

# Women in Radiology: Exploring the Gender Disparity

**EC:** Editor's Choice

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## Abstract

**Purpose:** In 2015, only 1.5% of female Canadian medical students pursued radiology as a specialty, versus 5.6% of men. The aim of this study was to determine what factors attract and deter Canadian medical students from pursuing a career in radiology, and why fewer women than men pursue radiology as a specialty.

**Methods:** An anonymous online survey was e-mailed to English-speaking Canadian medical schools, and 12 of 14 schools participated. Subgroup analyses for gender and radiology interest were performed using the Fisher exact test ( $P < .05$ ).

**Results:** In total, 917 students (514 women; 403 men) responded. Direct patient contact was valued by significantly more women who were not considering specialization in radiology (87%), compared with women who were (70%;  $P < .0001$ ). Physics deterred more women (47%) than it did men (21%), despite similar educational backgrounds for the two gender groups in physical sciences ( $P < .0001$ ). More women who were considering radiology as a specialty rated intellectual stimulation as being important to their career choice (93%), compared with women who were not (80%;  $P = .002$ ). Fewer women who were not interested in radiology had done preclinical observerships in radiology (20%), compared with men who were not interested in radiology (28%;  $P = .04$ ).

**Conclusions:** A perceived lack of direct patient contact dissuades medical students from pursuing radiology as a career. Women have less preclinical radiology exposure than do men. Programs that increase preclinical exposure to radiology subspecialties that have greater patient contact should be initiated, and an effort to actively recruit women to such programs should be made.

**Key Words:** Radiology residency, women in radiology, gender, radiology exposure, specialty selection

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## INTRODUCTION

Women constituted more than half (53%) of Canadian medical graduates applying to Canadian residency programs in 2015, yet diagnostic radiology was the first-choice discipline for only 1.5% of women, compared with 5.6% of men [1]. Despite equal success rates among men and women in obtaining radiology residency positions in Canada, this gender difference has remained relatively constant during the past decade [1,2].

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In the 2015 Canadian residency match, 25% of medical students matching into diagnostic radiology were women [1]. In contrast, women constituted 40% of all medical students who matched into a surgical specialty [1]. Similarly, in the United States, radiology ranks 17th of 20 among the largest training specialties for its proportion of women, and it is the lowest ranked of the nonsurgical specialties [3,4].

Underrepresentation of women in radiology has been the topic of several papers, including a review by Potterton et al [5], which discussed how positive exposure to a specialty during medical school may influence specialty choice [5]. Other studies [6,7] have found that direct patient contact is a factor influencing specialty choice. Although a survey by Fielding et al [7] found that a lack of direct patient contact was the factor that most strongly dissuaded American clerkship students from pursuing radiology as a specialty [6], no significant gender-specific differences in factors dissuading men and women were elicited [6].

These studies point to a need for further research, as the factors that account for the significantly lower proportion of women who choose radiology, compared with that of men, are still not well understood [5-7]. Historically, in the United States, the relative attractiveness of diagnostic radiology as a specialty has been related to its economic vitality (ie, job market and salary) [8]. Overall, medical students' knowledge of the interplay between economic factors and radiology has been suggested as a relevant factor in their selection of a specialty, but the role of gender in this context has not been examined.

The reasons underlying gender disparity in radiology training programs remain unknown. Are women who consider radiology attracted to different qualities in a specialty, compared with women who do not? Are men and women deterred from pursuing radiology as a specialty for different reasons? The purpose of this study was to investigate what factors attract Canadian medical students to and deter them from radiology, and to determine if these factors differ between women and men.

## METHODS

This study was fully approved by the Western University Research Ethics Board. Institutional research ethics board approval for the study was obtained from our home university, as well as from the other schools that subsequently agreed to participate in the study. Factors included in the questionnaire were identified based on the published literature, as well as discussion among study team members. The study was pilot tested, with multiple medical students rotating through our radiology department, and revised for clarity and ease of use, through multiple iterations, to minimize potential ambiguity in the questions. The main survey questions were peer reviewed by three radiologists, two radiology residents, and four medical students (Online Appendix 1).

Survey participants provided demographic data, including age, gender, medical school attended, level of training (years 1 and 2: preclerkship; years 3 and 4: clerkship), and field of study before medical school. Students who were potentially interested in considering a career in radiology were asked to identify factors that attracted them to the field. Students who were definitely not considering a career in radiology were asked to identify factors that were dissuading them from pursuing a career in radiology. Students were asked to indicate their prior radiology exposure, any previous mentoring they had received in radiology, and factors influencing their specialty choice in general.

All 14 English-language Canadian medical schools were invited to participate in the anonymous online survey hosted on [SurveyMonkey.com](https://www.surveymonkey.com) in the 2012-2013 academic year. Eleven of the medical schools directly distributed the invitation to participate in the survey to their students, via e-mail, which contained a link to the online survey. One school posted the invitation on a notice board in their medical school. Two schools declined to distribute the survey to their students, citing frequent survey requests as the reason for not participating. Based on data from the Canadian Resident Matching Service [1], approximately 6,770 students had the opportunity to participate in the survey.

All statistical analyses were performed using commercially available software (GraphPad Prism, version 6.00, GraphPad Software, La Jolla, California). Categorical data, including the number of male and female medical students classifying a factor as important, and the corresponding proportions, with their numerators and denominators expressed as percentages, were calculated. Regarding overall specialty choice and radiology exposure, for each factor, comparisons were made between: (1) women and men; and (2) students who were considering radiology and students who were not. Subgroup analyses for each factor were performed for both men and women, based on whether they were considering radiology. Two-by-two tables were formed, using the numerators and denominators for the number of individuals who did and did not select a particular factor. Statistical analyses were performed using the Fisher exact test, with a significance level of  $P < .05$ .

## RESULTS

In total, 917 participated in the survey, for a response rate of approximately 14%. Of these, 514 were women (56%), and 403 were men (44%). Level of training was reported by 896 students: 560 students were in pre-clerkship (63%); 336 were in clerkship (38%). No significant difference was found in level of training by gender. Students who were potentially interested in considering radiology numbered 291 (32%), whereas 626 students (68%) were definitely not considering radiology as a specialty. Among the former group, 109 were women (37%), and 182 were men (63%).

### Radiology Exposure

Among students considering radiology as a specialty, more men did radiology-related research compared with women, whereas among students who were not considering a radiology specialty no gender-specific differences

**Table 1.** Medical students' exposure to radiology, by gender and interest in radiology

| Type of Exposure to Specialty | Considering Radiology |               |         | Not Considering Radiology |               |         |
|-------------------------------|-----------------------|---------------|---------|---------------------------|---------------|---------|
|                               | Women (n = 109)       | Men (n = 180) | P Value | Women (n = 403)           | Men (n = 219) | P Value |
| Preclinical observerships     | 38 (35)               | 84 (47)       | .05     | 82 (20)                   | 61 (28)       | .04*    |
| Selectives                    | 1 (1)                 | 5 (3)         | .41     | 16 (4)                    | 9 (4)         | 1       |
| Electives                     | 5 (5)                 | 20 (11)       | .08     | 24 (6)                    | 16 (7)        | .5      |
| Radiology research            | 14 (13)               | 43 (24)       | .02*    | 11 (3)                    | 11 (5)        | .17     |
| Radiology mentor              | 12 (11)               | 25 (14)       | .59     | 17 (4)                    | 3 (1)         | .06     |
| Radiology conferences         | 6 (6)                 | 19 (11)       | .19     | 7 (2)                     | 7 (3)         | .26     |
| Radiologist family member     | 8 (7)                 | 14 (8)        | 1       | 17 (4)                    | 5 (2)         | .26     |

Note: Values are n (%), unless otherwise indicated. Percentages were rounded. A preclinical observership is one undertaken in radiology, before clerkship, that is not required and is pursued out of personal interest. A selective is a required rotation in which a student chooses radiology from a limited list of specialty options provided to them. An elective is a rotation in which a student is allowed to choose any specialty, and chooses radiology.

\* $P < .05$ .

were found in radiology research experience. Among students who were not considering radiology, more men had done preclinical observerships in radiology, compared with women (Table 1).

### Specialty Choice

Direct patient contact was valued by significantly more women who were not considering radiology as a specialty (87%), compared with women who were considering it (70%;  $P < .0001$ ) (Fig. 1). More women who were considering choosing radiology rated intellectual stimulation and job opportunities as important. In addition, significantly more women who were considering radiology as a specialty were attracted by income, fewer working hours, the use of emerging technology, and the perceived favorability toward having children, compared with women who were not considering radiology. Factors that influence medical student specialty interest are summarized in Table 2.

### Factors Attracting Students to Radiology

The top factors attracting medical students to radiology as a specialty included job flexibility, interest in acquiring a broad range of knowledge, and income (Fig. 2; Table 3).

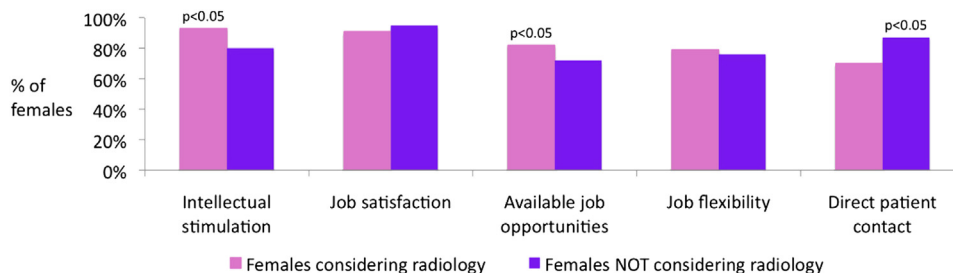
Significantly more women were attracted by job flexibility, whereas more men were attracted by income and the involvement of physics.

### Factors Deterring Students From Radiology

Lack of direct patient contact was the most common deterrent to choosing radiology as a specialty, dissuading 83% of both women and men who had decided not to pursue a career in radiology (Fig. 3; Table 4). Despite women and men having similar educational backgrounds, with approximately 10% of students having studied the physical sciences before medical school, lack of knowledge of physics deterred significantly more women (47%), compared with men (21%) ( $P < .0001$ ). Approximately 60% of medical students were deterred by the prospect of working in a dark environment.

### DISCUSSION

Radiology has been perceived as a specialty with an ostensibly controllable lifestyle [9]; yet, it is one of the few with less than 40% female representation [10]. According to the 2014 Canadian National Physician Survey, 28% of radiologists were women [11]. Increasingly, more female radiologists work part



**Fig 1.** Top factors influencing female medical students' specialty choice.

**Table 2.** Factors influencing overall specialty choice, by gender and interest in radiology

| Factor                       | Women Considering Radiology (n = 109) | Women Not Considering Radiology (n = 405) | P Value | Men Considering Radiology (n = 182) | Men Not Considering Radiology (n = 221) | P Value |
|------------------------------|---------------------------------------|---|---------|-------------------------------------|---|---------|
| Intellectual stimulation     | 101 (93)                              | 325 (80)                                  | .002*   | 163 (90)                            | 191 (86)                                | .36     |
| Job satisfaction             | 99 (91)                               | 384 (95)                                  | .17     | 170 (93)                            | 214 (97)                                | .16     |
| Available job opportunities  | 89 (82)                               | 290 (72)                                  | .04*    | 136 (75)                            | 157 (71)                                | .43     |
| Direct patient contact       | 76 (70)                               | 351 (87)                                  | <.0001* | 97 (53)                             | 172 (78)                                | <.0001* |
| Job flexibility              | 86 (79)                               | 306 (76)                                  | .5      | 136 (75)                            | 125 (57)                                | .0002*  |
| Fewer working hours          | 49 (45)                               | 115 (28)                                  | .0017*  | 74 (41)                             | 68 (31)                                 | .05     |
| Favorable to having children | 84 (77)                               | 266 (66)                                  | .03*    | 77 (42)                             | 86 (39)                                 | .54     |
| High income                  | 44 (40)                               | 91 (22)                                   | .0003*  | 112 (62)                            | 80 (36)                                 | <.0001* |
| Using emerging technology    | 36 (33)                               | 42 (10)                                   | <.0001* | 105 (58)                            | 75 (34)                                 | <.0001* |

Note: Values are n (%), unless otherwise indicated. Percentages were rounded.

\*P < .05.

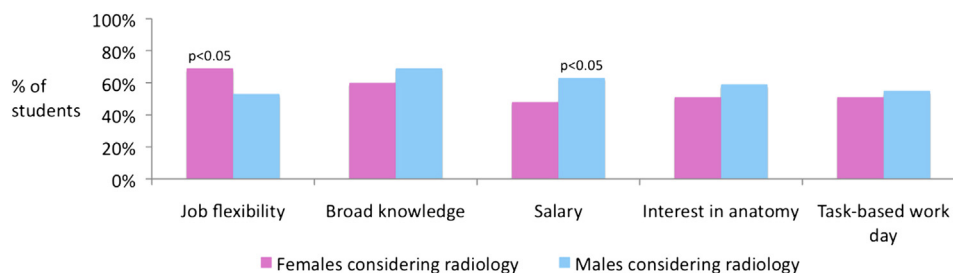
time [12]. As demonstrated in our study, job flexibility attracted more women than men to radiology, and this finding is congruent with previous evidence showing that many women choose radiology as a specialty because of the potential for part-time work [12,13]. Good work-family balance and minimal administrative responsibilities have been found to be more influential to practicing female, compared with male, radiologists in Switzerland [14].

Their perception of the availability of job opportunities was one of the top factors influencing female medical students' overall specialty choice: This factor was significantly more important to women who were considering a radiology career than to women who were not. Perceived job availability has been found to have the largest impact on Spanish medical students' specialty choice [15]. In our study, high income was important to a greater proportion of students who were considering radiology as a specialty, compared with those who were not, and it was significantly more important to men, compared with women. This finding is congruent with a gender-specific attraction

toward higher income among staff radiologists in Switzerland [14].

Negative perceptions, such as perceived hiring and promotion inequities among female radiologists, have been postulated to spiral down and negatively influence female medical students [16]. Moreover, female radiologists have significantly attributed deficient career support to their gender [14], and they are underrepresented at higher levels of administration and in tenured positions in radiology [17]. Although previous studies have concluded that a lack of mentorship relates to the radiology field's gender disparity [18], we found no significant difference in radiology mentorship for female versus male medical students. We speculate that the aforementioned gender distinction among staff radiologists may relate to their experience during residency and in early practice, rather than in medical school.

Lack of direct patient contact deters medical students from pursuing radiology as a specialty, and we confirm that this factor is especially important for women who are not considering a career in radiology. However, the lack



**Fig 2.** Top factors attracting students to radiology as a specialty, by gender.

**Table 3.** Factors attracting students to radiology, by gender, among those considering radiology as a specialty

| Factor   | Women<br>(n = 109) | Men<br>(n = 182) | P<br>Value |
|--|--------------------|------------------|------------|
| Job flexibility  | 75 (69)            | 97 (53)          | .01*       |
| Task-based work day  | 56 (51)            | 101 (55)         | .54        |
| Having focused patient interactions with minimal paperwork | 51 (47)            | 84 (46)          | 1          |
| High income  | 52 (48)            | 114 (63)         | .01*       |
| Interest in acquiring a broad range of knowledge           | 65 (60)            | 125 (69)         | .13        |
| Interest in anatomy  | 56 (51)            | 107 (59)         | .23        |
| Interest/background in medical imaging                     | 22 (20)            | 58 (32)          | .04*       |
| Physics knowledge  | 19 (17)            | 58 (32)          | .009*      |

Note: Values are n (%), unless otherwise indicated. Percentages were rounded.

\* $P < .05$ .

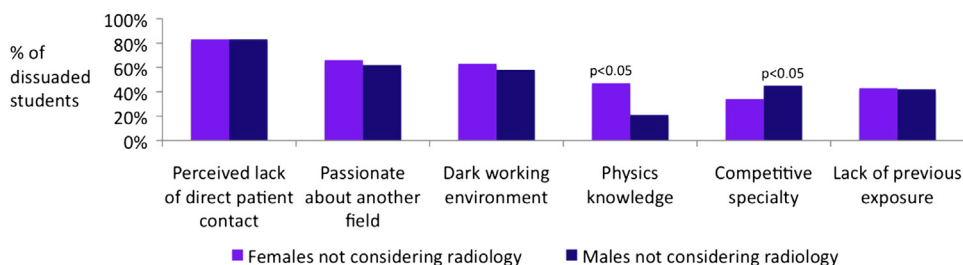
of patient contact cannot entirely explain why fewer women pursue radiology as a career, because significantly greater female representation is found in specialties such as pathology (54.1%) [19]. Women are markedly underrepresented in interventional radiology (9.5-12.2%) [19,3], despite its having the most patient contact; presumably, this underrepresentation relates to the field's relatively more demanding work life, with more on-call requirements, less predictability and flexibility, and lack of part-time work. Women are attracted to specialties that are favorable to having children, so the increased radiation exposure and more physically demanding work involved in interventional radiology may deter women.

The dark work environment deterred a large, equal proportion of men and women from radiology. This factor may reflect an outdated radiology perception, given that some radiologists now work with the lights on, or have windows in their offices, since the advent of PACS and modern monitors.

Evidence on the effect of radiology exposure on medical student interest is inconclusive and contradictory in the literature. Although taking radiology electives improves medical student acceptance of the radiologist as a consultant [20,21], and increases interest among students who are already interested in the specialty [21-23], such coursework has not been found to influence the career path of students who are already interested in pursuing primary care, or another specialty [21,24,25]. Even though interest in radiology did not vary by gender among American first-year medical students at a single institution after they completed a mandatory introductory course in radiology [25], one could argue that the relative deficiency of radiology pre-clerkship exposure among women comes at an influential time in their medical education.

This study advances knowledge of specific deterrents from radiology as a specialty for medical students by finding that, despite having similar undergraduate educational backgrounds, significantly more women than men are deterred by the physics component of radiology. Comparatively, significantly more women are practicing in other specialties with a strong emphasis on physics, such as radiation oncology; women constituted 70% of graduates matching into radiation oncology as their first-choice discipline in the 2015 Canadian residency match [1]. Although physics may deter some women, this factor can only partially account for female underrepresentation in radiology.

Having less pre-clerkship radiology exposure may lead to women's misperception of the role of physics in radiology, and their lack of awareness of radiology subspecialties that involve more patient interaction. Given the ongoing underrepresentation of women in radiology [26], increasing the early exposure of female medical students to areas of radiology that involve direct patient contact, such as interventional radiology [27] or women's imaging, may affect their perception of and interest in radiology. In addition to initiating programs that increase preclinical exposure to radiology



**Fig 3.** Top factors deterring medical students from radiology as a specialty, by gender.



**Table 4.** Factors deterring students from radiology, by gender, among those not considering radiology

| Factor                             | Women<br>(n = 405) | Men<br>(n = 221) | P<br>Value |
|------------------------------------|--------------------|------------------|------------|
| Lack of direct patient contact     | 335 (83)           | 183 (83)         | 1          |
| Lack of acknowledgment by patients | 69 (17)            | 64 (29)          | .0007*     |
| Dark working environment           | 255 (63)           | 129 (58)         | .3         |
| Physics knowledge                  | 191 (47)           | 46 (21)          | <.0001*    |
| Competitive specialty              | 139 (34)           | 99 (45)          | .01*       |
| Lack of previous exposure          | 174 (43)           | 93 (42)          | .87        |
| Passionate about another field     | 266 (66)           | 136 (62)         | .34        |

Note: Values are n (%), unless otherwise indicated. Percentages were rounded.

\* $P < .05$ .

subspecialties that have greater patient contact, a commitment to actively recruiting women to these programs must be made.

The limitations of this study include the fact that two schools did not distribute the online survey; however, every Canadian province with a medical school was represented. Given this response pattern, we believe that the respondents reflect the composition of the medical student population in Canada. More than one half of the respondents were in pre-clerkship; consequently, their knowledge of radiology and their exposure to various specialties may have been more limited, compared with that of clerkship students. Given that more of the respondents were pre-clerkship, the number of students who were potentially interested in considering radiology may be an overestimate, compared with the number who ultimately will apply for radiology residency. Although this study was made available to all medical students, a response bias may be present toward students who were potentially interested in considering radiology as a specialty.

### TAKE-HOME POINTS

- Job flexibility, interest in acquiring a broad range of knowledge, and income are the top factors that attract medical students to radiology.
- Lack of direct patient contact deters medical students from pursuing a career in radiology.
- Women are underrepresented to a greater degree in radiology compared to other male-dominated specialties.
- Direct patient contact is valued by significantly more women who are not considering a radiology career, compared with women who are.

- Among medical students who are not considering a radiology career, significantly more women, compared with men, are deterred by physics.
- Female medical students have statistically significantly less pre-clerkship exposure to radiology than do male medical students; this difference may contribute to women's misperceptions about the intensity of the physics involved in radiology, and to their lack of awareness of radiology subspecialties that involve more patient interaction.

### ADDITIONAL RESOURCES

Additional resources can be found online at: <http://dx.doi.org/10.1016/j.jacr.2015.10.019>.

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## APPENDIX 1: MAIN SURVEY QUESTIONS

1. Your previous radiology exposure (Select all that apply)
  - a. None
  - b. Preclinical observerships
  - c. Preclinical didactic lectures
  - d. Radiology research experience
  - e. Selective rotations in clerkship
  - f. Core rotations in clerkship
  - g. Elective rotations in clerkship
  - h. Radiology mentor
  - i. Radiologist family member
  - j. Previously attended a radiology conference
2. What factors are important to you when choosing a medical specialty (Select all that apply)
  - a. High income
  - b. Fewer working hours
  - c. Job flexibility (ie, ability to work part time)
  - d. Intellectual stimulation
  - e. Use of emerging technology within the specialty
  - f. Direct patient contact
  - g. Impact on patient care
  - h. Perception of the specialty by others
  - i. Job satisfaction
  - j. Available job opportunities
  - k. Length of residency training (ie, fewer years of training)
  - l. High current debt load
  - m. Research opportunities
  - n. Positive elective experience
  - o. Positive mentoring experience
  - p. Favorable toward having children
3. Answer the following question if you are **not** considering a career in radiology. What factors dissuade you from choosing a career in radiology? (Select all that apply)
  - a. Physics knowledge
  - b. Role as a consultant to other physicians
  - c. Lack of direct patient contact
  - d. Negative perception by other physicians
  - e. Lack of acknowledgment by patients
  - f. Potential exposure to radiation
  - g. Competitiveness in obtaining a radiology residency position
  - h. Lack of previous exposure to radiology as a specialty
  - i. Lack of structured radiology rotations/selectives/courses
  - j. Lack of radiology mentorship
  - k. Perceived lack of job flexibility (ie, ability to work part time)
  - l. Perceived lack of job satisfaction
  - m. Perceived lack of job opportunities
  - n. Already passionate about another specialty
  - o. Negative personal experience in radiology
  - p. Dark work environment (ie, working in a dark room)
  - q. Perception as a male-dominated specialty
  - r. Lack of research culture/support or opportunities
  - s. Perceived lack of procedures performed by non-interventional radiologists
4. Answer the following question if you are potentially **considering** a career in radiology. What factors attract you to pursue a career in radiology? (Select all that apply)
  - a. Physics knowledge
  - b. Interest in anatomy
  - c. Interest in learning a broad range of medical knowledge
  - d. Role as a consultant to other physicians
  - e. Having a task-based work day
  - f. Having focused patient interactions with minimal paperwork
  - g. Impact on patient care
  - h. High income
  - i. Positive perception of radiology by colleagues
  - j. Positive previous exposure to radiology as a specialty
  - k. Positive mentorship experience in radiology
  - l. Job flexibility (ie, option to work part time)
  - m. Desire to be an interventional radiologist
  - n. Intellectual stimulation
  - o. Interest/background in imaging-related research
  - p. Perceived availability of job opportunities