

Increasing Promotion of Women Faculty in Academic Medicine: Impact of National Career Development Programs

Shine Chang, PhD,¹ Michele Guindani, PhD,² Page Morahan, PhD,³⁻⁵ Diane Magrane, MD,⁶
Sharon Newbill, PhD,⁷ and Deborah Helitzer, ScD⁸

Abstract

Background: Three national career development programs (CDPs)—Early and Mid-Career Programs sponsored by the Association of American Medical Colleges and the Hedwig van Ameringen Executive Leadership in Academic Medicine sponsored by Drexel University—seek to expand gender diversity in faculty and institutional leadership of academic medical centers. Over 20 years of success and continued need are evident in the sustained interest and investment of individuals and institutions. However, their impact on promotion in academic rank remains unknown. The purpose of the study is to compare promotion rates of women CDP participants and other faculty of similar institutional environment and initial career stage.

Methods: The study examined retrospective cohorts of 2,719 CDP participants, 12,865 nonparticipant women, and 26,810 men, from the same institutions, with the same degrees, and first years of appointment in rank. Rates of promotion to Associate and Full Professor ranks in respective cohorts of Assistant and of Associate Professors were compared using Kaplan-Meier survival curves and log-rank tests, and logistic regression adjusting for other predictors of academic success.

Results: In adjusted analyses, participants were more likely than men and non-participant women to be promoted to Associate Professor and as likely as men and more likely than non-participant women to be promoted to Full Professor within 10 years. Within 5 years, CDP participants were more likely than nonparticipant women to be promoted to Associate Professor and as likely as to be promoted to Full Professor; in the same interval, participants were promoted to both higher ranks at the same rates as men. For both intervals, nonparticipant women were significantly less likely than men to be promoted to either rank.

Conclusions: The higher rates of promotion for women participating in national CDPs support the effectiveness of these programs in building capacity for academic medicine.

Keywords: career, promotion, gender, development

¹Division of Cancer Prevention and Population Sciences, Department of Epidemiology, Cancer Prevention Research Training Program, The University of Texas MD Anderson Cancer Center, Houston, Texas, USA.

²Department of Statistics, University of California, Irvine, Irvine, California, USA.

³Academic Medicine (ELAM) Program for Women, Philadelphia, Pennsylvania, USA.

⁴Foundation for Advancement of International Medical Education and Research (FAIMER) Institutes, Philadelphia, Pennsylvania, USA.

⁵Microbiology and immunology at Drexel, Drexel University College of Medicine, Philadelphia, Pennsylvania, USA.

⁶Academic Medicine Program, Obstetrics and Gynecology, Drexel University College of Medicine, Philadelphia, Pennsylvania, USA.

⁷Folkstone: Evaluation Anthropology, Pensacola, Florida, USA.

⁸College of Health Solutions, Arizona State University, Phoenix, Arizona, USA.

Preliminary findings were presented as a poster at the 22nd Annual Congress Academy of Women's Health in April 4, 2014, in Washington, DC.

Introduction

DESPITE OVER FOUR decades of gains for women's participation in academic medicine as medical and graduate students, advances in the number and proportion of women among faculty ranks continue to lag.¹ This is especially true among higher academic ranks, both tenured and nontenured, and in leadership roles at academic health centers.²⁻⁶ Evidence indicates that the pipeline theory—passively waiting for women's critical mass within lower faculty ranks to produce gender diversity at higher levels in academic medicine—is insufficient to support achievement of equity.²⁻⁵ Moreover, common strategies that focus solely on individual women's skill building and work schedules cast implicit blame for gender disparities on women, releasing academic health centers from their contribution to systemic institutional gender bias.^{2,6,7}

Promotion in academic rank recognizes scholarship, establishes credibility in the field, and in turn, offers greater opportunity for selection into leadership roles. Multiple intrinsic and extrinsic factors influence the career progression and success of women faculty in academic medicine.⁷ Several studies have documented disadvantage inherent in the academic promotions process for women,⁸ including the "child care tax."⁹ Women have described greater difficulty than men in getting access to mentors and champions, resources, and support,^{10,11} which influences how well prepared individuals are for promotion review.

As these factors operate at the intersection of professional and personal values and organizational priorities,⁷ interventions designed to address gender disparities must target multiple aspects of the academic advancement process. System interventions must identify and remediate policies, processes, and practices that exert bias, unintended or not, within and among institutions.¹² Interventions for individuals must help to develop the professional capacity needed for career advancement as well as to prepare them to engage successfully within systems and institutions in which such biases and practices that impede career advancement for women persist.^{7,13-15}

This study explores the experience of promotion in academic rank of individuals participating in three national career development programs (CDPs) designed for women faculty. For nearly three decades, since 1988, the Association of American Medical Colleges (AAMC) has sponsored the 4-day Early and Mid-Career Women Faculty Professional Development programs [EWIM and MWIM, respectively^{16,17}] for faculty to increase their individual professional effectiveness in academic medicine. Special topics and facilitators have changed over time, but core programming has maintained a focus on understanding how to advance within academic medical systems. Early career programs focus more on career development (promotion systems and scholarship); mid-career programs build on that knowledge and add leadership topics (early management and leadership skills).¹⁸ Since 1995, Drexel University College of Medicine has sponsored the yearlong Hedwig van Ameringen Executive Leadership in Academic Medicine [ELAM^{®19,20}] program for increasing both leadership capacity and the number of women faculty prepared for executive leadership; the program thus encompasses both leadership development and strategic career planning.

Although the programs vary in intensity and duration, they share overall program goals to advance academic women's careers. The three programs are limited to women for enrollment, but the programs are not about being women; the skills are those recommended for any leaders, men, women, or other minorities, as important for leaders.²¹ However, women-only professional development programs enable safe environments to address gender bias issues that are always present, even if not the core of the programs.²²⁻²⁴

This study analyzes data collected by the AAMC to track faculty appointments from accredited U.S. medical schools²⁵ to compare promotion rates of CDP participants, non-CDP participating women, and men faculty similar in their initial career stage, type of degree, tenure-eligibility status, and working in the same home institution. We hypothesized that the CDP participants have both a higher likelihood of promotion in general to both Associate and Full Professor ranks than their comparison groups and higher promotion at 5 and 10 years since initial appointment.

Methods

Population sample and analytic procedures

Using attendance lists of de-identified data from the AAMC and ELAM programs held between May 1, 1988, and December 31, 2008, AAMC staff linked CDP faculty participants to their faculty records in the AAMC Faculty Roster database²⁵ and identified 4,575 individuals for analysis. Each individual and institution were assigned a unique ID number and data used by the study team were linked using only their ID numbers. We excluded those without a faculty appointment at an institution accredited by the Liaison Committee on Medical Education (LCME) at the time of CDP participation ($n=1,122$), men ($n=18$), individuals for whom sex was not reported ($n=4$), and those with unknown rank, primary appointment, faculty appointment dates, or degree ($n=38$). From this group of 3,393 individual CDP faculty participants, we excluded those who participated in CDPs as Instructor ($n=125$), because their numbers were small, and Full Professor ($n=466$), as our focus was on promotions to Associate and Full Professor ranks. We also excluded those who were part time at the time of CDP participation ($n=33$) and those who had held a higher rank before a lower academic rank ($n=50$). Data from the resulting group of 2,719 women (1729 Assistant Professors and 990 Associate Professors) faculty who participated in at least one CDP were available for analysis.

Identification of CDP participants and comparison women and men faculty

For comparison with CDP participants, we identified two faculty groups from the de-identified Faculty Roster database (MTA#21272 for data made available from AAMC to The University of Texas MD Anderson Cancer Center): women who did not participate in any of the CDP programs of interest (non-CDP) and men. To create groups as similar as possible to CDP participants in career stage and shared organizational environment at the same institution, we identified non-CDP women and men faculty from the same home institution (assigned a unique institutional ID), with the same degree type or its equivalent (*i.e.*, MD, PhD, or MD/PhD) and appointed in the same year at the same academic rank (*i.e.*,

Assistant or Associate Professor) as those held by the CDP participant when she participated in the CDP (CDP index rank), including all peer comparisons identified. As the focus was to create groups similar in career attributes using data available in the Faculty Roster database, neither race, ethnicity, nor age range was considered in forming the comparison groups. For comparison with Assistant Professor CDP participants, we identified 19,594 men and 10,735 non-CDP women faculty, and for comparison with Associate Professor CDP participants, we identified 7,216 men and 2,130 non-CDP women faculty.

Evaluation of promotion in academic rank

We conducted separate analyses within Assistant and Associate Professor groups, and defined “promotion to the next higher academic rank” as promotion from Assistant to Associate Professor rank and as promotion from Associate to Full Professor rank, with all other outcomes coded as “not promoted” (e.g., death, departure from academic medicine). We assessed multiple dimensions of the possible relevance of CDP participation. We first considered overall likelihood of promotion to the next higher rank (i.e., ever vs. never). Then, we assessed successful promotion within defined time intervals of 5 and 10 years among those for whom relevant years of follow-up were available. We identified promotion to the next rank within 10 years of the initial appointment in the lower academic rank to account for variations in institutional policies regarding intervals for faculty promotions. We assessed promotion within 5 years to evaluate the more immediate association between CDP participation and career success early after the CDP experience. Because the national variability in the length of the promotion process makes impossible the accurate identification and exclusion of individuals whose CDP participation was so close to the time of promotion as not likely to have had critical influence, we included all participants in the analysis without regard to time since CDP, whether recent or not (see Discussion).

Statistical analyses of promotion in academic rank

For evaluating the association between CDP participation and promotion in academic rank, we first conducted time-to-promotion analysis comparing Kaplan-Meier survival curves for CDP participants and matched comparison women and men,²⁶ assessing significance of difference between groups using log-rank tests. As a nonparametric method, the Kaplan-Meier approach does not accommodate possible confounding factors and instead, directly depicts events (i.e., promotions) for each group in separate curves that are easy to distinguish visually. Time to promotion was measured from the year of first appointment in rank to the year of promotion to the next higher rank or the last date of follow-up, either for the study (December 31, 2008) or date of last departure from academic medicine positions. Unless otherwise indicated, for three group comparisons, the significance threshold was adjusted using the Bonferroni correction that increases the threshold for determining statistical significance when larger numbers of comparisons are conducted during analysis, thus improving rigor of the method; the correction for these analyses yielded an adjusted significance threshold of $\alpha=0.0167$.

Given that time-in-rank expectations before promotion to Associate Professor at most schools constrain time-to-event

intervals, and thus, violate the requirement for independence of events (e.g., promotion in rank) for parametric time-to-event methods (e.g., Cox proportional hazards modeling), the second analytic method used was logistic regression with adjustment for confounding factors in estimating the odds of being promoted in rank.²⁷ For each cohort, we assessed the odds of ever being promoted to a higher academic rank during one’s career, and for promotion within 10 and 5 years of initial appointment in the lower rank. Analyses for each cohort were adjusted for the covariate variables listed above, such as department type, tenure-track status, and change of institution. For the 300 women in this group who participated in two ($n=271$) or all three ($n=29$) CDP programs, we assessed the impact on promotion from the academic rank held only at the first CDP they attended; the effect of subsequent program participation was indicated as participation in more than one CDP ($CDP>1$) and is included using a Kaplan-Meier curve separate from that for participants attending only one CDP.

Description of available covariates

In addition to the factors used to identify comparison groups of faculty, the analysis took into account factors that are known to influence the likelihood of promotion in academic rank. Specifically, we adjusted for tenure-track status (i.e., on the tenure track, tenured, nontenure track, and tenure track not institutionally available), change in institution (i.e., having more than one institutional affiliation during appointment in lower rank), and also department type (i.e., clinical vs. basic science).

Results

Of 2,719 women faculty who participated in CDPs, 1,729 (64%) were Assistant Professors and 990 (36%) were

TABLE 1. DEGREES OF CDP PARTICIPANTS AND NON-CDP PEER COMPARISONS BY RANK AND GENDER

	n (%)		
	Non-CDP faculty		
	CDP faculty n = 2,719	Women n = 12,865	Men n = 26,810
	Assistant professors		
	n = 1,729	n = 10,735	n = 19,594
Degree			
MD	1,417 (82)	9,646 (90)	17,839 (91)
PhD	212 (12)	967 (9)	1,320 (7)
MD/PHD	100 (6)	122 (1)	435 (2)
	Associate professors		
	n = 990	n = 2,130	n = 7,216
Degree			
MD	767 (77)	1,828 (86)	6,452 (89)
PhD	167 (17)	268 (13)	616 (9)
MD/PHD	56 (6)	34 (2)	148 (2)

CDP, career development program.

Associate Professors (Table 1). These individuals participated 238 times in the ELAM program and 2,811 times in the AAMC programs; in total, while the 300 (11%) individuals who attended more than one CDP—the majority of whom participated in 2 CDPs (90%, $n=271$)—experienced significantly earlier promotion only to Associate Professor rank than comparison groups (Fig. 1a and 1b), the remaining analyses presented in this report focus on CDP participation, not number of experiences, using attendance at the first CDP as the index experience. In both academic rank cohorts, the proportions of individuals holding PhD and MD/PhD degrees were higher among CDP participants ($n=100$, 6%) than among comparison women ($n=122$, 1%) and men ($n=435$, 2%). Median follow-up was 6 years for all Assistant Professors and 7 years for all Associate Professors included in these analyses.

CDP participation and successful promotion in rank

Figures 1a and b illustrate the results of the time-to-promotion analysis using Kaplan-Meier curve estimates and log-rank tests, without adjusting for covariate variables. The figures show that Assistant Professor CDP participants had significantly higher rates of promotion to Associate Professor than non-CDP participant women ($p<0.0001$) and comparison men ($p<0.0001$). Similar advantage was observed for Associate Professors CDP participants' promotion to Full Professor versus non-CDP participant women ($p<.0001$). Associate Professor CDP participants were promoted to Full Professor at a rate equal to that of the Associate Professor men (*i.e.*, rates not statistically significantly different after adjusting for multiple comparisons, ($p_{unadjusted}=0.0299$ and $p_{Bonferroni\ adjusted}=0.0897$ [based on $\alpha=0.0167$]). Non-CDP women faculty had significantly lower rates than comparison men for promotion both to Associate and to Full Professor ranks ($p<0.0001$, both).

Subsequent logistic regression analysis, after making adjustments for covariates also related to promotion (*i.e.*, department type, tenure status, and change of institution), estimated the likelihood of ever being promoted in one's career to the next academic rank related to participation in CDPs (Table 2). Compared with non-CDP women faculty, Assistant Professor CDP participants were three times more likely to be promoted to Associate Professors (odds ratio [OR]=3.25, 95% confidence interval [CI]=2.91–3.63), and Associate Professor CDP participants were more than twice as likely to be promoted to Full Professors (OR=2.31, 95% CI=1.96–2.73). Compared with men, Assistant Professor CDP participants were nearly twice as likely to be promoted to Associate Professors (OR=1.92, 95% CI=1.73–2.14), while Associate Professor CDP participants were more than a third more likely to be promoted to Full Professors (OR=1.37, 95% CI=1.19–1.58). Non-CDP women faculty were less likely to be promoted to higher ranks than men, regardless of academic rank and significantly so (OR_{Assistant Professors}=0.60, 95% CI=0.57–0.63; OR_{Associate Professors}=0.60, 95% CI=0.54–0.67).

Promotion in academic rank within 10 and 5 years

Logistic regression adjusting for covariates further revealed that CDP participation was significantly associated with higher promotion within 10 years at Assistant Professor

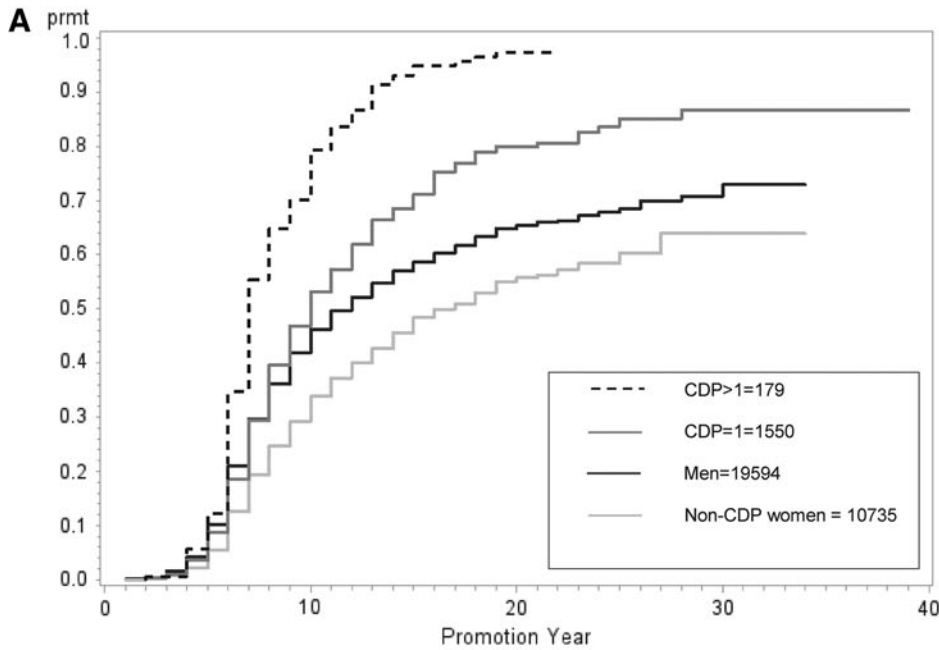
ranks in comparison to men and at both Assistant and Associate Professor ranks in comparison to non-CDP women faculty (Table 3). For promotion from Associate Professor ranks within 10 years, CDP participants had similar promotion rates as men. At 10 years, in comparison with non-CDP women, CDP Assistant Professor participants were more than two and a half times as likely to be promoted to Associate Professors (OR=2.84, 95% CI=2.53–3.19), and CDP Associate Professors more than 80% as likely to be promoted to Full Professors (OR=1.82, 95% CI=1.53–2.17). In comparison with men, Assistant and Associate CDP women faculty were, respectively, 60% more likely to have advanced to Associate Professor (OR=1.60, 95% CI=1.44–1.78) and similar in their likelihood to have advanced to Full Professor ranks (OR=1.15, 95% CI=0.99–1.33). Non-CDP women faculty were significantly less likely than men faculty to be promoted after 10 years in rank from Assistant to Associate Professor (OR=0.57, 95% CI=0.54–0.61) and from Associate to Full Professor (OR=0.64, 95% CI=0.57–0.72).

After adjustment for covariates, those with CDP experience had almost twice the likelihood of non-CDP women for promotion within 5 years to Associate Professor ranks (OR=1.90, 95% CI=1.53–2.33, Table 4), but not significantly so for promotion to Full Professor ranks (OR=1.13, 95% CI=0.84–1.51). The 5-year promotion rates to Associate and Full Professor for CDP participants were similar to those of men, after adjustment for covariates (OR_{Assistant Professors}=0.92, 95% CI=0.76–1.11; OR_{Associate Professors}=0.83, 95% CI=0.65–1.06). Five-year rates for non-CDP women were significantly lower relative to those for men, in promotion to both Associate and Full Professor ranks (OR_{Assistant Professors}=0.51, 95% CI=0.45–0.56; OR_{Associate Professors}=0.74, 95% CI=0.61–0.89).

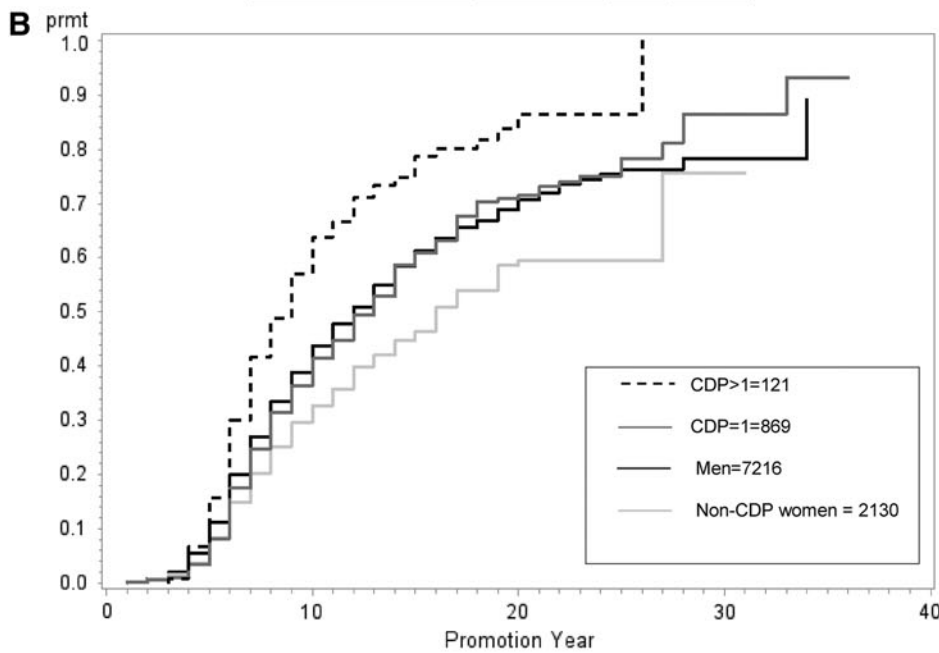
Discussion

This analysis of national data from faculty at academic health centers across the United States showed a strong association with promotion in rank for women Assistant and Associate Professors who attended AAMC Women in Medicine programs and the ELAM CDPs, more than for other faculty starting at similar career stages at the same schools and on similar promotional tracks. The magnitude of the differences, measured across various statistical approaches that included adjustments for other factors that influence promotion locally, point to a real impact of the programs on this important academic advancement process.

First, the magnitude is large—a nearly twofold advantage for promotion from Assistant to Associate Professor compared to men and more than threefold compared to women who did not attend a CDP, but were similar in other ways. The advantage is also evident for Associate to Full Professor promotion with 37% advantage achieved for CDP participants compared to men and almost two-and-a-half fold advantage compared to non-CDP women. Second, this significant promotion advantage to CDP participation emerged from study design intentionally constructed to promote for CDP participant similarity in career characteristics with comparison groups at their initial appointments in rank, except for their CDP participation (and gender), with cohort inclusion based on CDP participants' home institution, the same academic rank and year of appointment in that



	Chi-Square	DF	P-value
Test of Equality over Strata			
Overall	528.7874	3	<0.0001
Adjustment for Multiple Comparisons for the Logrank Test			
CDP>1 vs. CDP=1	10.6288	1	0.0067
CDP>1 vs. Men	102.5	1	<0.0001
CDP>1 vs. Non-CDP Women	427.9	1	<0.0001
CDP=1 vs. Men	52.4176	1	<0.0001
CDP=1 vs. Non-CDP Women	376.0	1	<0.0001
Men vs. Non-CDP Women	262.4	1	<0.0001



	Chi-Square	DF	B adjusted P-value
Test of Equality over Strata			
Overall	88.7450	3	<0.0001
Adjustment for Multiple Comparisons for the Logrank Test			
CDP>1 vs. CDP=1	2.2691	1	0.7918
CDP>1 vs. Men	14.4129	1	0.0009
CDP>1 vs. Non-CDP Women	82.4993	1	<0.0001
CDP=1 vs. Men	12.7909	1	0.0021
CDP=1 vs. Non-CDP Women	38.8372	1	<0.0001
Men vs. Non-CDP Women	50.4469	1	<0.0001

FIG. 1. (a) Promotion curves of Assistant Professors to Associate Professor rank by group [participants attending >1 CDP, participants attending one CDP, men, and non-CDP women]. **(b)** Promotion curves of Associate Professors to Full Professor rank by group [participants attending >1 CDP, participants attending one CDP, men, and non-CDP women]. CDP, career development program.

TABLE 2. ADJUSTED ODDS RATIO AND 95% CONFIDENCE INTERVALS^a ESTIMATING LIKELIHOOD OF PROMOTION IN RANK FOR CDP PARTICIPANTS RELATIVE TO MEN AND NON-CDP WOMEN COMPARISON GROUPS, AND FOR NON-CDP WOMEN RELATIVE TO MEN, ADJUSTED FOR TYPE OF DEPARTMENT, TENURE STATUS, AND TRANSFERRING TO A NEW MEDICAL SCHOOL

Variable	Assistant to associate professor			Associate to full professor		
	CDP vs. Men	CDP vs. non-women	Non-CDP women vs. men	CDP vs. men	CDP vs. non-women	Non-CDP women vs. men
Promotion in rank	1.92 (1.73–2.14)	3.25 (2.91–3.63)	0.60 (0.57–0.63)	1.37 (1.19–1.58)	2.31 (1.96–2.73)	0.60 (0.54–0.67)
Basic vs. clinical science ^b	1.07 (0.93–1.24)	1.42 (1.18–1.71)	1.18 (1.04–1.33)	0.81 (0.68–0.97)	1.11 (0.84–1.46)	0.95 (0.80–1.13)
Tenure not available vs. tenure track ^b	0.55 (0.48–0.62)	0.64 (0.53–0.78)	0.59 (0.52–0.65)	0.96 (0.79–1.17)	0.72 (0.49–1.04)	0.92 (0.76–1.12)
Nontenure vs. tenure track ^b	0.45 (0.42–0.48)	0.59 (0.54–0.65)	0.48 (0.45–0.51)	0.47 (0.43–0.52)	0.50 (0.42–0.59)	0.47 (0.43–0.52)
One institution vs. multiple ^b	1.33 (1.19–1.48)	1.26 (1.08–1.46)	1.33 (1.21–1.47)	1.49 (1.23–1.81)	1.78 (1.32–2.44)	1.52 (1.26–1.85)

^aA 95% CI for the adjusted OR that does not overlap the null value (OR = 1) is assumed to indicate statistical significance.

^bReference group.

CI, confidence interval; OR, odds ratio.

TABLE 3. ADJUSTED ODDS RATIOS AND 95% CONFIDENCE INTERVALS^a ESTIMATING LIKELIHOOD OF PROMOTION WITHIN 10 YEARS FOR CDP PARTICIPANTS RELATIVE TO MEN AND NON-CDP WOMEN COMPARISON GROUPS, AND FOR NON-CDP WOMEN RELATIVE TO MEN, ADJUSTED FOR TYPE OF DEPARTMENT, TENURE STATUS, AND TRANSFERRING TO A NEW MEDICAL SCHOOL

Variable	Assistant to associate professor			Associate to full professor		
	CDP vs. men	CDP vs. non-women	Non-CDP women vs. men	CDP vs. men	CDP vs. non-women	Non-CDP women vs. men
Promotion within 10 years	1.60 (1.44–1.78)	2.84 (2.53–3.19)	0.57 (0.54–0.61)	1.15 (0.99–1.33)	1.82 (1.53–2.17)	0.64 (0.57–0.72)
Basic vs. clinical science ^b	1.17 (1.00–1.35)	1.48 (1.22–1.78)	1.26 (1.10–1.43)	0.73 (0.60–0.88)	0.97 (0.72–1.29)	0.88 (0.73–1.05)
Tenure not available vs. tenure track ^b	0.48 (0.42–0.55)	0.59 (0.48–0.72)	0.51 (0.45–0.57)	1.09 (0.89–1.33)	0.87 (0.58–1.27)	1.00 (0.82–1.22)
Nontenure vs. tenure track ^b	0.45 (0.42–0.48)	0.58 (0.53–0.64)	0.47 (0.44–0.50)	0.49 (0.45–0.55)	0.57 (0.48–0.68)	0.50 (0.45–0.55)
One institution vs. multiple ^b	2.02 (1.79–2.29)	2.06 (1.73–2.46)	1.91 (1.71–2.14)	2.37 (1.89–3.02)	2.72 (1.88–4.06)	2.28 (1.81–2.90)

^aA 95% CI for the adjusted OR that does not overlap the null value (OR = 1) is assumed to indicate statistical significance.

^bReference group.

TABLE 4. ADJUSTED ODDS RATIOS AND 95% CONFIDENCE INTERVALS^a ESTIMATING LIKELIHOOD OF PROMOTION WITHIN 5 YEARS FOR CDP PARTICIPANTS RELATIVE TO MEN AND NON-CDP WOMEN COMPARISON GROUPS, AND FOR NON-CDP WOMEN RELATIVE TO MEN, ADJUSTED FOR TYPE OF DEPARTMENT, TENURE STATUS, AND TRANSFERRING TO A NEW MEDICAL SCHOOL

Variable	Adjusted ORs (95% CIs)					
	Assistant to associate professor			Associate to full professor		
	CDP vs. men	CDP vs. non-women	Non-CDP women vs. men	CDP vs. men	CDP vs. non-women	Non-CDP women vs. men
Promotion within 5 years.	0.92 (0.76-1.11)	1.90 (1.53-2.33)	0.51 (0.45-0.56)	0.83 (0.65-1.06)	1.13 (0.84-1.51)	0.74 (0.61-0.89)
Basic vs. clinical science ^b	1.14 (0.90-1.42)	1.48 (1.05-2.03)	1.17 (0.95-1.44)	0.89 (0.66-1.19)	1.06 (0.66-1.66)	1.15 (0.87-1.48)
Tenure not available vs. tenure track ^b	0.68 (0.55-0.83)	0.73 (0.48-1.06)	0.70 (0.57-0.84)	1.60 (1.22-2.07)	1.41 (0.79-2.39)	1.46 (1.11-1.90)
Non-tenure vs. tenure track ^b	0.48 (0.43-0.54)	0.67 (0.56-0.81)	0.50 (0.46-0.55)	0.55 (0.47-0.65)	0.60 (0.44-0.80)	0.57 (0.49-0.66)
One institution vs. multiple ^b	4.04 (3.03-5.54)	4.91 (3.00-8.80)	3.92 (2.99-5.27)	5.14 (2.96-10.00)	5.45 (2.28-71.79)	6.35 (3.48-13.33)

^aA 95% CI for the adjusted OR that does not overlap the null value (OR = 1) is assumed to indicate statistical significance.

^bReference group.

rank, and type of degree. Third, the reported associations resulting from two methods of statistical analysis conducted (*i.e.*, Kaplan-Meier and logistic regression analysis) were both statistically significant, including one that adjusted for other factors that also likely influence promotion in rank, including type of department, tenure status, and change of institution. Thus, evidence for a potent impact associated with CDP attendance was provided in multiple ways.

These findings suggest that selection and participation of women faculty in national professional development programs can contribute to narrowing the gender gap in promotion rates for medical school faculty. Consistent with previous research showing diminished rates and delayed promotion among newly appointed faculty and women leaders, when compared with their men counterparts,^{28,29} the comparison group of non-CDP women faculty in this study notably lagged in promotion behind the comparison group of men, statistically significantly so. The analysis of early promotion rates (*i.e.*, 5 years from prior appointment) identifies the population of CDP participants as being on par with comparable men and already moving ahead of the non-CDP women initially at comparable career stage in academic promotion; the 10-year comparisons show even greater advantage.

Faculty who are nominated and selected for these programs represent a pool of women who have been recognized for their academic success and leadership talents. Comparing this select pool of women who are already on the path to academic success with a mixed pool of peers who were not supported for the programs lends results open to interpretation that the pools are too dissimilar for comparison. However, early promotion analyses suggest only equivalent performance between CDP women and their male counterparts, not superior. Thus, it is unlikely that selection alone would account for the early success of CDP participants over the comparison groups. These findings support the report that visibility and sponsorship afforded by nomination and selection to prestigious programs, the capacity building, and the motivation by a CDP community of like-minded scholars and clinicians have a positive effect on success at home institutions.¹⁴ In addition, networking, problem-solving skills, exposure to critical career information and to knowledge about academic medicine, and access to other career resources gained from CDP participation may help individuals counter the effects of gender bias in their work environments that inhibit publication rates, senior author attribution, federal grant success, and other factors that build academic credibility.³⁰⁻³²

The results of this large national association research study suggest strong positive impact of formal CDPs in academic advancement for women faculty, adding to previous descriptive studies and theoretical models of gendered experiences.^{7,14,33} Analysis of outcomes and experiences of ELAM graduates showed the importance of curriculum features such as developing a community of practice, learning how to increase one's visibility among leaders, development of self-efficacy as leaders, and strategic career planning.¹³⁻¹⁵ Responses to surveys and interviews of CDP participants in the same national programs revealed the importance of career stage-relevant curriculum, namely early career preparation for promotion, mid-career capacity building in negotiation and interpersonal effectiveness, and senior career expansion

of knowledge in finance.¹⁸ Although linking these experiences causally to their influence on academic promotion is not possible in this analysis, they are consistent with principles of individual influences that contribute to advancing women's careers.³⁴

A strength of this project is its retrospective cohort study design. Available data allowed an estimate of the impact of CDP participation on promotion in rank without random assignment to CDP participation, which is neither a feasible nor ethical research study design to evaluate the influence of CDPs on academic promotion. The comparability of the CDP participants, from three programs with shared common core focus and generally similar approaches, although over different durations, with the comparison groups in their career profiles was enhanced by selecting comparisons appointed in the same academic rank and degree in the same year of appointment. Another strength is the inclusion of the three comparison groups by home institution, which meant exposure to the same promotion criteria and policies. A limitation is that many women who participated in these national CDPs were selected by their sponsoring institutions, using similar, but not identical criteria, as well as by CDP organizers, and thus, may differ from others in their pursuit of, interest in, and visibility for training and leadership opportunities; this may contribute to and explain, in part, the greater likelihood of promotion we observed for CDP participants. However, in a previous prospective cohort study in which women who applied to the ELAM CDP and were not accepted served as a comparison group, the results showed that this group of women, who were interested in leadership and did not attend ELAM, had less gain in knowledge of leadership concepts than did ELAM participants,³² indicating an intervention effect and not a selection bias. In this study, 11% of CDP participants had more than one CDP experience, with a dose effect possibly strengthening the association with promotion, but information about the career or professional development training that non-CDP women and men comparison faculty may have received was not available, and thus, could not be used to adjust for their impact on promotion rates. However, if such training helped individuals from the comparison groups get promoted in rank, the resulting differences between promotion rates of CDP participants and their comparison groups would have likely been smaller. Another concern is possible inflation of findings from including potentially large numbers of women promoted shortly after attending CDPs. Neither the length of time from CDP participation to submission of promotion applications nor the length of promotion processes at individual institutions was available to permit such calculations. However, in our sample, less than 5% of CDP participants attended CDPs within 6 months of promotion to either rank ($n = 24$, 3.2% of Assistant Professors, $n = 19$, 4.8% of Associate Professors), and the effect of this proximity of participation to promotion is likely to be minimal.

The hypothesis upon which this study was based is derived from models of academic advancement⁶ and leadership as a continuum of professional development,^{7,35} in which each faculty member's potential for contribution to the organization is influenced by the institutional culture and practices and guided by individual choices within the context of personal and professional challenges and opportunities. Participation in professional development programs is hy-

pothesized to help mitigate observed gender disparities in academic advancement, which are often attributed to gender-related social and cultural challenges in two realms—institutional environment and individual experience.³⁶ The strong associations between academic career advancement and participation in career programs for women faculty found in this study add to those of a previous study of the same comparison groups that shows evidence for higher rates of retention in academic medicine for such program participants.³⁷ Together, they suggest an important potential approach for a powerful capacity building effort for the academic health science workforce, contributing diversity in research, teaching, clinical service, and leadership.

Conclusion

In comparisons with men and with women faculty selected with similar degrees, the same academic rank and initial year of appointment in that rank, and from the same home institutions, participants in three national CDPs for women faculty were significantly more likely to be promoted in academic rank within 10 years from Assistant to Associate Professor and with equal advantage to men from Associate to Full Professor. For promotion within 5 years, program participants were as likely as men to be promoted to either rank and more likely than non-CDP participant women at the Assistant Professor rank to do so. Women who did not participate in the CDPs were significantly less likely to be promoted than men to either rank within 5 and 10 years. These findings suggest an important role for such national CDPs to address gender disparities in academic medicine as a method to level the playing field for career advancement and thereby increase the diversity in the leadership pool for academic health centers.

Acknowledgments

The authors would like to thank Drs. Kevin Grigsby, Hershel Alexander, and Ms. Diana Lautenberger of the Association of American Medical Colleges for their interest and support. We would also like to thank the individuals who served on our project's Advisory Committee: Drs. Jasit Ahluwalia, Carol Aschenbrener, Lorris Betz, Molly Carnes, Carmen R. Green, Sharon McDade, Lois Nora, and Diane Wara. We would also like to thank Drs. Ho-lan "Glenn" Peng and Hwa Young Lee for their statistical analytic support for this project and Gina Cardinali, Erin Dahlstrom, and Yen-Nhi H. Pham for their contributions to this project.

Ethical Approval

The study protocol was approved by the Institutional Review Board of University of Texas MD Anderson Cancer Center (DR09-0396, 2/26/2010) and the Human Research Review Committee of University of New Mexico (09-556, 12/16/2009), which served as IRB of record for Drexel University College of Medicine (IRB 00000696, FWA 00005917).

Author Disclosure Statement

No competing financial interests exist.

Funding Information

This work was supported by grant funding from NICHD (R01 HD064655, “Achieving a Critical Mass of Women Biomedical Faculty: Impact of Three US Programs”) for RFA-GM-09-012 “Research on Causal Factors and Interventions that Promote and Support the Careers of Women in Biomedical and Behavioral Science and Engineering.” This work was also supported, in part, by the NIH/NCI under award number P30CA016672 and used the Biostatistics Resource Group (Guindani). The NIH provides funds for selected expenses for certain AAMC staff associated with the AAMC Faculty Roster under contract 75N94019C00007.

References

- Lautenberger DM, Dandar VM, Raezer CL, Sloane RA: The State of Women in Academic Medicine 2014. Available at: <https://www.aamc.org/data-reports/faculty-institutions/report/state-women-academic-medicine> Accessed May 15, 2020.
- Helitzer DN, Newbill SL, Cardinali G, et al. Changing the culture of academic medicine: Critical mass or critical actors? *J Womens Health* 2017;26:540–548.
- Bakker MM, Jacobs MH. Tenure track policy increases representation of women in senior academic positions, but is insufficient to achieve gender balance. *PLoS One* 2016; 11:e0163376.
- Thibault GE. Women in academic medicine. *Acad Med* 2016;91:1045–1046.
- Byington CL, Lee V. Addressing disparities in academic medicine: Moving forward. *JAMA* 2015;314:1139–1141.
- Morahan PN, Newbill SL, Magrane D, et al. Managing mission tensions in academic health centers. *Pharos Alpha Omega Alpha Honor Med Soc* 2016;79:8–13.
- Magrane D, Helitzer D, Morahan P, et al. Systems of career influences: A conceptual model for evaluating the professional development of women in academic medicine. *J Womens Health* 2012;21:1244–1251.
- Carr PL, Gunn CM, Kaplan SA, Raj A, Freund KM. Inadequate progress for women in academic medicine: Findings from the National Faculty Study. *J Womens Health* 2015;24:190–199.
- Mason MA, Wolfinger NH, Goulden M. Do babies matter? Gender and family in the ivory tower. New Brunswick, NJ and London, UK: Rutgers University Press, 2013.
- Ibarra H, Carter NM, Silva C. Why men still get more promotions than women. *Harv Bus Rev* 2010;88:80–85, 126.
- Patton EW, Griffith KA, Jones RD, et al. Differences in mentor-mentee sponsorship in male vs female recipients of National Institutes of Health Grants. *JAMA Intern Med* 2017;177:580–582.
- Burgess DJ, Joseph A, van Ryn M, Carnes M. Does stereotype threat affect women in academic medicine? *Acad Med* 2012;87:506–512.
- Morahan PS, Dannels SA, Yamagata H, et al. Evaluating a leadership program: A comparative, longitudinal study to assess the impact of the Executive Leadership in Academic Medicine (ELAM) Program for Women. *Acad Med* 2008; 83:488–495.
- Morahan PS, Kasperbauer D, McDade SA, et al. Training future leaders of academic medicine: Internal programs at three academic health centers. *Acad Med* 1998;73:1159–1168.
- Morahan PS, Gleason KA, Richman RC, Dannels SA, McDade SA. Advancing women faculty to senior leadership in US academic health centers: Fifteen years of history in the making. *NASPA J Women Higher Educ* 2010;3:140–165.
- Trujillo G, Tanner KD. Considering the role of affect in learning: Monitoring students’ self-efficacy, sense of belonging, and science identity. *CBE Life Sci Educ* 2014;13: 6–15.
- Tucker JD, Hughes MA, Durvasula RV, et al. Measuring success in global health training: Data from 14 years of a postdoctoral fellowship in infectious diseases and tropical medicine. *Clin Infect Dis* 2017;64:1768–1772.
- Helitzer D, Newbill S, Cardinali G, et al. Perceptions of skill development of participants in three national career development programs for women faculty in academic medicine. *Acad Med* 2014;89:896–903.
- The Hedwig van Ameringen Executive Leadership in Academic Medicine. Available at: <http://drexel.edu/medicine/academics/womens-health-and-leadership/elam/about-elam/> Accessed March 17, 2020.
- Magrane D, Morahan PS. Fortifying the pipeline to leadership: The international center for executive leadership in academics. In: Heller R, Mavriplis C, Sabila P, eds. *FORWARD to Professorship in STEM*. London, UK: Academic Press, 2015:319–336.
- Magrane D, Morahan P, Ambrose S, Dannels DA. Competencies and practices in academic engineering leadership development: Lessons from a national survey. *Soc Sci* 2018;7:1–13.
- Ohlott PJ, Hughes-James MW. Single-gender and single-race leadership development programs: Concerns and benefits. *Leadership Action* 1997;17:8–12.
- Litwin A. Women’s Leadership Development Programs: What is working well now? *CGO Insights, Briefing Note* Number 44, September, 2018.
- Madsen SR, Andrade MS. Unconscious gender bias: Implications for women’s leadership development. *J Leadership Stud* 2018;12:62–67.
- The Faculty Roster Home, 2020. Available at: <https://www.aamc.org/data-reports/faculty-institutions/faculty-roster> Accessed March 17, 2020.
- Kleinbaum DG. *Survival analysis: A self-learning text*. New York: Springer, 1996.
- Kleinbaum DG. *Logistic regression: A self-learning text*. New York: Springer, 1994.
- White FS, McDade S, Yamagata H, Morahan PS. Gender-related differences in the pathway to and characteristics of U.S. medical school deanships. *Acad Med* 2012;87:1015–1023.
- Liu CQ, Alexander H. Promotion rates for first assistant and associate professors appointed from 1967 to 1997. *Acad Med* 2010;9:1–2.
- Morahan P, Bickel J. Capitalizing on women’s intellectual capital in the professions. *Acad Med* 2002;77:110–112.
- Villablanca AC, Li Y, Beckett LA, Howell LP. Evaluating a medical school’s climate for women’s success: Outcomes for faculty recruitment, retention, and promotion. *J Womens Health* 2017;26:530–539.
- Dannels SA, Yamagata H, McDade SA, et al. Evaluating a leadership program: A comparative, longitudinal study to assess the impact of the Executive Leadership in Academic Medicine (ELAM) Program for Women. *Acad Med* 2008; 83:488–495.

33. Roskovensky LB, Grbic D, Matthew D. The changing gender composition of U.S. medical school applicants and matriculants. *Acad Med* 2012;12:1–2.
34. Ely EJ, Meyerson DE. *Theories of gender in organizations: A new approach to organizational analysis and change*. Boston, MA: Center for Gender in Organizations. Simmons School of Management, 2000.
35. Morahan PS, Rosen SE, Richman RC, Gleason KA. The leadership continuum: A framework for Organizational and Individual Assessment Relative to the Advancement of Women Physicians and Scientists. *J Womens Health* 2011;20:10.
36. Laursen SL, Austin AE, Soto M, Martinez D. ADVANCing the Agenda for Gender Equity. *Change* 2015;47:16–23.
37. Chang S, Morahan PS, Magrane D, et al. Retaining Faculty in Academic Medicine: The Impact of Career Development Programs for Women. *J Womens Health* 2016;25:687–696.

Address correspondence to:

Shine Chang, PhD

Division of Cancer Prevention and Population Sciences

Department of Epidemiology

Cancer Prevention Research Training Program

The University of Texas MD Anderson Cancer Center

PO Box 301439

Houston, TX 77230-1439

USA

E-mail: shinechang@mdanderson.org