



Female Medical Students' Interest in Radiology Careers

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Objective: Women are underrepresented in radiology. The aim of this study was to measure first-year medical students' level of interest in radiology and their attitudes toward factors that could affect residency specialty choices to further understand how to recruit women into radiology careers.

Materials and Methods: First-year medical students were administered surveys before and after a 7-week required introductory radiology course. Students rated interest in radiology on a scale ranging from 0 to 10 (low to high). Ten factors that could affect residency choice ("competitive residency," "shorter residency," "role models," "more jobs," "above average income," "flexible work hours," "work is technological," "work is visual," "intellectual challenge," and "more patient contact") were each rated as negative, neutral, or positive. Correlations between level of interest in radiology and the 10 factors were analyzed using Spearman's coefficients.

Results: The mean levels of interest in radiology were 4.5 for men and 4.0 for women ($P = .38$) among 116 precourse respondents and 5.2 for men and 4.3 for women ($P = .11$) among 80 postcourse respondents. The factors most frequently rated as having a positive impact on residency choice were "flexible work hours," "intellectual challenge," "role models," and "more patient contact." Compared with men, women less frequently rated "work is technological" (20% vs 43%; $P = .0002$) and "work is visual" (50% vs 72%; $P = .03$) as having a positive impact and more frequently rated "more patient contact" (89% vs 77%; $P = .02$) as having a positive impact. For women, the strongest correlation between level of interest in radiology and the 10 factors was for "role models" (correlation coefficient = .30, $P = .03$).

Conclusion: Interest in radiology did not differ by gender. Opportunities in radiology for flexible hours, intellectual challenge, patient care, and mentoring should be promoted early in medical education to female students to maintain and increase their interest in radiology.

Key Words: Medical student education, specialty choice, women, breast imaging

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INTRODUCTION

There are too few qualified radiologists to serve the increasing population of women over 40 years of age who need breast cancer screening [1-3]. From 2004 to 2007, breast imaging had the highest proportion of unfilled

positions among all diagnostic radiology subspecialties, with vacancies reported in almost 30% of radiology practices, although there was an overall excess capacity of radiologists of 3% in 2007 [3,4]. Vacancies in radiology practices also correlated to longer appointment waiting times for symptomatic patients, an indicator of how patient care is affected. The group of radiologists who devote careers to and subspecialize in breast imaging is composed largely of female radiologists. Although many breast imaging fellowship positions are not filled every year [5,6], of radiologists who do fellowships in breast imaging, 82% are women [7]. Additionally, of radiologists who consider breast imaging their primary or secondary subspecialties, 75% are women [7]. As an example, in one coauthor's current radiology practice, 10 of the 11 breast imaging radiologists are women. Therefore, the number of female medical students who choose radi-

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ology residencies can ultimately affect patients' access to breast cancer screening.

Fewer female medical students than expected choose careers in radiology, for unclear reasons [8]. Although the number of female medical students has progressively increased, now equaling that of male students, women remain underrepresented in some specialties, especially diagnostic radiology [9], wherein the proportion of female residents in diagnostic radiology has been static (27% in 2006) and not significantly more than from 1992 to 1995 [10-14]. A representative distribution of medical abilities is important for the sake of patients' access to health services, and ideally, medical students' gender and ethnicities would be distributed across specialties, resulting in equal and efficient access to medical services [8]. The underrepresentation of women in radiology is not merely an abstract inequity but has a concrete negative impact on the workforce, not only in breast imaging but also in pediatric radiology and women's imaging in ultrasound [8,14,15]. The unequal representation of women in medical specialties highlights the importance of understanding gender-related issues in medical specialty choice [8]. Although medical students' selections of specialties have been recently changing in ways that seem to be influenced by lifestyle and income considerations [16], these changes have not resulted in an increase in the proportion of female students choosing radiology. Women often consider family responsibilities in choosing specialties, and diagnostic radiology has lifestyle features that would seem attractive to women with families. Further research is warranted to illuminate the reasons women may not select diagnostic radiology during medical school [8,9,17].

There are no studies about whether level of interest in radiology differs by gender early in medical school or whether a required radiology course would increase the level of interest in radiology. We studied first-year medical students' interest in radiology during a required radiology course, along with attitudes about factors that affect specialty choice, especially to facilitate understanding of how to recruit more women into radiology careers.

MATERIALS AND METHODS

Participants

At the end of the first year of medical school, we conducted a written survey of medical students' attitudes regarding their interest in diagnostic radiology as a career and the factors that influenced their residency career choices. There were 250 first-year medical students enrolled in a required 7-week radiology course that was a separate course, not part of another course, such as anatomy. One male radiologist instructor gave 10 hours of formal classroom PowerPoint (Microsoft Corporation,

Redmond, Washington) lectures over the 7 weeks, including 3 examinations. Topics covered were introduction to radiology (imaging modalities), radiation safety and biology, radiology of metabolic processes, radiology of physiologic processes, radiology of development, radiology of neoplasms, radiology of trauma, and radiology of aging. Lectures were all image intensive and included examples of all radiologic imaging modalities. Students who attended class on the day the survey was distributed were invited to complete the voluntary and anonymous survey. The same survey questions were distributed to students twice: in the first week of the course and on the last day of the course. Institutional review board administrative approval was obtained.

Questionnaire

The survey consisted of a simple two-part questionnaire, without identifiers except for gender (see the [Appendix](#)). The first part assessed the level of students' interest in a career in diagnostic radiology. They rated their levels of interest using a scale ranging from 0 (no interest) to 10 (great interest). In the second part, students rated the impact of 10 factors on their choices of residencies, selected from prior reports about influences on career choice [8,18-20]: "competitive residency," "shorter residency," "role models," "more jobs," "above average income," "flexible work hours," "work is technological," "work is visual," "intellectual challenge," and "more patient contact." Respondents rated the impact these factors had on residency choice using a 3-point rating scale (negative, neutral, or positive).

Data Analysis

All surveys were entered into an Excel (Microsoft Corporation) spreadsheet in which responses to each question were recorded. The distribution and proportions of responses for each question were summarized. We compared the scores for the level of interest in radiology according to gender both before and after the course using two-sided *t*-tests and linear regression models. We also analyzed and ranked the ratings of the factors that influenced residency choice and compared these responses by gender and by level of interest in radiology using Spearman's correlation coefficients. Correlations of 0.1 to 0.3 were considered mild, and those of 0.3 to 0.5 were considered moderate. *P* values $\leq .05$ were considered significant.

RESULTS

Survey Respondents

One hundred sixteen of 250 students (46.4%) completed the precourse survey, and 80 (32%) completed the post-course survey. Sixty-eight women (59%) completed the

Table 1. Survey participants and level of interest in a radiology career

Survey	n	Mean \pm SD Level of Interest in Radiology*
Precourse		
Men	48 (41%)	4.5 \pm 2.5
Women	68 (59%)	4.0 \pm 2.7
Total	116 (100%)	4.2 \pm 2.6
Postcourse		
Men	30 (38%)	5.2 \pm 2.9
Women	50 (62%)	4.3 \pm 2.3
Total	80 (100%)	4.5 \pm 2.5

Note: $P = .20$, postcourse vs precourse (all); $P = .10$, men vs women (all); $P = .38$, men vs women (precourse); $P = .11$, men vs women (postcourse); $P = .11$, men, precourse vs postcourse; $P = .28$, women, precourse vs postcourse.
*On a scale ranging from 0 to 10.

precourse survey, and 50 women (62%) completed the postcourse survey.

Interest in Radiology

Responses regarding level of interest in radiology are summarized in Table 1 and Figure 1. Although the data showed that men reported higher mean levels of interest than women before and after the radiology course and an increase in interest after the course, these differences were not statistically significant. Unlike the women none of the men rated no interest in radiology either before or after the course. Fewer women rated no interest in radiology after the course (1%) compared with before the course (10%).

Ratings of Factors That Influenced Residency Choice

The factors that were classified as having positive influences on residency choice are summarized in Table 2, by gender and by precourse or postcourse survey, in order of statistical significance of differences by gender and then in order of frequency. Overall, the factors most commonly rated by both genders as having positive influences were “flexible work hours,” “intellectual challenge,” “more patient contact,” and “role models.”

There were differences by gender: the two factors less frequently rated by women than by men as having a positive impact on residency choice were “work is visual” and “work is technological.” The factor more frequently rated positively by women was “more patient contact.”

Most factors were seldom rated (<3% frequency) as negative influences on residency choice, except for “competitive residency” and “work is technological,” as shown in Table 3. More women than men rated “work is tech-

nological” as having a negative influence on residency choice.

Correlations Between Interest in Radiology and the Factors That Influenced Residency Choice

Correlations indicate how the level of student interest in radiology corresponded to the ratings (negative, neutral, positive) of the 10 factors. The significant correlations between the factors and interest in radiology among women are shown in Table 4. Among women, “above average income” and “work is technological” had weak correlations. “More patient contact” had a negative (inverse) correlation in the precourse survey. Among women after the radiology course, there was increased strength and significance of the correlation between interest in radiology and “role models.” There was no significant correlation between ratings for “flexible work hours” and level of interest in radiology.

DISCUSSION

Medical students develop opinions about residency choices during their preclinical years, and perceptions about radiology that form in the first year seem to persist through graduation [18-20]. Some perceptions about radiology among medical students are inaccurate and persist through the senior year, unchanged even by senior

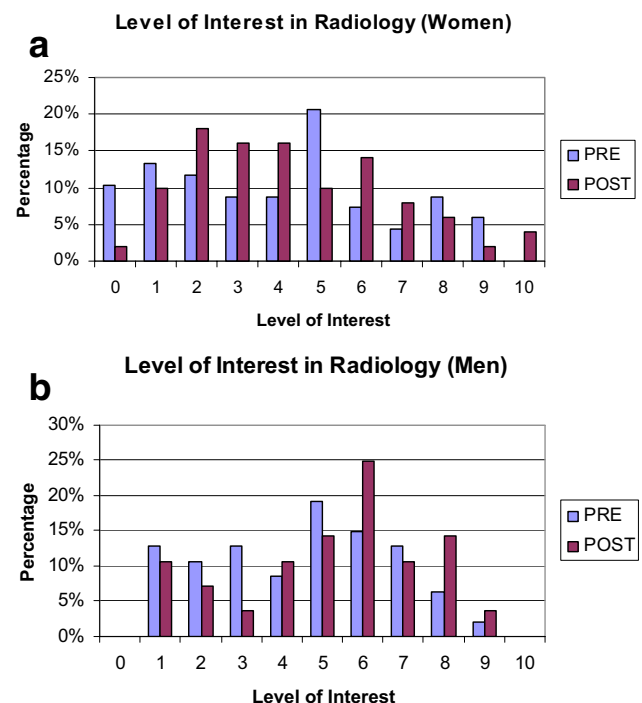


Fig 1. Levels of interest in a radiology career before and after a required radiology course among female (a) and male (b) medical students.

Table 2. Factors that were rated as having positive influences on residency choices, provided as percentages and ranked in order of statistical significance of differences

Factor	Female (n = 118)			Male (n = 78)		
	Precourse (n = 68)	Postcourse (n = 50)	Mean	Precourse (n = 48)	Postcourse (n = 30)	Mean
Work is technological	21*	18*	20*	48*	38*	43*
More patient contact	88	90†	89†	77	76†	77†
Work is visual	53	46‡	50	67	76‡	72
Flexible work hours	91	88	90	83	90	86
Intellectual challenge	88	90	89	85	79	83
Role models	82	82	82	71	76	73
More jobs	72	82	78	71	76	72
Shorter residency	54	60	57	44	69	57
Above average income	50	58	54	54	55	55

*Men vs women: precourse, $P = .04$; postcourse, $P = .02$; all, $P = .0002$.
†Men vs women: postcourse, $P = .04$; all, $P = .02$.
‡Men vs women: postcourse, $P = .03$.

radiology electives [19,20]. It is important to detect negative perceptions of radiology that might appear early in medical school [8]. Therefore, initiatives should begin during the first year of medical school, not the third and fourth years, when students' minds are made up [15]. Understanding first-year medical students' level of interest in radiology and attitudes toward residency choices may be useful in the design of early interventions to increase interest in radiology careers among women. There have been two studies of medical students' attitudes about radiology that described findings by gender, one in the first year and one in a select group of third- and fourth-year students in a radiology elective [17,18]. There have been no previous studies of the spectrum of interest in radiology early in medical school, whether interest would increase if students were exposed to a required radiology course, or how radiology interest correlates with factors that can determine residency choice.

We found that interest in radiology was not significantly different by gender at this early time in medical education. Therefore, it remains uncertain why the number of women who choose radiology at the end of medical school is 2 to 3 times lower than that of men. Usually, radiology content is sprinkled throughout medical school as an adjunct topic to other courses [20,21] rather

than being a separate, stand-alone course. In this dedicated radiology course, interest in radiology was not significantly different at the end compared with the beginning among either men or women. This may be because of its short, 7-week duration. In contrast, Branstetter et al [21] studied first-year students who were exposed to an integrated radiology curriculum that continued over an entire year and found that afterward, students had more interest in choosing radiology careers.

Of 10 factors that could affect residency choice, those that were most commonly rated as having positive influences were "more patient contact," "flexible work hours," "intellectual challenge," and "role models." Previous studies have also reported patient contact and intellectual stimulation as the most important factors in career decisions [18,20]. In our findings, 3 differences were seen in responses between men and women: women more commonly rated patient contact positively, less commonly rated visual work positively, and more commonly rated technological work negatively than men. These findings are consistent with previous speculation that women have less interest in "high-tech" equipment or computer games (visual work) than men [14]. On the basis of these results, if women perceive that there is no opportunity in radiology for patient interaction and have an exaggerated

Table 3. Factors that were rated as having negative influences on residency choices, by gender

Factor	Female			Male		
	Precourse	Postcourse	Mean	Precourse	Postcourse	Mean
Competitive residency	29%	28%	29%	29%	33%	31%
Work is technological	12%	26%	21%*	2%	10%	6%*

Note: All factors other than those listed had responses that were $\leq 3\%$ and are not included in the table.
* $P = .02$ for values between men and women; no other significant differences were found.

Table 4. Significant correlations between students' ratings for level of interest in radiology and ratings of the factors that influenced residency choice among women

Factor	Precourse		Postcourse	
	Coefficient	P	Coefficient	P
More patient contact	-.31	.009	-.20	.16
Work is technological	.26	.03	.27	.06
Above average income	.21	.04	.25	.04
Role models	0	.97	.30	.03

Note: Responses are grouped by precourse or postcourse and in approximate order of strength of correlation. Factors with nonsignificant correlations are excluded from this table. Significant correlations are in boldface type.

idea of the degree of technological work in radiology, few will consider radiology careers.

Role models were frequently rated as having a positive influence on residency choice, and in addition, women with high levels of interest in radiology were more likely to rate role models positively. Role models have been reported in multiple studies as strongly associated with the choice of residency [22-24], and for women, female role models determine their choices in internal medicine and surgery [24,25]. There are no data-specific outcomes regarding role models in radiology, but it is likely that the visibility of women radiologists and improving mentoring might encourage female students in their early years to more strongly consider radiology careers [8]. One radiologist has established a mentoring program recruiting medical students into breast imaging rotations at an early time point in education, and programs such as this should be more widespread [15].

Levels of interest in radiology among female were correlated with how they rated "above average income." This finding is correlated with those from other studies reporting that students pursuing radiology rate lifestyle and income to be of higher importance than students choosing any other specialty [26,27]. Lifestyle is reported to have become more important to students in recent studies, with differences between generation X and the older baby boomer generation hypothesized to explain this recent trend [28]. In some studies, lifestyle and work hours were more important for women than for men [16,18,26,29]. Because radiology in general and breast imaging in particular tend to have regular or flexible work hours, and because women often consider work schedules and family responsibilities in choosing specialties [1,8,17], female students need to be aware of opportunities for controllable work hours in radiology.

Levels of interest in radiology among female students were inversely correlated with ratings for patient care, suggesting that students who are less interested in patient care are more interested in radiology, and vice versa. Perhaps the shortage of breast imaging radiologists is a consequence of a relative lack of residents in radiology

who like patient contact. Female students must be taught that certain subspecialties of radiology (eg, breast imaging, pediatrics) can accommodate an interest in patient care. Breast imagers in particular have become the gatekeepers for patients with breast problems, and they participate in the management of patients from the time of screening through biopsy and therapy [1].

Limitations of our study include the inability to track students because of the respondents' anonymity. Thus, precourse and postcourse results could not be correlated to individual students. Because the survey was voluntary, it is possible that only those students who were most interested in radiology completed it. Finally, predictors of specialty choice or interest in radiology may also depend on demographic characteristics, personality characteristics, and practical barriers, including spouse's career and finances [30-32], factors that were not measured in this survey.

A US Government Accountability Office [33] report in 2006 indicated that there were more mammography centers closing than opening and that recruiting and retaining radiologists who interpret mammograms affects closures. The flow of personnel into screening mammography may be insufficient to serve the growing number of women needing screening [33]. The shortage of qualified breast radiologists is also limited by the Mammography Quality Standards Act of 1992, which makes it almost impossible for foreign-trained radiologists to qualify to do mammography in the United States and make up for manpower shortages, unlike in other subspecialties in radiology or medicine. Shortages of breast radiologists are likely to worsen for another reason: increasing demand for breast screening and diagnosis by other modalities using ultrasound and magnetic resonance imaging [34,35]. The majority of breast magnetic resonance imaging studies are currently interpreted by breast radiologists certified according to the Mammography Quality Standards Act, who also do mammography as >50% of their work [34]. Furthermore, 95% of breast biopsies are now performed by breast imaging radiologists [1], and these incremental activities cut into the

time available for screening mammography. Because it seems that female radiology residents are more likely than male radiology residents to perform and specialize in breast imaging, and because female physicians are more likely to pursue careers in academic medicine [36], more women recruited to radiology would be advantageous for workforce shortages that exist in academic radiology practices as well as breast imaging.

Our findings suggest that there is no significant difference in interest in radiology early in medical school, but interventions besides radiology courses are necessary to maintain or increase interest in radiology. Mentoring and making female role models visible should be helpful. Female students are likely unaware of the diversity of subspecialty career paths in radiology, such that technological work and patient care can be either maximized or minimized. The opportunities for meaningful patient management in breast imaging need to be taught [1,17]. Because students prefer flexible work schedules, the schedule advantages in teleradiology and emergency room radiology and the typically regular (no-call) work hours in breast imaging must be brought to female students' attention. Students also desire intellectual challenge, and certainly intellectual challenge is inherent in a breast radiologist's work, in which exciting new technologies, research, and interventional procedures make this subspecialty dynamic and multidimensional, more than medical students may realize [1]. Another way to increase the number of women in radiology would be a women's student research program or sophomore elective, which reportedly increases the likelihood that students will choose radiology [1,37,38].

CONCLUSION

Increasing the proportion of female medical students in radiology residencies could result in more qualified breast imaging radiologists and increase patients' access to breast cancer screening. Further studies about gender differences in radiology are warranted, especially among preclinical students, to determine why interest in radiology seems to decline through medical school years. Previous studies have already made other specific suggestions and recommendations specific to recruiting women of generation X into radiology [14]. Radiology educators can implement many of these ideas in a dedicated effort to recruit female medical students, beginning early in undergraduate medical education.

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APPENDIX**First-Year Medical Student Survey**

Thanks a lot for helping!

1. Sex: Female
 Male

2. Please indicate your level of interest in Diagnostic Radiology as a career. (circle one)

0 1 2 3 4 5 6 7 8 9 10
None..... Very
Strong

3. Please rate how the following items impact your choice of residency (surgery, pediatrics, radiology, etc.):

	Negative Influence	No Influence	Positive Influence
a) Competitive Residency	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) Shorter Residency	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) Role Models	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) More jobs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e) Above average income	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f) Flexible Work Hours	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g) Work is technological	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h) Work is visual	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i) Intellectual Challenge	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j) More Patient Contact	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>