Washington University School of Medicine
Digital Commons@Becker

Open Access Publications

2017

Academic productivity among fellowship associated adult total joint reconstruction surgeons

Adam Z. Khan
Washington University School of Medicine in St. Louis

Benjamin V. Kelley
University of California, Los Angeles

Ankur D. Patel
University of California, Los Angeles

David R. McAllister
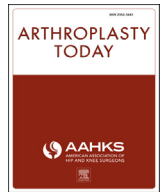*University of California, Los Angeles*

Natalie L. Leong
University of California, Los Angeles

Follow this and additional works at: https://digitalcommons.wustl.edu/open_access_pubs

Recommended Citation

Khan, Adam Z.; Kelley, Benjamin V.; Patel, Ankur D.; McAllister, David R.; and Leong, Natalie L., ,"Academic productivity among fellowship associated adult total joint reconstruction surgeons." Arthroplasty Today.3,4. 298-302. (2017).
https://digitalcommons.wustl.edu/open_access_pubs/6383

Original research

Academic productivity among fellowship associated adult total joint reconstruction surgeons

Adam Z. Khan, MD [a], [*], Benjamin V. Kelley, BS [b], Ankur D. Patel, MD [b],
David R. McAllister, MD [b], Natalie L. Leong, MD [b]

[a] Department of Orthopaedic Surgery, Washington University School of Medicine, St. Louis, MO, USA
[b] Department of Orthopaedic Surgery, David Geffen School of Medicine at UCLA, Los Angeles, CA, USA

ABSTRACT

Background: The Hirsch index (h-index) is a measure that evaluates both research volume and quality—taking into consideration both publications and citations of a single author. No prior work has evaluated academic productivity and contributions to the literature of adult total joint replacement surgeons. This study uses h-index to benchmark the academic impact and identify characteristics associated with productivity of faculty members at joint replacement fellowships.
Methods: Adult reconstruction fellowship programs were obtained via the American Association of Hip and Knee Surgeons website. Via the San Francisco match and program-specific websites, program characteristics (Accreditation Council for Graduate Medical Education approval, academic affiliation, region, number of fellows, fellow research requirement), associated faculty members, and faculty-specific characteristics (gender, academic title, formal fellowship training, years in practice) were obtained. H-index and total faculty publications served as primary outcome measures. Multivariable linear regression determined statistical significance.
Results: Sixty-six adult total joint reconstruction fellowship programs were identified: 30% were Accreditation Council for Graduate Medical Education approved and 73% had an academic affiliation. At these institutions, 375 adult reconstruction surgeons were identified; 98.1% were men and 85.3% had formal arthroplasty fellowship training. Average number of publications per faculty member was 50.1 (standard deviation 76.8; range 0-588); mean h-index was 12.8 (standard deviation 13.8; range 0-67). Number of fellows, faculty academic title, years in practice, and formal fellowship training had a significant ($P < .05$) positive correlation with both h-index and total publications.
Conclusions: The statistical overview presented in this work can help total joint surgeons quantitatively benchmark their academic performance against that of their peers.
© 2017 Published by Elsevier Inc. on behalf of The American Association of Hip and Knee Surgeons. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

Introduction

In the past decade, there has been a significant push toward benchmarking performance and productivity within the field of medicine, ranging from institutional rankings [1,2] to the academic productivity of individual faculty. Within academic medicine, research productivity remains a key determinant in professional achievement and eligibility for promotion. While tracking total publications, grant funding, and total citations are helpful in evaluating a surgeon's quantity of academic output, these metrics do not necessarily reflect the quality of academic production.

The Hirsch index (h-index) [3], however, accounts for both the quality of an author's impact in addition to the quantity of publications. An author's h-index is calculated by comparing the total number of publications with the number of citations per paper [3]. For example, an h-index of 5 indicates that an author has published 5 papers that were each cited at least 5 times. Originally developed as a predictor of scientific achievement in the realm of theoretical physics [3,4], the h-index has been widely adopted as a

benchmarking tool in other scientific fields, including academic medicine [5-14]. Furthermore, within the orthopaedic literature, the fields of spine [15], hand [16], and sports medicine [17] have all identified the h-index as a reliable, objective metric of academic productivity.

As far as we are aware, no prior work has specifically evaluated the contributions to the literature and academic productivity of adult total joint replacement surgeons at fellowship training programs. We aim to synthesize an outline of academic productivity among fellowship associated total joint replacement surgeons. Furthermore, we intend to use the h-index metric to identify both fellowship program and individual faculty characteristics associated with increased research production and academic impact.

Material and methods

Study design

This was a cross-sectional study of total joint replacement surgeons in the United States and Canada associated with fellowship training programs. Seventy-one fellowship training programs were identified via the American Association of Hip and Knee Surgeons website as of January 31, 2016. From the San Francisco (SF) match website, 66 of these programs were confirmed to be active. From the Accreditation Council for Graduate Medical Education (ACGME) website, programs were split into ACGME vs non−ACGME-approved fellowships. For institutions that had both ACGME and non−ACGME-approved fellowships, faculty were classified as ACGME approved.

For each institution, fellowship program websites were queried to identify names of total joint faculty members. Inclusion criteria for this cohort were active practicing full-time faculty members with primary appointments as total joint replacement surgeons associated with a fellowship in adult total joint reconstruction. Faculty not affiliated with joint replacement fellowship training, or not actively practicing were excluded from this cohort. Furthermore, faculty were categorized as academic-affiliated if they practiced at an institution associated with a medical school.

Study variables—predictor (independent)

Predictor variables were identified via the SF match and program-specific websites. These included program specific characteristics: ACGME approval, academic affiliation, region, number of fellows, and fellow research requirement. Each of these characteristics was assigned to each faculty member at the selected institution. Faculty-specific characteristics were also identified for each specific faculty member. There were 4 academic title categories identified: Assistant Professor, Associate Professor, Professor, and Clinical Instructor. Any surgeon not on an academic tenure tract or associated with an academic institution was assigned to Clinical Instructor. Years in practice was calculated from last year of fellowship or residency training to year 2015.

Study variables—outcomes (dependent)

The Scopus database (Elsevier B.V., Waltham, MA) was queried to obtain faculty cumulative h-index and total number of publications. For surgeons with multiple profiles in the database (because of changes in practice location during training or afterwards), h-index and total number of publications were manually calculated to include all works. Both these variables were used as outcome variables in this analysis.

Table 1
Program-specific characteristics.

Characteristic	N (%)
ACGME approved	
Yes	20 (30)
No	46 (70)
Academic affiliation	
Yes	48 (73)
No	18 (27)
Research requirement	
Yes	14 (21)
No	52 (79)
Number of fellows	
1	28 (42)
2	21 (32)
3	6 (9)
4	6 (9)
5	0 (0)
6	4 (6)
7	1 (2)
Region	
Northeast	13 (20)
Southeast	20 (30)
Midwest	12 (18)
Southwest	6 (9)
Mountain	5 (8)
Pacific	8 (12)
Canada	2 (3)
Number of faculty members	
Mean	5.68
SD	4.18
Range	1-22

Statistical analysis

Multivariable regression was performed to identify statistically significant independent predictors of h-index and total publications. Variables that exhibited a P value <.05 and a 95% confidence interval (CI) that excluded 0 were considered independent predictors. R^2 statistic was used to determine each model's discriminative capacity. Multicollinearity between predictor variables was assessed using the variance inflation factor (VIF); a VIF <10.0 indicates the absence of multicollinearity. All testing was conducted with STATA, version 14.1 (STATA Corp., College Station, TX).

Results

Program-specific characteristics

Sixty-six total joint reconstruction fellowship programs were identified (Table 1). Twenty (30%) were ACGME approved and 48 (73%) had an academic affiliation. Of note, one institution had both an ACGME and a non-ACGME program; because common faculty were shared, this institution and their faculty were included in the ACGME-approved cohort. Fourteen (21%) programs stated an explicit fellow research requirement, 52 (79%) did not. By region, Southeast had the greatest plurality (30%, n = 20), followed by the Northeast (20%, n = 13), and then the Midwest (19%, n = 12). Mean number of faculty was 5.7 (standard deviation [SD] 4.2; range 1-22). Twenty-eight (42%) programs had a position for one fellow and 21 (32%) supported positions for two fellows.

Faculty-specific characteristics

Within the 66 programs, 375 adult reconstruction surgeons were identified (Table 2). Of these faculty members, 368 (98%) were men. Three hundred-twenty faculty members (85%) were fellowship trained in total joint replacement. The mean years in practice

Table 2
Faculty-specific characteristics.

Characteristic	N (%)
Academic affiliation	
Yes	265 (17)
No	110 (29)
Gender	
Male	368 (98)
Female	7 (2)
Title	
Clinical Instructor	160 (43)
Assistant Professor	100 (27)
Associate Professor	57 (15)
Professor	58 (15)
Joints fellowship trained	
Yes	320 (85)
No	55 (15)
Years in practice	
Mean	17.7
SD	11.5
Range	0-48
H-index	
Mean	12.8
SD	13.8
Range	0-67
Total publications	
Mean	50.1
SD	50.1
Range	0-588
Total citations	
Mean	1153.9
SD	2065.7
Range	0-13,961

was 17.7 (SD 11.5; range 0-48). The mean h-index was 12.8 (SD 13.8; range 0-67). The average number of publications per faculty member was 50.1 (SD 76.8; range 0-588); the average number of total citations was 1153.9 (SD 2065.7; range 0-13,961). Regarding academic title, there were 160 Clinical Instructors (43%), 100 Assistant Professors (27%), 57 Associate Processors (15%), and 58 Professors (15%). Greater than 60% of all publications appeared in 1 of 8 journals (Fig. 1). Of those, 20% (n = 3755) were published in the Journal of Arthroplasty.

Statistical analysis

Multivariate linear regression identified number of fellows (regression coefficient [RC] 4.62; 95% CI: 0.89, 8.36) as the only program-specific characteristic to be significantly associated with total publications per faculty. In terms of faculty-specific characteristics, having formal fellowship training (RC 23.53; 95% CI: 3.58, 43.49), total years in practice (RC 0.98; 95% CI: 0.31, 1.66), and having an academic title of Associate Professor (RC 23.09; 95% CI: 1.59, 44.58) or Professor (RC 123.47; 95% CI: 100.98, 145.95) were all significantly associated with total publications per faculty (Table 3). Practicing at an ACGME approved (P = .241) or academically affiliated program (P = .366), fellowship research requirement (P = .735), gender (P = .517), and academic title of Clinical Instructor (P = .294) or Assistant Professor (P = .442) were not shown to be significantly associated with total publications. The present regression model explained 39% of the variation in total publications; furthermore, there was no evidence of multicollinearity among independent variables (mean VIF 1.48).

The number of fellows (RC 0.97; 95% CI: 0.35, 1.59) also demonstrated a significant positive correlation with faculty h-index, whereas fellowship program research requirement (RC −3.18; 95% CI: −6.21, −0.16) demonstrated a significant negative correlation with faculty h-index. For faculty-specific

characteristics, having formal fellowship training (RC 5.11; 95% CI: 1.81, 8.42), total years in practice (RC 0.27; 95% CI: 0.16, 0.38), and having an academic title of Associate Professor (RC 4.79; 95% CI: 1.23, 8.35) or Professor (RC 22.04; 95% CI: 18.32, 25.76) were also all significantly associated with faculty h-index (Table 4). Practicing at an ACGME approved (P = .470) or academically affiliated program (P = .761), gender (P = .281), and academic title of Clinical Instructor (P = .374) or Assistant Professor (P = .916) were not shown to be significantly associated with h-index. The present regression model explained 49% of the variation in h-index; furthermore, there was no evidence of multicollinearity among independent variables (mean VIF 1.45).

Discussion

Research productivity, along with clinical service and teaching, is an important component of a successful academic career for many orthopaedic surgeons. Despite a recent push toward developing objective metrics to evaluate research productivity in academic medicine [5,7-14], and more specifically, orthopaedic surgery [6,15-17], the research productivity of total joint replacement faculty has not been specifically studied. This study aims to provide an overview of academic productivity within the field of total joint replacement as well as identify factors associated with increased research production and academic impact. The h-index metric has been widely used and proven to be a robust predictor of academic impact [4], and was therefore used as the primary marker of academic impact in this study.

Our findings demonstrate that fellowship associated total joint faculty have academic output akin to that of faculty in other orthopaedic subspecialties, and are in fact comparably more productive than the average academic orthopaedic faculty member. Our findings demonstrated a mean h-index of 12.8 among fellowship associated total joint faculty. This compares to an average h-index of 5 for all academic orthopaedic surgeons [6], 12.8 among musculoskeletal tumor surgeons [18], 10.2 among fellowship associated hand faculty [16], and 13.6 among all fellowship associated spine faculty [15].

ACGME approval and academic affiliation were both shown to not have a significant association with fellowship associated total joint faculty research output or impact. This contrasts with fellowship associated spine surgeons, for which a significant positive correlation between academic affiliation and total publications (RC 22.1) as well as mean h-index (RC 11.8) was demonstrated [15].

Prior work [6] indicated a significant geographic trend toward lower h-indices among orthopaedic surgeons in the southern US, and regional influence on h-index has been demonstrated as well in other fields of medicine [14]. However, the present study did not demonstrate any significant regional correlation with higher levels of academic productivity.

Gender has been a point of attention within the medical literature in regard to metrics of academic productivity. Prior work [5,7,9,11,19] in a variety of surgical subspecialties has indicated a significant gender gap in academic output with female faculty members lagging behind their male peers in both total publications and mean h-index. Family responsibilities during early career development [20,21] has been cited as a possible source of early research productivity loss, with an observed upward trend in productivity later in one's career [5,22,23]. Unfortunately, the h-index statistic is cumulative rather than dynamic, thereby preventing it from serving as a succinct metric to evaluate productivity variations over time. Ence et al. [6] demonstrated that female orthopaedic surgeons follow the trend of a significantly lower mean h-index (3 vs 5, P < .001); however, when normalized for career duration, there was not a significant difference between sexes—indicating

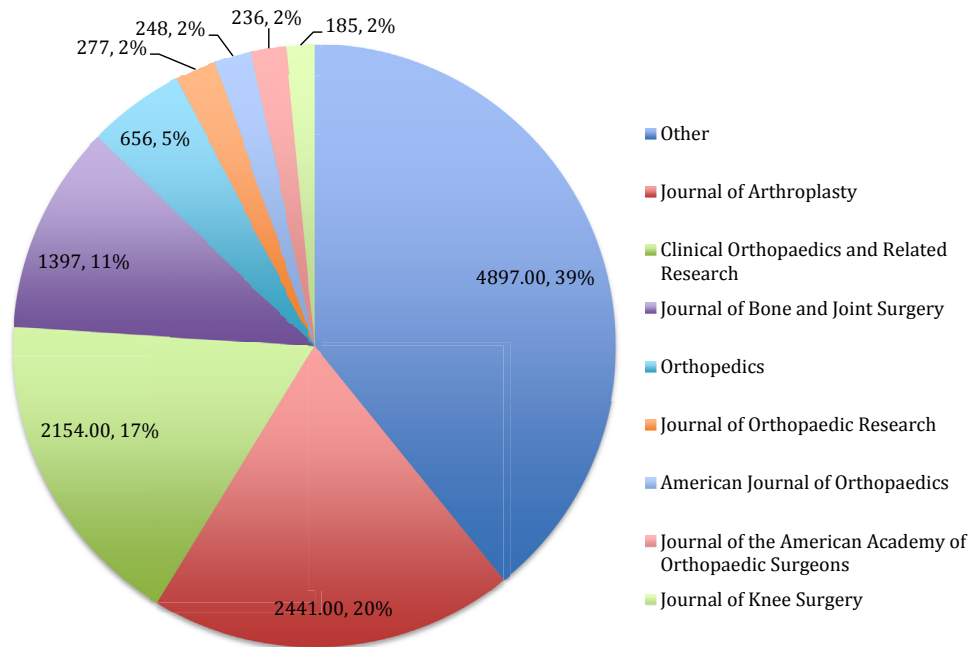# Journals in Which Research From Joints Fellowship was Published

Figure 1. Journals in which research from joints fellowship was published.

disparities in career length to account for this perceived gender gap in academic productivity. Among fellowship associated total joint replacement faculty, the present study indicated a strong bias toward male faculty members (98%). Yet, this study did not identify a significant association between gender and h-index (*P* = .281) or publication output (*P* = .563). A key factor that contributed to an inability to demonstrate significance was the low power resulting from a limited number of female total joint faculty [20].

Career duration and academic rank have been shown to be significant predictors of academic output and impact [6,9,16]. Our findings were consistent with prior work identifying years in practice as a significant predictor of total publications and mean h-index. Regarding academic rank, there was not a significant difference between Clinical Instructor and Assistant Professor, but there was a significant increase in both total publications and mean h-index for total joint faculty who had reached the level of Associate Professor or Professor.

Our results indicate a positive correlation between number of fellows at a faculty member's institution with both h-index and total publications. This finding was expected and quite

intuitive—increasing the pool of fellows enhances a faculty member's ability to initiate and support development of novel, achievable research projects. Schoenfeld et al. [15] demonstrated a similar finding among the number of fellowship positions supported at an institution and the research productivity of their spine faculty.

Formal fellowship training was identified as a significant positive predictor of both total publications (RC 23.53) as well as h-index (RC 5.11). Given the strong association of total joint fellowship programs with an academic affiliation (73%), the increased early research exposure during fellowship may not only contribute to a faculty member's overall output, but also likely inspires faculty to remain in the academic environment and pursue future academic work. Regression analysis indicated a significant correlation between formal fellowship training and practicing at an institution with an academic affiliation (*P* = .02). Among other surgical specialties, multiple studies [7,13,14] have found a similar significant correlation between fellowship training and mean h-index.

Notably, our study demonstrated a negative correlation (RC −3.18) between mandated research requirement and the mean h-index of an institution's total joints faculty. Interestingly, this is

Table 3
Significant factors associated with total publications for faculty in fellowship programs.

Predictor	*P* value	RC (95% CI)
Program-specific		
Number of fellows	.015	4.62 (0.89-8.36)
Faculty-specific		
Fellowship trained	.021	23.53 (3.58-43.49)
Years in practice	.004	0.98 (0.31-1.66)
Academic title		
Associate Professor	.035	23.09 (1.59-44.58)
Professor	<.001	123.47 (100.98-145.95)

Table 4
Significant factors associated with h-index for faculty in fellowship programs.

Predictor	*P* value	RC (95% CI)
Program-specific		
Number of fellows	.002	0.97 (0.35-1.59)
Research requirement	.039	−3.2 (−6.21 to 0.16)
Faculty-specific		
Fellowship trained	.003	5.11 (1.81-8.42)
Years in practice	<.001	0.27 (0.16-0.38)
Academic title		
Associate Professor	.008	4.79 (1.23-8.35)
Professor	<.001	22.04 (18.32-25.76)

consistent with the work by Schoenfeld et al. [15] demonstrating a negative correlation between average h-index and spine surgeons at programs with a fellow research requirement. A potential explanation posed by Shoenfeld et al. [15] is the establishment of a fellow research requirement in an attempt to boost research productivity at fellowship programs with faculty that are less established.

Finally, we would like to emphasize that research productivity is only one metric. Therefore, h-index is by no means the only factor that an arthroplasty surgeon should be benchmarked. Clinical expertise, technical skill, leadership, and teaching ability are other factors that should be considered when evaluating an arthroplasty surgeon's academic career.

While we consider the h-index to be a robust predictor metric of research impact, it does come with several limitations. Potential sources of bias can arise from confounding through author self-citation, skew toward more established faculty (given increased time for publications to accrue citations), inability to account for author order number, and the lack of preference for original scientific research vs review articles. As a cumulative rather than dynamic measure, the h-index is unable to differentiate variance or significant decline in an author's academic impact over time. Regarding data acquisition, this study is limited by the accuracy and timeliness of updated information on the American Association of Hip and Knee Surgeons, SF match, ACGME, and program-specific websites. For h-indices acquired from Scopus, there is always potential for a publication to be wrongly credited to an author with a similar name. Furthermore, while we did account for institutional changes when calculating an author's h-index, we did not account for names changes potentially related to divorce/marriage, although this should have minimal impact as 98% of surgeons were men. Finally, given our decision to limit our study population to fellowship associated total joint surgeons, we recognize the inherent selection bias and inability of our study to characterize the field of adult total joint reconstruction as a whole.

Although it is important to recognize these limitations, they do not invalidate the utility of our findings. Our work is the first to present metrics of research productivity for total joint reconstruction surgeons, which helps compare the subspecialty to other orthopaedic and nonorthopaedic specialties. Furthermore, our results hold the potential to not only help individual faculty benchmark their performance against that of their peers, but also provide academically oriented residents information valuable for career planning. As the h-index is a progressive metric, and trends in faculty research productivity vary over time, we anticipate and hope this will continue to be a source of future investigation.

Conclusions

To our knowledge, this is the first study to specifically study the academic productivity of adult total joint reconstruction surgeons. The mean h-index was 12.8 within our study population of fellowship associated total joint reconstruction faculty. Academic affiliation and gender did not have a significant association with either total publications or mean h-index. The factors with a significant positive correlation to both outcome variables were number of fellows, years in practice, formal fellowship training, and academic titles of Associate Professor or Professor. The results presented in this study will assist total joint replacement surgeons benchmark their research performance against that of their peers. Furthermore, understanding the characteristics associated with academic productivity may help guide residents and faculty in career decision-making.

References

[1] Residency navigator. In. San Mateo, CA: Doximity, Inc., 2016
[2] US News and World Report. U.S. news best hospitals. Washington, DC: US News & World Report LLC; 2015-2016.
[3] Hirsch JE. An index to quantify an individual's scientific research output. Proc Natl Acad Sci U S A 2005;102:16569.
[4] Hirsch JE. Does the H index have predictive power? Proc Natl Acad Sci U S A 2007;104:19193.
[5] Eloy JA, Svider P, Chandrasekhar SS, et al. Gender disparities in scholarly productivity within academic otolaryngology departments. Otolaryngol Head Neck Surg 2013;148:215.
[6] Ence AK, Cope SR, Holliday EB, Somerson JS. Publication productivity and experience: factors associated with academic rank among orthopaedic surgery faculty in the United States. J Bone Joint Surg Am 2016;98:e41.
[7] Gast KM, Kuzon Jr WM, Adelman EE, Waljee JF. Influence of training institution on academic affiliation and productivity among plastic surgery faculty in the United States. Plast Reconstr Surg 2014;134:570.
[8] Gast KM, Kuzon Jr WM, Waljee JF. Bibliometric indices and academic promotion within plastic surgery. Plast Reconstr Surg 2014;134:838e.
[9] Lee J, Kraus KL, Couldwell WT. Use of the h index in neurosurgery. Clinical article. J Neurosurg 2009;111:387.
[10] Pagel PS, Hudetz JA. An analysis of scholarly productivity in United States academic anaesthesiologists by citation bibliometrics. Anaesthesia 2011;66: 873.
[11] Paik AM, Mady LJ, Villanueva NL, et al. Research productivity and gender disparities: a look at academic plastic surgery. J Surg Educ 2014;71:593.
[12] Ponce FA, Lozano AM. Academic impact and rankings of American and Canadian neurosurgical departments as assessed using the h index. J Neurosurg 2010;113:447.
[13] Sood A, Therattil PJ, Chung S, Lee ES. Impact of subspecialty fellowship training on research productivity among academic plastic surgery faculty in the United States. Eplasty 2015;15:e50.
[14] Svider PF, Mady LJ, Husain Q, et al. Geographic differences in academic promotion practices, fellowship training, and scholarly impact. Am J Otolaryngol 2013;34:464.
[15] Schoenfeld AJ, Bhalla A, George J, Harris MB, Bono CM. Academic productivity and contributions to the literature among spine surgery fellowship faculty. Spine J 2015;15:2126.
[16] Lopez J, Susarla SM, Swanson EW, Calotta N, Lifchez SD. The association of the H-index and academic rank among full-time academic hand surgeons affiliated with fellowship programs. J Hand Surg Am 2015;40:1434.
[17] Makhni EC, Buza JA, Byram I, Ahmad CS. Academic characteristics of orthopedic team physicians affiliated with high school, collegiate, and professional teams. Am J Orthop (Belle Mead NJ) 2015;44:510.
[18] Martinez M, Lopez S, Beebe K. Gender comparison of scholarly production in the musculoskeletal tumor society using the Hirsch index. J Surg Educ 2015;72:1172.
[19] Lopez SA, Svider PF, Misra P, et al. Gender differences in promotion and scholarly impact: an analysis of 1460 academic ophthalmologists. J Surg Educ 2014;71:851.
[20] Kuehn BM. More women choose careers in surgery: bias, work-life issues remain challenges. JAMA 2012;307:1899.
[21] Zhuge Y, Kaufman J, Simeone DM, Chen H, Velazquez OC. Is there still a glass ceiling for women in academic surgery? Ann Surg 2011;253:637.
[22] Pashkova AA, Svider PF, Chang CY, et al. Gender disparity among US anaesthesiologists: are women underrepresented in academic ranks and scholarly productivity? Acta Anaesthesiol Scand 2013;57:1058.
[23] Yang G, Villalta JD, Weiss DA, Carroll PR, Breyer BN. Gender differences in academic productivity and academic career choice among urology residents. J Urol 2012;188:1286.