

Exploring Interventional Radiology: A Multicentre Study on Saudi Medical and Radiology Technology Students' Perspectives

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Background: Interventional radiology (IR) is a subspecialty of diagnostic radiology that uses image-guided radiological methods to carry out minimally invasive procedures. Medical schools in Saudi Arabia minimally expose students to IR unless it is part of an elective rotation. The study aims to gauge how well informed medical and radiology technology students are regarding the variations in educational and clinical experiences offered at different universities in Jeddah, Saudi Arabia. It also aims to assess students' interest in IR as a potential career path and their opinions about their life experiences concerning the department's future.

Methods: This study used a cross-sectional study design. Between April and May 2023 in Jeddah, Saudi Arabia, students studying radiology technology and medicine who were in their second year to internship year were given access to a cross-sectional questionnaire.

Results: The study found that 31.5% of the students reported having poor knowledge of IR, while 7.8% reported not knowing about it at all. Additionally, 45.9% of respondents felt that their knowledge was adequate, while a minority of 14.7% reported having an excellent understanding of IR concepts. Therefore, in order to enhance students' knowledge about IR, IR courses should be introduced early into curricula, IR symposiums and conferences.

Conclusion: The limited exposure of medical and radiology technology students to IR was highlighted. Over one-third indicated interest in IR as a career, with radiology technology students demonstrating greater familiarity. Enhancing IR education through early curriculum integration, symposiums, and conferences is essential. Furthermore, addressing the lack of a standardized radiology curriculum in Saudi medical schools could further enhance IR awareness and career development.

Keywords: interventional radiology, awareness, students, knowledge, career

Introduction

Interventional radiology (IR) is where medical images can be performed to guide treatments and diagnosis for a wide range of pathological cases using various imaging modalities,¹ including X-ray fluoroscopy, ultrasonography, computed tomography (CT) and magnetic resonance imaging, as specifically targeted therapy.² Diagnostic radiology includes a variety of subspecialties, including neuroradiology, paediatric radiology, nuclear radiology, hospice and palliative medicine, pain medicine, and vascular.³ In 2012, the American Board of Medical Specialties (ABMS) approved IR as a primary medical specialty.⁴ The practice of IR includes embolization, angioplasty, stent insertion, drainage, ablation and treatment of thrombus, among many other therapeutic interventions.³ The role of IR in the management of several

conditions has expanded in the last few years to include a variety of organ systems.^{5,6} However, these expanded indications for IR have been accompanied by an increase in demand, complexity and shortage of manpower.^{7,8}

Despite some medical schools in the US exposing students to IR, one study showed that only 5.5% of these students participated in elective rotations, and among these students, only 12.5% were interested in IR as a specialty.⁹ The degree of awareness and knowledge of IR remains relatively low among the US medical students in general, especially among those in their preclinical years because radiology rotations do not start until the clinical years.^{10–13} Several studies across different countries have been performed in Spain,¹⁴ Europe, the United States and Canada; These studies have evaluated medical students' knowledge and awareness, with most of them revealing poor and inadequate knowledge about IR.^{15,16} In one study, poor exposure to IR procedures was noted among medical students during the clinical practice and the internship year of their educational process.¹³ Similar results have been shown in studies of Saudi medical students from Riyadh, Hail and Jeddah.^{16–18}

Artificial intelligence (AI) is revolutionizing radiology education by enhancing diagnostic accuracy, streamlining workflows, and enabling advanced image analysis. As AI continues to integrate into radiological practice, it is essential for medical and radiological students to develop a strong understanding of its applications and implications. Interventional radiology, a rapidly growing subspecialty that relies on image-guided procedures, is particularly influenced by AI-driven advancements, such as automated image interpretation, robotic-assisted interventions, and predictive analytics. However, awareness of interventional radiology among students remains limited, partly due to gaps in medical curricula. By incorporating AI-related topics into radiology education and aligning them with interventional radiology training, institutions can better prepare future practitioners for the evolving technological landscape. Introducing AI-based modules and case studies within medical and radiology programs would not only improve students' knowledge of AI applications but also enhance their awareness of interventional radiology as a career path. Strengthening curricula in this way will ensure that students are equipped with the necessary skills to leverage AI in both diagnostic and interventional radiology, ultimately improving patient care and procedural outcomes.^{19–21}

Overall, awareness and knowledge of IR is still relatively low, especially among medical students and radiology technology students.^{13,19,20} There is a need for ongoing research on this issue, particularly in Saudi Arabia. Therefore, large-scale awareness studies must be conducted to raise the current understanding and perception of IR among medical students and radiology technology students.²¹ The study aims to evaluate medical and radiology technology students' awareness and knowledge of IR about the differences in educational and clinical rotations at various universities in Jeddah, Saudi Arabia. Likewise, it aims to evaluate students' interest in pursuing IR as a future career and their perceptions about how their medical expertise could contribute to the future of this field.

Materials and Methods

Ethical Consideration

Approval for this study was granted by the Bioethics Committee of Scientific and Medical Research at the University of Jeddah (Reference Number: HAP-02-J-094 – Application number: UJ-REC-128). Participants were fully briefed on the study's nature, and their participation was voluntary with assured confidentiality. Written consent was obtained from each participant. Local researchers were actively involved in every stage of the research, including design, implementation, data management, intellectual property considerations, and authorship. The study's relevance was ensured through collaboration with local partners. The roles and responsibilities for conceptualization, supervision, methodology, analysis, data management, drafting, and editing were clearly established among all collaborators prior to the research. All authors reviewed and approved the final manuscript. The study also incorporated relevant local and regional research into its references and citations. All procedures adhered to the appropriate guidelines and regulations.

Study Design and Sample Collection Technique

This study employed a cross-sectional design. An online questionnaire was distributed between April and May 2023 to medicine and radiology technology students, ranging from their second year to their internship year, in Jeddah, Saudi Arabia. To ensure clarity and relevance, three academic faculty members specializing in radiography, each with 6 to 10 years of experience, validated the survey. Based on their feedback from the pilot study, the survey questions were revised accordingly.

After an initial pilot phase, several refinements to enhance the clarity was implemented, comprehensiveness, and effectiveness of the survey. Some faculty members in the pilot phase found the term “IR” (Interventional Radiology) unclear. To address this, a brief definition at the beginning of the survey was added to ensure all respondents have a consistent understanding of the topic. In the question about “image guidance modalities used in conjunction with IR”, initially it was provided only three options. Based on pilot feedback, “All of the above” and “CT” were added as answer choices to capture a broader range of responses. In addition, the original question on career interest in IR was a simple Yes/No format. It was revised to include a “Not sure” option, as some faculty members suggested that participants might not have enough exposure to make a definitive choice. To better gauge how students prefer to learn about IR, a new question was added: “Would you like to have more exposure to IR during the educational process?” With multiple options such as “Lectures and Tutorials”, “Clinical Attachment”, and “Integrated Learning”. Some faculty members interpreted the question on radiation risks ambiguously. To address this, it was reworded for clarity and an additional response option was added: “I don’t have a negative opinion.” These modifications were made to ensure more accurate, inclusive, and could capture a wider range of experiences/opinions about IR education and career interest. Data from the pilot study were excluded from the main dataset. A radiologic technologist consultant validated the data by documenting inconsistencies and checking for duplicates and errors using Excel software.

In March 2023, the questionnaire was piloted using Microsoft Forms, with participants answering anonymously after providing informed consent. They were given a brief explanation of the study’s aims and the objectives of the questionnaire. The final questionnaire consisted of 18 questions divided into three categories:

1. **Demographic Information:** This included questions about gender, educational major, years of education, and the university attended.
2. **Basic Knowledge of IR:** This section assessed the participants’ general knowledge about IR and any challenges they experienced regarding IR during their clinical rotations.
3. **Personal Impressions of IR:** This section evaluated whether participants were familiar with basic IR procedures and whether they would consider IR as a future career choice.

A non-probability convenient sampling technique was employed.²² Participants were recruited through invitations sent via various online platforms, including social media applications like WhatsApp and Twitter. These invitations outlined the study’s goals and provided information about the research team, ensuring participants gave informed consent. The inclusion criteria were medicine and radiology technology students from the second year to the internship year. Students from other medical specialties, such as dentistry, nursing, physiotherapy, clinical nutrition, and laboratory sciences, were excluded from the study.

Statistical Analysis

Data analysis was conducted using IBM SPSS Statistics version 28 (PASW, Chicago, IL, USA). Both descriptive and inferential statistics were employed, with results presented through graphs and tables. The chi-square test was utilized to examine the relationship between demographic variables and knowledge items, with a significance level set at $P < 0.05$ for all tests.

Results

Three hundred and thirty-three participants completed the questionnaire; [Table 1](#) shows that more than half of the participants (62.8%) were female and that most of them were studying medicine (81.7%), while 18.3% were studying radiological technology. Most participants were in their 4th year (43.8%), followed by the 3rd (22.2%) and 2nd years (13.5%), with smaller numbers in other educational years. The University of Jeddah had the highest representation (43.5%), followed by King Abdulaziz University (30.3%), King Saud University for Health Sciences (7.2%), Batterjee Medical College (5.4%) and others.

[Table 2](#) shows that most of the students were aware of IR (82%) and more than half (63.4%) of the participants had attended courses or lectures related to IR. Additionally, less than one-third of the participants had been exposed to IR procedures during their clinical rotation. For the question regarding aspects dealt with in IR, about 55% of the

Table 1 Sociodemographic Characteristics of Participants (n=333)

Variables	Frequency (%)	
Sex		
Male	124	37.2%
Female	209	62.8%
Major		
Medicine	272	81.7%
Radiological technology	61	18.3%
Educational year		
2 nd year	45	13.5%
3 rd year	74	22.2%
4 th year	146	43.8%
5 th year	28	8.4%
6 th year	6	1.8%
Intern	34	10.2
University:		
University of Jeddah	145	43.5%
King Abdulaziz University	101	30.3%
King Saud University for Health Sciences	24	7.2%
Batterjee Medical College	18	5.4%
Fakeeh College for Medical Sciences	8	2.4%
Al Ghad International Colleges	17	5.1%
Ibn Sina National College for Medical Studies	10	3.0%
Others	10	3.0%

Table 2 Student's Awareness Regarding IR

Variables	Frequency (%)	
Do you know what IR* is?		
Yes	273	82.0%
No	60	18.0%
Have you had any courses and lectures about IR*?		
Yes	211	63.4%
No	122	36.6%
Have you attended any IR* procedures in the theatre as a part of your clinical rotation?		
Yes	101	30.3%
No	232	69.7%
Which of the following aspects deal with IR*?		
Diagnosis	73	21.9%
Treatment	76	22.8%
Both	184	55.3%
Which of the following image guidance modalities can be used in conjunction with IR*?		
Ultrasound	40	12.0%
MRI	28	8.4%
X-ray	59	17.7%
All	165	49.5%
CT	41	12.3%
Do you agree that the basics of IR* should be a part of the medical undergraduate program?		
Agree	303	91.0%
Disagree	30	9.0%

(Continued)

Table 2 (Continued).

Variables	Frequency (%)	
Do you think a mandatory radiology course during medical school would be beneficial?		
Yes	262	78.7%
No	24	7.2%
Not sure	47	14.1%
Would you like to know or learn more about IR?		
Yes	234	70.3%
No	66	19.8%
Not sure	33	9.9%
If you answered No or Not sure to the previous question, please choose the most appropriate reason.		
Not applicable	234	70.3%
I do not find it interesting	41	12.3%
I do not know enough about it	25	7.5%
The lifestyle is not for me	23	6.9%
Others	10	3.0%
Would you like to have more exposure to IR* during the educational process?		
Yes, in the form of lectures and tutorials	101	30.3%
Yes, in the form of a clinical attachment	99	29.7%
Yes, in the form of integrated lectures, tutorials, and clinical	98	29.4%
No	30	9.0%
Others	5	1.5%
Do you think that the radiation risks might be a reason for the negative opinions about IR*?		
Yes	146	43.8%
No	74	22.2%
I do not have a negative opinion	113	33.9%
Are you interested to know more knowledge about radiation protection related to this department?		
Yes	269	80.8%
No	60	18.0%
Not sure	4	1.2%
What would make you interested in considering IR* as a career?		
Search about it personally	116	34.8%
Study it as a curriculum	85	25.5%
Expose to it more during my clinical practice	94	28.2%
I do not find it interesting	38	11.4%
Would you consider IR* as a career choice?		
Yes	136	40.8%
No	54	16.2%
Not sure	143	42.9%
If you answered No or Not sure to the previous question:		
Not applicable	136	40.8%
I do not find it interesting	37	11.1%
I do not know enough about it	81	24.3%
The lifestyle is not for me	51	15.3%
Others	28	8.4%
By the end of this questionnaire, I consider myself?		
Interested and might search further about IR*	259	77.8%
Not interested at all	39	11.7%
I have enough knowledge about IR*	35	10.5%

Abbreviation: IR*, Interventional Radiology.

participants answered “Both” for diagnosis and treatment. In terms of image guidance modalities used in conjunction with IR, about half of the students (49.5%) answered all (X-ray, CT, US and MRI). About half of the respondents felt that their knowledge of IR was adequate (45.9%), while a few reported that they had an excellent grasp of IR (14.7%) [Figure 1].

A majority (70%) of the respondents believed that IRs were used for image-guided tumour biopsy, ablation of tumour (53.5%), endovascular repair of aortic aneurysm (53.6%) and vertebroplasty (48.6%), whereas 45.6% believed that they performed percutaneous nephrostomy [Figure 2]. Regarding whether participants would consider IR as a career choice, 40.8% answered yes, 16.2% answered no and 42.9% answered not sure. For participants who answered “no” or “not sure”, the top reasons were that they did not know enough about it (24.3%) or that the lifestyle was not for them (15.3%). Other reasons included not finding it interesting (11.1%) or having other, unspecified reasons (8.4%) [Table 2].

Table 3 shows that female students attended lectures about IR more often than males ($P=0.044$). They were also aware that IR is used for both diagnostics and treatment ($P<0.001$). However, male participants can be seen to consider IR as a career choice more than females ($P<0.001$). Table 4 shows that radiological technique students were more knowledgeable about IR than medical students ($P=0.003$). Table 5 shows that 6th-year students followed by internship, 5th-year, 4th-year, 3rd-year and 2nd-year students, respectively, rated their knowledge as excellent ($P<0.001$).

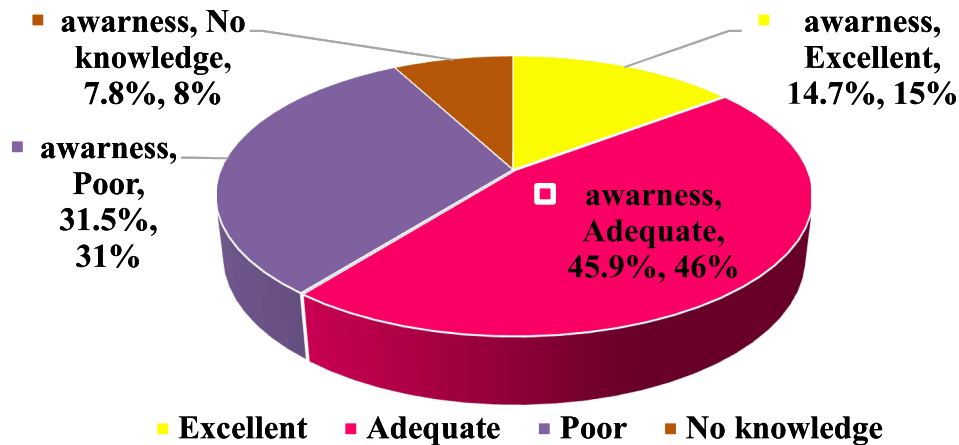


Figure 1 How respondents rated their knowledge of IR?.

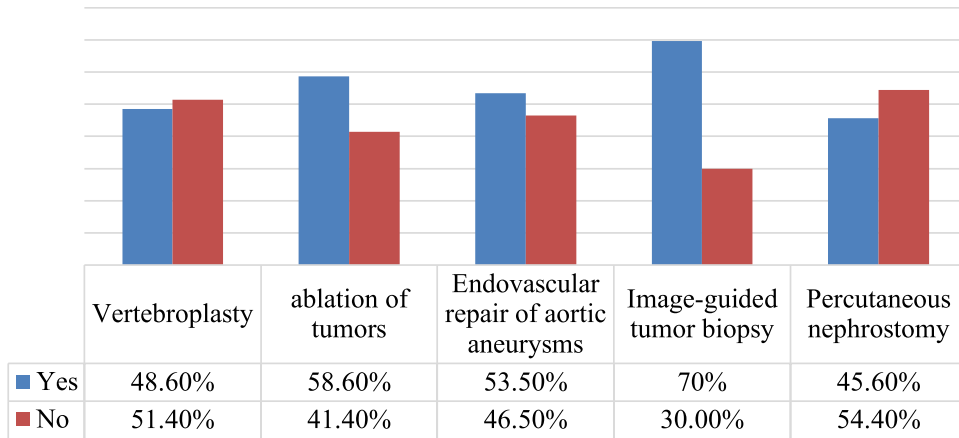


Figure 2 Which of these procedures' respondents believed are performed by interventional radiologists?.

Table 3 Relationship by Chi-Square Test Between Awareness Items and Gender

Variables		Gender				P-value
		Male		Female		
		N	%	N	%	
Do you know what IR* is?	Yes	96	77.4%	177	84.7%	0.095
	No	28	22.6%	32	15.3%	
Have you had any courses and lectures about IR*?	Yes	70	56.5%	141	67.5%	0.044
	No	54	43.5%	68	32.5%	
How would you rate your knowledge of IR* as compared to other subjects?	Excellent	16	12.9%	33	15.8%	0.201
	Adequate	50	40.3%	103	49.3%	
	Poor	47	37.9%	58	27.8%	
	No knowledge	11	8.9%	15	7.2%	
Which of the following aspects deal with IR*?	Diagnosis	38	30.6%	35	16.7%	<0.001
	Treatment	37	29.8%	39	18.7%	
	Both	49	39.5%	135	64.6%	
Which of the following image guidance modalities can be used in conjunction with IR*?	Ultrasound	21	16.9%	19	9.1%	0.021
	MRI	10	8.1%	18	8.6%	
	X-ray	23	18.5%	36	17.2%	
	All	49	39.5%	116	55.5%	
	CT	21	16.9%	20	9.6%	
Do you agree that the basics of IR should be a part of the medical undergraduate program?	Agree	115	92.7%	188	90.0%	0.390
	Disagree	9	7.3%	21	10.0%	
Do you think a mandatory radiology course during medical school would be beneficial?	Yes	98	79.0%	164	78.5%	0.987
	No	9	7.3%	15	7.2%	
	Not sure	17	13.7%	30	14.4%	
Would you like to know or learn more about IR*?	Yes	106	85.5%	165	78.9%	0.236
	No	10	8.1%	19	9.1%	
	Not sure	8	6.5%	25	12.0%	
Would you like to have more exposure to IR* during the educational process?	Yes, lectures	40	32.3%	61	29.2%	0.730
	Yes, clinical attachment	40	32.3%	59	28.2%	
	Yes, lectures and clinical	33	26.6%	65	31.1%	
	No	10	8.1%	20	9.6%	
	Others	1	0.8%	4	1.9%	
Do you think that the radiation risks might be a reason for the negative opinions about IR*?	Yes	62	50.0%	84	40.2%	0.197
	No	26	21.0%	48	23.0%	
	I do not have a negative opinion	36	29.0%	77	36.8%	
Are you interested to know more knowledge about radiation protection related to this department?	Yes	101	81.5%	168	80.4%	0.871
	No	22	17.7%	38	18.2%	
	Not sure	1	0.8%	3	1.4%	
Would you consider IR* as a career choice?	Yes	81	65.3%	83	39.7%	<0.001
	No	14	11.3%	39	18.7%	
	Not sure	29	23.4%	87	41.6%	
By the end of this questionnaire, I consider myself?	Interested and might search further about IR	101	81.5%	158	75.6%	0.307
	Not interested at all	14	11.3%	25	12.0%	
	I have enough knowledge about IR	9	7.3%	26	12.4%	

Abbreviation: IR*, Interventional Radiology.

Table 4 Relationship by Chi-Square Test Between Awareness Items and Major

Variables		Major				P-value
		Medicine		Radiology Technique		
		N	%	N	%	
Do you know what IR* is	Yes	215	79.0%	58	95.1%	0. 003
	No	57	21.0%	3	4.9%	
Have you had any courses and lectures about IR*?	Yes	160	58.8%	51	83.6%	<0.001
	No	112	41.2%	10	16.4%	
How would you rate your knowledge of IR* as compared to other subjects?	Excellent	41	15.1%	8	13.1%	0.010
	Adequate	115	42.3%	38	62.3%	
	Poor	90	33.1%	15	24.6%	
	No knowledge	26	9.6%	0	0.0%	
Which of the following aspects deal with IR*?	Diagnosis	64	23.5%	9	14.8%	0.109
	Treatment	65	23.9%	11	18.0%	
	Both	143	52.6%	41	67.2%	
Which of the following image guidance modalities can be used in conjunction with IR*?	Ultrasound	34	12.5%	6	9.8%	0.097
	MRI	27	9.9%	1	1.6%	
	X-ray	48	17.6%	11	18.0%	
	All	127	46.7%	38	62.3%	
	CT	36	13.2%	5	8.2%	
Do you agree that the basics of IR* should be a part of the medical undergraduate program?	Agree	243	89.3%	60	98.4%	0.026
	Disagree	29	10.7%	1	1.6%	
Do you think a mandatory radiology course during medical school would be beneficial?	Yes	213	78.3%	49	80.3%	0.387
	No	22	8.1%	2	3.3%	
	Not sure	37	13.6%	10	16.4%	
Would you like to know or learn more about IR*?	Yes	219	80.5%	52	85.2%	0.605
	No	24	8.8%	5	8.2%	
	Not sure	29	10.7%	4	6.6%	
Would you like to have more exposure to IR* during the educational process?	Yes, lectures	84	30.9%	17	27.9%	0.111
	Yes, clinical attachment	86	31.6%	13	21.3%	
	Yes, lectures, and clinical attachment	72	26.5%	26	42.6%	
	No	25	9.2%	5	8.2%	
	Others	5	1.8%	0	0.0%	
Do you think that the radiation risks might be a reason for the negative opinions about IR*?	Yes	128	47.1%	18	29.5%	0.023
	No	54	19.9%	20	32.8%	
	I do not have a negative opinion	90	33.1%	23	37.7%	
Are you interested to know more knowledge about radiation protection related to this department?	Yes	221	81.3%	48	78.7%	0.256
	No	49	18.0%	11	18.0%	
	Not sure	2	0.7%	2	3.3%	
Would you consider IR* as a career choice?	Yes	136	50.0%	28	45.9%	0.061
	No	48	17.6%	5	8.2%	
	Not sure	88	32.4%	28	45.9%	
By the end of this questionnaire, I consider myself?	Interested and might search further about IR	210	77.2%	49	80.3%	0.632
	Not interested at all	34	12.5%	5	8.2%	
	I have enough knowledge about IR	28	10.3%	7	11.5%	

Abbreviation: IR*, Interventional Radiology.

Table 5 Relationship by Chi-Square Test Between Awareness and Educational year

Educational Year	How would you Rate Your Knowledge of IR* as Compared to Other Subjects?				P-value**
	Excellent	Adequate	Poor	No knowledge	
2 nd year	4.4%	11.1%	62.2%	22.2%	<0.001
3 rd year	5.4%	44.6%	37.8%	12.2%	
4 th year	17.8%	56.8%	23.3%	2.1%	
5 th year	21.4%	39.3%	32.1%	7.1%	
6 th year	50.0%	33.3%	16.7%	0.0%	
Internship	23.5%	55.9%	14.7%	5.9%	

Note: P-value** < 0.05 = significance.

Abbreviation: IR*, Interventional Radiology.

Discussion

IR is a branch of diagnostic radiology that performs minimally invasive procedures using image-guided radiological techniques. In Saudi Arabia, medical schools provide no exposure to IR unless through an elective rotation. This study surveyed male and female medical and radiological technology students in Jeddah, with a majority (62.8%) being female. The higher female participation may have been influenced by the fact that the interviewers were women, potentially making it easier to reach female students. In Saudi Arabia, medical education follows a six-year undergraduate program, comprising three phases: preclinical (years 1–4), clinical (years 5–6), and a mandatory one-year internship. The preclinical phase focuses on foundational medical sciences, while the clinical phase involves rotations across major specialties, including radiology.²³ In contrast, radiologic technology education follows a four-year academic curriculum, emphasizing imaging techniques, radiation safety, and patient care, followed by a one-year clinical internship.²⁴ While radiologic technology students receive structured exposure to IR, medical students' exposure to IR remains limited, highlighting the need for greater integration of IR education into medical curricula.

The study found that 31.5% of students reported poor knowledge of IR, while 7.8% were completely unaware of it.^{18,25} Meanwhile, 45.9% considered their knowledge adequate, and only 14.7% reported an excellent understanding. These results are like those obtained from other countries. For instance, surveys conducted at a Canadian medical school and among final-year medical students in a European country found out that 53% and 63% of respondents, respectively, admitted having little knowledge of IR. Likewise, a study at Pt. JNM Medical College in India conducted similar survey and concluded that 60% of students had very poor or poor knowledge of IR.^{11,15}

In Saudi Arabia, a study at King Khalid University analysed the students' perceptions concerning their knowledge in the field of IR and discovered that 52% of medical students and interns perceived their IR knowledge as deficient. Reports from University of Hail, and King Faisal University in Al-Hasa, suggested that an alarming 45% of students and 83% of students, respectively, claimed insufficient IR knowledge, as well as final year medical students from Riyadh where 36.7% of students shared the same sentiments.^{18,26} However, findings from Tabuk University revealed that more than half of clinical-year medical students considered their IR knowledge as good or adequate.^{27,28} Differences in IR knowledge among students may be attributed to variations in curricula, clinical rotations, and institutional resources.

A significant portion of students (90%) believed that IR fundamentals should be included in the medical undergraduate programs, while 78.8% favoured the idea of compulsory attendance to a radiology course. Furthermore, 70.3% of them expressed interest in broadening their knowledge of IR, whereas 29.7% were not interested in pursuing that goal, with some citing a lack of knowledge (7.5%), disinterest (12.3%), or lifestyle preferences (6.9%) as reasons. Additionally, students in radiological technology programs exhibited a higher level of knowledge about IR compared to their medical students' counterparts. They were also more inclined to support the inclusion of IR fundamentals in undergraduate medical curricula ($P = 0.003$) and attended more IR lectures ($P < 0.001$).

Concerning IR exposure in medical education, most students (89.4%) indicated they had some form of exposure, with lectures and tutorials (30.3%), clinical attachments (29.7%), and integrated learning (29.4%) being the most preferred methods. In terms of understanding the risks of radiation, the study indicated that 40.8% of students are open to pursuing

a career in IR. The primary reasons for not considering IR included a lack of knowledge, reported by (24.3%) of respondents, and concerns about lifestyle (15.3%). 43.8% reported have some concerns, and 80.8% expressed a desire to learn more about radiation protection. There were some differences by gender; female students were more likely to attend IR lectures than males ($P = 0.044$) and had higher level of knowledge that IR is both diagnostic and therapeutic procedure ($P < 0.001$). On the other hand, male students seemed to have stronger tendencies towards considering IR as a profession ($P < 0.001$).

Similarly, a study at a Chinese medical college revealed that just 13.24% of male students were considering IR as a career.²⁹ At King Khalid University, 38% of respondents were open to an IR career, but 43% cited lack of knowledge as the main barrier.¹³ A study at King Abdulaziz University in Jeddah found that only 16.1% of students expressed interest in radiology careers.¹⁸ In India, 61.6% of students cited limited awareness as their main reason for not choosing IR.²⁶ In contrast, 40.5% of final-year medical students in a European country showed interest in IR, while only (18%) of students at a Canadian medical school considered pursuing it, with 48% attributing their hesitating to a lack of knowledge and 43% to a lack of interest.¹⁵ The differences in student familiarity with IR and their career aspirations underscore the influence of IR's relative novelty in medical education and the lack of dedicated IR rotations in some institutions.³⁰

IR compelled further attention from most students (77.8%). Meanwhile, 11.7% showed more willingness, while 10.5% deemed their knowledge as sufficient. These observations are in agreement with the IR survey in a Chinese medical college, where 68.45% of them were above third-year suggested interest in IR.^{28,31} In Al-Hasa, 72.5% of students had no previous exposure to IR, and only 36.5% expressed interest to participate in a two-week IR elective.²⁶ At different academic levels, sixth year and intern students showed the highest levels of IR knowledge compared to the rest ($P < 0.001$).

International studies have shown similarly high interest in IR education. In India, 91.5% of medical students supported IR-based teaching in undergraduate programs, while in Canada, 74% of students from a medical school supported a mandatory two-week radiology rotation.²⁸ Additionally, 71% of Canadian students served actively expressed interest in participating in two-week IR electives during their core surgery rotation. This data is in favour of the argument that introduction of IR modules in medical programs can positively impact students' objective knowledge and interest in a career in IR.

Most medical students (70%) accurately identified that interventional radiologists perform procedures which include tumor biopsy (70%), tumor ablation (58.6%), endovascular aortic aneurysm repair of (53.5%), vertebroplasty (48.6%), and percutaneous nephrostomy (45.6%). A study in a Chinese medical college, students were most familiar with percutaneous transluminal coronary angioplasty (78.59%) and transcatheter arterial chemoembolization (44.51%). Similarly, King Khalid University students identified cardiac angioplasty (81%) and femoral-popliteal bypass (74%) as common IR procedures,¹³ while final-year medical students in Riyadh correctly associated IR with uterine artery embolization (71%) and lower limb angioplasty (73%).¹⁰

This study has several limitations. It was conducted in Jeddah, which may not comprehensive representation of medical students across Saudi Arabia. A broader study covering different regions could yield more generalizable results. Additionally, the survey was conducted within a month, and a longer study duration could lead to increased participation rate.

The study's survey-based nature may result in biased responses, as students with an interest in IR may have been more inclined to respond. Additionally, gender inequality was another issue, with female students outnumbering males. It is possible that the imbalance may have resulted from the fact that female interviewers conducted the survey, which could have affected male students' willingness to participate. Future studies should use a more equal distribution of participants through an interviewer team or alternative data collection methods to mitigate this factor.

To address the knowledge gap in IR, future research should explore undergraduate awareness on a national scale and evaluate the impact of mandatory IR courses in medical schools. Various strategies, such as focused IR lectures, integrated learning platforms for pre-clerkship students, mentorship by IR physicians, and required rotations or electives, could enhance students' understanding and awareness of IR. In addition, to integrate further AI integration in IR education, curricula need to cover AI-based imaging, machine learning applications, and AI-assisted interventions. Practical exposure in the form of workshops, simulation, and web modules needs to be introduced to improve practical

skills. Research and case studies on AI in IR will bridge knowledge gaps, whereas interdisciplinary interaction between radiology departments, AI researchers, and technologists can further augment AI education. Ongoing curriculum revisions are necessary to keep pace with changing AI developments, so that future radiologists are adequately equipped to handle AI-based innovations in IR.^{19,20}

Conclusion

IR is an integral part of the radiology department; it is a highly important modality that contributes to a better understanding of the important medical specialty of radiology and thus confers a great advantage to healthcare. This study demonstrated that about half of the medical and radiology technology students surveyed had limited exposure to IR. Most students believed that the fundamentals of IR should be included in undergraduate medical programs, and they were interested in learning more about IR. More than one third indicated that they would consider IR as a career choice. These results could have been influenced by differences in academic interests or priorities. For example, radiological techniques students are more specialized in IR and have more exposure to it. These high positive rates and the great desire of the surveyed students to know more about IR suggest to us that the future is bright for the field of IR. Several methods can be used to improve students' knowledge concerning IR, including the early introduction of IR courses into curricula, IR symposiums and conferences. In addition, the absence of a standard radiology curriculum at medical schools by the Council of Deans of Saudi Medical Schools need to be addressed.^{32,33}

Data Sharing Statement

The data are available from the corresponding author on a reasonable request.

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Disclosure

The authors report no conflicts of interest in this work.

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