Journal of Clinical Neuroscience 21 (2014) 1102–1105

Contents lists available at ScienceDirect

Journal of Clinical Neuroscience

journal homepage: www.elsevier.com/locate/jocn

Education

A gender-based comparison of academic rank and scholarly productivity in academic neurological surgery

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ARTICLE INFO

Article history:
Received 25 May 2013
Accepted 13 November 2013

Keywords:
Academic productivity
Academic promotion
Academic rank determination
Academic rank in surgical specialties
Gender comparison
h-index
Surgical faculty productivity

ABSTRACT

The number of women pursuing training opportunities in neurological surgery has increased, although they are still underrepresented at senior positions relative to junior academic ranks. Research productivity is an important component of the academic advancement process. We sought to use the *h-index*, a bibliometric previously analyzed among neurological surgeons, to evaluate whether there are gender differences in academic rank and research productivity among academic neurological surgeons. The *h-index* was calculated for 1052 academic neurological surgeons from 84 institutions, and organized by gender and academic rank. Overall men had statistically higher research productivity (mean 13.3) than their female colleagues (mean 9.5), as measured by the *h-index,* in the overall sample ($p < 0.0007$). When separating by academic rank, there were no statistical differences ($p > 0.05$) in *h-index* at the assistant professor (mean 7.2 male, 6.3 female), associate professor (11.2 male, 10.8 female), and professor (20.0 male, 18.0 female) levels based on gender. There was insufficient data to determine significance at the chairperson rank, as there was only one female chairperson. Although overall gender differences in scholarly productivity were detected, these differences did not reach statistical significance upon controlling for academic rank. Women were grossly underrepresented at the level of chairpersons in this sample of 1052 academic neurological surgeons, likely a result of the low proportion of females in this specialty. Future studies may be needed to investigate gender-specific research trends for neurosurgical residents, a cohort that in recent years has seen increased representation by women.

1. Introduction

The number of women pursuing training opportunities in neurological surgery has increased substantially in recent years, with women representing approximately 12% of neurosurgery residents in 2003 and about 19.6% in 2011 [1]. However, these numbers still trail behind the percentage of females training in other specialties. For instance, women comprise approximately 30% of residents in general surgery residency programs and well over half of medical student classes [2–4].

In addition to the differences in gender composition of academic departments, there exist observed differences in academic productivity throughout the career of academic physicians. A 2007 intra-institutional longitudinal cohort study from the Mayo Clinic suggested that while men published an overall greater amount of articles throughout their career, research productivity amongst women increased throughout their career, ultimately leading to higher publication rates later in life [5]. The authors concluded that early and middle career assessments of research productivity may not be appropriate for evaluating academic advancement. We attempted to investigate the gender-specific research patterns within neurological surgery to investigate if similar trends exist.

There are several commonly used methods to assess research productivity among academic physicians [6]. As mentioned above, the total number of publications is frequently used [7]. Another regularly used measure is total number of citations of an author's works by other publications [8]. Although both are objective and easily quantified, they have their limitations. Total number of publications indicates little about the quality and type of research. Additionally, total number of citations also has the potential to be skewed and is dependent on several factors. One example is if an individual was just one of many co-authors on a single significantly cited study, total number of times cited

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0967-5868/$ - see front matter
http://dx.doi.org/10.1016/j.jocn.2013.11.006

would be disproportionately affected by that one project regardless of whether the author was a primary contributor.

One recently described bibliometric that attempts to evaluate the relevance of an individual's research contributions and produce an objective quantification is the *h-index*. Initially described by Dr. J.E. Hirsch in 2005, an author's *h-index* is defined as the number of publications *h* that has been cited by other publications at least *h* times [8]. An author with an *h-index* of 30 has had 30 publications that have been cited at least 30 times in peer-reviewed journals. This measure judges the relevance of a researcher's contributions by evaluating not only the number of publications, but also the frequency that his or her works are cited. This measure can be calculated using one of several online *h-index* calculators, including those available from Google Scholar, Scopus, and ISI Web of Knowledge.

The use of the *h-index* has been examined in a wide variety of medical disciplines [9–20]. One study examined the use of the *h-index* in neurological surgery and demonstrated a direct correlation between the *h-index* score and academic rank, although there was no evaluation of research output by gender [21]. The same paper utilized resources from both Google Scholar and Scopus, finding that results from these two databases had a high correlation.

In addition to clinical performance, educational contributions, and administrative roles, research productivity is an important component of the evaluation process of academic physicians when evaluating applications for promotion. Our objectives were to evaluate whether there are gender-associated differences in academic rank and research productivity among neurological surgeons, as measured by the *h-index*.

2. Methods

A list of academic neurological surgery departments was obtained from the American Medical Association's Fellowship and Residency Electronic Interactive Database Access System (FREIDA). The faculty listings from the websites of these programs were used to compile a list of faculty members and their respective academic ranks. These faculty members were additionally categorized by gender. An *h-index* calculator from the Scopus Database (www.scopus.com) was used to calculate the *h-indices* of each of these faculty members.

Faculty members were organized into the following cohorts: junior faculty (assistant professor) and senior faculty (associate professor, professor, and chairperson). For institutions where neurological surgery was a division of surgery, division chiefs or directors were counted under the chairperson category for the purposes of this analysis. Full-time non-clinical research faculty, adjunct professors, instructors, non-academic, and non-physician faculty were excluded from this analysis. Individuals whose academic ranks were not listed anywhere on the website of the academic department or related clinical website were also excluded from the study. Out of the 102 neurological surgery programs listed on FREIDA, the websites of 18 departments did not list all required data for faculty members, and were thus excluded from this analysis. All data were collected between May and June 2012. Mann–Whitney U tests and Kruskal–Wallis tests were calculated where appropriate using the Statistical Package for the Social Sciences version 20 (SPSS, Chicago, IL, USA). Non-parametric statistical analyses were performed due to the asymmetrical distribution of the data. Statistical significance was set at $p < 0.05$.

3. Results

Out of the 1052 academic neurosurgeons from 84 institutions included in this analysis, 93 (8.8%) were women and 959 (91.1%) were men (Fig. 1). At the rank of full professor, women comprised only 3.7% of faculty. There was one female chairperson out of the 84 departments included in this analysis. When including all academic neurosurgeons, males had higher research productivity, mean 13.3 (95% confidence interval [CI] 12.6–14.0) as measured by the *h-index*, relative to their female counterparts' mean of 9.5 (95% CI 7.7–11.3) in this analysis (Mann–Whitney U test, $p = 0.0007$) (Table 1). This finding persisted when the predominantly male cohort of chairpersons were excluded from the calculation (*h-index* = 12.4 *versus* 9.5, $p = 0.008$). When broken down further by faculty rank, the statistical significance did not persist. Men had a higher mean *h-index* of 7.2 (95% CI 6.7–7.8) than women at 6.3 (95% CI 4.5–8.1) at the junior rank of assistant professor (Mann–Whitney U test, $p = 0.0673$) (Table 1). For associate professors, the average male *h-index* was 11.2 (95% CI 10.2–12.2) compared to 10.8 (95% CI 8.1–13.5) in females (Mann–Whitney U test, $p = 0.6965$). The average *h-index* of male professors was 20.0 (95% CI 18.7–21.3), higher than that of their female counterparts (*h-index* = 18.0, 95% CI 10.2–25.1) (Mann–Whitney U test, $p = 0.6241$). Upon aggregating senior faculty data (i.e. associate professors and professors), men had a statistically higher *h-index* (Table 1). However, upon removing chairpersons from the cohort of senior faculty, this comparison bordered but did not reach statistical significance (*h-index* = 16.1 *versus* 13.2, $p = 0.05$). For chair positions, the average male *h-index* was 22.5. However, given the low sample size of women (n = 1) in this category, adequate statistical analysis could not be calculated.

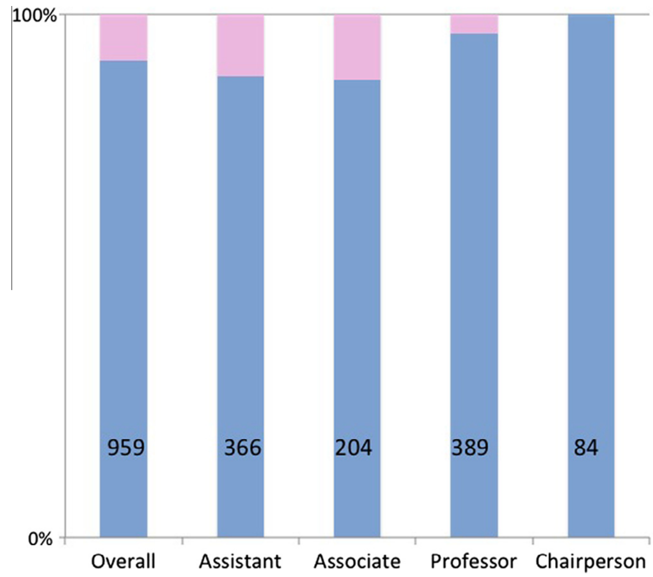

Fig. 1. Gender breakdown of 1052 academic neurological surgeons from 84 institutions included in this analysis. Numbers in bars represent actual sample size. Bottom numbers represent men, top numbers represent women, y-axis represents percentage.

Table 1
h-index organized by academic rank and gender

	Median [Interquartile range], (n)	
	Male	Female
Overall	10 [5–18], (959)	8 [3–12], (93)
Assistant professor	6 [3–10], (366)	4 [2–9], (49)
Associate professor	10 [6–16], (204)	9 [6–15], (29)
Professor (no chairs)	17 [10–27], (389)	15 [12–23], (15)
Chairpersons	20 [12–31], (84)	14, (1)
Senior faculty	15 [8–24], (593)	11 [8–15], (44)
Overall (no chairs)	10 [5–16], (875)	8 [3–12], (92)