

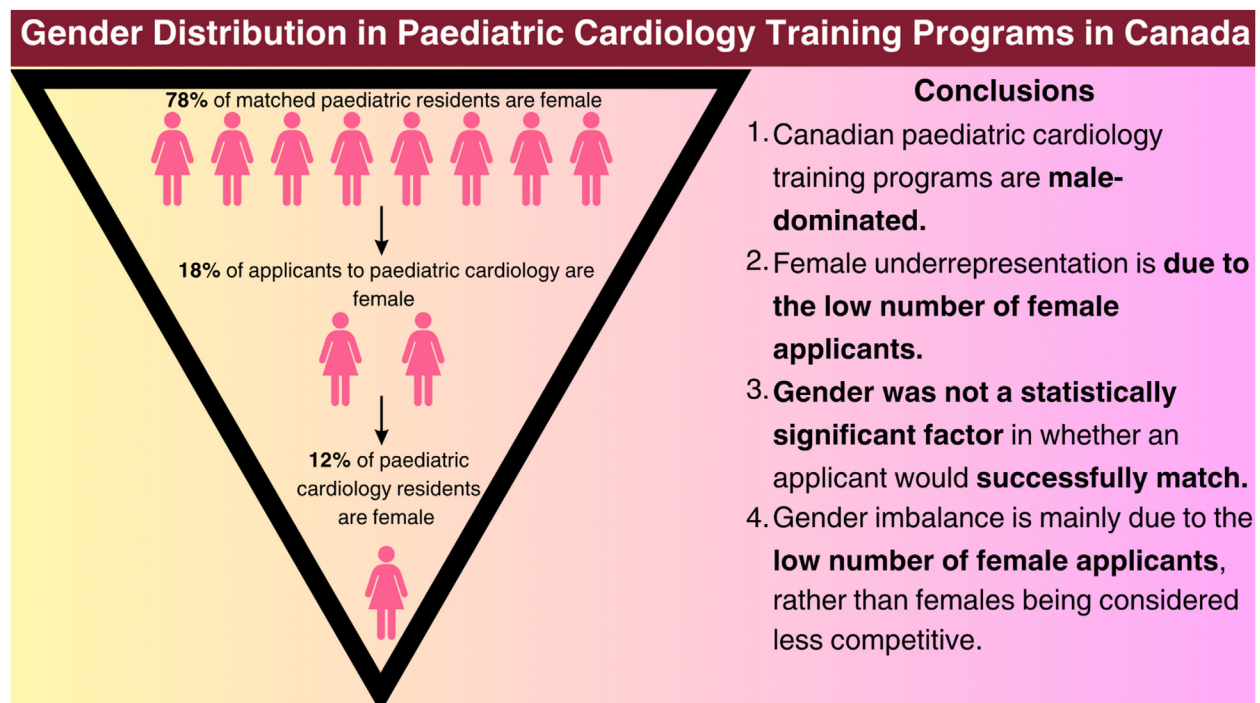
## Original Article

# Gender Distribution in Paediatric Cardiology Training Programs in Canada

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## ABSTRACT

**Background:** Despite female medical students being the majority, there are certain medical specialties that continue to have a prevalence of male trainees, such as adult cardiology. The purpose of this

## RÉSUMÉ

**Contexte :** Bien que la cohorte d'étudiants en médecine soit majoritairement composée de femmes, les cours dans certaines spécialités, comme la cardiologie chez l'adulte, sont surtout composés d'hommes.

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Medicine is a field that has shown significant gender discrepancy, with women being historically under-represented within medicine in Canada.<sup>1</sup> However, in recent decades, there has been a shift of Canadian medical student demographics, with females entering medical training at equal numbers or greater numbers than males.<sup>1</sup> Despite this fact, there are certain medical specialties that continue to have a prevalence of males at the residency, subspecialty resident,

study is to examine gender distribution within Canadian paediatric cardiology training programs.

**Methods:** Both application and successful matches to core paediatric residency programs and paediatric cardiology programs were obtained through the Canadian Resident Matching Service. Analysis was performed to determine if the association between gender of paediatric residents and paediatric cardiology applicants/fellows was significant.

**Results:** Between 2016 and 2024, 12% ( $n = 3/26$ ) of individuals who successfully matched into a Canadian paediatric cardiology training program identified as female and 88% ( $n = 23/26$ ) identified as male. Between 2013 and 2023, 78% ( $n = 947/1220$ ) of individuals who successfully matched into a Canadian paediatrics residency identified as female and 22% ( $n = 273/1220$ ) identified as male. There was a statistically significant difference between the gender of paediatric residents and the gender of paediatric cardiology residents ( $P < 0.0001$ ). There was no significant association between applicant gender and match outcome within paediatric cardiology training programs ( $P < 0.23$ ).

**Conclusions:** There is a gender discrepancy within Canadian paediatric cardiology training programs with a predominance of male trainees in the recent era. It appears that female under-representation in the field is due to the low number of female applicants. Although limited by sample size, there was no clear association between applicant gender and success of admission to a paediatric cardiology training program.

and staff/consultant level.<sup>1</sup> Adult cardiology has the lowest number of practising female physicians of all internal medicine subspecialties.<sup>2</sup> With that being said, there may be unique characteristics in the field of cardiology that allows for gender imbalance to persist in multiple countries, over multiple decades and to such an extent.

Paediatric cardiology is an interesting field for the analysis of trainee demographics given that the gender of paediatric residencies appears to be overwhelmingly female. Canadian specific literature on the demographics of the training programs in paediatric cardiology is limited. The objective of this study is to examine the gender make-up of those who applied to and of those who matched to Canadian paediatric cardiology training programs. In addition, we looked to quantify the gender discrepancy between Canadian paediatric programs and paediatric cardiology training programs across the country.

## Methods

### Study design and population

Data were obtained from the Canadian Resident Matching Service (CaRMS). The interpretations made in this article using CaRMS data were made by the investigators, not by CaRMS. The paediatrics residency matching data reflect the 2013-2023 R1 match, inclusively. The paediatric cardiology resident data reflect the 2016-2024 paediatric subspecialty match, inclusively. These timeframes were chosen to ensure that the data reflect the current landscape of the field of

Cette étude vise à examiner la répartition des sexes au sein des programmes de formation en cardiologie pédiatrique au Canada.

**Méthodologie :** Les demandes d'inscription et les jumelages réussis dans les programmes de base de résidence en pédiatrie et les programmes en cardiologie pédiatrique ont été obtenus par l'intermédiaire du Service canadien de jumelage des résidents (CaRMS). Une analyse a été utilisée pour déterminer si le lien entre le sexe des résidents en pédiatrie et les candidats/boursiers en cardiologie pédiatrique était important.

**Résultats :** De 2016 à 2024, 12 % ( $n = 3/26$ ) des personnes ayant été jumelées avec succès dans un programme de formation en cardiologie pédiatrique au Canada s'identifiaient comme femmes, et 88 % ( $n = 23/26$ ) comme hommes. De 2013 à 2023, 78 % ( $n = 947/1220$ ) des personnes ayant été jumelées dans une résidence en pédiatrie au Canada s'identifiaient comme femmes et 22 % ( $n = 273/1220$ ) comme hommes. Il y avait une différence statistiquement significative entre les sexes des résidents en pédiatrie et les sexes des résidents en cardiologie pédiatrique ( $p < 0,0001$ ). Aucun lien notable n'a été observé entre le sexe des candidats et le résultat des jumelages dans les programmes de formation en cardiologie pédiatrique ( $p < 0,23$ ).

**Conclusions :** Il existe une disparité entre les sexes dans les programmes de formation en cardiologie pédiatrique au Canada, avec une prédominance des étudiants masculins au cours des dernières années. Il semble que la sous-représentation des femmes dans le domaine est due au petit nombre de candidates. Bien que les résultats soient limités par la taille de l'échantillon, aucun lien évident n'a été observé entre le sexe des candidats et les admissions réussies dans un programme de formation en cardiologie pédiatrique.

paediatrics and paediatric cardiology in Canada. Gender was self-reported by the applicants, specifically to CaRMS. CaRMS is used by all Canadian residency programs and Canadian paediatric subspecialty programs, thus ensuring complete data within the study. Any interpretation of these CaRMS data is representative of the authors' views, not CaRMS itself.

CaRMS data showed the number of female and male applicants for paediatrics and paediatric cardiology. The number of female and male paediatric residency spots and paediatric cardiology residency spots were also reported. Paediatric cardiology residents are individuals accepted to complete a 3-year fellowship that trains them in paediatric cardiology, after having completed either 3 or 4 years of general paediatrics residency. Gender was self-reported as male, female, or other/did not disclose. Because of small subsets and to ensure privacy, CaRMS did not include applicants who did not disclose their gender, as these samples were  $<5$  individuals per year and would risk identifying these individuals. Because of the nature of the study, the research ethics board at our institution was not involved.

### Statistical analysis

Data are presented as frequency with percentages (%) for the categorical variables of gender for both paediatrics and paediatric cardiology. A  $\chi^2$  test was performed to determine the association between gender of paediatric residents and gender of paediatric cardiology applicants. A 2-tailed, Fisher's exact test was performed to determine the association between

paediatric residents' gender and paediatric cardiology residents' gender. Another 2-tailed, Fisher's exact test was performed to determine the association between paediatric cardiology applicant gender and match outcome. All analyses used a  $P < 0.05$  to determine significance.

### Results

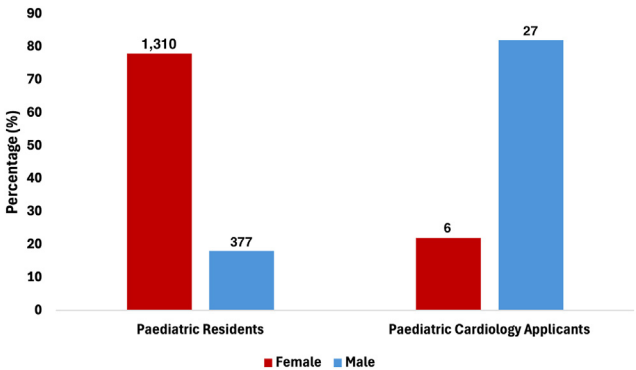
Between 2013 and 2023, there were 1723 paediatric residency spots available and 1687 matched applicants to paediatric residency programs in Canada, resulting in a match rate of 98% ( $n = 1687/1723$ ) for paediatrics. Of the match applicants, 78% ( $n = 1310/1687$ ) identified as female and 22% ( $n = 377/1687$ ) identified as male. Between 2013 and 2023, less than 15 individuals who matched into a Canadian paediatric residency program did not disclose their gender and/or did not identify as either male or female. These individuals are not included in the analysis of the study.

Between 2016 and 2024, there were 49 positions available in paediatric cardiology residency programs across Canada. In total, 33 people applied to the field and 26 people were matched, resulting in a match rate of 53% ( $n = 26/49$ ). The filled and unfilled spots in paediatric cardiology are shown in Figure 1. Of the applicants to paediatric cardiology, 18% ( $n = 6/33$ ) identified as female and 82% ( $n = 27/33$ ) identified as male ( $P < 0.0001$  compared with the gender proportion of paediatric residents). This result is shown in Figure 2. Of those who matched, 12% ( $n = 3/26$ ) identified as female and 88% ( $n = 23/26$ ) identified as male ( $P < 0.0001$  compared with the gender proportion of paediatric residents). There was not a significant difference between applicant gender ( $n = 6/33$ , 18% female) and match outcome ( $n = 3/26$ , 12% female) in paediatric cardiology programs ( $P < 0.23$ ). This result is shown in Figure 3.

### Discussion

#### Overview

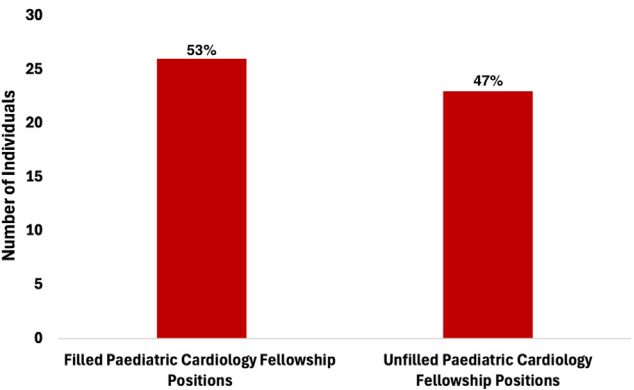
This research was conducted to quantify the gender distribution in Canadian paediatric cardiology residency programs. As expected, general paediatric residency



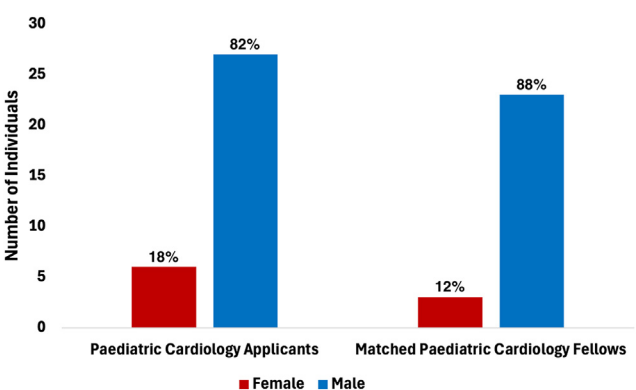
**Figure 2.** Comparison of males and females in paediatric residency compared to paediatric cardiology fellowship applicants in Canada.

programs continue to have a high prevalence of female residents in Canada; however, paediatric cardiology training programs have a high prevalence of males. The difference in gender of potential applicants to the field (female majority in paediatrics) compared with matched applicants (male majority in paediatric cardiology) is statistically significant. There is also a statistically significant gender difference between the potential applicant pool (paediatric residents) and applicants to paediatric cardiology training programs.

The proportion of males increased after matching; however, gender was not a statistically significant factor in whether an applicant to a Canadian paediatric cardiology training program would successfully match. The data suggest that the imbalance of gender in paediatric cardiology is mainly due to the upstream issue of the low number of female applicants, rather than female applicants not being considered as competitive as their male peers within the program selection committee. The association between gender and successfully matching is difficult to comment on due to the lower number of female applicants limiting statistical power. To improve gender diversity within the field, strategies must be implemented to encourage female paediatric residents to apply to cardiology fellowships and to address potential gender bias within the field.



**Figure 1.** Comparison of filled and unfilled paediatric cardiology fellowship spots between 2016 and 2024.



**Figure 3.** Comparison of males and females applying to paediatric cardiology and matched to paediatric cardiology.

## The potential pool: paediatric trainees in Canada

The path to become a paediatric cardiologist in Canada consists of an applicant completing a minimum of 3 years of general paediatrics residency, with some applicants completing 4 years of general paediatrics residency before applying.<sup>3</sup> This will change to a mandatory 4-year program for the 2025 cohort.<sup>3</sup> We found that 78% of individuals who are eligible to apply for paediatric cardiology fellowships identify as female. The potential trainee pool has an over-representation of females, which makes the dramatic drop in female paediatric cardiology trainees even more interesting.

The lack of female interest in paediatric cardiology creates an issue for both institutions and patients. It is in the best interest of fellowship programs to attract female applicants, as diversity within a speciality can allow for better patient care and resilience.<sup>4-9</sup> In paediatrics specifically, meeting the physician-gender preferences of children allows them to feel comfortable and have a positive attitude about their physician.<sup>4</sup> Correcting the gender imbalance within paediatric cardiology advocates for both female paediatric residents and young female patients seeking care who may prefer gender congruent physicians.<sup>4</sup>

## Paediatric cardiology training: male dominated

Our study shows that paediatric cardiology training programs in Canada are male dominated. The reasons for females not pursuing paediatric cardiology training is likely multifactorial. Currently, the minimum training period for paediatric cardiology is 7 years, which may concern female applicants who have time-based fertility concerns for family planning.<sup>3,5</sup> The additional mandatory year that will be required for paediatrics training in 2025 may further discourage females from applying, creating an even larger gender imbalance.<sup>3,5</sup> The additional mandatory year of paediatrics training will now be required of applicants to all paediatric fellowships, potentially amplifying gender discrepancies across all paediatric fellowships, as well as possibly decreasing applicant rates to the subspecialty as a whole.

Female physicians cite structural and interpersonal reasons, including gender discrimination, for not entering male-dominated specialities.<sup>10,11</sup> In the critical care environment, some women cited a preference for male traits and discriminatory actions as reasons for gender inequality within that field.<sup>6</sup> Institutional barriers to fulfilling family responsibilities, such as long hours and inflexibility, which were worsened by the COVID19 pandemic, are also supportive of gender discrimination within the field.<sup>6,12</sup> Specialties with an over-representation of male physicians place less value on the contributions of female physicians, preventing female career advancement.<sup>9</sup> Addressing the gender imbalance of Canadian cardiology fellows at the applicant level will create an environment that allows for academic promotion in the field in the future. Given the Canadian paediatric cardiology training landscape, it is plausible that these gender bias systems are present and may discourage females from entering our profession.

## Applicant bias not seen

Over an 8-year period, there were only 6 females who applied to paediatric cardiology residency in the country. This

supports our conclusion that the low number of females in paediatric cardiology fellowships is due to the low number of applicants applying rather than applicant reviewers preferentially ranking male applicants. Other research has shown that implicit gender bias in medicine can affect selection rankings, for example, the male physician being perceived as career focused and female physicians being perceived as family focused.<sup>13</sup> The inconsistency between our results (applicant gender bias not seen) and the literature (gender bias seen in medicine) is possibly explained by the very low number of females applying to paediatric cardiology, which limited our statistical power to determine the impact of gender of the success of an applicant applying to paediatric cardiology. With that, we recommend challenging implicit biases of those within medicine to create a more inclusive culture for women in paediatric cardiology despite no evidence that this implicit or explicit bias is impacting the selection of paediatric cardiology fellows in Canada at present.<sup>6</sup>

## Untapped potential: unfilled positions in paediatric cardiology

Many paediatric cardiology spots in Canada remain unfilled each year. Between 2016 and 2024, only 26 individuals entered paediatric cardiology fellowship programs despite 49 spots being available, totalling only 53% of training spots being filled. This is much lower than in general paediatrics, where 98% of spots are filled. Although there are differences in the way the paediatrics match and paediatric cardiology training spots are regulated, there is a lack of interest in the field among Canadian medical graduates. The field of paediatric cardiology is considered a high-stress career that involves a long and difficult training pathway.<sup>3</sup>

We must continue to train Canadian paediatric cardiologists to ensure that the communities we serve in the future have access to competent care in the field. The barriers and negatives of the field deter high-calibre applicants who would excel within the fellowship from applying.<sup>3</sup> Considering that 78% of potential applicants are female, equity-based programs with the goal of inspiring female paediatric residents to apply will yield the greatest results in terms of increasing the number of fellowship applicants. As such, the strategies for applicant recruitment suggested in this paper are key methods of not only improving gender diversity, but simply increasing the number of applicants to the field by improving opportunity and desirability.

## Comparison to adult cardiology training programs

In Canada, 49% of internal medicine residents are female; this is similar to the gender demographics of internal medicine trainees in the United Kingdom and Australia.<sup>2</sup> Internationally, 27% of adult cardiology trainees are female, suggesting that the under-representation of female adult cardiologists will continue in the foreseeable future. Current modelling estimates that gender inequality will persist in the international cardiology community for the next 50 years given the low rates at which female physicians are entering the field and the low rates of change seen in the speciality.<sup>14</sup> We can make similar inferences about the field of paediatric cardiology, stating that if the status quo continues, we will continue to see gender imbalance within the field.



The drop in female representation between paediatrics and paediatric cardiology training mimics the “residency to fellowship cliff” used to describe the decrease in the number of female trainees in internal medicine who go on to pursue a fellowship in cardiology.<sup>15</sup> A total of 35% of internal medicine physicians identify as female, yet only 15% of cardiologists in North America, the United Kingdom, and Australia are female.<sup>2</sup> Within the field of interventional cardiology, the gender imbalance is heightened, with only 7% identifying as female.<sup>2</sup> The drastic drop in female representation within certain cardiology subspecialties is defined as the “second cliff.”<sup>2</sup> Women reported lack of opportunity, rather than work-life-balance factors, as the main reason for not pursuing interventional cardiology.<sup>2</sup> Systemic and institutional factors discourage female physicians from the opportunity to pursue cardiology training at both the adult population and child population levels.

### Comparison with US paediatric cardiology training programs

Only 12% of Canadian paediatric cardiology trainees are female, compared with 55% in the United States.<sup>16</sup> The low number of female applicants to paediatric cardiology in Canada possibly reflects an unsupportive work culture and/or hidden curriculum that is unique to the Canadian field of paediatric cardiology. We cannot comment more specifically on this subject with this data. The number of American paediatric cardiology fellowship spots has increased, but the number of applicants has remained stable.<sup>14</sup> If this trend continues, American paediatric cardiology fellowship spots will go unfilled in the future, an occurrence that is common with the Canadian positions, as our data shows. The drastic difference in gender between Canada and the United States further emphasizes how Canadian paediatric cardiology is losing potential talent at the fellowship match level.

### Upstream factors

When choosing a speciality, medical students overtly consider their interests in the field, work-life balance, and lifestyle.<sup>17</sup> The literature suggests that gender has a strong impact on the residencies and fellowships medical trainees choose to apply for; this conclusion is further supported by the results of our study.<sup>18</sup> Female cardiologists express high career satisfaction, but female medical trainees recognize parenting responsibilities, the work environment culture, and poor work-life balance as reasons not to pursue cardiology.<sup>19</sup> The culture of cardiology training differs for male and female trainees. Male cardiology fellows seeking parental leave are usually treated favourably, whereas no female cardiology fellows seeking leave for parental duties reported favourable responses by their programs.<sup>19</sup>

Lack of women within a medical speciality leads to a cycle of further female under-representation.<sup>2</sup> Female role models and opportunity for female mentorship impact trainees’ choice of speciality.<sup>2</sup> Female medical students report challenges to integrate into male-dominated networks within medicine.<sup>1</sup> The number of female medical trainees in a speciality is directly correlated with female representation within that speciality.<sup>1</sup> Improving work-life balance, gender

discrimination, and female representation will encourage female paediatric residents to apply.<sup>2,15</sup>

### Recommendations for improving the system

We suggest the following approach to actively increase the number of female applicants to paediatric cardiology fellowship programs in Canada. First, a formal female paediatric cardiology mentorship program should be created to allow female potential applicants to recognize female success within the field and they should be provided mentorship early in their career development, thus empowering them to apply to paediatric cardiology. Secondly, we must take definitive action to create a culture in paediatric cardiology that is inclusive and celebratory of female trainees and physicians. This involves structural changes such as flexible scheduling, appropriate maternity leave policies, and equal pay, as well as a mental shift where the contributions of female cardiologists are respected; gender-biased microaggressions are not accepted and potential female applicants are made to feel welcome in the field.

### Limitations

Statistical limitations are due to the low number of Canadian paediatric fellowship spots in Canada, thus limiting analyses to a small population. More specifically, the low number of female applicants ( $n = 6$ ) and female residents who successfully matched to paediatric cardiology ( $n = 3$ ) decreased the statistical power. CaRMS does not provide specifics on if applicants completed 3 or 4 years of training before application, citizenship of applicants, or if accepted applicants withdrew or completed the program, further limiting our analyses due to unknown confounding variables. In addition, the match data during the COVID-19 pandemic are included in the study and may impact the results as there is some evidence that the pandemic increased gender-based barriers to pursuing certain medical specialties.<sup>2</sup> Lastly, this is a quantitative study and thus cannot identify the reasons why females chose not to apply to cardiology fellowships and/or their specific experiences within the field; future research should focus on the root causes of the significant gender discrepancy.

### Conclusions

This study found that Canadian paediatric cardiology training programs are a male-dominated field and that female under-representation in the field is due to the low number of female applicants. Our study found no impact of gender on the success of an applicant applying to Canadian paediatric cardiology. Further research is needed to examine the impact of gender on the success of applicants due to low statistical power and the literature showing evidence of gender bias in medicine. As such, programs should focus on recruiting female paediatric residents to paediatric cardiology to improve this workforce concern.

### Ethics Statement

Because of the nature of the study, the research ethics board at the authors’ institution was not involved.

## Patient Consent

The authors confirm that patient consent is not applicable to this article. No patient information was collected or used in this study.

## Funding Sources

No funding was received for this study.

## Disclosures

The authors have no conflicts of interest to disclose.

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