Gender is associated with promotion among Canadian academic surgeons

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Abstract:	Background: Gender disparities in faculty rank have yet to be studied among Canadian physicians. The purpose of this study is to determine if differences in region, training, research productivity, and years in practice explain gender differences in academic promotion among Canadian general surgeons. Methods: A cross-sectional database of practicing faculty-appointed general surgeons in Canada in 2017 was developed using publicly available directories, university/hospital websites, and direct communication. Information included gender, residency completion year, graduate education, fellowships, number of publications, and Scopus H-index. The dependent variable was binary: full professor or not. We also analyzed a combined outcome of associate or full professor. All variables were analyzed in a multivariable logistic regression model. Results: Of the 405 surgeons included, 111 (27.4%) were female. Sixty-eight (61.2%) females were assistant professors, versus 120 (47.2%) males. Nine (8.1%) females were full professors, versus 75 (29.5%) males. While females completed residency more recently (15.2 vs. 19.2 years, $p<0.001$), males and females didn't differ in their number of publications as residents (2.98 vs. 2.74, $p=0.68$) or per year of practice (3.12 vs. 2.09, $p=0.24$), number of fellowships pursued ($p=0.69$), or graduate education ($p=0.16$). In the multivariable model (c-

	statistic=0.88), gender remained significantly associated with full professorship (OR 2.79, 95%CI: 1.13-6.92, p=0.03) along with years in practice (OR 1.61, 95%CI: 1.13-2.30). Interpretation: Female surgeons with faculty appointments in Canada are less likely to receive promotion to full professor when controlling for years in practice, training, and research productivity measures. Pervasive inequities in systems of promotion must be addressed.

There are no relevant reporting guidelines for this study.

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Abstract

Background: Gender disparities in faculty rank have yet to be studied among Canadian physicians. The purpose of this study is to determine if differences in region, training, research productivity, and years in practice explain gender differences in academic promotion among Canadian general surgeons.

Methods: A cross-sectional database of practicing faculty-appointed general surgeons in Canada in 2017 was developed using publicly available directories, university/hospital websites, and direct communication. Information included gender, residency completion year, graduate education, fellowships, number of publications, and Scopus H-index. The dependent variable was binary: full professor or not. We also analyzed a combined outcome of associate or full professor. All variables were analyzed in a multivariable logistic regression model.

Results: Of the 405 surgeons included, 111 (27.4%) were female. Sixty-eight (61.2%) females were assistant professors, versus 120 (47.2%) males. Nine (8.1%) females were full professors, versus 75 (29.5%) males. While females completed residency more recently (15.2 vs. 19.2 years, $p<0.001$), males and females didn't differ in their number of publications as residents (2.98 vs. 2.74, $p=0.68$) or per year of practice (3.12 vs. 2.09, $p=0.24$), number of fellowships pursued ($p=0.69$), or graduate education ($p=0.16$). In the multivariable model (c-statistic=0.88), gender remained significantly associated with full professorship (OR 2.79, 95%CI: 1.13-6.92, $p=0.03$) along with years in practice (OR 1.61, 95%CI: 1.13-2.30).

Interpretation: Female surgeons with faculty appointments in Canada are less likely to receive promotion to full professor when controlling for years in practice, training, and research productivity measures. Pervasive inequities in systems of promotion must be addressed.

Introduction

Gender disparity with respect to faculty rank has been thoroughly investigated among physicians the United States (US).(1,2) After accounting for age, experience, specialty, and measures of research productivity, women are significantly less likely than men to be full professors.(2) Markers suggestive of inequity in academia exist among Canadian professors as well, with women representing only 27.6% of full professors(3) and receiving on average $10,263 less per year in salary(4) compared to men. In addition, specific to physician leadership, women make up just 12% of Faculty of Medicine Deans.(5)

With respect to specialty-specific disparity, the deterrents and barriers faced by women have been known to be more pronounced in surgical careers.(6) Despite recent increases, women still represent just 27% of Canadian surgeons(7) and an even lower proportion of academic surgeons.(6) Studies demonstrate consistent challenges faced by women to include perception of fewer career advancement opportunities,(8) suboptimal maternity leave and childcare opportunities,(7,9) gender-based discrimination,(10) an 'old boys' club' culture of practice,(11) and lack of female mentors.(12,13) Given the longer standing higher number of women in surgery in Canada, the pipeline effect should have lessened. Thus, the purpose of this study was to determine if there are gender differences in academic promotion among Canadian general surgeons and if these differences persist after controlling for region, training, research productivity, and years in practice.

Despite the congruence in gender disparity within Canadian and American academia, perhaps the longstanding female majority among medical graduates and increased proportion of female surgical trainees seen in Canada has allowed for the correction of the inequities that occurred during the era dominated by men. Furthermore, the barriers thought to be exacerbated

for women in surgery are mostly demonstrated through perception-based outcomes, and the extent to which they translate into tangible outcomes is unknown. Thus, the purpose of this study was to determine if differences in region, training, research productivity, and years in practice explain gender differences in academic promotion among Canadian general surgeons.

Methods

Study Population

The study population consisted of all currently practicing Canadian adult general surgeons with a faculty appointment designated as assistant, associate, or full professor. Pediatric, vascular, and thoracic surgeons were excluded from our database since for the majority of Canadian institutions, these surgeons function in separate divisions. Community surgeons with a purely clinical, part-time, or adjunct University affiliation, as well as those holding status as professor emeritus, clinical instructor/associate, or a locum position were also excluded. Lists of general surgeons included in this study were obtained from publicly available directories and verified directly with their respective divisions for 16 of 17 institutions. Direct communication with respective Division Heads was sought when professorship status was unknown. Given the publicly available nature of the data, a request for waiver of ethics was approved by the Ottawa Health Science Network Research Ethics Board.

Data Sources

A cross-sectional database was created to include all academic Canadian general surgeons. This was done by hand-searching physician directories as well as University and

hospital websites. For each surgeon, data were gathered from these sources by study authors with respect to 1) institution of practice 2) faculty appointment and rank 3) year of completion of residency described by year of becoming a Fellow of the Royal College of Physicians and Surgeons of Canada (FRCSC), 4) completion of graduate degrees (Master's, PhD) or certificates, 5) gender, 6) and number, subspecialty, and location of fellowship training. Additional information regarding markers of research productivity were obtained from the Scopus database including number of authored publications (first author, senior author, total) both in-residency and overall, as well as Scopus h-index as a marker of impact. Discussion and group consensus was used to make a judgment in areas of uncertainty regarding publication. Since demographic data was compiled from multiple sources, a 10% audit was performed independently by a second study author to ensure reliability of information retrieved. There were no discrepancies observed. Of note, some directories such as the College of Physicians and Surgeons of Ontario (CPSO) list both maiden and married names. When available, Scopus was searched for authorship listed under both names.

Statistical Analysis

For descriptive analyses, we described categorical variables using proportions and Chi-Square testing and defined continuous variables using means, standard deviations and T-Testing. Possible confounders for differences in professorship status between men and women may include number of years since residency, graduate degrees, fellowship training, and markers of research productivity. Thus, we created a multivariable logistic regression model to evaluate the relationship between gender and likelihood of promotion to full professorship (binary dependent variable) while controlling for level of graduate study (none, Master's, PhD), fellowship training

(yes or no), years in practice (continuous), total number of publications (continuous), and h-index (continuous). Variables for confounding adjustment were determined *a priori* based on previously demonstrated importance in the literature.(2,14,15) As in existing literature on gender difference in academic rank,(2) the primary outcome was full professorship because it represents the highest level of academic promotion and is generally based on having achieved international recognition. A secondary analysis was performed to evaluate the relationship between gender and the composite outcome of promotion to either associate or full professorship, as described in a previous study.(2) To do so, we fit a secondary multivariable logistic regression model utilizing the same predictors variables previously described though with the composite outcome as the dependent variable. The absolute adjusted difference between men and women with full professor status is reported along with the 95% confidence intervals. Statistical significance was defined as $p<0.05$. SAS® 9.4 (SAS Institute Inc., Cary, NC, USA) software was used for all analyses.

Results

The study population consisted of 405 academic general surgeons, of whom 111 (27.4%) were women. On average, women had been in practice for fewer years (15.20 ± 8.92 vs. 19.24 ± 11.08 years, $p<0.0001$) and were less likely than men to be full professors (8% [9 of 111] vs. 26% [75 of 294], $p<0.001$). Similar proportions of women and men completed graduate degrees (i.e. Master's, PhD) and fellowship training. An overview of the characteristics of the study population are further described in Table 1.

Further metrics to describe measures of research productivity are presented in Table 2. As residents, there was no difference in the average number of first author (1.45 ± 2.94 vs. 1.41 ±

2.16, p=0.90), senior author (0.14 ± 0.47 vs. 0.18 ± 0.57, p=0.47), or total number of publications (2.98 ± 5.48 vs. 2.74 ± 4.71, p=0.68) produced by men and women, respectively. Over their entire careers, there was also no difference in the number of first author publications (median (IQR) = 5.0 (11.0) vs. 4.5 (7.0)). However, men published significantly more senior author (4.0 (11.3) vs. 2.0 (5.0)), and total author publications (25.0 (54.0) vs. 15.0 (28.3)) over the length of their careers. Figure 1 demonstrates the relationship between number of publications and number of years in practice among male and female general surgeons. In addition, the H-index, a time-dependent marker of publication impact, was significantly higher for men (11.0 (14.0) vs. 7.5 (11.0)). However, the mean (±SD) number of publications per year of practice (i.e. post-FRCSC) was similar between men and women (3.12 ± 9.09 vs. 2.09 ± 2.48, p=0.24).

After adjusting for graduate degree, fellowship training, total publications, H-index, and years in practice, women were less likely than men to be full professors (OR 2.79, 95% CI 1.13-6.92, p=0.03) (Table 3). Years in practice was also independently positively associated with full professorship (OR 1.61, 95% CI 1.13-2.30, p=0.01). Total number of publications was also positively associated with full professorship, but did not reach significance (OR 1.18, 95% CI 1.00-1.39, p=0.05). The concordance statistic (c-statistic) for the model was 0.88 therefore suggesting excellent predictive performance.

A secondary analysis was performed to evaluate a composite outcome of promotion to associate or full professor. Women were less likely than men to be associate or full professors (OR 2.11, 95% CI 1.07-4.19, p=0.03) (Table 4) after adjusting for the same variables. Again, years in practice was also independently positively associated with promotion to associate or full professorship (OR 2.73, 95% CI 1.80-4.15, p<0.001) as was H-index, a time-based metric of

publication impact (OR 1.09, 95% CI 1.00-1.19, p=0.04). The c-statistic for this model was 0.87, also suggesting excellent predictive performance.

Interpretation

This study explored the factors associated with academic promotion among Canadian general surgeons. After controlling for years in residency, graduate and fellowship training, and markers of research productivity, men were still significantly more likely to be promoted to professorship status than women. Given the longstanding substantial proportion of female general surgeons in Canada, this study serves as a natural experiment to determine if the pipeline explains the gender disparity in promotion. The model demonstrates good overall predictive ability and expected relationships between promotion and other variables, such as years in practice. The findings of this study are important because they highlight ongoing gender inequity in academia, and underscore the need to identify and eliminate existing barriers.

The gender inequity found in this study is consistent with a recent US study of 91,000 physicians that demonstrated women were significantly less likely than men to be full professors after accounting for variables including age, experience, specialty, and measures of research productivity.(2) Among the 4,455 general surgeons included in the study population, the absolute adjusted sex difference in professorship was statistically significant at -4.6% (95% CI -7.6% to -1.6%). Metrics controlled for included age, years since residency, publications (total, first author, last author), number of NIH grants, whether the physician had conducted a clinical trial, and whether a physician was a faculty at a top-20 US medical school in research ranking. The reason for the association between gender and promotion is unclear and likely multifactorial. Gender discrimination has been demonstrated to exist in academic medicine,(14,16–18) and thus gender

bias, however unintentional, may contribute to the inequitable promotion given the inherent subjectivity of the promotion process. In addition, institutional barriers such as difficulty finding mentorship, sponsorship, and female role models, lack of accommodation for differential family responsibilities, and underrepresentation of women in leadership positions have been studied to explain the gender inequity.(15,19,20) Despite the existing literature, the potential for correction of the gender inequity as a result of the pipeline effect is unstudied. Interestingly, the above described study by Jena et al(2) reports the proportion of US female academic surgeons between 12.8% and 20%, allowing for the slightly variable definition of general versus subspecialty surgeon in the US compared to Canada. In contrast, we found a 37.7% proportion of Canadian female academic general surgeons. The difference in proportion of female faculty surgeons, combined with the higher proportion of female surgery residents for decades longer in Canada compared to the US, renders the findings of this study novel in that it demonstrates the pipline is insufficient to be relied upon to correct gender inequity.

A system of academic promotion is common to all faculties of medicine in Canada, with similar criteria that revolves around acknowledgement of faculty achievements and contributions to specific aspects of the academic mission.(21–25) While there are some institutional variations, the main themes guiding promotion are relatively universal across faculties of medicine internationally.(26–29) Upon review of promotion guideline manuals from various Canadian faculties of medicine, we note common themes relating to achievement of excellence, and recognition by peers both within the institution, and at national and international levels. Promotion to full professor generally requires international recognition, which may serve as a barrier due to less acceptance and fewer invitations to female surgeons in many countries.(27,29,30)

Promotion criteria are often described as a multifaceted, and generally include demonstration of excellence in three major spheres: education, scholarship, and service to the University. Promotion committees provide specific examples of metrics in each of these main themes (Table 5). The lack of specificity within these guidelines introduces the potential for subjectivity, which may enable subtle implicit biases to become influential. This subjectivity may be further exacerbated with the currently broadening definition of scholarly output (i.e. inclusion of education)(2) compared to the traditional definition represented by grants and publications. Although publication is a common theme across all promotion processes, the inability to capture non-research based metrics (i.e. teaching evaluations, invited talks) that may also support promotion serves as a limitation to our study. Obtaining information on promotion track would allow direct comparison of surgeons within each track to more accurately assess the impact of gender on professorship status.

There are several other limitations to this study, including the reliance on hand-searched data, which introduces the potential for misclassification. We attempted to minimize this potential for error by triangulating our data sources and auditing our database. However, as any misclassification errors are equally likely to occur for data gathered on male and female surgeons, this limitation is unlikely to bias the findings of this study in either direction. Capture of demographic data was also limited by the following considerations: some but not all physician directories list maiden names, Scopus may incorrectly include or exclude publications for surgeons with common names, and heterogeneity exists in professor titles between Canadian universities. Finally, we were unable to capture leaves of absence, such as parental leave, which may influence metrics that take years into account. Although these demographic limitations may be impacted by gender differences in a small subset of academic surgeons, they are unlikely to

affect the results in a substantive way. Failure to identify publications due to maiden names is unlikely to affect the findings of an association because it would increase the number of publications for affected women specifically, thus resulting in bias to the null. In addition, the effect of common names and heterogeneity in professor titles between institutions are unlikely to affect gender differentially. Although parental leave may affect the findings of this study, as discussed below, the impact of parental leave on the promotion of female surgeons may instead represent one causal barrier contributing to the inequity observed.(31)

It is important to not only identify gender inequities in our population, but also to develop strategies to achieve equity. Multiple approaches have been studied and are likely necessary to mitigate the barriers that result in the demonstrated promotion inequity. To date, the success of most of these programs is undermined by their 'bottom-up' approach which requires additional investment of those they intend to support, as opposed to a 'top-down' approach which begins with change from the higher management within academic institutions.(32) Two particularly notable studies of 'top-down' approaches have demonstrated promising results: first, Stewart et al. created a committee of full professor faculty members and provided implicit bias training with respect to gender inequity in academia. The committee brainstormed ways of improving hiring practices within their departments and disseminated strategies via workshops with their staff. Over two years the University-wide women faculty members increased from 15% to 30%.(33) Second, Jagsi et al. created a professional development grant for assistant professors responsible for child care, where they were each given $30,000 USD to be used for professional development. The institution invested a total of two million dollars. However, the return on investment generated by grant recipients was over 51 million dollars.(34) The strategies employed by these studies are consistent with a recent position paper by the American College of

Physicians, which recognizes the need for gender equity in career advancement.(31) Future studies should assess the effects of such 'top-down' approaches on equity in systems of promotion. Acknowledgment of the inequity in our own population, followed by its purposeful elimination, is integral to allowing our patients and the medical profession as a whole to benefit from the full potential of a diverse and inclusive physician workforce.

Conclusion

Among Canadian general surgeons with faculty appointments, women are significantly less likely to receive promotion to full professor when controlling for years in practice, clinical and graduate training, and measures of research productivity. With increasing awareness of the pervasive gender inequity in systems of promotion, we must employ effort in identifying and eliminating the existing equity barriers.

References

1. Association of American Medical Colleges. Women in US academic medicine and science:statistics and benchmarking report [Internet]. 2012 [cited 2018 May 16]. Available from: https://www.aamc.org/download/415556/data/2011-2012wimsstatsreport.pdf
2. Jena AB, Khullar D, Ho O, Olenski AR, Blumenthal DM. Sex Differences in Academic Rank in US Medical Schools in 2014. JAMA [Internet]. 2015 Sep 15 [cited 2018 Mar 12];314(11):1149. Available from: http://jama.jamanetwork.com/article.aspx?doi=10.1001/jama.2015.10680
3. Statistics Canada. Number of full-time teaching staff at Canadian universities, by rank, sex, Canada and Provinces [Internet]. Statistics Canada. 2016 [cited 2018 May 16]. Available from: http://www.statcan.gc.ca/daily-quotidien/171128/dq171128b-cansim-eng.htm
4. Statistics Canada. Number and salaries of full-time teaching staff at Canadian universities, 2016-2017 [Internet]. Statistics Canada. 2017 [cited 2018 May 16]. Available from: http://www.statcan.gc.ca/daily-quotidien/171128/dq171128b-cansim-eng.htm
5. The Association of Faculties of Medicine of Canada. Governance [Internet]. The Association of Faculties of Medicine of Canada. 2017 [cited 2018 May 16]. Available from: https://afmc.ca/about-afmc/governance
6. Brown JB, Fluit M, Lent B, Herbert C. Surgical culture in transition: gender matters and generation counts. Can J Surg [Internet]. 2013 Jun [cited 2018 May 16];56(3):153–8. Available from: http://www.ncbi.nlm.nih.gov/pubmed/23484466
7. Acai A, Steyn C, Reid S, Sonnadara R. A solution to gender inequity in surgery? Better caregiving policies. Can J Surg [Internet]. 2018 [cited 2018 May 16];61(1). Available

from: https://canjsurg.ca/wp-content/uploads/2018/01/61-1-6.pdf

8. Schroen AT, Brownstein MR, Sheldon GF. Women in academic general surgery. Acad Med [Internet]. 2004 Apr [cited 2018 May 16];79(4):310–8. Available from: http://www.ncbi.nlm.nih.gov/pubmed/15044162

9. Troppmann KM, Palis BE, Goodnight JE, Ho HS, Troppmann C. Women surgeons in the new millennium. Arch Surg [Internet]. 2009 Jul 20 [cited 2018 May 16];144(7):635. Available from: http://www.ncbi.nlm.nih.gov/pubmed/19620543

10. Bruce AN, Battista A, Plankey MW, Johnson LB, Marshall MB. Perceptions of gender-based discrimination during surgical training and practice. Med Educ Online [Internet]. 2015 [cited 2018 May 16];20:25923. Available from: http://www.ncbi.nlm.nih.gov/pubmed/25652117

11. Gargiulo DA, Hyman NH, Hebert JC. Women in surgery: do we really understand the deterrents? Arch Surg [Internet]. 2006 Apr 1 [cited 2018 May 16];141(4):405. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16618901

12. Neumayer L, Kaiser S, Anderson K, Barney L, Curet M, Jacobs D, et al. Perceptions of women medical students and their influence on career choice. Am J Surg [Internet]. 2002 Feb [cited 2018 May 16];183(2):146–50. Available from: http://www.ncbi.nlm.nih.gov/pubmed/11918878

13. Entezami P, Franzblau LE, Chung KC. Mentorship in surgical training: a systematic review. Hand (N Y) [Internet]. 2012 Mar [cited 2018 May 16];7(1):30–6. Available from: http://www.ncbi.nlm.nih.gov/pubmed/23448749

14. Tesch BJ, Wood HM, Helwig AL, Nattinger AB. Promotion of women physicians in academic medicine: glass ceiling or sticky floor? JAMA. 1995;273(13):1022–5.

15. Hamel MB, Ingelfinger JR, Phimister E, Solomon CG. Women in academic medicine - progress and challenges. N Engl J Med [Internet]. 2006 [cited 2018 Jul 25];355(3):310–2. Available from: www.nejm.org

16. Fried LP, Francomano CA, MacDonald SM, Wagner EM, Stokes EJ, Carbone KM, et al. Career development for women in academic medicine. JAMA [Internet]. 1996 Sep 18 [cited 2019 Feb 9];276(11):898. Available from: http://jama.jamanetwork.com/article.aspx?doi=10.1001/jama.1996.03540110052031

17. Carr PL, Szalacha L, Barnett R, Caswell C, Inui T. A "ton of feathers": gender discrimination in academic medical careers and how to manage it. J Women's Heal [Internet]. 2003 Dec [cited 2019 Feb 17];12(10):1009–18. Available from: http://www.liebertpub.com/doi/10.1089/154099903322643938

18. Reed V, Buddeberg-Fischer B. Career obstacles for women in medicine: an overview. Med Educ [Internet]. 2001 [cited 2019 Feb 17];35:139–47. Available from: https://journals-scholarsportal-info.proxy.bib.uottawa.ca/pdf/03080110/v35i0002/139_cofwimao.xml

19. Kaplan SH, Sullivan LM, Dukes KA, Phillips CF, Kelch RP, Schaller JG. Sex differences in academic advancement. N Engl J Med [Internet]. 1996 [cited 2018 Jul 25];335(17):1282–90. Available from: https://www-nejm-org.proxy.bib.uottawa.ca/doi/pdf/10.1056/NEJM199610243351706

20. Yedidia MJ, Bickel J. Why aren't there more women leaders in academic medicine? The views of clinical department chairs. Acad Med. 2001;76(5):453–65.

21. The General Faculties Council and The Board of Governors. Procedures Pertaining to Appointment, Promotion, and Tenure of Academic Staff [Internet]. Calgary; 2009 [cited

2019 Feb 4]. Available from: www.ucalgary.ca/provost/academic_agreements.

22. Faculty of Medicine. Guidelines for Academic Promotion of Clinical Faculty [Internet]. 2016 [cited 2019 Feb 4]. Available from: https://med.uottawa.ca/professional-affairs/faculty/promotion/academic-promotion-guidelines

23. Szeri A, Mathieson C. Guide to Reappointment, Promotion and Tenure Procedures at UBC [Internet]. Vancouver; 2018 [cited 2019 Feb 4]. Available from: http://www.hr.ubc.ca/faculty-relations/files/SAC-Guide-July-2018-Update.pdf

24. Human Resources Office F of M. Manual for Academic Promotion to Associate and Full Professor [Internet]. Toronto; 2015 [cited 2019 Feb 4]. Available from: http://medicine.utoronto.ca/sites/default/files/ManualforAcademicPromotion2015.pdf

25. University of Toronto Governing Council. Policy and Procedures Governing Promotions [Internet]. Toronto; 1980 [cited 2019 Feb 4]. Available from: https://share.utorcsi.utoronto.ca/sites/gc/Governing Council/All Policies/P/policy and procedures for governing promotions.docx[Website:http://www.governingcouncil.utoronto.ca/

26. Todisco A, Souza RF, Gores GJ. Trains, tracks, and promotion in an academic medical center. Gastroenterology [Internet]. 2011 Nov 1 [cited 2019 Feb 17];141(5):1545–8. Available from: http://www.ncbi.nlm.nih.gov/pubmed/21939624

27. Johns Hopkins University School of Medicine Medical School Council and Advisory Board. Policies and Guidelines Governing Appointment, Promotion, and Professional Activities of Full-Time Faculty of The Johns Hopkins University School of Medicine [Internet]. Baltimore; 2017 [cited 2019 Feb 17]. Available from: https://www.hopkinsmedicine.org/som/faculty/policies/goldbook/goldbook.pdf

28. Coughlan S. Cambridge academics call for more women professors [Internet]. British Broadcasting Corportion. 2017 [cited 2019 Feb 17]. Available from: https://www.bbc.com/news/education-26259644

29. Imperial College London. Academic Promotions [Internet]. Imperial College London. 2019 [cited 2019 Feb 17]. Available from: https://www.imperial.ac.uk/human-resources/working-at-imperial/career-development-opportunities/academic-promotions/

30. Human Resources Office F of M. Manual for Academic Promotion [Internet]. Toronto; 2018 [cited 2019 Apr 2]. Available from: https://medicine.utoronto.ca/sites/default/files/July_2018 Academic Promotions Manual - Final_2.pdf

31. Butkus R, Serchen J, Moyer D V., Bornstein SS, Hingle ST. Achieving gender equity in physician compensation and career advancement: a position paper of the American College of Physicians. Ann Intern Med [Internet]. 2018 [cited 2018 May 16];168(10):721–3. Available from: http://annals.org/article.aspx?doi=10.7326/M17-3438

32. Laver KE, Prichard IJ, Cations M, Osenk I, Govin K, Coveney JD, et al. A systematic review of interventions to support the careers of women in academic medicine and other disciplines. BMJ Open [Internet]. 2018 [cited 2018 Apr 10];8:1–16. Available from: http://

33. Stewad AJ, LaVaque-Manty D, Malley JE. Recruiting female faculty members in science and engineering: preliminary evaluation of one intervention model. J Women Minor Sci Eng [Internet]. 2004 [cited 2018 May 16];10:361–75. Available from: http://www.escalate.wayne.edu/PDF/ESCALATE NSF ADVANCE Workshop/UMich-RecruitFemaleFac.pdf

34. Jagsi R, Butterton JR, Starr R, Tarbell NJ. A targeted intervention for the career development of women in academic medicine. Arch Intern Med [Internet]. 2007 [cited 2018 May 16];167(4):343. Available from: http://www.ncbi.nlm.nih.gov/pubmed/17325295

Table 1. Characteristics of practicing Canadian academic general surgeons by gender (n=405)

	Male (n = 294)	Female (n = 111)	Significance
Year of FRCSC Graduation			P < 0.01
Pre-1990s	68 (23.1%)	10 (9.0%)	
1990-1999	69 (23.5%)	27 (24.3%)	
2000-2009	97 (33.0%)	41 (36.9%)	
2010 - 2017	45 (15.3%)	33 (29.7%)	
Number of Years in Practice (Post-FRCSC)	18.5 (18.0)	13.5 (14.3)	P < 0.001
Graduate Education			P = 0.16
None	153 (52.0%)	45 (40.5%)	
Master's	93 (21.4%)	48 (43.2%)	
PhD	28 (9.5%)	14 (12.6%)	
Other	48 (16.3%)	22 (19.8%)	
Fellowship Training			P = 0.69
None	83 (28.2%)	31 (27.9%)	
One	176 (59.9%)	70 (63.1%)	
Two or more	35 (11.9%)	10 (9.0%)	
Professorship Level			P < 0.001
Assistant	120 (40.8%)	68 (61.3%)	
Associate	99 (33.7%)	34 (30.6%)	
Full	75 (25.5%)	9 (8.1%)	

FRCSC = Fellow of the Royal College of Surgeons of Canada

Table 2. Research productivity of Canadian academic general surgeons by gender (n=405)

Variable	Professorship Status		
	Assistant (n=188)	Associate (n=133)	Full (n=84)
Publications (Prior to FRCSC)			
All			
First Author	0.0 (2.0)	0.0 (2.0)	0.0 (2.0)
Senior Author	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Total	1.0 (4.0)	1.0 (3.0)	1.0 (4.3)
Male			
First Author	0.0 (1.3)	0.0 (1.5)	0.0 (2.0)
Senior Author	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Total	0.5 (4.0)	1.0 (3.0)	1.0 (5.0)
Female			
First Author	0.0 (2.0)	0.5 (2.0)	1.0 (2.0)
Senior Author	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Total	1.0 (4.0)	1.0 (3.0)	2.0 (3.0)
Career Publications			
All			
First Author	2.0 (6.0)	5.0 (9.0)	17.0 (24.5)
Senior Author	0.0 (3.0)	5.0 (8.0)	22.5 (35.3)
Total	9.0 (17.3)	29.0 (33.0)	98.5 (125.3)
Male			
First Author	2.0 (6.0)	4.0 (9.0)	17.0 (25.0)
Senior Author	0.0 (3.0)	5.0 (8.0)	21.0 (35.5)
Total	8.5 (17.5)	28.0 (32.0)	102.0 (123.0)
Female			
First Author	3.0 (5.3)	6.0 (8.5)	16.0 (12.0)
Senior Author	0.5 (2.3)	5.0 (10.0)	24.0 (48.0)
Total	9.0 (14.8)	32.0 (34.0)	95.0 (128.0)
H-Index			
All	4.0 (6.3)	11.0 (9.0)	28.0 (23.5)
Male	4.0 (7.3)	11.0 (10.0)	28.0 (25.0)
Female	4.5 (6.3)	12.5 (8.8)	29.0 (18.0)

*Reported as median (IQR)
FRCSC = Fellow of the Royal College of Surgeons of Canada

Table 3. Multivariable analysis of variables associated with full professorship (n=405)

Variable	Odds Ratio (95% CI)	Significance
Degree		
None	Reference	
Master's	0.87 (0.39 to 1.95)	p = 0.73
PhD	0.70 (0.22 to 2.29)	p = 0.56
Total Publications		
Per Ten Publications	1.18 (1.00 to 1.39)	p = 0.05
H-Index	1.05 (0.97 to 1.13)	p = 0.20
Fellowships		
None	Reference	
Yes (one or more)	0.52 (0.24 to 1.13)	p = 0.10
Practice Years		
Per Decade of Practice	1.61 (1.13 to 2.30)	p = 0.01
Gender		
Female	Reference	
Male	2.79 (1.13 to 6.92)	p = 0.03

Table 4. Multivariable analysis of variables associated with combined outcome of associate or full professorship (n=405)

Variable	Odds Ratio (95% CI)	Significance
Degree		
None	Reference	
Master's	1.47 (0.79 to 2.76)	p = 0.22
PhD	0.85 (0.32 to 2.21)	p = 0.73
Total Publications		
Per Ten Publications	1.15 (0.91 to 1.46)	p = 0.24
H-Index	1.09 (1.0 to 1.19)	p = 0.04
Fellowships		
None	Reference	
Yes (one or more)	1.00 (0.54 to 1.87)	p = 0.99
Practice Years		
Per Decade of Practice	2.35 (1.72 to 3.19)	p < 0.0001
Gender		
Female	Reference	
Male	1.93 (1.10 to 3.38)	p = 0.02

Table 5. Examples of activities associated with promotion, extracted from various Canadian Faculty of Medicine guidelines(21–25)

EDUCATION
▪ Clinical teaching and mentorship ▪ Classroom, lectures, seminar discussion, clinical supervision, laboratory supervision, tutorials, graduate supervision, field supervision, practicum supervision, distance education, collaborative teaching with associated institutions, the advising of students, etc. ▪ Development of educational material with national/international dissemination (assessment tools, syllabi, curricula, courses, simulation technologies). ▪ Innovation and enhancements to teaching, learning and assessment that has impact beyond the classroom ▪ Significant contributions to curriculum development ▪ Activities that advance interdisciplinary, inter-professional and inter-institutional collaborations in teaching and learning. ▪ Recognition and distinction in the form of awards, fellowships and other recognition for teaching and learning related activities ▪ Capacity building for excellence in education, including mentoring and inspiration of colleagues. ▪ Development, testing, and application of computer-assisted learning techniques and software shall ▪ Evidence of contributions to administrative and organizational aspects of education, including course design, course evaluation, etc. ▪ Development of new courses or curricula ▪ Creation of new teaching resources and materials ▪ Development of innovative approaches to teaching ▪ Development of new or improved methods of evaluation ▪ Contributions to national professional examinations and standards ▪ Evidence of educational consultancies or recognition of expertise and leadership by other jurisdictions ▪ Participation in site visits for accreditation at a national or international level
SCHOLARSHIP
▪ Publication of original peer-reviewed research, chapters, reviews, and/or textbooks related to area of expertise ▪ Published abstracts accepted for presentation at major national and international scientific conferences also provide evidence that the research in progress is being disseminated to the scientific community. ▪ Sustained record of scientific publications demonstrating that the research has led to a significant source of new information in the field. ▪ Development of guidelines and/or protocols for patient treatment or delivery of care that are adopted nationally. ▪ Research that results in significant changes in the understanding of basic mechanisms of molecular or cellular function and disease, clinical care, health services delivery or health policy, or the social sciences and humanities as applied to health. ▪ Strong and continuing record of external funding commensurate with the type and area of research.
SERVICE TO THE UNIVERSITY
▪ Membership/leadership on University committees ▪ Administrative or supervisory work; service on committees and university bodies; all continuing education activity in the community including professional education; special work with professional, technical, scholarly or other organizations or with ▪ Service on editorial boards of disciplinary or interdisciplinary journals, on grant selection committees and adjudication panels of provincial, regional, or national agencies, and similar professional involvement. ▪ Contributions to the professional community, the Province, and the Nation through the application of scholarly or professional knowledge and expertise. ▪ Establishment of new programs within the Faculty or University ▪ Development of new or revised departmental, faculty or university policies and procedures ▪ Representation and active involvement on Boards and other organizational committees ▪ Contributions in a leadership role in discipline or professional organizations ▪ Development of policies or procedures within a discipline, profession or relevant organization

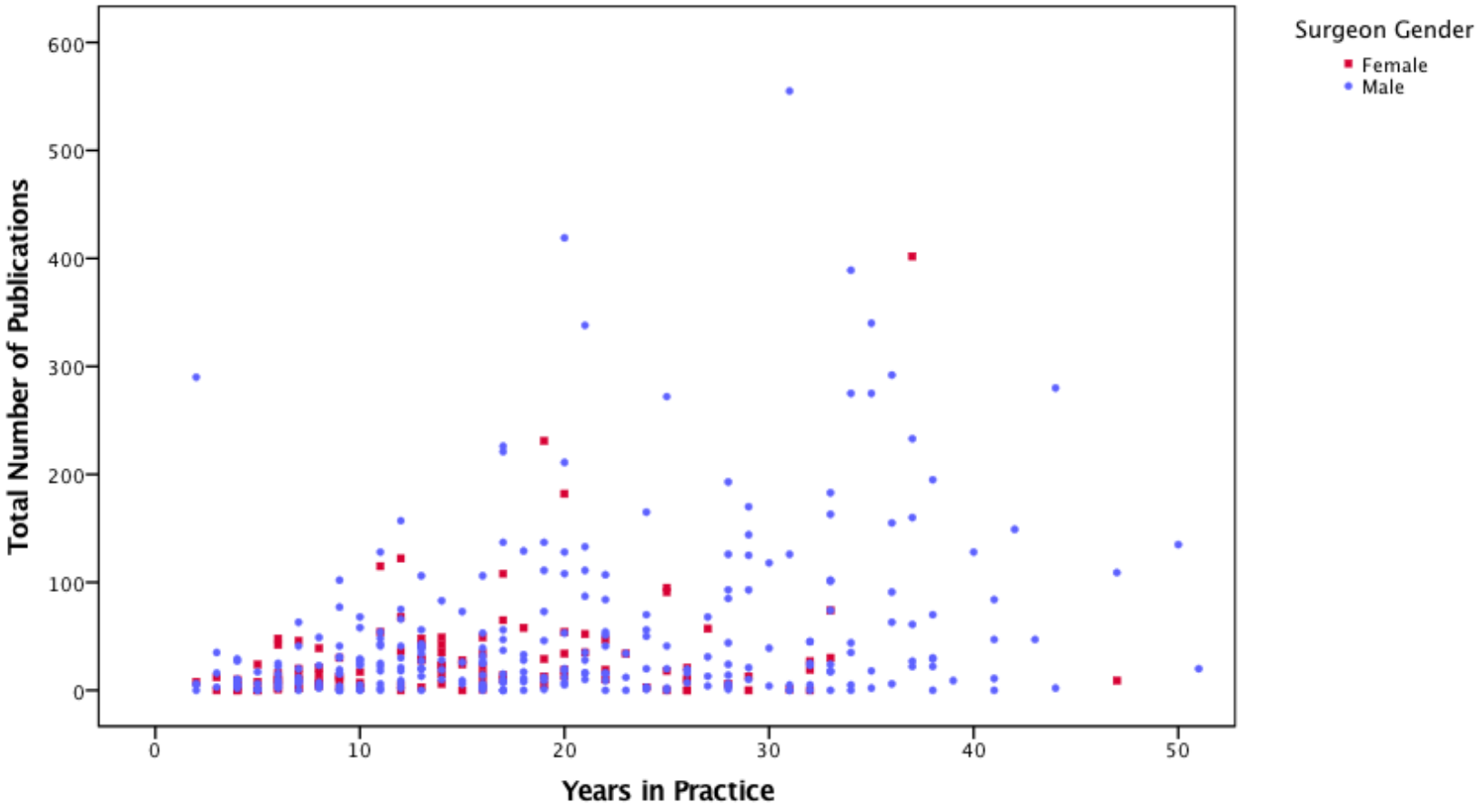

Figure 1. Scatterplot of number of publications by male and female surgeons based on number of years in practice.