

## Persistent and Consistent Underpromotion of Women in Academic Medicine: It's Time to Make Some Waves

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**M**erging medical school graduate and faculty data spanning 1979-2018 from the Association of American Medical Colleges, we compared expected versus actual proportions of women promoted. We calculated survival curves and hazards models to examine differences between early and later cohorts. The sample included 559,098 students graduating from 134 U.S. medical schools. For promotion to upper ranks (associate/full professor) and department chair, the great majority of class cohorts had fewer women than expected achieve promotion. Findings were similar across basic science and clinical departments. In adjusted analyses, women assistant professors were less likely to be promoted to associate professor after adjusting for graduation year, race, and work in clinical versus basic science department. Similar gender disparities were found for women's promotion to full professor and appointment to department chair. Women from recent medical school cohorts were less likely to be promoted to associate or full professor, and less likely to be appointed chair, than women from original study cohorts. Twenty years later, women physicians are no closer to promotion equity.

### Introduction

Twenty years ago, a landmark longitudinal cohort study of medical school graduates from 1979 to 1997 demonstrated that high rates of women physicians were entering the ranks of academic medicine as assistant professors, but were not advancing in rank to associate or full professor at the same pace as men (Nonnemaker, 2000). Since then, a number of studies have focused on the promotion gap. A 2014 cross-sectional study (Jena et al., 2015) found that gender dis-

parity in promotion remains even after accounting for age, experience, specialty, and research productivity. We here summarize findings from an update of Nonnemaker's study that includes additional cohorts from 1997 to 2018 (Richter et al., 2020). We also report analyses of the intersection of race and gender on promotion, as well as analyses of the impact of gender on attrition.

### Methods

Data from the AAMC Student Records System (SRS) include every gradu-

ate of U.S. MD-granting medical schools. Data from the AAMC Faculty Roster include information on every full-time faculty or department chair appointment ever held by a graduate of a U.S. MD-granting medical school. Our main outcome measures were full-time faculty appointments at the level of assistant, associate, full professor, and department chair. We calculated the actual versus expected numbers of women who were promoted to each rank. The expected number was the number of women who would have achieved a given rank under conditions of parity between women and men on the basis of their representation in a given graduation cohort. For the analysis of appointment to department chair, we included all faculty who held associate or full professor positions.

We used nonparametric Kaplan-Meier survival curves to depict time to promotion by gender and rank across all study cohorts (1979-2013) and between original (1979-1997) versus later (1998-2013) cohorts. We estimated differences in the average “hazards” for promotion between genders using four sets of Cox Proportional Hazards models. The first set of models used the censoring criteria as described (above) and described the risks for promotion/appointment across all cohort years adjusting for year of graduation, race, and department type (where applicable). The second set

of models examined whether hazards for promotion have changed between the original cohorts included in the 2000 landmark paper (1979-1997) versus later cohorts (1998-2013) added by this paper. Details of the methods and results are available in our full publication (Richter et al., 2020).

### Results

Our sample consisted of 559,098 medical students. Women accounted for 38.9% of graduates and 40.8% of assistant professors, reflecting women being slightly more likely to choose a career in academic medicine than men. Woman graduates were more diverse than male graduates with 33.3% versus 24.4% racial/ethnic minorities, respectively.

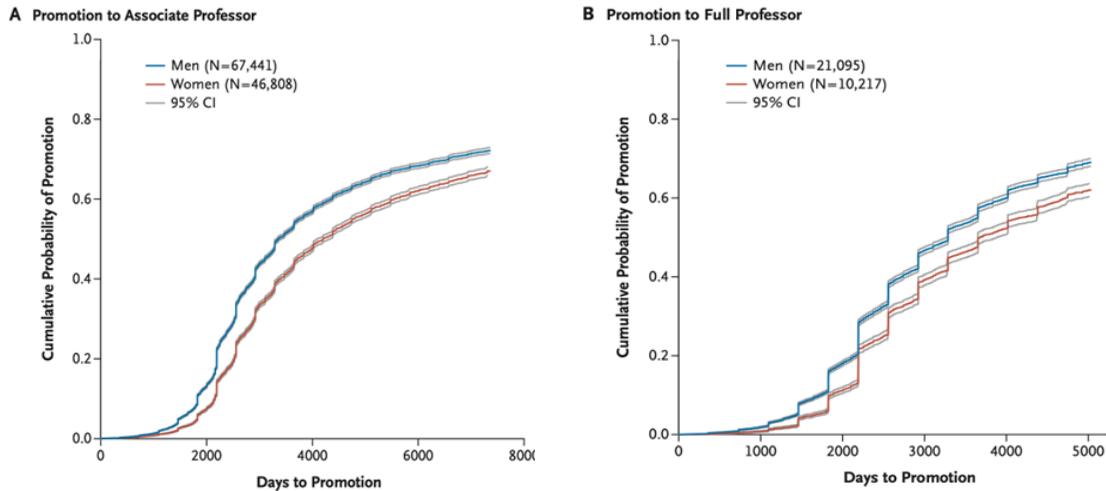
### Actual Versus Expected Representation of Women in Faculty Ranks

*Cohort analysis, appointment/promotion to associate, full professor, and chair.*

Among assistant professors, across 32 of 35 medical school graduating cohorts, fewer women than expected were promoted to associate professor (Table 1). This difference ranged from 3% (1979 cohort) to 10% (2010 cohort) (not shown). In no cohort did women exceed the rate of promotion of males to associate professor. Among associate professors, across 28 of 35 cohorts fewer women than expected were promoted to full professor. This difference ranged from 3% (1986 cohort) to 19% (2000 cohort) (not shown).

**Table 1. Summary of actual versus expected promotion to associate professor, full professor, and department chair.**

Promotion/Appt to:	No. cohorts in which actual is equal to or greater than expected	No. of all cohorts in which actual is less than expected	No. of all cohorts in which fewer women were promoted than expected and 95% CIs did not cross 0
Associate professor	3	32 of 35	28 of 35
Full professor	7	28 of 35	22 of 35
Chair	4	31 of 35	19 of 35



**Figure 1. Kaplan-Meier survival curves depicting time to promotion for male versus female faculty.**

In two cohorts women exceeded proportional promotion by just one more promotion than expected. Across 31 of 35 cohorts, fewer women than expected were appointed to lead a department as chair. This difference ranged from 7% (1981 cohort) to 25% (1999 cohort) (not shown). In no cohorts did women exceed the proportion of appointments of males to department chair.

### Survival Analysis

Kaplan-Meier survival curves for time to promotion by gender suggest that women are appointed to assistant professor earlier and at higher rates than men (not shown). Men, however, are promoted more quickly to associate and full professor (Figure 1) and appointed more quickly to chair (not shown). Curves by gender never converge or cross—women never catch up to or exceed rates of promotion achieved by men.

### Cox Proportional Hazards Models

With respect to promotion to associate professor, across all cohorts, women were 24% less likely to be promoted compared to men (0.757, CI=0.739, 0.776) (not shown). Women’s odds for promotion in later cohorts were approximately the same as women’s odds for promotion in earlier cohorts (Table 2).

**Table 2. Summary of odds for promotion to associate professor among assistant professor, comparison of early versus late cohorts.**

	Hazard Ratio (95% CI)
Female for 1979-1997	0.754 (0.733, 0.776)
Male for 1979-1997 (reference)	--
Female for 1998-2013	0.755 (0.723, 0.788)
Male for 1998-2013 (reference)	--

Trends are actually worse for promotion to full professor and appointment to chair. To full professor, across all cohorts, women were 23% less likely to be promoted compared to men (0.773, CI=0.740, 0.807) (not shown). The hazards model with sex by cohort interaction terms finds that women in the later cohorts had 27% lower odds for promotion compared to women in the earlier cohorts (not shown). Across all cohorts, women were 54% less likely to be appointed to chair compared to men (0.458, CI=0.392, 0.536) (not shown). The hazards model with sex by cohort interaction terms finds that wom-

**Table 3. Hazards of promotion to associate professor by race/ethnicity, sex, and graduation decade.**

Assistant to Associate: Hazard Ratio (95% CI)

Race	Sex	Graduation Decade				
		70s	80s	90s	00s	10s
AI/AN/ NH/PI	F	0.83 (0.47, 1.47)	0.85 (0.57, 1.25)	0.87 (0.65, 1.15)	0.89 (0.63, 1.24)	0.91 (0.55, 1.51)
	M	0.66 (0.38, 1.15)	0.67 (0.47, 0.97)	0.69 (0.53, 0.88)	0.70 (0.51, 0.95)	0.71 (0.43, 1.16)
Asian	F	0.88 (0.79, 0.99)	0.83 (0.77, 0.89)	0.77 (0.74, 0.81)	0.73 (0.68, 0.77)	0.68 (0.62, 0.75)
	M	1.30 (1.18, 1.42)	1.21 (1.14, 1.28)	1.13 (1.08, 1.17)	1.05 (1.00, 1.10)	0.98 (0.90, 1.06)
Black	F	0.40 (0.34, 0.47)	0.44 (0.39, 0.48)	0.47 (0.44, 0.51)	0.51 (0.46, 0.56)	0.55 (0.48, 0.64)
	M	0.53 (0.46, 0.61)	0.57 (0.52, 0.63)	0.61 (0.57, 0.67)	0.66 (0.59, 0.74)	0.71 (0.61, 0.84)
H/L/ MRH	F	0.57 (0.48, 0.67)	0.56 (0.50, 0.63)	0.56 (0.51, 0.61)	0.56 (0.50, 0.62)	0.55 (0.47, 0.64)
	M	0.75 (0.65, 0.86)	0.74 (0.67, 0.81)	0.73 (0.68, 0.78)	0.72 (0.65, 0.79)	0.71 (0.61, 0.82)
O/MRNIH /U	F	0.52 (0.35, 0.75)	0.53 (0.40, 0.71)	0.54 (0.44, 0.68)	0.56 (0.45, 0.69)	0.57 (0.44, 0.75)
	M	0.87 (0.64, 1.18)	0.89 (0.72, 1.11)	0.91 (0.78, 1.07)	0.93 (0.78, 1.11)	0.95 (0.74, 1.22)
White	F	0.76 (0.72, 0.80)	0.77 (0.74, 0.79)	0.77 (0.75, 0.79)	0.78 (0.75, 0.81)	0.78 (0.74, 0.83)
	M	Reference	Reference	Reference	Reference	Reference

en in the later cohorts had 55% lower risk for being appointed compared to women in the earlier cohorts (not shown).

**Promotion by Race/Ethnicity, Sex, and Graduation Decade**

We provide here preliminary, unpublished data based on analyses of a data set with several additional years of medical school cohorts. White males had better odds of promotion to the rank of associate professor than almost all other racial/ethnic and sex groups identified, and these differences were reflected over the span of four decades of data analyzed (Table 3). Trends are similar for promotion to full professor and department chair (not shown).

**Retention by Race/Ethnicity, Sex, and Graduation Decade**

We describe here preliminary, unpublished data based on analyses of a data set with several additional years of cohorts. We are finding that women faculty leave academic medicine a median of one year earlier than men. Racial and Ethnic minority faculty leave academic medicine a median of one to four years earlier than White faculty.

**Discussion**

The glass ceiling persists in academic medicine. In an era where women have

closed the medical school admission gender gap (Colleges, 2020), women remain underrepresented in upper faculty ranks. These new analyses find that compared to men, women are less likely to be appointed to department chair. Results are consistent across 35 years of graduating classes. Survival analysis suggests that women never close the promotion gap. Adjusting for race/ethnicity, year of graduation, and type of department did not eliminate gender differences in promotion. Notably, woman associate/full professors are half as likely as men of equal rank to be appointed to department chair.

Interaction terms examining early versus late cohorts by sex find that women, if anything, are losing ground in terms of promotion. This confirms findings from other recent studies. A study published in 2018 found that, over 17 years among 1,273 faculty at 24 U.S. medical schools, women were less likely to attain leadership positions such as dean, associate dean, provost, and department chair than men, even after adjusting for publication-related productivity (Carr et al., 2018). A cross-sectional analysis of cardiology faculty at U.S. medical schools found that women were less likely to be full professors after accounting for years

since residency, cardiology sub-specialty, publications, NIH grants, and registered clinical trials (Blumenthal et al., 2017).

Academic medicine appears to be falling behind Science, Technology, Engineering, and Mathematics (STEM) in eliminating gender differences in promotion (Williams & Ceci, 2015). Across 2,966 assistant professors in science and engineering tracked over time at 14 U.S. universities, men and women were retained and promoted at the same rate in all departments except for mathematics (Kaminski & Geisler, 2012).

Our preliminary analyses of the intersection of race/ethnicity and sex on promotion suggest that women of color face a “double-whammy.” Analyses of retention by race/ethnicity and sex yield similar findings.

There are numerous potential causes of disparities in promotion and retention. These include a persisting “old boys club” mentality and climate; lack of gender parity in leadership and compensation; lack of retention of women; disproportionate burden of family responsibilities; and difficulties in achieving work-life balance (Carr et al., 2015). A nationally representative survey at U.S. medical colleges found that female faculty had similar leadership aspirations as male faculty but a lower sense of belonging and were less likely to perceive their institution as family friendly or willing to make changes to address diversity goals (Pololi et al., 2013).

Lack of women at higher ranks, especially in chair positions, may perpetuate the cycle. Women are underrepresented among residency program directors, who are role models and sponsors for career

advancement (Long et al., 2011), and on medical journal editorial boards, which prioritize areas of research and select who gets published (Amrein et al., 2011).

Lower earnings, harassment, or disproportionate family responsibilities could cause women to drop out of academic medicine (Jena et al., 2016) or forgo advancement. Nearly one in three woman physicians and clinician-researchers report experiencing workplace sexual harassment (Adesoye et al., 2017; Jaggi et al., 2016), which appears to be more common in academic medical centers than in community or outpatient medical settings (Nora et al., 2002). Most woman physicians have children (Jolly et al., 2014), and most physician mothers report they experienced discrimination due to being pregnant, taking maternity leave, or breastfeeding on the job (Adesoye et al., 2017).

### **Conclusions**

Twenty years later, women are still less likely to advance into upper faculty ranks than men, barriers appear to be worse for faculty of color, and retention rates are lower for women and faculty of color. To address this, two recent reports propose changes to the academic work environment (Butkus et al., 2018; Carr et al., 2019) designed to remove systemic barriers to career advancement and supplement programs in place for women at signal institutions (Laver et al., 2018). Making academic medicine a better environment for women would likely improve the environment for all faculty. Concerted efforts are needed to remove the additional barriers to advancement and retention among faculty of color.

## References

- Adesoye, T., Mangurian, C., Choo, E. K., Girgis, C., Sabry-Elnaggar, H., Linos, E., & Physician Moms Group Study, G. (2017, Jul 1). Perceived Discrimination Experienced by Physician Mothers and Desired Workplace Changes: A Cross-sectional Survey. *JAMA Intern Med*, 177(7), 1033-1036. <https://doi.org/10.1001/jamainternmed.2017.1394>
- Amrein, K., Langmann, A., Fahrleitner-Pammer, A., Pieber, T. R., & Zollner-Schwetz, I. (2011, Dec). Women underrepresented on editorial boards of 60 major medical journals. *Gen Med*, 8(6), 378-387. <https://doi.org/10.1016/j.genm.2011.10.007>
- Blumenthal, D. M., Olenski, A. R., Yeh, R. W., DeFaria Yeh, D., Sarma, A., Stefanescu Schmidt, A. C., Wood, M. J., & Jena, A. B. (2017, Feb 7). Sex Differences in Faculty Rank Among Academic Cardiologists in the United States. *Circulation*, 135(6), 506-517. <https://doi.org/10.1161/CIRCULATIONAHA.116.023520>
- Butkus, R., Serchen, J., Moyer, D. V., Bornstein, S. S., Hingle, S. T., Health, & Public Policy Committee of the American College of, P. (2018, May 15). Achieving Gender Equity in Physician Compensation and Career Advancement: A Position Paper of the American College of Physicians. *Ann Intern Med*, 168(10), 721-723. <https://doi.org/10.7326/M17-3438>
- Carr, P. L., Gunn, C. M., Kaplan, S. A., Raj, A., & Freund, K. M. (2015, Mar). Inadequate progress for women in academic medicine: findings from the National Faculty Study. *J Womens Health (Larchmt)*, 24(3), 190-199. <https://doi.org/10.1089/jwh.2014.4848>
- Carr, P. L., Helitzer, D., Freund, K., Westring, A., McGee, R., Campbell, P. B., Wood, C. V., & Villablanca, A. (2019, Mar). A Summary Report from the Research Partnership on Women in Science Careers. *J Gen Intern Med*, 34(3), 356-362. <https://doi.org/10.1007/s11606-018-4547-y>
- Carr, P. L., Raj, A., Kaplan, S. E., Terrin, N., Breeze, J. L., & Freund, K. M. (2018, Nov). Gender Differences in Academic Medicine: Retention, Rank, and Leadership Comparisons From the National Faculty Survey. *Acad Med*, 93(11), 1694-1699. <https://doi.org/10.1097/ACM.0000000000002146>
- Colleges, A. o. A. M. (2020). *2019 Fall Applicant, Matriculant, And Enrollment Date Tables A. o. A. M. Colleges*. [https://www.prod.cms.aamc.org/system/files/2019-12/2019%20AAMC%20Fall%20Applicant%2C%20Matriculant%2C%20and%20Enrollment%20Data%20Tables\\_0.pdf](https://www.prod.cms.aamc.org/system/files/2019-12/2019%20AAMC%20Fall%20Applicant%2C%20Matriculant%2C%20and%20Enrollment%20Data%20Tables_0.pdf)
- Jagsi, R., Griffith, K. A., Jones, R., Perumalswami, C. R., Ubel, P., & Stewart, A. (2016, May 17). Sexual Harassment and Discrimination Experiences of Academic Medical Faculty. *JAMA*, 315(19), 2120-2121. <https://doi.org/10.1001/jama.2016.2188>
- Jena, A. B., Khullar, D., Ho, O., Olenski, A. R., & Blumenthal, D. M. (2015, Sep 15). Sex Differences in Academic Rank in US Medical Schools in 2014. *JAMA*, 314(11), 1149-1158. <https://doi.org/10.1001/jama.2015.10680>
- Jena, A. B., Olenski, A. R., & Blumenthal, D. M. (2016, Sep 1). Sex Differences in Physician Salary in US Public Medical Schools. *JAMA Intern Med*, 176(9), 1294-1304. <https://doi.org/10.1001/jamainternmed.2016.3284>
- Jolly, S., Griffith, K. A., DeCastro, R., Stewart, A., Ubel, P., & Jagsi, R. (2014, Mar 4). Gender differences in time spent on parenting and domestic responsibilities by high-achieving young physician-researchers. *Ann Intern Med*, 160(5), 344-353. <https://doi.org/10.7326/M13-0974>

- Kaminski, D., & Geisler, C. (2012, Feb 17). Survival analysis of faculty retention in science and engineering by gender. *Science*, 335(6070), 864-866. <https://doi.org/10.1126/science.1214844>
- Laver, K. E., Prichard, I. J., Cations, M., Osenk, I., Govin, K., & Coveney, J. D. (2018, Mar 22). A systematic review of interventions to support the careers of women in academic medicine and other disciplines. *BMJ Open*, 8(3), e020380. <https://doi.org/10.1136/bmjopen-2017-020380>
- Long, T. R., Elliott, B. A., Warner, M. E., Brown, M. J., & Rose, S. H. (2011, Dec). Resident and program director gender distribution by specialty. *J Womens Health (Larchmt)*, 20(12), 1867-1870. <https://doi.org/10.1089/jwh.2011.2906>
- Nonnemaker, L. (2000, Feb 10). Women physicians in academic medicine: new insights from cohort studies. *N Engl J Med*, 342(6), 399-405. <https://doi.org/10.1056/NEJM200002103420606>
- Nora, L. M., McLaughlin, M. A., Fosson, S. E., Stratton, T. D., Murphy-Spencer, A., Fincher, R. M., German, D. C., Seiden, D., & Witzke, D. B. (2002, Dec). Gender discrimination and sexual harassment in medical education: perspectives gained by a 14-school study. *Acad Med*, 77(12 Pt 1), 1226-1234. <https://www.ncbi.nlm.nih.gov/pubmed/12480632>
- Pololi, L. H., Civian, J. T., Brennan, R. T., Dottolo, A. L., & Krupat, E. (2013, Feb). Experiencing the culture of academic medicine: gender matters, a national study. *J Gen Intern Med*, 28(2), 201-207. <https://doi.org/10.1007/s11606-012-2207-1>
- Richter, K. P., Clark, L., Wick, J. A., Cruvinel, E., Durham, D., Shaw, P., Shih, G. H., Befort, C. A., & Simari, R. D. (2020, Nov 26). Women Physicians and Promotion in Academic Medicine. *N Engl J Med*, 383(22), 2148-2157. <https://doi.org/10.1056/NEJMsa1916935>
- Williams, W. M., & Ceci, S. J. (2015, Apr 28). National hiring experiments reveal 2:1 faculty preference for women on STEM tenure track. *Proc Natl Acad Sci U S A*, 112(17), 5360-5365. <https://doi.org/10.1073/pnas.1418878112>

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