Similarities and Differences in the Career Trajectories of Male and Female Career Development Award Recipients

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Abstract

Purpose
To examine the careers of career development award recipients.

Method
In 2009, a postal survey was conducted of 818 recipients of K08 and K23 awards in 2000–2001 to examine career paths and personal characteristics.

Results
Of 589 respondents (72% response rate), 211 (35.9%) were female. Women were less likely to have children ($P <$ .001) than men. The vast majority of respondents (89.6%) remained in academic medicine. Among those, over three-quarters continued to spend significant time on research. On univariate analysis, women were not significantly less likely to report promotion, leadership positions, or application for R01 grants. They were less likely to have received an R01 ($P =$ .006) and to perceive themselves as successful ($P =$ .002), and they published fewer papers ($P =$ .001). Overall, 118 women (55.9%) and 274 men (72.5%) met at least one of the following criteria for success: serving as principal investigator on an R01 or grants >$1,000,000 since K award receipt, publishing at least 35 publications since K award year, or serving as dean, department chair, or division chief. In a multivariate model, gender (odds ratio 1.72, $P =$ .003) was associated with the likelihood of success by this definition, and analysis revealed no significant interactions (including with parental status).

Conclusions
Most of these promising investigators of both genders remained in academia and received promotions. However, gender differences in success existed, unrelated to parental status, suggesting a need for ongoing investigation of the causes of gender differences in academic medical careers.

In recent years, studies have suggested various problems in the physician–scientist pipeline in the United States.[1,2] Several studies have suggested that women seeking careers in academic medicine may fare even less well in traditional measures of academic success than their male colleagues,[3–5] and the situation may be particularly problematic for women with children.[6] However, comparisons between men and women in academic medicine have often been difficult because of the possibility that differences observed may result from "sex differences in career and life goals."[7]

The cohort of individuals receiving K awards from the National Institutes of Health (NIH) is an ideal population within which to study issues of gender and academic success. K08 and K23 awards are mentored career development awards granted to select individuals holding health professional doctorates who wish to pursue research that either does (K23) or does not (K08) involve human subjects. Because these awards are highly competitive grants, made to the most promising and dedicated medical researchers, gender differences in this cohort would merit particular attention, since differences in aptitude or the underlying desire to pursue research between the men and women who received these awards are unlikely to account for differences between genders.

Using publicly available data, including NIH's Computer Retrieval of Information on Scientific Projects (CRISP)[8] database and information available through detailed Internet searches, we have previously shown that women holding K08 and K23 awards from 1997 to 2003 were significantly less likely to receive R01 grants than their male peers.[9] However, these data did not permit us to assess other important measures of career success, such as promotions or receipt of other grants, publications, or leadership positions. Nor were we able to assess the influence of other factors, such as race and parental status, on outcomes. To address these gaps in knowledge, we conducted a survey study to assess in a more comprehensive manner the midcareer outcomes of promising young male and female medical faculty.

Method

Study population and data collection

We identified recipients of new K08 and K23 awards in 2000 and 2001 using the NIH's CRISP database. For the 875 individuals so identified, after approval by the University of Michigan institutional review board, we conducted comprehensive Internet searches and telephone calls to determine current addresses. We identified mailing addresses for 818 K awardees and employed a modified Dillman[10] method to encourage response.

In August 2009, we mailed each of these 818 individuals a cover letter, survey questionnaire with unique tracking

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identifier, and $20 cash incentive payment. Those who did not respond within three weeks were mailed a second copy of the questionnaire with a cover note. Two coders entered all data, and we subsequently compared the two data entries to ensure accuracy; a supervising coder resolved all discrepancies prior to analysis.

We then merged individual survey responses to data we had previously collected from CRISP identifying K award type and year of award, and the awardee's specialty, institution at time of K award, and subsequent R01 attainment (through 2009). We removed from analysis one respondent who removed the tracking identifier necessary for this merger.

Measures

We designed the questionnaire after review of the relevant literature, consideration of other instruments used to determine success in academic careers,[11,12] and detailed cognitive pretesting with a small number of physician–researchers.[13] The ultimate questionnaire included 39 items that assessed demographic characteristics, educational background and medical specialization, nature of current employment, publication history, grant application history and outcomes, current academic rank and promotions, leadership positions, and the respondent's own perception of his or her success as a medical researcher.

For clarity of presentation, we grouped respondents into four age categories (37–40; 41–45; 46–50; and >50) and into two categories for their percentage of working time spent on research (>25% versus 25% or less). We grouped institutions so that all hospitals affiliated with a single university were considered to be a single institution. We then grouped institutions at the time of the respondent's K award into four tiers containing roughly equal numbers of K awardees, based on the amount of total NIH funding received by each institution in 2000, as listed in the NIH's Research Portfolio Online Reporting Tool.[14] We grouped the NIH institutes that funded respondents' K awards into three tiers of funding activity, based on the total dollar amount of R01 awards granted in 2000.

We grouped specialties into six categories as in previous studies[9]: medical specialties (internal medicine and its subspecialties, as well as neurology); surgical specialties (general surgery and surgical subspecialties); clinical specialties for women, children, and families (family medicine, obstetrics–gynecology, pediatrics, and their subspecialties); hospital-based specialties (such as radiology, anesthesiology, and pathology); basic sciences; and unknown (no specialty reported in the survey response and no department listed in CRISP).

We constructed a binary composite measure of success that was positive for those respondents satisfying at least one of the following criteria: (1) serving as principal investigator on an R01 grant or on other grants totaling more than $1 million since receipt of K award, (2) publishing 35 or more peer-reviewed articles since K award receipt, or (3) appointment as dean, department chair, or division chief.

Data analysis

We analyzed the tabulated data using SAS version 9.2 statistical software (SAS Institute Inc., Cary, North Carolina). We compared the distributions of demographic data for respondents versus nonrespondents, and within respondents by gender, using the chi-square or Fisher's exact tests for categorical data and the two-sample *t* tests for continuous data. We described various characteristics and outcomes in the responding population by gender using counts and percentages for categorical data and means and standard deviations for continuous data. We constructed multiple variable logistic regression models for success using the following respondent characteristics: gender, race, age, parental status, degree, specialty group, original institution tier, funding institute type, and K award type. We present both a full model, containing

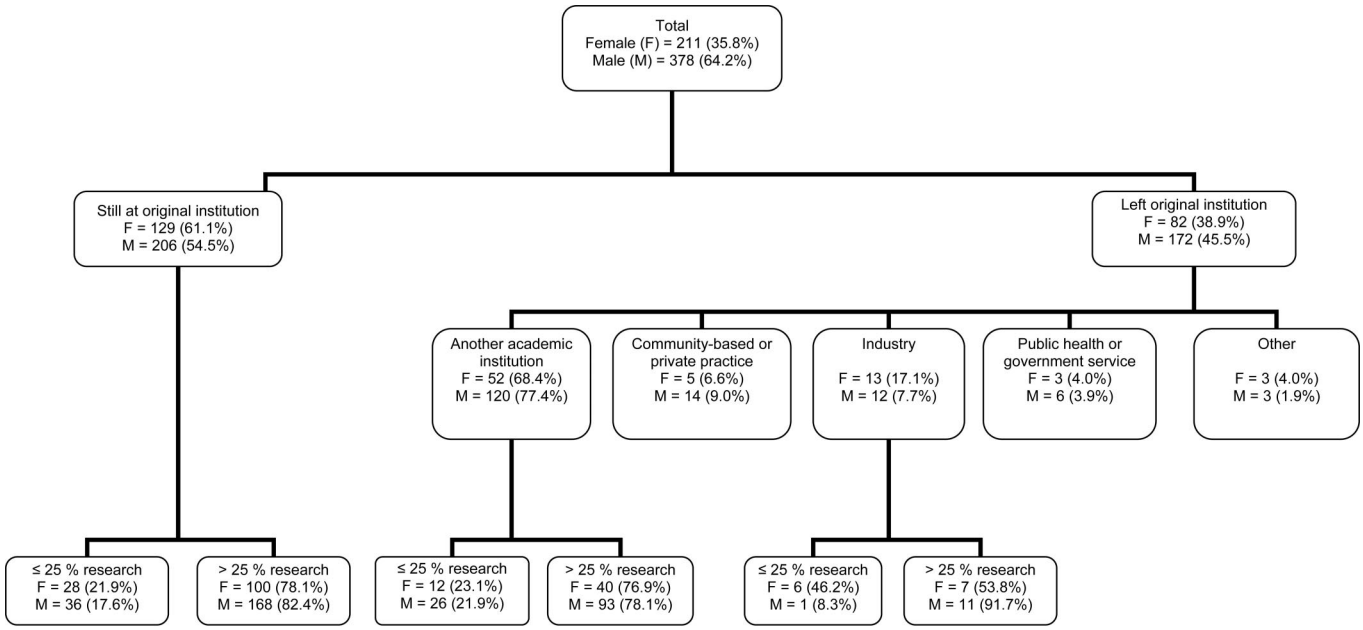

Figure 1 This diagram depicts the career paths by gender of 589 individuals who received National Institutes of Health K awards in 2000 and 2001 and responded to a survey in 2009.

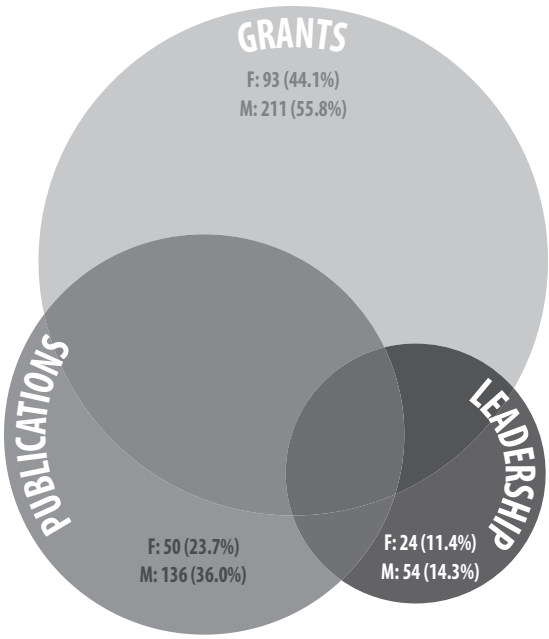

Figure 2 This Venn diagram depicts the attainment of success in grant attainment, publications, and leadership by gender in the responding population of 589 National Institutes of Health K awardees (211 women and 378 men). Success in grants was defined as receipt of an R01 grant or greater than $1 million in grant funding since K award; success in publications was defined as 35 or more peer-reviewed papers published since K award; success in leadership was defined as appointment as division chief, department chair, or dean. Numbers on the figure represent the total number of respondents attaining success in each domain, including individuals who had attained success in that domain and one or both of the others. One hundred eighteen women (55.9%) and 274 men (72.5%) gained success in at least one area.

all of these independent variables, and a reduced model that was developed through a backward selection algorithm, in which we iteratively removed nonsignificant characteristics until only significant characteristics remained. The presence of significant pairwise interaction between gender and the other covariates was explored. For statistical inference, we considered test statistics with P values at or below 5% to be significant.

Results

Ultimately, 589 individuals from the 818 we contacted (72% response rate) returned completed questionnaires; one respondent who removed the tracking number necessary to link survey responses to CRISP data on K award is included in the counts for Figures 1 and 2 but otherwise removed from analysis.

Of the 588 included respondents, 211 (35.9%) were female. Comparison of survey respondents with nonrespondents demonstrated no differences by K award type ($P = .14$), K award year ($P = .31$), gender ($P = .79$), institutional group ranked by funding received ($P = .36$), or funding institute group ranked by funding provided ($P = .28$). However, respondents were significantly more likely to have received an R01 (44.6%, 262/588) than nonrespondents (26.1%, 60/230, $P = .007$). Analysis revealed no evidence of a gender interaction with the association between R01 attainment and response to survey ($P = .83$).

Respondents received their MD or equivalent clinical doctoral degrees approximately two decades ago (mean time since degree receipt: 18.3 years for women and 18.0 years for men). Table 1 details more educational, personal, and other characteristics of respondents by gender. Female respondents were more likely than male respondents to hold non-MD degrees ($P < .001$), to specialize in family medicine, obstetrics–gynecology, or pediatrics ($P < .001$), and to have K23 awards ($P < .001$). Female respondents were also more likely than male respondents to be in the oldest age category ($P = .04$), less likely to be married ($P = .004$), and less likely to have children ($P < .001$).

The vast majority of respondents remained in academic medicine (507 of the 566 who fully responded to this item, or 89.6%), and there was no gender difference in retention: 181 women (88.3% of the 205 women who fully responded to this item) and 326 men (90.3% of the 361 men who fully responded to this item) reported that they continued to work at academic institutions ($P = .37$). Among those working at academic institutions, over three-quarters (78.9%, 400) continued to spend a meaningful portion of their time (>25%) on research. Of men who remained in academic positions, 36.8% (120) reported changing institutions at least once, and of women who remained in academic positions, 28.7% (52) reported changing institutions ($P = .08$). Figure 1 illustrates the career paths of male and female respondents.

Table 2 details a number of career outcomes by gender. Most respondents reported a promotion in academic rank. On univariate analysis, female respondents were not significantly less likely to report academic promotion ($P = .37$), national and institutional leadership positions ($P = .22$ and .54, respectively), or application for R01 grants ($P = .20$). They were less likely to have received an R01 ($P = .006$) and to perceive themselves as successful as medical researchers ($P = .002$). The mean number of publications by female respondents since receipt of their K award was lower than that reported by men (26.7 versus 33.6, $P = .001$), as was the number of publications senior-authored by female respondents (7.2 versus 11.5, $P < .001$), whereas the number of first-authored publications was not significantly different by gender (8.6 versus 9.9, $P = .11$).

Even among the 133 women and 194 men who did not receive an R01 grant, a high proportion (78.9% [105] of women and 79.4% [154] of men not receiving R01s) remained at academic institutions, and the majority (61.7% [82] of women and 59.8% [116] of men not receiving R01s) reported spending over 25% effort on research. Some individuals who did not have R01 grants (11.3% [15] of women and 13.9% [27] of men not receiving R01s) reported having over a million dollars in other grants, and most (64.7% [86] of women and 66.5% [129] of men not receiving R01s) reported that

they did plan to apply for R01 or equivalent funding in the future. Those who did not receive R01s had still published a number of papers since their K award (mean 22.2 papers for women and 28.5 for men). Of these findings for respondents not receiving an R01 grant, we only observed a significant gender difference for the number of publications ($P = .02$).

Figure 2 depicts the proportion of respondents who were particularly successful in grant attainment (serving as the principal investigator on an R01 grant or on grants totaling at least one million dollars since K award receipt), publications (authoring at least 35 publications since K award year, placing the respondent in the top tertile of all respondents), or leadership (serving as dean, department chair, or division chief). Approximately half of the respondents had attained success in grant funding, but some respondents who had failed to succeed in this way were nevertheless successful in publishing prolifically or in attaining substantial leadership positions. The majority of respondents (118 women and 274 men; 55.9% versus 72.5%; $P < .001$) met at least one of these criteria for success. Table 3 presents a multivariate model of the likelihood of achieving greater academic success in this population. In that model, gender, degree, and specialty were significantly associated with the likelihood of success. The odds ratio for men was 1.72 (1.16–2.50). We observed no statistically significant interactions.

Discussion

This study assesses the midcareer outcomes of a highly select cohort of able and motivated physician–researchers. Many of its findings are heartening. A high proportion of respondents reported maintaining careers in academic medicine and continued to spend a meaningful proportion of their working time on research, as one would hope within such a highly select population who received considerable societal resources to support their career development as medical researchers. Even though only a minority of respondents had gone on to receive R01 funding from the NIH, the vast majority had achieved promotions in academic rank and had published numerous papers since their K award. The study did not

Table 1

Characteristics of 588* Respondents to a 2009 Survey of 818 Recipients of National Institutes of Health (NIH) K08 and K23 Awards in 2000 and 2001

Characteristic	No. (%) Women	No. (%) Men	*P* value†
Degree			<.001
MD only	94 (44.6)	191 (50.6)	
MD plus other degree	72 (34.1)	150 (39.8)	
Non-MD	45 (21.3)	36 (9.6)	
Specialty group			<.001
Medical	80 (37.9)	176 (46.7)	
Surgical	2 (1.0)	26 (6.9)	
Clinical specialties for families, women, and children	55 (26.1)	62 (16.5)	
Hospital based	48 (22.8)	81 (21.5)	
Basic sciences	12 (5.7)	12 (3.2)	
Unknown	14 (6.6)	20 (5.3)	
Institution (at K award) rank group (ranked by NIH funding)			.20
First	47 (22.3)	102 (27.0)	
Second	49 (23.2)	104 (27.5)	
Third	57 (27.0)	88 (23.3)	
Fourth	58 (27.5)	83 (22.0)	
K award type			<.001
K08	95 (45.0)	229 (60.7)	
K23	116 (55.0)	148 (39.3)	
Funding institute rank group (ranked by monetary amount of R01 grants funded)			.07
1	48 (22.8)	119 (31.6)	
2	87 (41.2)	143 (37.9)	
3	76 (36.0)	115 (30.5)	
Age			.04
37–40	15 (7.1)	19 (5.0)	
41–45	101 (47.9)	203 (53.9)	
46–50	64 (30.3)	124 (32.9)	
51+	25 (11.9)	22 (5.8)	
Unknown	6 (2.8)	9 (2.4)	
Marital status			.004
Married	173 (82.0)	339 (89.9)	
Widowed	2 (1.0)	1 (0.3)	
Divorced	14 (6.6)	23 (6.1)	
Single, never married	19 (9.0)	10 (2.7)	
Unknown	3 (1.4)	4 (1.1)	
Parental status			<.001
Have children	166 (78.7)	343 (91.0)	
No children	44 (20.8)	29 (7.7)	
Unknown	1 (0.5)	5 (1.3)	

* Excludes one survey respondent who removed the tracking number used to connect survey responses to NIH data.

† *P* values calculated excluding "unknown" categories where present.

Table 2

Key Outcomes by Gender Among 588* Respondents to a 2009 Survey of 818 Recipients of National Institutes of Health (NIH) K08 and K23 Awards in 2000 and 2001

Outcome	No. (%) Women	No. (%) Men	*P* value
Current academic rank			.17
Instructor	5 (2.4)	2 (0.5)	
Assistant professor	54 (26.0)	87 (23.3)	
Associate professor	108 (51.9)	203 (54.3)	
Professor	23 (11.1)	56 (15.0)	
Not applicable	18 (8.7)	26 (7.0)	
Promoted in rank			.37
Yes	171 (83.0)	320 (85.8)	
No	24 (17.0)	53 (14.2)	
National leadership position			.76
Yes	55 (26.7)	114 (31.6)	
No	151 (73.3)	247 (68.4)	
Institutional leadership position			.54
Dean, department chair, or division chief	24 (11.5)	54 (14.7)	
Clinical or residency director	38 (18.3)	68 (18.5)	
None or other	146 (70.2)	245 (66.8)	
Applied for R01			.20
Yes	144 (68.3)	276 (73.2)	
No	67 (31.7)	101 (26.8)	
Received R01			.006
Yes	78 (37.0)	184 (48.7)	
No	133 (63.0)	193 (51.3)	
Self-perception of success as a medical researcher			.002
Very or quite a bit	94 (45.2)	218 (58.8)	
Somewhat, a little bit, or not at all	114 (54.8)	153 (41.2)	
Publications, mean (SD)			
Total since K award	26.7 (22.1)	33.6 (26.0)	.001
First-authored since K award	8.6 (8.0)	9.9 (10.5)	.11
Senior-authored since K award	7.2 (9.2)	11.5 (14.4)	<.001

* Excludes one survey respondent who removed the tracking number used to connect survey responses to NIH data on K award.

detect gender differences in retention in academic medicine or promotion in academic rank. However, the study did detect certain gender differences that merit attention.

For this study, we deliberately selected a population of physician–researchers known to be outstanding in aptitude and motivation, among whom no gender differences in career trajectory or outcomes would be expected on the basis of those characteristics. In a previous study, using administrative data alone, we showed that women in this population were less likely to go on to receive R01 funding.[9] However, we acknowledged the possibility that women who did not receive R01 grants had careers that were successful in other ways, including the possibility that they received other substantial grants, published prolifically, or went on to take early leadership positions—information that was not available in administrative databases. To account for the possibility that men and women might succeed in different ways in their careers, we conducted this survey study to gather additional data that allowed us to consider a more comprehensive measure of success. In this study, we considered a composite measure, for which particular success in any one area—grant funding, publications, or administrative leadership—sufficed. Unfortunately, we observed that male gender was an independent, significant predictor of greater success, even using this broader definition, within this highly select population.

A number of explanations are possible for this finding. Some studies have suggested that much of the sex difference observed in academic career outcomes is related to whether or not an individual is a parent, with mothers particularly less likely to succeed.[6] In this study, we did observe that within this highly select group, women were less likely to have children than men, perhaps because some of these women perceived that motherhood is particularly challenging for women who wish to succeed in such careers, or perhaps because the conflict between the tenure clock and the biological clock is more pronounced for females than for males. However, in this study we did not observe an interaction between gender and being a parent; even women without children were less likely to succeed than men. This suggests that gender differences in academic medicine may not be related exclusively to motherhood.

Another possibility is that even within this highly select population, the men prioritized greater career success more than the women did.[15] Although this seems unlikely to be the sole explanation within a population of individuals who sought competitive career development awards as fully mature adults, it is possible, for example, that these researchers internalized to some degree society's gendered expectations of career success, and these expectations may contribute to some of the difference observed.[16] Moreover, stereotype threat may play a role even in this highly accomplished group,[17] and women may react to competitive situations[18,19] or to the rejection of a paper or grant in systematically different ways than men.[20,21]

Another potential explanation is gender bias. Numerous psychological studies suggest the existence of small yet meaningful gender biases, often

Table 3

Multivariate Model for Success* Among 588† Respondents to a 2009 Survey of 818 Recipients of National Institutes of Health (NIH) K08 and K23 Awards in 2000 and 2001

	Full model			Reduced model		
Characteristic	Odds ratio	95% CI	*P* value	Odds ratio	95% CI	*P* value
Gender			.007			.003
Male	1.72	1.16–2.50		1.79	1.22–2.56	
Female	1.0			1.0		
Race			.75			
White	1.0					
All others	0.93	0.56–1.47				
Age group			.51			
37–40	0.82	0.38–1.80				
41–45	1.0					
46–50	0.96	0.63–1.47				
51+	0.61	0.31–1.18				
Parental status			.92			
Yes	1.0					
No	0.97	0.54–1.74				
Degree			.04			.003
MD	1.0			1.0		
MD+ other degree	1.31	0.86–1.99		1.33	0.88–1.98	
Non-MD	0.55	0.29–1.07		0.49	0.26–0.91	
Specialty			.008			.009
Medical	1.0			1.0		
Surgical	4.35	1.21–15.56		3.68	1.06–12.85	
Women/children/ families	0.69	0.42–1.11		0.61	0.39–0.98	
Hospital based	1.79	1.05–3.07		1.59	0.95–2.68	
Basic science	1.34	0.48–3.80		1.18	0.43–3.24	
Other/unknown	1.50	0.61–3.73		1.44	0.60–3.46	
Institution tier			.57			
First	1.0					
Second	0.76	0.44–1.30				
Third	0.72	0.42–1.23				
Fourth	0.70	0.40–1.22				
K award type			.26			
K08	1.0					
K23	1.25	0.84–1.87				
NIH funding institute tier			.07			
First	1.0					
Second	1.07	0.66–1.71				
Third	0.64	0.39–1.06				

* Success was defined as receiving an R01 grant or greater than $1 million in grant funding since K award, authoring more than 35 publications since K award, or being named dean, department chair, or division chief.
† Excludes one survey respondent who removed the tracking number used to connect survey responses to NIH data on K award.

unconscious, that may ultimately have substantial influence on the outcomes of women's careers.[22] For example, Steinpreis and colleagues[23] sent academic psychologists a curriculum vitae of a hypothetical candidate for a tenure-track faculty position, varying only the gender of the candidate, and found that both men and women were less likely to hire a woman than a man, even when they had identical qualifications. Others have shown through simulation models how gender biases like this, even when small, can result in substantial disparities in the senior-most positions of pyramidal systems like academic medicine.[24] This sort of accumulation of disadvantage may be particularly insidious.[25]

Yet another possibility is gender differences in values. Women may value quality over quantity in publications,[26,27] for example, and our study only measured the latter. It is also possible that gender differences in interpersonal relationships and behaviors disadvantage women in the ascent to senior authorship and leadership of research groups.[28,29] Of note, differences in non-first-authored publications primarily drove the difference we observed in quantity of publications.

This study has a number of strengths, including its focus on a particularly appropriate population for the investigation of gender differences and its access to multiple measures of success. It also has certain limitations. Like any survey study, it is vulnerable to selection bias. Although the response rate is excellent, particularly for a survey of physicians, it is nevertheless possible that the responding population was not similar to the overall target population. Comparison of respondents with nonrespondents revealed many similarities, but it did show, as we expected, that respondents were more successful than nonrespondents, as measured by R01 attainment. It is likely that respondents to this survey were more successful in general, and therefore the estimates of productivity and success reported here are likely to be the upper bounds of the level of success achieved by the population of K08 and K23 awardees more generally. Thus, the results we describe as heartening at the outset of this discussion should be taken with this caveat. On the other hand, we found no evidence of gender difference in response, and there is no reason to doubt the findings of gender similarities and differences observed here. Finally, it is important to note that this study relies largely on self-report for many of its measures. Although the questions used were developed with standard and rigorous techniques of survey design,

including cognitive pretesting, and have high face validity, it is possible that recall or other biases influenced response. Nevertheless, there is little reason to suspect that such biases would affect the identification of gender similarities and differences.

Ultimately, this study has both reassuring and sobering findings. On the one hand, it is reassuring that this promising group of physician–researchers was generally able to advance in academic medicine, even though only a minority received R01 grants. On the other hand, the finding of significant gender differences in academic success within this population requires further attention. This study suggests that gender differences in career outcomes do occur, even among a select, highly able, and highly motivated group, and simply waiting for more time for women to pass through the pipeline will not bring about parity. Efforts to investigate the mechanisms by which these gender differences develop and ways to mitigate their effects merit continued attention.

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