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Impact of gender and caregiving responsibilities on academic success in hematology

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Key Points

- ASH CRTI alumni are productive clinical researchers, but men had more publications than women, regardless of caregiving responsibilities.
- Caregiving has a negative impact on academic productivity, primarily among men, and more work is needed to reduce gender disparities.

We previously identified gender disparities in academic success during evaluation of the American Society of Hematology (ASH) Clinical Research Training Institute (CRTI) and hypothesized that it may be related to caregiving. The objective was to evaluate the impact of gender and caregiving responsibilities on academic success. A cross-sectional survey that included a question about caregiving responsibilities was distributed to alumni who participated in CRTI from 2003 to 2016 and asked about academic productivity in the previous 3 years. Publications and grants were abstracted from submitted curriculum vitae. Academic success was defined as number of first- or senior-author publications, total publications, grants, and percent effort in research. Of 280 potential respondents, 258 responded (92% response rate), 169 (66%) had caregiving responsibilities, and 110 (43%) were men. Respondents with caregiving responsibilities had fewer first- or senior-author publications (median, 3 vs 5; $P = .003$) and less percent effort in research (median, 40% vs 50%; $P = .006$). Men had more first- or senior-author publications (median, 4 vs 3; $P = .002$) and more total publications (median, 12 vs 6.5; $P = .0002$) than women. When stratified by those without ($P = .0001$) or with ($P = .042$) caregiving responsibilities, men had more publications than women. Among men, caregiving responsibilities significantly reduced all outcomes. However, among women, caregiving did not have an impact. In conclusion, men had more publications than women whether or not they had caregiving responsibilities. However, among men, caregiving reduced academic productivity whereas among women, caregiving did not have impact. The scientific community will need to continue to identify the reasons for disparities and implement changes to address them.

Introduction

The American Society of Hematology (ASH) has focused on improving the training of hematologists in patient-oriented research and increasing the likelihood of academic success.¹ This effort culminated in the creation and ongoing evolution of the Clinical Research Training Institute (CRTI), which has been training junior hematologists since 2003.^{2,3}

In 2014, we conducted a cross-sectional evaluation with a goal of identifying factors associated with academic success. We found a gender disparity among 115 CRTI alumni who participated from 2005 to 2012.⁴ When compared with men, women respondents had fewer median published research articles in

Table 1. Demographic characteristics of CRTI alumni from 2003 to 2016 (N = 258)

Characteristic	n	%
Sex		
Male	110	43
Female	148	57
Race		
Black or African American	10	4
American Indian or Alaskan Native	2	1
White	169	66
Asian	57	22
Other	18	7
Missing	2	1
Hispanic		
Yes	10	4
No	245	95
Missing	3	1
Position at time of CRTI participation		
Faculty	108	42
Fellow	141	55
Other	9	3
Current career setting		
Academic	222	86
Government agency	3	1
Industry	14	5
Private practice/other	13	5
Other	4	2
Missing	2	1
Child or caregiving responsibilities		
Yes	169	66
No	83	32
Missing	6	2
Child or caregiving responsibilities affected academic productivity		
Strongly agree	59	23
Agree	75	29
Neutral	21	8
Disagree	7	3
Strongly disagree	3	1.2
Not applicable	87	34
Missing	6	2
Marital status		
Married	219	85
Living with partner	6	2
Divorced	1	<1
Single	28	11
Missing	4	2
Partner's employment status		
Does not work	25	10
Works full-time from home	17	7

Table 1. (continued)

Characteristic	n	%
Works part-time from home	14	5
Works full-time outside home	144	56
Works part-time outside home	23	9
Not applicable	29	11
Missing	6	2

the past year (2 vs 3; $P = .009$) and a lower median percent effort in research (40% vs 50%; $P = .0029$). This finding has led to focused efforts toward highlighting female role models and discussing gender issues at CRTI. We hypothesized that the observed gender disparity could be related to caregiving responsibilities, so we developed the subsequent cross-sectional study to specifically address this question. The objective of this study was to evaluate the impact of gender and caregiving responsibilities on academic success as defined by number of publications and percent effort in research.

Methods

Design

We have previously described the CRTI program in depth.⁴ In brief, CRTI is a 1-year mentored experience that begins with a week-long summer workshop held in August. To be eligible for the program, applicants must be a senior fellow or junior faculty member with an intended career in patient-oriented hematology research. Typically, 20 participants are chosen each year. Faculty consist of about 20 established clinical researchers, 5 to 6 biostatisticians, and representatives from key funding agencies. The summer workshop consists of didactic lectures, small group sessions, and interactive learning sessions. Participants develop their own clinical research questions and proposals during the summer workshop. Two follow-up reunions in December and May allow the small groups to reconvene and permit ongoing discussions focused on career development. A 1-year mentorship program is also incorporated, with each trainee being matched with a CRTI faculty mentor who attended the summer workshop.

In 2016, ASH formalized its evaluation plan, which now includes cross-sectional surveys of all CRTI alumni every 3 years. The survey allows for an evaluation of outcomes at a variety of time points since CRTI participation, and the sample size allows for relatively robust statistical analyses. The survey that forms the basis of this article was distributed in January 2017 to all 285 alumni who had participated in the program (summer workshops from 2003 to 2016) and asked about productivity in the previous 3 years (since January 2014). The survey included 24 questions (see supplemental Appendix), was created in REDCap,⁵ and was extensively pilot tested by non-CRTI trainees (E.V. and S.C.) and the investigators (A.A.K. and A.C.) before being disseminated. The time needed to complete the survey was approximately 10 minutes. Follow-up reminders occurred via e-mail for non-respondents. Several questions presented a statement and requested a response using a 5-point Likert scale (Strongly agree, Agree, Neutral, Disagree, Strongly disagree). Respondents were also asked to provide their curriculum vitae (CV) from which grants and publications were abstracted by 2 members of the study team (E.V. and S.C.).

The abstracted data were then provided to the respondent, who either confirmed that the data were correct or edited the data.

Outcomes

The primary outcome of academic success was based on promotion committee criteria from the authors' institutions and was defined as one of the following in the previous 3 years (since January 2014): (1) the number of first- or senior-author peer-reviewed publications, (2) the number of total publications regardless of author position, (3) percent effort in research, and (4) being the principal investigator for any federal grant. Federal grants included operating grants from the National Institutes of Health (including R, K, U, P, and T mechanisms), the Agency for Healthcare Research and Quality, the Patient-Centered Outcomes Research Institute, and the Human Resources and Services Administration. Canadian federal funding sources were the Canadian Institutes of Health Research and the Canadian Cancer Society Research Institute. A foundation grant included any private foundation that awards funds to support research. The secondary outcomes we evaluated were being a principal investigator on a foundation grant and being a principal investigator on a federal or foundation grant.

Primary exposure variable and covariates

The primary exposure variable was whether respondents had caregiving responsibilities defined by child caregiving or providing care to an adult family member who needed assistance. Other variables of interest were whether respondents agreed or strongly agreed that caregiving responsibilities affected their career, whether participants were married or living with a partner, whether the partner worked and whether that partner worked at home or outside the home, gender, and whether respondents self-identified as being an underrepresented minority. We also evaluated whether respondents were faculty at the time of CRTI participation and whether respondents agreed or strongly agreed that CRTI facilitated their career development.

Statistical analysis

Descriptive statistics, including percentages and medians, were calculated for all demographic, predictor, and outcome variables. To describe the relationship between the variables of interest and the number of publications and percent effort in research, we performed Wilcoxon rank-sum tests. To evaluate whether differences in those with and without caregiving responsibilities were similar by gender, we stratified by gender and re-evaluated the effect of caregiving. We similarly stratified by caregiving and re-evaluated the effect of gender. Analysis of being principal investigator on a federal grant was conducted using χ^2 analysis. All tests were two-sided, and $P < .05$ was used to define statistical significance. SAS version 9.4 was used for all statistical analyses (SAS Institute, Cary, NC).

Results

There were 285 surveys distributed to alumni who had participated in any CRTI program from 2003 to 2016. Of these alumni, 2 had died and 3 could not be contacted, leaving 280 total potential respondents. There were 258 alumni who responded and submitted a CV (92% response rate). Demographics of participants are provided in Table 1. Of the respondents, 169 (66%) stated that they had child or other caregiving responsibilities, and 134 (52%) agreed or strongly agreed that child or caregiving responsibilities

Table 2. Academic outcomes among CRTI alumni and CRTI influence on outcomes (N = 258)

Outcome	Total no. of respondents	%	Median	IQR
Outcomes for previous 3 y				
Publications as first or last author			3	1-6
Total publications irrespective of authorship position			8	4-18
Percent time in research*			45	25-70
Principal investigator on any federal grant	62	24		
Principal investigator on any foundation grant	94	36		
Principal investigator on any federal or foundation grant	116	45		
CRTI influences on outcomes and career				
At least one protocol, manuscript, or grant attributable to CRTI†	174/232	75		
Protocol	153/231	66		
Manuscript	123/227	54		
Grant	106/227	47		
CRTI-related currently ongoing collaboration†				
CRTI faculty	137/257	53		
CRTI trainee	105/257	41		
Non-CRTI attendee but CRTI facilitated	66/257	26		
CRTI facilitated career development as independent researcher				
Strongly agree	157	61		
Agree	75	29		
Neutral	17	7		
Disagree	8	3		
Strongly disagree	1	<1		
CRTI was instrumental to retaining me in the field of hematology research				
Strongly agree	132	51		
Agree	83	32		
Neutral	35	14		
Disagree	6	2		
Strongly disagree	2	1		

IQR, interquartile range.

*One person did not report time in research.

†Some items had missing values.

had affected their career. In terms of marital status, 225 (87%) were married or living with a partner, and 25 had a partner who did not work.

There were 124 alumni who had been promoted in the previous 3 years (48%), of which 101 were academic promotions (45% of those in academia). There were 49 (19%) who had obtained an advanced degree related to clinical research, 104 (40%) who were teaching clinical research, and 247 (96%) who stated that they were still currently involved in research. Specific research roles

Table 3. Factors associated with number of publications, first-author or senior-author publications, and percent effort

Factor	Total no. of respondents	First- or senior-author publications			Any publications			Percent effort in research*		
		Median	IQR	P	Median	IQR	P	Median	IQR	P
Child or caregiving responsibilities*				.003			.293			.006
Yes	169	3	1-6		8	4-19		40	20-60	
No	83	5	2-8		10	4-18		50	35-75	
Strongly agree or agree caregiving responsibilities affected career*				.422			.435			.785
Yes	134	3	1-6		8	4-16		40	20-60	
No	31	4	1-10		10	3-25		45	20-75	
Married or living with partner				.480			.712			.595
Yes	225	3	1-6		8	4-17		45	23.5-70.0	
No	29	4	2-6		7	4-19		50	25-70	
Partner does not work*				.851			.756			.117
Yes	25	4	1-7		6	4-19		40	10-50	
No	204	3	1-6		8.5	4-17		45	25-70	
Sex				.002			.0002			.349
Male	110	4	2-9		12	5-21		50	30-65	
Female	148	3	1-6		6.5	3-13.5		40	20-70	
Underrepresented minority				.444			.190			.865
Yes	22	3	2-6		6	5-10		45	20-75	
No	236	4	1-7		8.5	4-19		45	25-70	
Position at CRTI faculty				.370			.143			.103
Yes	108	3	2-7		8.5	4.5-20		50	30-70	
No	150	4	1-6		8	3-16		40	20-65	
Strongly agree or agree that CRTI facilitated career				<.0001			.0004			<.0001
Yes	232	4	2-7		9	4-19		50	30-70	
No	26	0	0-2		3	0-8		3.5	0-50	

*Missing or not applicable as follows: percent effort in research (n = 1), child or caregiving responsibilities (n = 6); strongly agree or agree that caregiving responsibilities affected career (n = 93); partner does not work (n = 29).

included being overall principal investigator or study chair of a multicenter study (n = 101; 39%), overall principal investigator or study chair of a single-center study (n = 156; 60%), institutional principal investigator of a multicenter trial (n = 146; 57%), grant reviewer (n = 95; 37%), and journal reviewer (n = 186; 72%). Of the 11 individuals not involved in research, their current career setting was academic (n = 5), private practice (n = 5), and other (n = 1).

Table 2 includes academic outcomes. Overall, the median number of publications as first or last author in the past 3 years was 3 (interquartile range [IQR], 1-6), the median total publications irrespective of authorship position was 8 (IQR, 4-18), and the median percent time in research was 45% (IQR, 25%-70%). Almost 1 in 4 respondents were principal investigators on a federally funded grant. Thirty-six percent were principal investigators of a grant funded by a foundation, and 45% were principal investigators on a federal or foundation grant. Table 2 also provides CRTI-related academic outputs. For example, 174 (75%) of 232 respondents had at least 1 academic product directly attributable to CRTI, with the most common product being development of a research protocol (66%). When asked about current ongoing collaborations, 137 (53%) of 257 were still collaborating with CRTI faculty, and 105 (41%) of 257 were still collaborating with CRTI trainees.

In terms of career development, 232 (90%) agreed or strongly agreed that CRTI facilitated their career development as an independent researcher, and 215 (83%) agreed or strongly agreed that CRTI was instrumental to remaining in hematology research.

Table 3 provides our evaluation of factors associated with the number of first- or senior-author publications, total publications, and percent effort in research. Those with child or caregiving responsibilities had significantly fewer first- or senior-author publications (median, 3 vs 5; $P = .003$) and less percent effort in research (median, 40% vs 50%; $P = .006$) compared with those without child or caregiving responsibilities. However, strong or very strong agreement that child or caregiving responsibilities affected their career was not significantly associated with the number of publications or percent effort in research. Men had more first- or senior-author publications (median, 4 vs 3; $P = .002$) and more publications in total (median, 12 vs 6.5; $P = .0002$) than women. Agreement that CRTI facilitated career development as an independent researcher was associated with more first-author publications (median, 4 vs 0; $P < .0001$), more total publications (median, 9 vs 3; $P = .0004$), and more percent effort in research (median, 50% vs 35%; $P < .0001$). Table 4 shows that none of the variables of interest were predictive of having at least 1 federal principal investigator grant.

Table 4. Factors associated with being principal investigator for at least 1 federal grant

Factor	Total no. of respondents	Federal grant principal investigator		
		n	%	P
Child or caregiving responsibilities*				.977
Yes	169	41	24	
No	83	20	24	
Strongly agree or agree that caregiving responsibilities affected career*				.128
Yes	134	30	22	
No	31	11	35	
Married or living with partner				.987
Yes	225	54	24	
No	29	7	24	
Partner does not work*				.320
Yes	25	4	16	
No	204	51	25	
Sex				.473
Male	110	24	22	
Female	148	38	26	
Underrepresented minority				.371
Yes	22	7	32	
No	236	55	23	
Position at CRTI faculty				.368
Yes	108	29	27	
No	150	33	22	
Strongly agree or agree CRTI facilitated career				.546
Yes	232	57	25	
No	26	5	19	

Table 5 provides the stratified analysis by caregiving status and gender separately. Among those without caregiving responsibilities, men had more first- or senior-author publications (median, 6.5 vs 4; $P = .001$) and more total publications (median, 16 vs 6; $P = .0001$) than women. Similarly, among those with caregiving responsibilities, men had more total publications than women (median, 10 vs 6.5; $P = .042$). When stratified by gender, among men, those with caregiving responsibilities had significantly fewer first- or senior-author publications ($P = .002$), total publications ($P = .036$), and percent effort in research ($P = .010$). Conversely, among women, those with and without caregiving responsibilities had similar first- or senior-author publications, total publications, and percent effort in research. All analyses were repeated using only participants who reported having a career in an academic setting, and the results were similar (data not shown).

Discussion

In this comprehensive evaluation of outcomes following a structured, mentored, clinical research training program, we found that having child and caregiving responsibility was significantly associated with fewer first- or senior-author publications and less percent effort in research, and that female gender was significantly associated with

fewer first- or senior-author and total publications. We also found that the gender effect persisted among those without caregiving responsibilities, suggesting that the discrepancy in academic success between women and men cannot be explained by this variable alone. In addition, caregiving significantly reduced academic productivity among men but not women.

Although we found that child and caregiving responsibility was significantly associated with reduced academic success, we did not find that participants' reported agreement that caregiving responsibilities affected their careers was associated with academic outcomes. There are several plausible explanations for this finding. First, a qualitative comment from a respondent noted that the wording of our question did not specify whether the impact of caregiving was positive or negative, and this respondent noted a positive impact of caregiving responsibilities on his or her career. Second, the sample size for the impact of caregiving question was reduced because those who did not have caregiving responsibilities were removed from this analysis. Third, parents may be reluctant to report that their children had an adverse impact on their career trajectories. We did not quantify the number of hours typically spent caregiving. This will be addressed in the next evaluation.

This analysis continues to confirm that female CRTI alumni have less academic success as measured by publication volume when compared with male CRTI alumni and provides some insight into a potential basis for this disparity. However, what we do not know is whether academic success continues to be lower among women in the long term or whether women catch up with their male counterparts later in their careers. In a single medical school, female faculty published fewer total manuscripts over the course of their careers, but after 27 years, women produced a mean of 1.57 more papers per year than men.⁶ With regard to being the principal investigator of a federal grant, the proportion of women vs men was similar, so an alternative explanation for decreased publication productivity may be that the women are more judicious about choosing which projects to invest time in. It is possible that women are focusing their writing efforts on manuscripts that are most likely to lead to the next funded grant. Another possibility is that women are less likely to request or receive middle authorship credit in multi-authored publications. There is a known bias for work submitted by male authors and for work with positive findings.⁷ Previous research demonstrated a higher acceptance rate for abstracts and manuscripts submitted with a male first-author's name in a blinded experimental review.⁸ Recently, an observational study of more than 6 million publications found that manuscripts with male first and last authors were more likely to use positive words in manuscript titles and manuscripts when compared with publications with female first and last authors.⁹ The combination of cognitive bias for male investigators' work seems to be compounded with writing styles. More long-term evaluation of CRTI data may be able to address this question and offer alternative approaches for females.

The strength of this study is the hypothesis-driven nature of the survey embedded in the evaluation of a training program. The second strength is the excellent response rate of 92% among this population who had participated in CRTI for as long as 14 years before the survey was distributed. We believe this response rate is a testament to both the alumni's commitment to ASH as an organization and, in turn, to the commitment of ASH to foster the ongoing development of its alumni.

Table 5. Number of first author, senior author, or any publications and percent effort stratified by child or caregiving responsibilities and by gender

Category	Total no. of respondents	First- or senior-author publications			Any publications			Percent effort in research*		
		Median	IQR	P	Median	IQR	P	Median	IQR	P
Analysis stratified by child or caregiving responsibilities										
Child or caregiving responsibilities*	169			.091			.042			.563
Male	73	3	2-6		10	4-21		40	30-50	
Female	96	3	0-6		6.5	3-14		40	20-67.5	
No child or caregiving responsibilities*	83			.001			.0001			.208
Male	34	6.5	4-16		16	10-25		60	38-75	
Female	49	4	1-6		6	3-12		50	30-70	
Analysis stratified by sex										
Female	145									
Child or caregiving responsibilities*				.149			.745			.134
Yes	96	3	0-6		6.5	3-14		40	20-67.5	
No	49	4	1-6		6	3-12		50	30-70	
Male	107									
Child or caregiving responsibilities*				.002			.036			.010
Yes	73	3	2-6		10	4-21		40	30-50	
No	34	6.5	4-16		16	10-25		60	38-75	

*Missing or not applicable as follows: percent effort in research (n = 1), child or caregiving responsibilities (n = 6).

However, this analysis must be interpreted in light of its weaknesses. First, we did not quantify the time spent in a caregiving role. In 2013, the Pew Research Center reported that mothers spent 13.5 hours per week on childcare, whereas fathers spent 7.3 hours a week in this role.¹⁰ So, although both mothers and fathers see themselves as providing care, the Pew report provided data that women typically spend more time than men preparing for reduced work hours for parenthood and take more time off to provide caregiving.¹⁰ Second, qualitative data may have been informative in trying to better understand the data, and we are planning such analyses in the future. Third, given that each class size is only 20 participants, we will always have limited power to examine questions for targeted periods and, in particular, the introduction of gender issues has been strengthened in the curriculum only recently. Thus, detecting changes in associations as the program matures will take a long time. Finally, we did not verify academic achievements by contacting institutions or by confirming grants and publications that use funding agencies' Web sites or publication databases. However, we had no reason to believe that this data would not be accurately reported in participants' CVs.

Men had more publications than women, whether or not they had caregiving responsibilities. However, among men, caregiving reduced academic productivity, whereas among women, caregiving did not have an impact. The scientific community will need to

continue to work to identify the reasons for disparities and implement changes to level the playing field for physician scientists.

Acknowledgment

This work was supported by a grant from the National Institutes of Health, National Cancer Institute (R25CA168526).

Authorship

Contribution: A.A.K. designed the research, interpreted the data, and wrote the article; S.K.V. designed the research, analyzed the data, and wrote and edited the article; E.V. and S.C. collected the data, assisted with the analysis, and edited the article; A.C. and W.S. interpreted the data and edited the article; M.H. and J.F. collected the data and edited the article; and L.S. designed the study, collected, interpreted, and analyzed the data, and wrote the article.

Conflict-of-interest disclosure: The authors declare no competing financial interests.

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