Gender inequality is prevalent in most surgical subspecialties, including urology. Despite small numbers of women in academic positions, differences in scholarly impact by gender are relatively unknown. We assembled a list of 1922 academic urologists (1686 men (87.7%), 236 women (12.3%)) at 124 academic institutions throughout the United States as of February 2016. Scopus and Google Scholar were queried for bibliometric data on each individual, including <i>h-index</i> and <i>m-quotient</i> . We analyzed these metrics for both genders by educational background, subspecialty, National Institutes of Health funding, and academic rank.
RESULTS	Men had higher median <i>h-indices</i> than women overall ($P < .05$), and had higher successive academic ranks ($P < .05$). Proportionally fewer women attained senior academic ranking (professor/chair), ($P < .05$). There was no difference in research productivity by successive rank after controlling for career duration (<i>m-quotient</i>). Women were more likely to choose a practice that specialized in pediatric urology or female urology/pelvic reconstructive surgery than their male counterparts ($P < .05$).
CONCLUSION	Women represent a growing proportion of academic urology faculty, but despite the recent increase in number entering the field, relatively few women occupy senior leadership positions. Improving psychosocial barriers to advancement such as lack of mentorship or discriminatory policies may help pioneering female urologists as they progress in their careers. UROLOGY 103: 39–46, 2017. © 2017 Published by Elsevier Inc.

Women in surgery, and particularly in urology, remain a significant minority despite medicine's closing gender gap.^{1,2} According to the 2015 American Urologic Association census data, there are just 922 practicing female urologists nationwide, accounting for 7.7% of all practitioners.² However, in recent years, women have been selecting careers in urology at an increasing rate. By 2050, it is predicted that approximately 28% of practicing urologists will be women.¹ This increase in the number of women entering urology represents substantial progress toward equality, but we have yet to see equalization of academic rank.

For women who do enter surgical academic practice, relatively few ever attain senior leadership positions.^{3,5} Teaching duties, clinical productivity, and administrative functions contribute to faculty member evaluations, but scholarly output is heavily weighted in decisions regarding individual promotion in academic medicine. Female urologists over the course of their careers publish at a rate that exceeds their relative number in the field,⁶ suggesting that female academic rank is not reflective of their academic output. This discordance between academic rank and lifetime publication productivity for female urologists deserves more attention.

Several medical specialties have used bibliometric analysis to examine gender differences in publication output and other related factors, but this approach has not yet been applied to urology.⁷⁻⁹ This study seeks to investigate the gender imbalance in scholarly output in academic urology using bibliometrics. By highlighting any disparities, we hope to encourage discussion of barriers to a woman's academic success and promote systematic change so that women with aspirations in urology have equal opportunity for prolific careers as leaders in the field.

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MATERIALS AND METHODS

Bibliometrics

The most commonly used objective indicator for research productivity is the Hirsch index (*h-index*), calculated using an author's publications where N papers have at least N citations. For example, an author with 10 publications cited at least 10 times will have an *h-index* of 10. Because citation number is accounted for with this metric, the *h-index* represents both a quantitative and qualitative measure of a researcher's output. One limitation of the *h-index* is its inherent temporal bias when using the metric to compare individuals. Investigators engaged in publication activities for a longer period of time will have more opportunities to publish, and publications that have been in circulation longer will have more opportunity to be cited. The *m-quotient* is a potential correction for the *h-index*'s inherent dependence on time by mitigating the effects of differing career lengths when comparing the *h-indices* of multiple authors ($m = h/n$, where *h* is the *h-index*, and *n* is the years since an author's first publication). This study uses the *h-index* and *m-quotient* to examine gender differences in academic urology.

Data Collection

We assembled a list of 128 accredited U.S. urology residency programs from the Accreditation Council for Graduate Medical Education (2015-2016). We then used institutional websites to compile a database of academic urologists. Information on academic rank, educational background, subspecialty (if mentioned), and gender were recorded (websites accessed from January to February 2016). We only included faculty members with an MD, DO, or MD/DO + PhD degree who held an appointment within the department/division of urology and completed a urology residency training program or trained in obstetrics/gynecology and now specialize in Female Urology/Pelvic Reconstructive Surgery. Four military programs were excluded from analysis because they lacked sufficient physician information. Academic rank was categorized as chair, professor, associate professor, assistant professor, and instructor (defined as clinical instructor, staff clinician, or unspecified faculty listing). Gender was imputed from extant data (names, photographs, and biographic descriptions).

Institutional review board approval was not required as the data were publicly available and subjects were not contacted. For each urologist listed in our database we performed a custom search string using author search functions in both Scopus Google Scholar to retrieve bibliometric data, including *h-index*, *m-quotient*, and date of first urology publication. In cases where an author's name was common and yielded multiple results, we used information on educational background, institutional affiliations, and publication subject (urology-related) to assign individual publications to an author. Where possible, both the current surname and maiden name were used to determine metrics for female faculty. Year of first publication was used as a proxy for inception of career in our calculation of academic career length (calculated by subtracting year of first publication from current year, 2016). The *h-index* and *m-quotient* from Scopus and Google Scholar databases were averaged for a combined *h-index* and *m-quotient*, which we used for all analyses. Previous studies report reasonably good concordance rates in *h-index* values between the 2 databases.^{10,11} Finally, we accessed the National Institutes of Health (NIH) Research Portfolio Online Reporting Tools website to procure data on research funding using the Principal Investigator (PI)/Project Leader function.

Statistical Analysis

Mann-Whitney *U* tests and Kruskal-Wallis tests were used for comparison of continuous variables, and Pearson chi-square test was used for comparison of categorical variables. All statistical analyses were performed using SAS (SAS Institute Inc., Cary, NC), with 2-sided $P < .05$ considered statistically significant.

RESULTS

Overall, 1922 urology faculty members from 124 academic institutions were included for analysis. Of these, 236 (12%) were women and 1686 (88%) were men. The *h-index*, *m-quotient*, career duration as well as number of faculty with PhDs and NIH funding stratified by gender and academic rank are listed in Table 1. The *h-index* for urology faculty by academic rank is displayed in Figure 1. As expected, *h-index* increased with ascending academic rank ($P < .0001$). The difference in *h-index* between department chair and professor was not significant ($P = .18$). The career duration for all faculty members was also calculated and stratified by academic rank.

Gender Comparison by Category

Academic Rank. The gender distribution by academic rank is displayed in Figure 2A. Men were more likely to occupy senior academic positions, that is, professor and department chair ($P < .0001$). Women were not represented in higher academic positions proportional to their numbers in the field as a whole (Fig. 2B). There were only 3 female chairs (1.3% of female urologists) vs 126 male chairs (7.5% of male urologists). There were 25 female professors (11% of female urologists) vs 441 male professors (26% of male urologists).

Specialty Choice. Subspecialty choice was significantly different between genders ($P < .0001$). Men were more likely to choose General Urology ($P = .0022$) or Urologic Oncology ($P < .0001$) as their subspecialty. Women were more likely to choose Female Pelvic Medicine and Reconstructive Surgery ($P < .0001$) or Pediatric Urology ($P < .0001$). There was no gender difference in Andrology or Stone Disease and Advanced Endourology ($P = .0763$ and $P = .0734$, respectively). These patterns largely remained even after examining distributions over time where we compared subspecialty for those who had been in academia for over 10 years with those who had just begun their careers (career duration < 10 years). The one exception was in General Urology, where there was no difference in gender for those with less than 10 years of experience ($P = .2453$).

Publication Productivity. The overall median *h-index* was 10.33, and men had a higher median *h-index* (11.67) than women (6.33), $P < .0001$. When organized by academic rank, there were also significant differences between gender for the same position (Fig. 1). The *h-indices* for men were higher than those for women in every rank. The differences were statistically significant at the assistant ($P = .02$), associate ($P = .01$), and professorship levels ($P = .03$).

Table 1. Academic productivity metrics, career duration, and National Institutes of Health (NIH) funding for urology faculty by gender and academic position, 2016*

Position and Gender	No. (%)	<i>h-index</i> , Median (Range)*	Career Duration		PhD, No. (%)*	NIH Funded, No. (%)*
			in Years, Median (Range)*	<i>m-quotient</i> , Median (Range)*		
Chair/chief	129	26.3 (2-109)	28 (8-46)	0.97 (0.07-2.97)	4 (3.1%)	15 (11.6%)
Men	126 (97.67%)	26.3 (2-109)	28 (10-46)	0.97 (0.07-2.97)	1 (3.1%)	15 (11.6%)
Women	3 (2.33%)	37.7 (4-43)	27 (8-32)	1.19 (0.50-1.50)	0 (0%)	0 (0%)
Professor	466	25.7 (0-112)	30 (4-46)	0.88 (0-6.38)	19 (4.1%)	37 (7.9%)
Men	441 (94.64%)	26.3 (0-112) [†]	31 (4-46) [†]	0.88 (0-6.38)	18 (3.9%)	34 (7.3%)
Women	25 (5.36%)	20.7 (4-45) [†]	24 (9-45) [†]	0.79 (0.26-1.69)	1 (0.2%)	3 (0.6%)
Associate professor	361	13.3 (0-56)	19 (1-54)	0.68 (0-2.82)	17 (4.7%)	22 (6.1%)
Men	315 (87.26%)	13.7 (0-56) [†]	20 (1-54) [†]	0.68 (0-2.82)	15 (4.2%)	19 (5.3%)
Women	46 (12.74%)	10.5 (0-28) [†]	14 (7-42) [†]	0.65 (0-1.46)	2 (0.6%)	1 (0.8%)
Assistant professor	744	5.7 (0-55)	13 (1-62)	0.44 (0-2.95)	18 (2.4%)	10 (1.3%)
Men	603 (81.05%)	6.0 (0-55) [†]	14 (1-62) [†]	0.43 (0-2.75)	15 (2.0%)	9 (1.2%)
Women	141 (18.95%)	4.7 (0-35) [†]	11 (1-46) [†]	0.46 (0-2.95)	3 (0.4%)	1 (0.1%)
Instructor	222	3.0 (0-61)	19 (2-52)	0.18 (0-2.96)	2 (0.9%)	5 (2.3%)
Men	201 (90.54%)	3.0 (0-61)	19 (2-52)	0.19 (0-2.96)	2 (0.9%)	5 (2.3%)
Women	21 (9.46%)	2.7 (0-26)	17 (4-45)	0.14 (0-1.27)	0 (0%)	0 (0%)
Total	1922	10.3 (0-112)	20 (1-62)	0.58 (0-6.38)	60 (3.1%)	89 (4.6%)
Men	1686 (87.72%)	11.7 (0-112) [†]	22 (1-62) [†]	0.60 (0-6.38) [†]	54 (2.8%)	82 (4.3%)
Women	236 (12.28%)	6.3 (0-45) [†]	13 (1-46) [†]	0.50 (0-2.95) [†]	6 (0.3%)	7 (0.4%)

* *h-index* for 1922 MD, MD/DO, or MD/DO + PhD faculty at 124 academic urology institutions as reported by Scopus (Elsevier BV, Amsterdam, The Netherlands). The career duration was calculated as the number of years from first reported publication to 2016. *m-quotient* was calculated by dividing the *h-index* by the career duration. Whether or not the faculty member had a PhD was determined from departmental and individual physician website. NIH funding was determined using the NIH research portfolio Online Reporting Tools (RePORTER) website.

[†] $P < .05$ for comparison of men vs women for that same column.

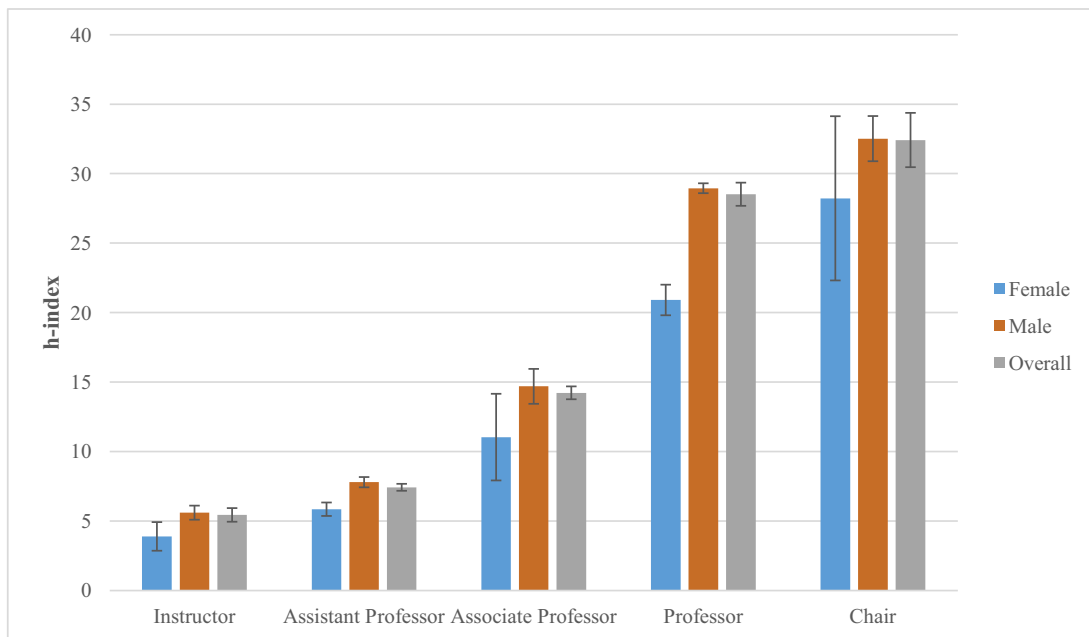


Figure 1. Mean *h-index* for 1922 academic urologists from 124 institutions according to academic rank. Error bars represent standard error of sample mean. (Color version available online.)

Because there were only 3 female chairs, statistical significance was not assessed. Similarly, the overall median *m-quotient* for men was higher at 0.60 than for women at 0.50 ($P = .0054$). However, the differences in *m-quotient* between genders were not significant when stratified by academic rank.

NIH Funding and PhD Status. Although more men (4.27%) received NIH funding than women (0.36%), the difference was not statistically significant ($P = .2462$). Similarly, there was not a significant difference in the number of faculty members who had obtained PhDs ($P = .6930$).

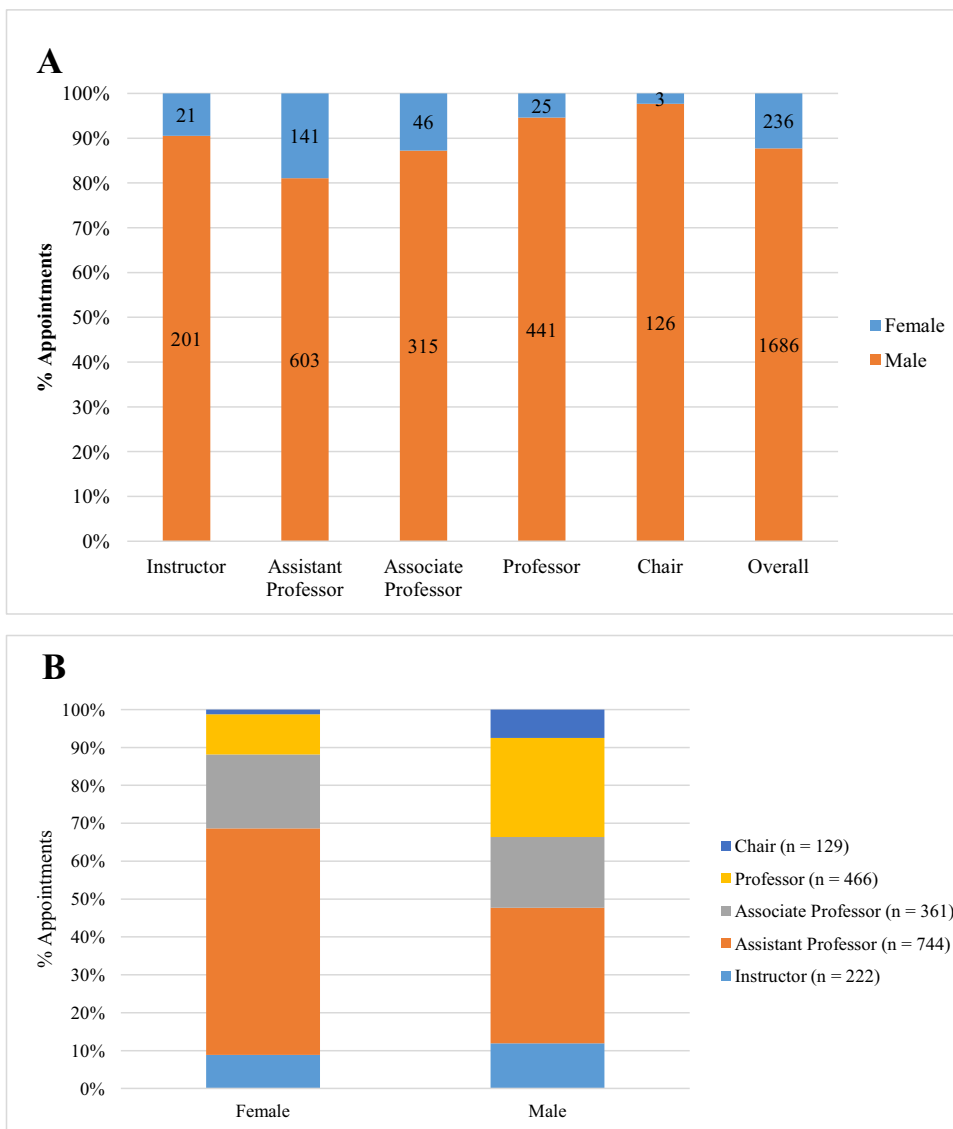


Figure 2. (A) Gender distribution of 1922 academic urologists from 124 institutions according to academic rank. Data labels represent number of faculty members for each gender, respectively. **(B)** Academic rank representation by gender. (Color version available online.)

Career Duration. Overall, men had a longer median career duration as measured by years since first research publication: 22.00 (range: 1-62) vs 13.00 (range: 1-46) ($P < .0001$). At every academic rank, men had longer career duration (Table 1). In Figure 3, *h*-indices were evaluated with regard to the length of research career. Gender differences were largest for individuals in mid-career (21-30 years). Women in this range had a mean *h*-index of 14.59 and men had a mean *h*-index of 21.21 ($P = .0257$). For urologists with less than 30 years of experience, men had a higher mean *h*-index than women ($P < .0001$). This difference in *h*-index by duration disappeared for faculty with greater than 30 years of active research activity ($P = .5242$) or less than 10 years ($P = .5242$). There were only 16 women with more than 30 years of experience.

Discussion

Our study demonstrates that there are significant differences in academic ranking, subspecialty choice, and publication productivity by gender within academic urology. Women are disproportionately underrepresented in senior leadership positions, more likely to subspecialize in certain fields, and have different publication profiles overall compared with men. However, there was no difference in research productivity by successive rank after controlling for career duration (*m*-quotient). So, when women achieve a certain academic rank, they are just as productive as their male counterparts, and differences in *h*-index are largely driven by longer careers of male urologists. The rapidly changing demographics within academic urology provide a unique opportunity for analysis of women's barriers to academic advancement.

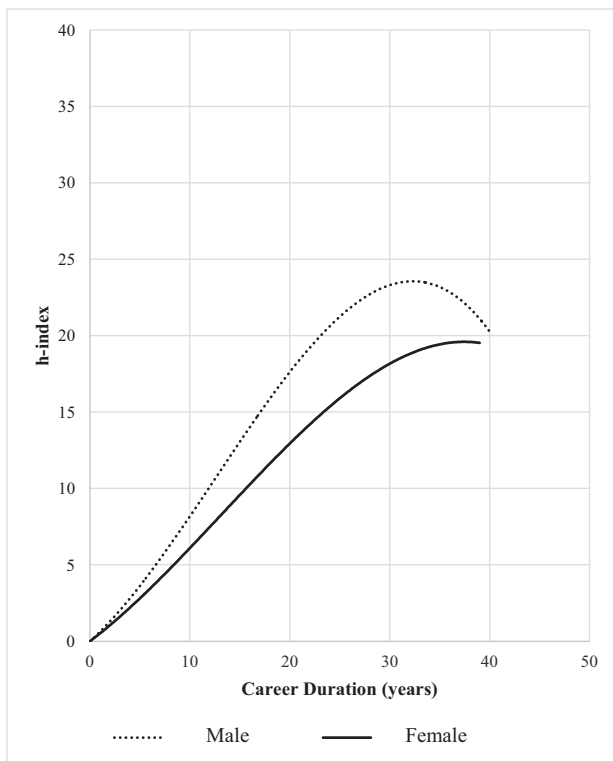


Figure 3. Chart of *h-index* plotted against career duration for 1922 academic urologists. Slope of the curve represents the rate of publication productivity. Note: The difference in *h-index* by gender at 10-year intervals is only significant for faculty with 11-20 years of experience ($P = .0019$) and 21-30 years of experience ($P = .0257$).

Gender Discrepancies in Medicine. Despite modest progress in recent years, women remain underrepresented in academic medicine as full-time faculty and in leadership positions.^{12,13} This problem is magnified in surgical fields where women have traditionally made up a smaller portion of the workforce. Studies in gastroenterology, otolaryngology, ophthalmology, and radiation oncology have confirmed a systematic gender association with academic position.^{7-9,14} Urology is no exception to these trends. Our results confirm previous findings where women tend to plateau at the rank of associate professor.^{15,16} Only 12% of all female urologists in our study have advanced past this level to senior positions compared with 33% of male urologists.

Women's underrepresentation in the upper echelons of academic medicine may simply be generational, as many years of significant research activity and clinical practice are required before senior promotion. In our analysis, men had a significantly longer career duration than women. This may be due to men's higher likelihood to publish during residency training,¹⁶ which would increase their years of active research activity. There may also be a time-lag effect, where relatively few women now have careers of sufficient length to warrant senior positions because of the relatively recent rise in female urology trainees (1.9% in 1978

to 23.1% in 2013).¹⁷ The American Urologic Association census data confirmed that high percentages of women are observed in younger age groups of practicing urologists: although only 7.7% of practicing urologists were women in 2015, they made up 17.2% of urologists <45 years of age. The outlook is bright for these young, female urologists. As women mature in their careers, increasing numbers will be eligible for advancement, and publication productivity will likely continue to be a significant factor considered in hiring and promotion. In our study, men had a higher *h-index* than women, and the differences remained significant even when comparing gender of the same academic rank. However, *h-index* is related to the career duration and we used the *m-quotient* to correct for these career length discrepancies. Overall, men had a higher *m-quotient* than women, but these differences were not significant on intra-rank comparison by gender, indicating that the overall *m-quotient* difference is due to a larger proportion of men in senior-level positions than women (a consequence of the time-lag effect for female trainees). Men and women are therefore publishing at similar rates in all ranks. There was no difference in *h-index* on subgroup analysis for faculty with less than 10 years of experience, suggesting that women entering the field of urology are equally contributing scientific knowledge. The differences beyond 10 years may represent a faster publication rate for men, which leads to a larger gap over time, or cohort differences in the accepted norms for men and women. For example, recent evidence suggests that women are more likely to enter a clinician-educator track than a traditional tenure track.¹⁸ This poses a considerable challenge to leadership parity for women because faculty on the clinician-educator track typically lag behind their colleagues in academic promotion. It is essential that we retain productive cohorts of junior women faculty to help close the tenure gap and provide mentorship for the next generation.

To increase publication productivity and better prepare for chairships, this group of rising female urologists desperately needs mentors that model senior-level leadership or head significant research groups. The approach should be twofold: (1) more same gender mentors, and (2) better opposite gender ones. Inadequate mentorship, especially early on in career development, may hamper women's opportunities for research output and advancement. A survey of medical students applying to the urology residency match cited mentorship in the field as one of the most important reasons for their decision to pursue urology.¹⁹ In fact, American medical schools with strong urology mentorship were much more likely to match applicants to urologic residency training programs.²⁰ However, in a systemic review of mentoring in academic medicine, less than half of all medical students claimed to have a mentor. The reviewers noted that women thought they had more difficulty obtaining a mentor than men, and many perceived that a mentor of the same gender would be more relatable. Several studies indicate that women have difficulty in finding same-sex mentors and role models,²¹⁻²³ and this may lead women to choose mentors of lower rank than

men.²⁴ This difficulty may be compounded in urology where women are sparsely represented. Over one-third of current female urologists surveyed in 1 study reported dissatisfaction with the lack of mentoring.¹⁵ In a group of women who left academic urology, 25% claimed a lack of mentorship as a reason for leaving.¹⁵ Obtaining adequate mentorship may be difficult for early-career female urologists, especially for those seeking senior female faculty mentors. However, these alarming statistics should serve as a clarion call not only for more female mentors, but also for better mentorship from male colleagues. Female urology residents and junior faculty should not sacrifice relationships with productive male mentors for less successful female mentors who may be less advanced in their careers.

Another reason for possible discrepancies in publication productivity for female urologist is pigeonholing, wherein women are relegated to practicing certain subspecialties. We found significant differences in the subspecialty based on gender in our cohort. Women were much more likely to describe their subspecialty practice as female or pediatric urology. Although we did not perform an analysis of publication productivity stratified by gender and subspecialty content, it may be that women have lower publication profiles because they publish within more niche specialties, where fewer articles are submitted or accepted for publication. Men, who are more likely to go into general urology and urologic oncology, will have broader readership and a higher citation rate for their work, although getting articles accepted may be more difficult with higher submission rates in these fields. Further work is needed to elucidate the effect of subspecialty choice on academic output.

The differences in research productivity and career trajectory may also be partially explained by greater obligation to family and parental responsibilities.^{4,25-27} Men are more likely to have children during residency training than women, but largely rely on their spouse for childcare.²⁸ Among residents and practicing surgeons who had children, more women take time off from work than men (67% vs 38% for residents and 64% vs 12% for post-training surgeons). Women considering pregnancy early in their careers face barriers trying to balance clinical/research activities with absence from work. As a result, nearly half of all women surgeons elect to delay childbearing until they have completed their training.²⁹ Female urologists are no exception, as they tend to have children later in life, a small number of children, a higher induction rate, and a higher rate of pregnancy complications.³⁰ Because surgical training spans the prime childbearing years for most women, concerns about the feasibility of starting a family may not only deter women from entering fields like urology, it may also pose a significant hurdle to early-career development and sustained productivity.

Our study has several limitations to consider. First, there is no quantification of non-NIH research funding. There may be gender differences in research funding that include institutional or private donor grants. Second, although we used the first urology-related publication as a proxy for ini-

tiation of an academic career, the duration of career is not necessarily defined by the year of first publication. However, this method has been used in other reported analyses of publication productivity within academic medicine.^{7,11} Third, there are possible inaccuracies with identification of an institution's complete faculty list and rank because departmental websites are not updated in real-time, but these measurement errors are not systematic as faculty member profiles are likely not updated preferentially by specific rankings. Finally, this study only reviews data pertinent to academic urologists as a group and cannot be applied to women seeking promotion in private practice or clinical-track faculty, which might have different criteria for promotion.

CONCLUSION

Although advancement in academic urology is based on a variety of achievements, our data show a gender disparity in senior leadership positions. This difference can partially be attributed to the difference in career length and its effect on publication productivity. Fortunately, when comparing the *m-quotient* (accounts for career duration) of men and women at the same academic rank, we observed no difference at any position. Because the most rigorous academic criteria are equivalent between the genders, perhaps psychosocial barriers, such as a lack of mentorship and role-modeling, are preventing women from attaining those highest leadership roles. As the percentage of women in urology increases, working toward a gender-neutral, merit-based work environment remains an optimal goal. Recognizing and identifying gender differences within urology is an important opportunity for leaders in the field.

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EDITORIAL COMMENT



An excellent work by Mayer et al demonstrates the continuing urology gender gap within academic medical centers; men have higher mean *h*-indices and academic ranks than their female colleagues. Notably, there was no difference in total number publications over career length (*m*-quotient). Unfortunately, this slower ramp up to equivalent productivity means that women will continue to leave academic positions at higher rates than men,¹ that our specialty will continue to lag in women in academic leadership positions.

Parity for women in leadership remains a challenge across all professional disciplines. Within academic medicine, the metrics include career-matched academic productivity, academic rank, department chair, leadership in national organizations, and even board leadership.² Parenthetically, the American Urologic Association is to be congratulated in welcoming E. Ann Gormley from the Geisel School of Medicine at Dartmouth College as its first female board member this year. Nonetheless, in almost every study and across every specialty where statistical significance can be achieved, women lag behind comparable male peers. Women are still failing to reach comparable levels in federally funded research, in annual income,³ even in financial ties to industry.⁴ Analogous discrepancies are also found within other sciences and the legal professions.

The ostensible reasons are both internal and external. Maternity leave, child-rearing, and the additional family responsibilities borne unevenly by women are often cited internal factors. External factors are huge: they include cultural differences in perceptions of women's competency, differences in male-female communication, differentials in recruitment, hiring, retention. Women have fewer professional mentors, are more likely to be offered, but also to say "yes" to, irrelevant responsibilities not contributing to professional advancement. The American Urologic Association 2015 census reports "both male and female practicing urologists in the United States work about the same number of combined total hours per typical week; however, male practicing urologists spend fewer hours on nonclinical activities and more hours on clinical activities than their female counterparts."⁵ Women should be encouraged to say "no" to administrative activities, but we, as peers and senior leaders, need to offer real opportunities and ongoing sponsorship for their personal and professional advancement.

A caveat, as physicians and surgeons, we should ensure that we are measuring success appropriately. What are the best measures of a surgeon's success? A recent article from the Harvard School of Public Health reported from a 20% Medicare sample, inclusive of over 1.5 million hospitalizations, that despite evenly matched illness acuity, female internists caring for elderly patients had significantly improved hospital mortality and readmission rates compared with male peers.⁶ Striving toward these outcomes may be more appropriate outcomes of a surgeon's success than her income or academic rank.

If developing *all* of the talents across our trainees and young urologists is a goal of urology, then defining what success is for a surgeon, educating on gender bias and its role in divergent female career pathways, and providing active mentorship for female colleagues and young urologists and in their leadership development remain critical issues for this specialty.

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