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Training Programs for Fundamental and Clinician-Scientists: Balanced Outcomes for Graduates by Gender

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Abstract

Background: Women scientists are less likely to obtain Assistant Professorship and achieve promotion, and obtain less grant funding than men. Scientist/clinician-scientist training programs which provide salary awards as well as training and mentorship are a potential intervention to improve outcomes among women scientists. We hypothesized whether a programmatic approach to scientist/clinician-scientist training is associated with improved outcomes for women scientists in Canada when compared with salary awards alone. Trainees within the Kidney Research Scientist Core Education and National Training Program (KRESCENT), Canadian Child Health Clinician Scientist Program (CCHCSP), and the Canadian Institutes of Health Research (CIHR) salary award programs were evaluated.

Objective: To examine whether the structured KRESCENT training program with salary support improves academic success for women scientists relative to salary awards alone.

Design: Retrospective cohort study.

Setting: Canadian national research scientist and clinician-scientist training programs and salary awards.

Participants: KRESCENT cohort (n = 59, 2005-2017), CCHCSP cohort (n = 58, 2002-2015), and CIHR (n = 571, 2005-2015) Salary Awardees for postdoctoral fellows (PDF) and new investigators (NI).

Measurements: National operating grant funding success, achieving an academic position as an Assistant Professor for PDF, or achieving promotion to Associate Professor for NI.

Methods: The gender distribution of each cohort was determined using first name and NamepediA and was examined for PDF and NI, followed by a description of trainee outcomes by gender and training level.

Results: KRESCENT and CIHR PDF were balanced (12/27, 44% men and 55/116, 47% women) while CCHCSP had a higher proportion of women (13/20, 65%). KRESCENT and CCHCSP NI retained women scientists (19/32, 59% and 22/38, 58% women), whereas CIHR NI had fewer women (165/455, 36% women vs 290/455, 64% men, $P = 0.01$). There was a high rate of NI operating grant success (91%-95%) with no gender differences in each cohort. There was a high proportion of CCHCSP PDF who achieved an Assistant Professorship (18/20, 90%) that may be due in part to a longer follow-up period (9.3 ± 3 years) compared with KRESCENT PDF (7/27, 26%, 0.88 ± 4.5 years), and these data were not available for CIHR PDF. Women KRESCENT NI showed increased promotion to Associate Professor ($P = 0.02$, 0.25 ± 3.2 years follow-up) and CCHCSP NI had high promotion rates (37/38, 97%, 6.9 ± 3.6 years follow-up) irrespective of gender. There was an overall trend toward more men pursuing biomedical research.

Limitations: KRESCENT and CCHCSP training program cohort size and heterogeneity; assigning gender by first name may result in misclassification; lack of data on the respective applicant pools; and inability to examine intersectionality with gender, ethnicity, and sexual orientation.

Conclusion: Overall trainee performance across programs is remarkable by community standards regardless of gender. KRESCENT and CCHCSP training programs demonstrated balanced success in their PDF and NI, whereas the CIHR awardees had reduced representation of women scientists from PDF to NI. This exploratory study highlights the utility of programmatic training approaches like the KRESCENT program as potential tools to support and retain women scientists in the academic pipeline during the challenging PDF to NI transition period.

Abrégé

Contexte: Les chercheuses sont moins susceptibles que les hommes d'obtenir une promotion ou un poste de professeur adjoint, en plus d'obtenir moins de subventions. Des programmes de formation pour les chercheurs et chercheurs cliniciens

offrant des bourses salariales ainsi que de la formation et du mentorat pourraient s'avérer pertinents pour améliorer la situation des femmes en sciences. Nous avons émis l'hypothèse qu'une approche programmatique de la formation des chercheurs et chercheurs cliniciens pourrait améliorer les résultats pour les chercheuses canadiennes comparativement aux bourses salariales seules. Pour ce faire, les stagiaires du Programme national de formation scientifique et d'encadrement des chercheurs spécialisés dans le domaine rénal (KRESCENT), du Programme canadien des cliniciens-chercheurs en santé de l'enfant (PCCCSE) et des programmes de bourses salariales des Instituts de recherche en santé du Canada (IRSC) ont été évalués.

Objectifs: Vérifier si le programme de formation structuré KRESCENT avec soutien salarial favorise le succès académique des scientifiques féminines par rapport aux bourses salariales uniquement.

Type d'étude: Étude de cohorte rétrospective.

Cadre: Programmes nationaux de formation et de bourses salariales pour les chercheurs et les chercheurs cliniciens du Canada.

Sujets: La cohorte KRESCENT (n = 59; 2005-2017), la cohorte PCCCSE (n = 58; 2002-2015) et les récipiendaires d'une bourse salariale des IRSC (n = 571; 2005-2015) destinées aux boursiers postdoctoraux (BPD) et aux nouveaux chercheurs (NC).

Mesures: Le succès du financement des subventions de fonctionnement nationales, l'obtention d'un poste de professeur adjoint à l'université pour les BPD ou l'obtention d'une promotion au poste de professeur agrégé pour les NC.

Méthodologie: La répartition des genres dans chaque cohorte a été déterminée à l'aide du prénom et de Namepedia, et a été examinée en fonction du statut (BPD ou NC). Les résultats des stagiaires ont été décrits selon le genre et le niveau de formation.

Résultats: Dans le cas des BPD, les cohortes KRESCENT et IRSC étaient plutôt équilibrées (44 % d'hommes [12/27] pour KRESCENT et 47 % [55/116] de femmes pour IRSC). Les femmes BPD étaient plus nombreuses dans la cohorte PCCCSE (13/20 [65 %]). Du côté des NC, les femmes étaient majoritaires dans les cohortes KRESCENT et PCCCSE (respectivement 59 % [19/32] et 58 % [22/38] de femmes) et les hommes étaient plus nombreux dans la cohorte IRSC (64 % d'hommes [290/455]; 36 % de femmes [165/455] [p = 0,01]). Nous avons observé un taux élevé de réussite des subventions de fonctionnement chez les NC (91 à 95 %) dans toutes les cohortes, sans égard au genre. Une forte proportion de BPD du PCCCSE avaient obtenu un poste de professeur adjoint (18/20 [90 %]); ceci pourrait s'expliquer en partie par le plus long suivi (9,3 ± 3 ans) comparativement aux BPD du KRESCENT (7/27 [26 %]; 0,88 ± 4,5 ans). Ces données n'étaient pas disponibles pour les BPD des IRSC. On a vu une augmentation des promotions à des postes de professeurs agrégés pour les nouvelles chercheuses de la cohorte KRESCENT (p = 0,02, pour 0,25 ± 3,2 ans de suivi). Les NC du PCCCSE présentaient un taux élevé de promotions (37/38 [97 %]; 6,9 ± 3,6 ans de suivi), indépendamment du genre. Une tendance globale pour un plus grand nombre d'hommes poursuivant des recherches biomédicales a été observée.

Limites: Parmi les limites, on compte la taille et l'hétérogénéité des cohortes KRESCENT et PCCCSE; de possibles erreurs de classification dues à l'attribution du genre par le prénom; le manque de données sur les bassins respectifs de candidats; l'incapacité d'examiner l'intersectionnalité avec le genre, l'origine ethnique et l'orientation sexuelle.

Conclusion: Le rendement global des stagiaires dans l'ensemble des programmes est remarquable, quel que soit leur genre, par rapport aux normes communautaires. Les programmes de formation de KRESCENT et PCCCSE ont démontré un succès équilibré chez leurs BPD et NC, tandis que les récipiendaires d'une bourse des IRSC ont montré une plus faible représentation de chercheuses tant chez les BPD et les NC. Cette étude exploratoire met en lumière la pertinence d'approches de formation programmatique comme le KRESCENT pour soutenir et retenir les scientifiques féminines dans le domaine académique pendant la difficile période de transition entre le statut de boursière postdoctorale et celui de nouvelle chercheuse.

Keywords

equity diversity inclusion (EDI), gender balance, academic women, research training program, mentorship

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Introduction

Women are underrepresented in science and academic medicine, comprising 28% of jobs in science worldwide,[1] and this gap widens further for women of ethnic minorities.[2,3] This gender imbalance exists throughout the career spectrum and becomes more pronounced over the course of a career.[4,5] Women are less likely to obtain an Assistant Professorship, even after controlling for postdoctoral training and research output.[6] Women achieve full Professorship less often and at a slower rate than men in academic medicine.[7] Women scientists achieve full-time employment less often, receive less research funding, have a lower likelihood of winning scholarly awards, are less likely to be involved in basic science research, and are less frequently invited as peer reviewers and editors.[7-12] Women-led papers and abstracts are less likely to be published in high impact journals, take longer to be published, and are cited less often.[13-16] Women are also less likely to be invited to speak at conferences or grand rounds.[17-20]

The American College of Physicians (ACP) recently summarized unique challenges faced by women physicians.[21] The ACP highlighted obstacles such as discrimination, gender bias, unequal compensation, lack of mentors, cultural environment of the workplace, harassment, and lack of flexibility for work-life integration.[21] Furthermore, the extensive training period required overlaps with peak child-bearing years which can lead to career interruptions or "deferred parenthood," with its own unique set of challenges.[22] The 2018 National Academy of Sciences, Engineering and Medicine Consensus study report on sexual harassment, highlighted that more than 50% women faculty and staff report harassment and this may contribute to the leaky pipeline of women in science, engineering, and medicine.[23] Risk factors include work settings dominated by men, hierarchical and dependent relationships, isolating environments, symbolic legal compliance policies/procedures, and organizational tolerance.[23]

The Kidney Research Scientist Core Education and National Training Program (KRESCENT, co-funded by Canadian Institutes of Health Research, CIHR) launched in 2005 to improve kidney research capacity through training a new generation of fundamental and clinician-scientists.[24,25] The Canadian Child Health Clinician Scientist Program (CCHCSP) launched in 2002 to address declining numbers of child health clinician-scientists. Each training program provides a core research curriculum, longitudinal mentorship, and funding support for trainees. CIHR also funds prestigious salary awards for postdoctoral fellows (PDF) and new investigators (NI) but without a structured training approach employing curriculum and mentorship. We sought to review barriers facing women scientists and explore in this natural experiment whether the structured KRESCENT program helped mitigate barriers to academic success in obtaining funding or professorship for women scientists compared with the CCHCSP training program or CIHR salary awardees without a training program.

Methods

Study Population

For this reanalysis of published data using a sex-gender lens,[24-26] ethics was submitted and review was waived (University of Manitoba Research Ethics, HS23225 H2019:365). The KRESCENT cohort from 2005-2017 and graduation dates from 2008-2020 consists of NI, PDF, and allied health PhD candidates, with outcomes ascertained from July to August 2015.[24,25] KRESCENT PDF and NI awards are each 3 years in length. The CCHCSP cohort from 2002-2015 consists of doctoral, PDF, and NI awards and the training program has been previously described, with outcomes ascertained from July to December 2016.[26] CCHCSP PDF and NI awards were 3 and 4 years in length, respectively. Doctoral awards from KRESCENT and CCHSCP were excluded as they were at an earlier career stage. The CIHR cohort from 2005 to 2015 consists of Banting PDF and NI salary awards with outcomes ascertained in November 2019. CIHR PDF and NI awards are 2 and 3 years in length, respectively. All awardees who received both a PDF and NI award were analyzed within the NI group alone to better reflect their career stage and its associated expected funding and academic appointments and to avoid repeated measures.

Gender was assigned by first name and NamepediA based on previous studies which employed similar methodology.[27-31] NamepediA is an online database which can link first names to the gender which it is most strongly associated based on countries and languages. Gender assignment was corroborated where possible using author's institutional, personal, or research webpages. Two individuals were excluded from the CIHR cohort for unknown gender.

Outcomes

The gender distribution of the cohorts was examined at each training level. Outcomes of interest included obtaining national operating grants from CIHR or KFoC as a principal investigator. CIHR operating grants were defined as any nonsalary award, such as the Project Scheme, Foundation, Catalyst, Team, Dissemination, Planning and Proof-of-Principle, and Knowledge Synthesis/Translation grants. Additional outcomes of interest were obtaining an Assistant Professorship for PDF and promotion to Associate Professor for NI. These data were only available for the main KRESCENT cohort and the CCHCSP cohort.

Statistical Analysis

JMP software version 10.0.2 (SAS Institute Inc, Cary, NC) was used for statistical analysis. Data are presented as means and standard deviation, or counts and percentages. For categorical data, Fisher exact test or Pearson chi-square test was used. Parametric continuous data were analyzed by Student *t* tests. Nonparametric continuous data were summarized as

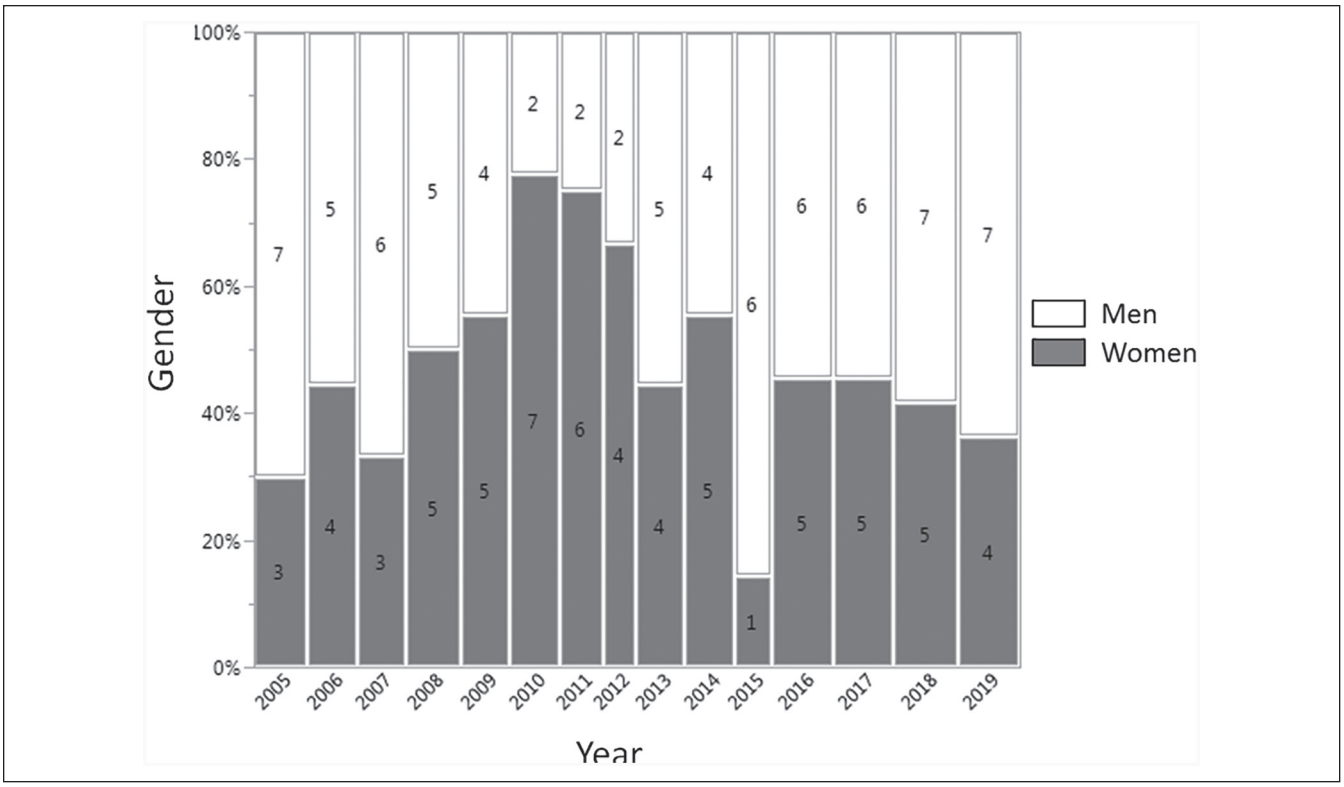

Figure 1. Gender distribution over time in the Kidney Research Scientist Core Education and National Training Program peer review panels.

median (interquartile range [IQR]) unless stated otherwise and analyzed by the Wilcoxon rank sum or Kruskal-Wallis rank sum tests. A two-tailed P value <0.05 was considered significant. KRESCENT outcomes were determined in 2015, and there were 33 awardees with less than 1 year follow-up. Therefore, a sensitivity analysis was undertaken excluding those individuals who had not yet graduated from the program at the time of follow-up for both the PDF and NI groups. Logistic regression was used to adjust for length of follow-up for obtaining an academic position.

Results

KRESCENT Training Program

KRESCENT (n = 59) consists of 27 PDF and 32 NI from 2005 to 2017 followed for 0.88±4.5 and 0.25±3.2 years. KRESCENT has had men and women co-leads since 2005. The gender distribution of KRESCENT peer review panels is variable over time but still relatively balanced (66/140, 47% women and 74/140, 53% men) (Figure 1).

KRESCENT PDF (n = 27) showed a similar distribution between men and women (12/27, 44% women and 15/27, 56% men). There were 56% clinician-scientists and predominantly biomedical researchers (23/27, 85%). KRESCENT PDF demonstrated no differences by gender in obtaining national operating grants (Table 1). There was no difference between men and women trainees in the proportion who achieved Assistant Professorship (2/12, 17% women and 5/15 men, 33% $P = 0.33$). Eighteen individuals received both a PDF and NI and are included in the NI group (below). When these dual awardees were considered a total of 56% (25/45), KRESCENT PDF obtained Assistant Professorship (9/25, 36% women and 16/25, 64% men). Excluding 13 PDF trainees with less than 1-year follow-up showed no differences by gender for obtaining an academic position or national operating grants (Supplementary Table 1).

KRESCENT NI showed a similar distribution between men and women (19/32, 59% women and 13/32, 41% men). They were predominantly clinician-scientists (25/32, 78%) involved in biomedical research (18/32, 56%). KRESCENT NI had significant national operating grant success (KFoC/CIHR, 97%; KFoC, 78%; CIHR, 91%) despite the short follow-up, and there were no differences by gender in operating grant success (Table 2). Excluding individuals with less than 1-year follow-up and adjustment for variable length of follow-up did not change these findings (Supplementary Table 2). A higher proportion of women KRESCENT NI achieved promotion to Associate Professor (10/19, 31% women and 3/13, 9% men, $P = 0.09$)(Table 2) which was significant after excluding those with less than 1-year follow-up ($P = 0.03$, Supplementary Table 2) and adjustment for variable length of follow-up ($P = 0.02$).

Table 1. KRESCENT Postdoctoral Research Fellow Outcomes by Gender.

Postdoctoral fellow	Total (n = 27)	Men (n = 15)	Women (n = 12)	*P* value
Trainee type				
MD	15 (55.6)	10 (37.4)	5 (18.5)	.19
PhD	12 (44.4)	5 (18.5)	7 (25.9)	
CIHR primary pillar				
Pillar 1 Biomedical	23 (85.2)	13 (48.2)	10 (37.4)	.16
Pillar 2 Clinical	2 (7.4)	2 (7.4)	—	
Pillar 3 Health Systems Services	2 (7.4)	0	2 (7.4)	
CIHR secondary pillar				
None	21 (77.8)	12 (44.4)	9 (33.3)	.80
Pillar 2 Clinical	5 (18.5)	2 (7.4)	3 (11.1)	
Pillar 3 Health Systems Services	1 (3.7)	1 (3.7)	—	
Academic job, Assistant Professorship	7 (25.9)	5 (18.5)	2 (7.4)	.33
National level funding	10 (37.0)	7 (25.9)	3 (11.1)	.25
Kidney Foundation of Canada funding	1 (3.7)	1 (3.7)	0	.36
CIHR funding	10 (37.0)	7 (25.9)	3 (11.1)	.25
Length of follow-up (years)	0.88 ± 4.5	1.4 ± 5.0	0.25 ± 3.9	.61

Note. The total and women postdoctoral research fellow population excludes dual awardees (those who received a postdoctoral research fellowship and new investigator award). Comparisons are between men and women postdoctoral research fellows. Data are presented as mean ± SD or counts (%). *P* values refer to a comparison between men and women KRESCENT graduates. Fisher exact test was performed on CIHR pillars due to low numbers. KRESCENT = Kidney Research Scientist Core Education and National Training Program; CIHR = Canadian Institutes of Health Research.

Table 2. KRESCENT New Investigator Outcomes by Gender.

New investigator	Total (n = 32)	Men (n = 13)	Women (n = 19)	*P* value
Trainee type				
MD	25 (78.1)	11 (34.4)	14 (43.8)	.46
PhD	7 (21.9)	2 (6.3)	5 (15.6)	
CIHR primary pillar				
Pillar 1 Biomedical	18 (56.3)	8 (25)	10 (31.3)	1.0
Pillar 2 Clinical	10 (31.3)	4 (12.5)	6 (18.8)	
Pillar 3 Health Systems Services	3 (9.4)	1 (3.1)	2 (6.3)	
Pillar 4 Population Health	1 (3.1)	0	1 (3.1)	
CIHR secondary pillar				
None	21 (65.6)	8 (25)	13 (40.6)	.59
Pillar 1 Biomedical	4 (12.5)	2 (6.3)	2 (6.3)	
Pillar 2 Clinical	5 (15.6)	3 (9.4)	2 (6.3)	
Pillar 3 Health Systems Services	2 (6.3)	0	2 (6.3)	
Promotion to Associate Professor	13 (40.6)	3 (9.4)	10 (31.3)	.09
National level funding	31 (96.9)	13 (40.6)	18 (56.3)	.40
Kidney Foundation of Canada funding	25 (78.1)	11 (34.4)	14 (43.8)	.46
CIHR funding	29 (90.6)	12 (37.5)	17 (53.1)	.79
Length of follow-up (years)	0.25 ± 3.2	−0.15 ± 2.5	0.52 ± 3.6	.66

Note. The total and women new investigator population includes dual awardees, or those who received a postdoctoral research fellowship and new investigator award. Comparisons are between men and women new investigators. Data are presented as mean ± SD or counts (%). *P* values refer to a comparison between men and women KRESCENT graduates. Fisher exact test was performed on CIHR pillars due to low numbers. KRESCENT = Kidney Research Scientist Core Education and National Training Program; CIHR = Canadian Institutes of Health Research.

CCHCSP Training Program

CCHCSP (n = 58) consists of 20 PDF and 38 NI from 2002 to 2015 followed for 9.3 ± 2.97 and 6.89 ± 3.6 years. CCHCSP has balanced gender leadership: executive committee (13/18, 72% women; active executive, 5/10, 50% women), Center leaders (21/39, 54% women), mentors (69/117, 59% women), and peer review committees (20/37, 54% women).

CCHCSP PDF and NI showed a higher proportion of women compared with men (PDF: 13/20, 65% women and

Table 3. CCHCSP Postdoctoral Research Fellow Outcomes by Gender.

Postdoctoral fellow	Total (n = 20)	Men (n = 7)	Women (n = 13)	*P* value
Trainee type				
MD	7 (35.0)	6 (30.0)	1 (5.0)	.001
PhD	13 (65.0)	1 (5.0)	12 (60.0)	
CIHR primary pillar				
Pillar 1 Biomedical	8 (40.0)	6 (30.0)	2 (10.0)	.016
Pillar 2 Clinical	5 (25.0)	1 (5.0)	4 (20.0)	
Pillar 3 Health Systems Services	5 (25.0)	—	5 (25.0)	
Pillar 4 Population Health	2 (10.0)	—	2 (10.0)	
Academic job, Assistant Professorship	18 (90.0)	7 (35.0)	11 (55.0)	.41
CIHR funding	15 (75.0)	6 (30.0)	9 (45.0)	.56
Length of follow-up (years)	9.30 ± 2.97	9.86 ± 2.10	9.00 ± 3.31	.54

Note. The total and women postdoctoral research fellow population excludes dual awardees (those who received a postdoctoral research fellowship and new investigator award). Comparisons are between men and women postdoctoral research fellows. Data are presented as mean ± SD or counts (%). *P* values refer to a comparison between men and women CCHCSP graduates. Fisher exact test was performed on CIHR pillars due to low numbers. CCHCSP = Canadian Child Health Clinician Scientist Program; CIHR = Canadian Institutes of Health Research.

Table 4. CCHCSP New Investigator Outcomes by Gender.

New investigator	Total (n = 38)	Men (n = 16)	Women (n = 22)	*P* value
Trainee type				
MD	26 (68.4)	14 (36.8)	12 (31.6)	.040
PhD	12 (31.6)	2 (5.3)	10 (26.3)	
CIHR primary pillar				
Pillar 1 Biomedical	13 (34.2)	10 (26.3)	3 (7.9)	.005
Pillar 2 Clinical	17 (44.7)	3 (7.9)	14 (36.8)	
Pillar 3 Health Systems Services	4 (10.5)	2 (5.3)	2 (5.3)	
Pillar 4 Population Health	4 (10.5)	1 (2.6)	3 (7.9)	
Promotion to Associate Professor	37 (97.4)	16 (42.1)	21 (55.3)	.43
CIHR funding	36 (94.7)	16 (42.1)	20 (52.6)	.53
Length of follow-up (years)	6.89 ± 3.60	7.50 ± 3.72	6.45 ± 3.45	.38

Note. Dual awardees who received both the postdoctoral research fellowship and new investigator awards are analyzed as new investigators. Comparisons are between men and women new investigators. Data are presented as mean ± SD or counts (%). *P* values refer to a comparison between men and women CCHCSP graduates. Fisher exact test was performed on CIHR pillars due to low numbers. CCHCSP = Canadian Child Health Clinician Scientist Program; CIHR = Canadian Institutes of Health Research.

7/20, 35% men; NI: 22/38, 58% women and 16/38, 42% men). The success of CCHCSP PDF and NI for obtaining Assistant Professorship (18/20, 90%) and promotion to Associate Professorship (37/38, 97%) was high irrespective of gender. CCHCSP PDF and NI had a high success rate in CIHR operating grants (NI, 95%) and there were no differences by gender ($P = .56$ and $P = .53$) (Tables 3 and 4). There was a higher proportion of men trainees pursuing biomedical research compared with women.

CIHR Salary Awardees

The CIHR cohort (n = 571) consists of 116 PDF and 455 NI from 2005 to 2015 followed for 4.15 ± 2.6 and 2.2 ± 3.8 years. CIHR PDF (n = 116) showed a gender-balanced distribution (55/116, 47% women and 61/116, 53% men, $P = .65$), whereas there were fewer women CIHR NI awardees compared with men (165/455, 36% women and 290/455, 64% men, $P = .01$). There was a high success rate in CIHR operating funding (NI, 95%) and there were no differences by gender (Tables 5 and 6). The majority of CIHR PDF and NI were conducting Biomedical research (78/116, 67% and 269/455, 59%). There was a higher proportion of men conducting biomedical research compared with women (PDF: 30/55, 55% women and 48/61, 79% men; NI: 68/165, 41% women and 201/290, 69% men).

Discussion

Gender inequality is a multifaceted issue that permeates science and medicine. The primary finding of this study is KRESCENT and CCHCSP training programs retained a similar proportion of PDF and NI women scientists, whereas CIHR PDF awardees were initially balanced by gender but then

Table 5. CIHR Postdoctoral Research Fellow Outcomes by Gender.

Banting postdoctoral fellowship award	Total (n = 116)	Men (n = 61)	Women (n = 55)	*P* value
CIHR pillar				
Pillar 1 Biomedical	78 (67.2)	48 (41.4)	30 (25.9)	.03
Pillar 2 Clinical	16 (13.8)	8 (6.9)	8 (6.9)	
Pillar 3 Health Systems Services	9 (7.8)	3 (2.6)	6 (5.2)	
Pillar 4 Population Health	13 (11.2)	2 (1.7)	11 (9.5)	
CIHR operating funding	27 (23.3)	15 (12.9)	12 (10.3)	.72
Length of follow-up (years)	4.15 ± 2.6	3.87 ± 2.9	4.50 ± 2.1	.45

Note. Data are presented as mean ± SD or counts (%). *P* values refer to a comparison between men and women CIHR awardees. CIHR = Canadian Institutes of Health Research.

Table 6. CIHR new investigator outcomes by gender.

CIHR new investigator salary awards	Total (n = 455)	Men (n = 290)	Women (n= 165)	*P* value
CIHR pillar				
Pillar 1 Biomedical	269 (59.1)	201 (44.2)	68 (14.9)	<.0001
Pillar 2 Clinical	83 (18.2)	46 (10.1)	37 (8.1)	
Pillar 3 Health Systems Services	47 (10.3)	23 (5.1)	24 (5.3)	
Pillar 4 Population Health	56 (12.3)	20 (4.4)	36 (7.9)	
CIHR operating funding	431 (94.7)	274 (60.2)	157 (34.5)	.76
Length of follow-up (years)	2.20 ± 3.8	2.35 ± 3.8	1.92 ± 3.9	.27

Note. Data are presented as mean ± SD or counts (%). *P* values refer to a comparison between men and women CIHR awardees. CIHR = Canadian Institutes of Health Research.

retained fewer women CIHR NI awardees. There was a high overall rate of operating grant success with no differences by gender across each cohort. KRESCENT, CCHCSP, and CIHR awards are all highly competitive, suggesting that successful salary awardees are also successful in obtaining operating grants irrespective of gender. There was an overall trend toward more men pursuing biomedical research than women. Women KRESCENT NI showed a higher proportion of promotion to Associate Professor, but there was a much shorter follow-up period compared with CCHCSP which showed a high rate of promotion (97%) irrespective of gender.

Compared with their masculine counterparts, women scientists face a number of barriers to achieving academic success. This narrative is rooted in a number of historical, biological, and structural factors which are often difficult to overcome at the individual level. As gender imbalance has gained more widespread attention, greater emphasis has been placed on addressing the underlying institutional biases which lead to its propagation.[21,23] Implicit bias studies demonstrate that women are less likely to be hired for mathematical tasks, irrespective of their performance on such tasks, requiring them to perform at a higher standard to receive comparable recognition.[32] These existing gender inequalities will only be amplified by the COVID-19 pandemic.[33] Indeed, early analyses of journal submissions since the beginning of the pandemic have shown disproportionately lower submission rates for women compared with men authors and historical comparators.[34-36] This is particularly pronounced for solo-authored articles and articles on COVID-19.[34,35] Pandemic restrictions such as school closures, social distancing requirements, and caring for ill relatives may limit time to work on projects and access to the workplace.[36] Young women researchers early in their careers are likely to be disproportionately affected.

We postulate that the retainment of women trainees at the NI level in both the KRESCENT and CCHCSP cohorts may have been influenced by a number of features of these training programs. The KRESCENT and CCHCSP programs were not designed to address gender imbalance, and there were no specific implicit bias interventions for reviewers or applicants during the study period. However, they were designed to support research trainees and promote scientific collaboration in a diverse and inclusive environment. Since the inception of both KRESCENT and CCHCSP, leadership, peer review panels, and the awardees have been balanced by gender. We speculate this environment may have helped to mitigate the effects of implicit bias and maintain women in science and academia, as evidenced by the gender balance in its trainees.[37]

Mentorship and sponsorship play a key role in helping trainees launch an independent research career, but the gender imbalance of senior academics in Canadian institutions may make it more difficult to identify women mentors or role models.[7] Women trainees may also be disadvantaged in developing an effective mentor-mentee relationship given the expressed fears of men as mentors in the #metoo era.[38]

Launching an independent research program frequently overlaps with childbearing/rearing years,[22] and women with dependent children may be limited in their ability to attend conferences/meetings, decreasing opportunities for mentor-mentee relationships, collaborations, and scientific supports outside of their home institution.[22,39] KRESCENT and CCHCSP has an equal balance of men and women mentors and similar men/women proportions within the trainee population for peer support and networking. Objectives for KRESCENT and CCHCSP mentors and trainees are clearly outlined and include topics such as transitioning to an independent research program, finding and negotiating a first academic job, timing of applications for grants/awards, and so on (Supplementary Appendix 1—KRESCENT mentoring agenda example). Standardizing the exposure to these career development topics in an inclusive forum may help enable conversations to "level the playing field."[40] This structured support system which is accessible to all for a minimum of 3 years and was absent for CIHR salary awardees who did not have a training program independent from their home institution, may have had a protective effect in the challenging transition from PDF to NI.

Traditional supervisor-trainee relationships can be considered hierarchical and dependent, and potentially very isolating within small research environments. KRESCENT and CCHCSP provide external peer support and mentorship, to discuss issues that may be in the trainee's best interests but not necessarily that of the primary supervisor or home institution (eg, job negotiation). KRESCENT and CCHCSP clearly distinguishes the role of Program Mentor from the Research Supervisor. In so doing, mentorship remains trainee-oriented, minimizes conflicts of interest, and decouples the success of a trainee from the success of their supervisor. We hypothesize that such an external training environment diffused these hierarchical tendencies and helped contribute to gender-balanced outcomes. Beyond comparisons of trainees in training programs compared with those with only salary awards, it is difficult to differentiate the effects of mentorship from the trainee's home-center versus the training program. Trainees attended a large number of institutions and we were therefore unable to appraise and account for the available home-center mentorship opportunities.

Although the gender distribution in the KRESCENT and CCHCSP cohorts were preserved from the PDF to NI stages, these absolute proportions should be considered in the context of the gender distribution of applicants to these programs. This information was not available for all-comer applicants including PhD trainees but the gender distribution in the clinical specialties[41] represented in these training programs tends to skew to a higher proportion of men in Nephrology for KRESCENT trainees, and more women in Pediatrics for CCHCSP. Given these baseline proportions, it is commendable that the KRESCENT cohort's selection process produced a gender-balanced cohort and it is unsurprising that there were more men physicians in the PDF group relative to women. Although the overall CCHCSP cohort was largely women, this was driven by PhD trainees while the Pediatric physicians were predominantly men. There was also a higher proportion of men PDF and NI among clinician-scientists compared with PhD awardees. This predilection for men clinician-scientists demonstrates ongoing gender imbalance in academic medicine and a need for further interventions to mitigate this gap.

The strengths of our study include addressing an important societal issue in a real-world experiment. The overall success of KRESCENT, CCHCSP, and CIHR graduates in obtaining operating grants is encouraging, albeit with small numbers in the KRESCENT and CCHCSP cohorts. The observed attrition of women scientists from PDF to NI in the CIHR awardees suggests that efforts might be focused on support systems during this critical transition period. While KRESCENT and CCHCSP utilize structural elements that may be broadly and readily applied to other training environments, further testing is required to clarify specific strategies effective at reducing gender imbalance.

There are several limitations to this study. First, this was a retrospective observational study and we cannot directly link an intervention to the trainee outcomes. The retrospective nature of this analysis precludes understanding the specific reasons for the lower proportion of CIHR NI women awardees. The evaluated time periods differed among the three cohorts and were sufficiently long that generational changes in focus on gender imbalance may have affected our results temporally. However, the cohort sizes were small and likely underpowered to detect temporal trends. Heterogeneity of the cohorts, including differential award durations and trainee types (eg, kidney or pediatric researchers vs. generalized CIHR research pool), precluded combining the training program cohorts and between cohort comparisons. KRESCENT and CCHCSP were smaller cohorts thereby limiting power and the ability to adjust for confounders. National operating funding is likely underestimated and largely focused on kidney-centric funding, as National Institutes of Health and other charitable organization grants are not captured here. Given the overall high funding rates we do not anticipate this would change the findings. Furthermore, women have been shown to obtain lower amounts of grant funding,[9,12] but data were not available on the amount awarded to evaluate this. Although the method for assigning gender by first names has been previously applied,[28] misclassification is possible in the event of gender-neutral names, incongruency between legal name and gender identity, or different social conventions in naming across cultures or generations. NamepediA provides linkages between first names and gender which varies between countries, and trainees may have been misclassified in this way as their nationalities were not known. Gender refers to a complex set of socially constructed characteristics which are applied to people and interacts with but ultimately differs from biologic sex. Data on the sex composition of the applicant pools in each cohort were not available. Finally, we

cannot comment on intersectionality as this data was not captured, but future studies should explore the intersection between gender as a multidimensional phenomenon and other societal factors including race, ethnicity, and sexual orientation.

Conclusion

We observed a strong representation of women scientists in the KRESCENT and CCHCSP training program cohorts from the PDF to NI career stages. The CIHR salary award cohort demonstrated similar representation of women among its PDF trainees, but experienced attrition of women scientists at the NI career stage. We speculate that the training programs were potential tools that supported women scientists during the challenging PDF to NI transition period. This exploratory study highlights the potential influence of programmatic training and gender-balanced award selection committees in promoting gender diversity and equity for future trainees.

Ethics Approval and Consent to Participate

Ethics was submitted and review was waived (University of Manitoba Research Ethics, HS23225 H2019:365.

Consent for Publication

All authors consent to publication.

Availability of Data and Materials

Supplementary Appendix 1 - KRESCENT mentoring agenda

Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: The authors have no financial conflicts of interest to declare. T.A., S.H., A.L., and S.S. are KRESCENT and CCHCSP program leaders, respectively. T.A., S.H., S.S., C.W., and J.H. are KRESCENT graduates. N.R. is Scientific Director, CIHR Institute of Nutrition, Metabolism and Diabetes.

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Supplemental Material

Supplemental material for this article is available online.

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