The *H*-Index in Medicine and Science: Does It Favor *H*-im or *H*-er? Successes and Hurdles for Women Faculty

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The percentage of women medical doctors has steadily increased, and 2019 was the first year in which women comprised the majority of medical students. Despite the increase in women physicians over decades, women remain underrepresented in academic medical positions, especially among the higher ranks. Of faculty at the rank of full professor, only 22% are women. In this issue of Digestive Diseases and Sciences, John et al. [1] published an important work that addresses the question of women's academic success as faculty (hiring into the Assistant Professor rank and promotion to Associate or full Professor) versus their professional productivity and impact as measured by the *h*-index, the number of published papers that have been cited in other publications *h* number of times, e.g., an *h*-index of 8 means that the author has published eight papers that have each been cited at least eight times. Thus, the *h*-index is one measure of professional impact and reputation. Though the *h*-index is not a perfect scoring mechanism, as discussed below, it is a reasonable comparative measure of faculty productivity and national or international standing. The study [1] of 1703 academic gastroenterologists shows that there is little difference between the *h*-indices of men and women faculty per rank. Women assistant professors had an average *h*-index of 5.59 compared with men with a 7.54 score. Yet, this difference was reversed at the rank of Associate Professor with women having attained 16.08 versus 15.06 for men. At the rank of Professor, men achieved an *h*-index of 29.98, and women 28.96. The only faculty rank difference that reached statistical significance was at the assistant professor level. These data show that women can be as productive and successful as men in academic gastroenterology.

The question remains regarding the underrepresentation of women in academic medicine. The authors suggest that women faculty are affected by factors that include marital status, number of children, hours worked, job flexibility, and negative perceptions of women as leaders [1]. Many studies show that gender bias is widespread today and disturbs women's entry, advancement, and persistence in academia (reviewed in [2]). For example, convincing studies document gender bias in hiring that was manifest simply by changing the first names of applicants on otherwise identical resumes or curriculum vitae. If a woman's name is on the application, the ratings of quality and 'hireability' drop significantly [2–4]. Similarly, just changing the gender inference of the first name of the author of scientific works significantly decreases the perceived quality of the work [5]. This phenomenon, apparent in these multiple studies, is likely to unfairly negatively bias all types of reviews of women's performance and submissions, including peer reviews for publication and grant applications. Furthermore, publications with women authors are cited less frequently. Together, these biases compound to unfairly reduce the *h*-index ratings of women; thus, in the study by John [1], the women may have outscored the men if the effects of gender bias were removed. This reduction in *h*-index then further exacerbates the bias already existing in evaluations of women for hiring and promotions. Moreover, there is strong evidence that grant reviews are biased against women [2, 6]. A reduction in grant funding will also reduce publications and likelihood of promotion as both are often criteria. All of these biases synergize to the detriment of the careers of women and their concomitant *h*-indices. Fortunately, educating faculty about bias can significantly reduce it and positively influence outcomes for women [2, 6, 7]. The *h*-index is skewed by factors other than bias as well. For example, citations of guidelines, reviews, and major clinical studies will be much higher than even important and innovative studies in narrow fields, and middle authors who contributed little to a high-impact publication will none-the-less benefit from its citations.

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In addition to bias against women's accomplishments, women often feel less included and respected in the workplace, the so-called chilly climate. Women physicians' professional titles are used much less frequently in formal settings than the titles of their male counterparts, and women receive lower pay [2, 8]. One study published in *JAMA Internal Medicine* found that at 24 US medical schools, "significant sex differences in salary exist even after accounting for age, experience, specialty, faculty rank, and measures of research productivity and clinical revenue." The study found a \$19,878 (95% CI, \$15,261–\$24,495) salary difference due to gender [8]. Women faculty also carry more of the less respected academic service responsibilities, and in turn, these tasks do not increase the status of women and may indeed contribute to reductions in publications, tenure, and promotion [2, 9].

Sexual harassment is also a substantial hurdle for many women in science and medicine. A study of 1,719 National Institutes of Health (NIH) recipients of career development grants in academic medicine reported that 30% of female physicians have been sexually harassed. Of those, almost half reported that it negatively impacted their careers [10]. There have been so many reports of sexual harassment in recent years that both the NIH and the National Science Foundation released statements condemning harassment, encouraging reporting offenders, and threatening to block funding to institutions that do not address issues of sexual harassment adequately. The NIH also launched an anti-sexual harassment website <https://www.nih.gov/anti-sexual-harassment>.

While all women experience the effects of bias, the barriers are likely especially difficult for women in early career stages before they have established professional security and a substantial record of accomplishments. This may partly explain why women assistant professors in gastroenterology had slightly lower *h*-indices than males at that rank in the report [1].

Problems of bias in hiring, evaluations, promotions, pay, respect, and sexual harassment have major cumulative effects on the careers of women and cause some to leave academia, science, and medicine. Despite these impediments, the study by John et al. indicates that the women who remain

in academic medicine are as successful and productive as their male colleagues.

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