CAHIERS MAGELLANES-NS
Volume 07 Issue 1
2025

ISSN:1624-1940
http://magellanes.com/

KNOWLEDGE AND PERCEPTIONS OF THE ROLE OF INTERVENTIONAL RADIOLOGY IN PATIENT TREATMENT AMONG SAUDI MEDICAL STUDENTS

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Abstract

Introduction: interventional radiology (IR) is a rapidly growing field in Western nations, even though it is relatively new to these regions. IR utilizes imaging modalities to guide minimally invasive procedures for treating patients. Several studies have been conducted across different provinces of Saudi Arabia, including Riyadh, Makkah, Hail, Tabuk, Arar, and others. These studies aim to assess and analyze the knowledge levels and perceptions of Saudi medical students regarding the role of interventional radiology (IR) in patient treatment. **Objective:** The study aimed to assess the knowledge levels and perceptions of Saudi medical students regarding the role of interventional radiology (IR) in patient treatment **Methodology:** This study is a cross-sectional study conducted between July 2024-December 2024 in Saudi Arabia. The study plans to recruit participants through social media platforms like Twitter, Snapchat, Instagram, WhatsApp, and Facebook. The inclusion criteria are medical students aged 19 years old or above, both males and females, from all provinces of Saudi Arabia, who agree to participate and complete questionnaires. Exclusion criteria are non-medical students under the age of 19 years old and non-Saudi medical students. The minimum target sample size of 384 was calculated using a formula based on prevalence estimation, 95% confidence level, and 5% acceptable error. **Results**: The study assessed knowledge and perceptions of interventional radiology (IR) among 874 Saudi medical students. Final results revealed that while 64.4% of participants were female, a significant knowledge gap existed regarding IR, with only 11.8% demonstrating high awareness of its

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techniques. Notably, 52.0% cited insufficient knowledge as a barrier to pursuing a career in IR. Despite 45.2% recognizing the need for residency training in radiology and surgery, 76.3% incorrectly believed IR does not treat minor illnesses. Preferred learning methods included ward rounds (16.7%) and electives in IR (38.6%), highlighting a need for enhanced educational engagement to improve understanding of this specialty. **Conclusion:** The findings of this study underscore a critical need for enhanced educational strategies and increased exposure to interventional radiology among medical students in Saudi Arabia.

Keywords: Knowledge, Awareness, Interventional radiology, Saudi Arabia, medical students

Introduction:
Interventional radiology (IR) is a radiological subspecialty in which a radiologist utilizes variety of radiological techniques to perform minimally invasive procedures. These techniques include fluoroscopy, ultrasound, computed tomography (CT), and magnetic resonance imaging, which are used as a guidance to approach the targeted area or disease [1]. The interventional specialty has expanded rapidly and is permeating multiple medical and surgical specialties [2]. Despite the field's rapid growth, there is a lack of awareness among medical students [3]. This may confuse and influence on medical students' decisions and get them away from the IR field, which directly impacts recruitment of young graduates [4]. In recent years, IR has expanded to treat more diverse illnesses. However, the specialty faces obstacles like rising demand, radiologist shortages, and low student awareness due to limited medical school exposure [5]. A small number of studies have been conducted in the literature to assess medical students' understanding of IR. In particular, several areas in Saudi Arabia have not had any studies published [6].

~~Staff and patients are more at risk from high radiation dose exposure from extended procedures done close together, such interventional radiology, than from standard radiology [7]. The risk profile of some IR procedures is higher, but many adverse events (55-84%) are avoidable, often due to device issues like incorrect use or malfunction [8].~~ I think this paragraph is not related to the topic

According to a cross-sectional study conducted among medical students in Riyadh, 562 participants were involved, with 294 (52.3%) in pre-clinical years and 268 (47.7%) in their clinical years. The results of the investigation showed that 178 students, which represented 31.7% of the total, had limited or inadequate knowledge about Interventional Radiology (IR). Additionally, 80 students, or 14.2%, were found to have a good understanding of the subject. However, only 42 students, constituting 7.5% of the group, were determined to possess excellent knowledge about Interventional Radiology. The research discovered that clinical students exhibited higher knowledge compared to pre-clinical students, with a statistically significant correlation (p-value < 0.00) [9]. In 2024, a cross-sectional investigation was carried out among 202 medical students at Majmaah University in Saudi Arabia. The results indicated that 97 (48%) of the participants were aware of IR, and 77 (38.1%) expressed interest in pursuing a career in IR. Additionally, 85 (42.7%) students were considering a career in radiology. The self-reported knowledge of IR was assessed, and it was found that 43 (21.3%) of the students had "no knowledge," 40 (19.8%) had "poor knowledge," 80 (39.6%) had "adequate knowledge," 30 (14.9%) had "good," and only 9 (4.5%) had "excellent knowledge" [10].
A study published regarding the awareness and level of knowledge of Interventional Radiology among clinical-year medical students at Tabuk University. Al-blewi SM reported that more than half of the participants said they have adequate and good knowledge about IR. However, 53% did not think that

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interventional radiologists have outpatient clinics or even do ward rounds in the hospital (51%). Also, 70% did not believe that they treat patients at all. Additionally, 55% believed that interventional radiologists must finish training in Surgery and Radiology, while 30% only correctly identified radiology as a method of training. Regarding the procedures done by interventional radiologists, they were familiar to the majority of the participants [11].

Another study was conducted among Riyadh medical students, involving a total of 314 students, with 49% in the preclinical years and 51% in the clinical years. A significant portion, 42% of the students, reported that they had poor information and knowledge about interventional radiology (IR). While 28% of the students were planning to take an elective and radiology rotation, only 27% said they would consider a career in IR. Among the 73% of participants who would not consider a career in IR, the top reasons were "I do not find it interesting" (45%), "Radiation exposure" (14%), and "The lifestyle is not for me" (12%). Regarding the training required for an IR, 48% of the students thought that an IR must complete a residency training program in both radiology and surgery, and only 36% of the students believed that an IR must finish training in radiology alone [12]. Among the existing studies, there were variations regarding awareness of interventional radiology among medical students. “A cross-sectional study conducted in 2022 at Tabuk University shows "that senior medical students in Saudi Arabia have a higher awareness and knowledge of IR than students in other countries. Meanwhile, 87 medical interns and 244 clinical-year medical students participated in cross-sectional research conducted at Hail University in 2021. They concluded that most undergraduate students knew very little about interventional radiology [11]. "Many prior studies assessed medical students' awareness and knowledge of IR; all of them showed that they lacked sufficient knowledge of this specialty." Medical students continue to lack a thorough awareness and comprehension of IR, which can have serious repercussions for patient care and healthcare systems [10]. “Everything being considered, IR is a cutting-edge and successful method of providing healthcare that has several advantages for patients. As this field grows, there is an enormous need for more employees. Unfortunately, this increasing need could not be met because of a lack of understanding [12].

The primary goal of this study is to assess and examine the knowledge and attitudes of Saudi medical students about the role of interventional radiology (IR) in patient care. Additionally, this research aims to explore future healthcare professionals' attitudes toward IR as a specialty and identify areas for potential educational enhancement.

Objectives:

The study set out to assess and analyze the knowledge levels and perceptions of Saudi medical students regarding the role of interventional radiology (IR) in patient treatment, aiming to identify areas for potential educational enhancement and to explore attitudes towards IR as a specialty among future healthcare professionals in Saudi Arabia.

Materials and Methods:

Study design:

This is a cross-sectional study conducted between July 2024- December 2024 study Based on structured questionnaire to evaluate Saudi medical students Knowledge and perceptions of the role of interventional radiology in patient treatment.

Study setting: participants, recruitment, and sampling procedure:

The study’s population consisted of all Saudi Medical students in their pre-clinical years, clinical years

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and senior year.

Inclusion and Exclusion Criteria:
The inclusion criteria for this study were as follows: medical students aged 19 years old or above, and they are Saudis. Non-medical students under the age of 19 years old, non-Saudis were excluded from this study.

Sample size:
Sample size calculations were performed to ensure the minimum number of respondents required for a representative sample of the entire population. Sample size was determined using the Raosoft sample size calculator. Keeping the index percentage at 0.50, margin of error at 5%, and confidence interval (CI) at 95%, the calculated sample size was 384.
The sample size was 384 by (Raosoft, Inc., Seattle, WA, USA) (22).

Method for data collection and instrument (Data collection Technique and Tools):
A self-administered online questionnaire was employed as a research instrument. This instrument was created after reviewing relevant Saudi Arabian articles [12,11]. There was a total of 31 questions, separated into five parts: Ten questions related to the participants' general characteristics were provided in the first section. Seven questions about the participants' awareness and understanding of IR clinical practice are included in the second section. Twelve questions related to the participants' opinions of procedures carried out by interventional radiologists are included in the third section. The fourth section included one question related to the sources of knowledge about interventional radiology. The fifth section included one question about the ways considered desired for acquiring knowledge about interventional radiology by the participants.

Scoring system:
Part, one covers the participants' knowledge and understanding of IR clinical practice. This section contains seven questions, each of which had two or more options. Correct answer received a score of one, while incorrect answers received a score of zero. The original Bloom's cut-off values of 80.0%-100.0%, 60.0%-79.0%, and 0.0%-59.0% were adapted and utilized to categorize the findings into three levels: 1. High level: 6-7 points; 2. Moderate level: 5 points; 3. Low level: 0–4 points.
Part two covers the participants' opinions of procedures carried out by interventional radiologists. This section has twelve questions, each of which had just two options. Correct answer received a score of one, while incorrect answer received a score of zero. The original Bloom's cut-off points, 80.0%-100.0%, 60.0%-79.0%, and 0.0%-59.0%, were adapted and utilized to categorize the findings into three levels: 1. High level: 9-12 points; 2. Moderate level: 7-8 points; and 3. Low level: 0-6 points.

Pilot test:
As part of a pilot study, fifteen participants answered the questionnaire to determine its clarity. This was done to test the feasibility of the study and the questionnaire's simplicity; any misunderstandings were cleared up based on the participants' responses.

Analyzes and entry method:
A windows computer running Microsoft Excel (2016) was used to gather and enter the data. For statistical analysis, the data was then imported into the version 20 of the Statistical Package for the Social Sciences (SPSS) program.

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Results:
Table (1) displays various demographic parameters of the participants with a total number of (874). In particular, a majority of the participants (64.4%) are female and originate from the southern (29.1%) and western (37.4%) regions respectively. A substantial amount of engagement from students that are likely to be more exposed to practical applications of their studies can be found in the distribution between clinical (66.9%) and pre-clinical years. The respondents also put out that an overwhelming number of them (53.5%) are generating an excellent GPA, which indicates the cohort is academically able. But knowledge of interventional radiology is varied: 24.7% reported that their understanding of surgical interventional radiology is poor, and 63.7% hadn't seen patients treated by surgical interventional radiologists. An absence of exposure may account for the high number (52.0%) of respondents who indicated that insufficient knowledge as a barrier to a career in the field. Interestingly, 49.3 % mentioned interest in a two-week elective.

Table (1): Sociodemographic characteristics of participants (n=874)

Parameter		***No.***	***Percent (%)***
Residential region	Northern region	26	3.0
	Southern region	254	29.1
	Center region	179	20.5
	Eastern region	88	10.1
	Western region	327	37.4
Gender	Female	563	64.4
	Male	311	35.6
Which year are you currently in	Clinical years	585	66.9
	Pre-clinical years	289	33.1
Current GPA	Excellent (at least 3.50 out of 4.00) or (at least 4.50 out of 5.00)	468	53.5
	• Very Good (2.75 to 3.49 out of 4.00) or (3.75 to 4.49 out of 5.00)	320	36.6
	• Good (1.75 to 2.74 out of 4.00) or (2.75 to 3.74 out of 5.00)	71	8.1
	• Satisfactory (1.00 to 1.74 out of 4.00) or (2.00 to 2.74 out of 5.00)	15	1.7
How would you rate your knowledge of interventional radiology as compared to other subjects?	• Excellent	129	14.8
	• good	210	24.0
	• adequate	244	27.9
	• poor	216	24.7
	• no knowledge	75	8.6
Have you seen patients who were treated by an interventional radiologist?	No	557	63.7
	Yes	317	36.3

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Have you completed or do you plan to complete an elective in radiology (diagnostic or interventional)?	• Yes	236	27.0
	• No	337	38.6
	• Not sure	301	34.4
Would you consider a career in diagnostic radiology?	• Yes	182	20.8
	• No	321	36.7
	• Not sure	371	42.4
If you answered "no" or "not sure" to the previous question, please choose the most appropriate reason why* (n=709)	I don't find it interesting	310	43.7
	I don't know enough about it	369	52.0
	The lifestyle is not for me	187	26.4
	Radiation exposure	227	32.0
Interest in doing a two-week interventional radiology elective?	• Yes	431	49.3
	• No	230	26.3
	• Not sure	213	24.4

Results may overlap

As shown in figure 1, Analysis of the residency completion data for interventional radiologists provides considerable insight into how training is distributed among different departments. Out of a total of 874 subjects sampled, 38.7% (338 subjects) have finished up residency in radiology department, thus indicates the need of specialized radiological training in this field. More noteworthy, 45.2 percent (395 people) have trained in both the radiology and surgery department concurrently which is obviously a solid twin preparing emphasis required for interventional procedures. On the converse, 7.7 percent (67 subjects) trained only in the surgery department, while 3.5 percent (30 subjects) completed the residency in internal medicine. A reasonable number, 70%, fall under category 1 – graduates of USABS with residency training in at least one medical subspecialty program. And a small number, 5% (44 individuals), fall under category "others" – which encompass varied origins into interventional radiology, among others.

Figure (1): Illustrates what residency do interventional radiologists complete according to participants.

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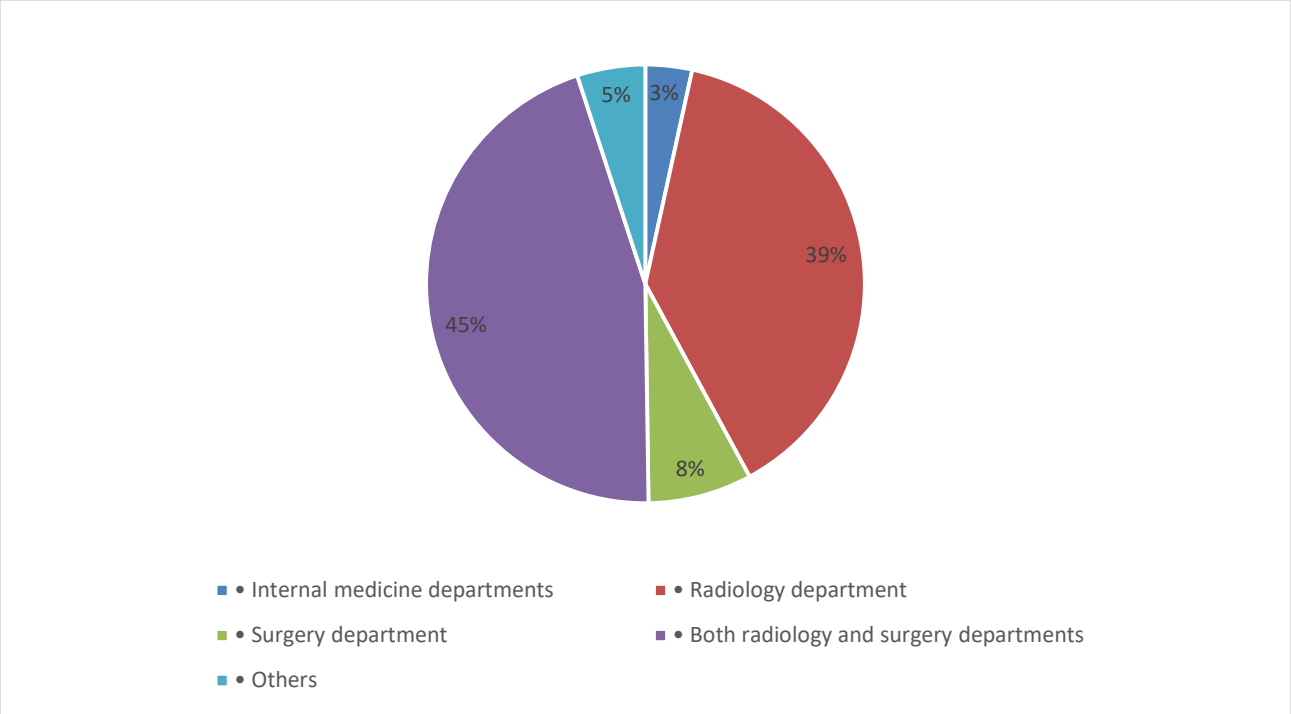

Table 2 presents informative parameters of participants' knowledge and awareness about IR clinical practice on a sample size of 874 participants. Notably 45.2 % respondents, recognize that an interventional radiologist should undergo residencies in radiology and surgery due to the interdisciplinary training required for this specialization. In addition, most participants (52.2%) confirm that interventional radiologists conduct outpatient clinics and a slightly higher percentage (55.0%) stated that interventional radiologists perform ward rounds in hospitals. However, although 76.3% of respondents believe that interventional radiologists do not treat minor illnesses, 86.6 % concede their involvement with major illnesses.

Table (2): Parameters related to participants' knowledge and awareness of IR clinical practice (n=874).

Parameter		***No.***	***Percent (%)***
An interventional radiologist must complete a residency in:	• Internal medicine departments	30	3.4
	• Radiology department	338	38.7
	• Surgery department	67	7.7
	• Both radiology and surgery departments	395	45.2
	• Others	44	5.0
Interventional radiologists have outpatient clinics?	No	418	47.8
	Yes	456	52.2
Interventional radiologists do ward rounds in the hospital?	No	393	45.0
	Yes	481	55.0
	• Yes	207	23.7

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Interventional radiologists treat patients with minor illnesses?	• No	667	76.3
Interventional radiologists treat patients with major illnesses.	• Yes	757	86.6
	• No	117	13.4
Interventional radiologists do not treat patients at all?	• No	600	68.6
	• Yes	274	31.4

As shown in figure (2), This data were the responses of a total sample size of 874 individuals about whether an Interventional Radiologist performs a cardiac angioplasty or stenting. Of the respondents, 711 of them – about 81.2 percent of the entire sample – indicate that Interventional Radiologist are involved in these procedures. On the contrary, 163 of the sample, about 18.6 percent, were on the opposing end.

Figure (2): Illustrates if interventional radiologists perform cardiac angioplasty according to participants.

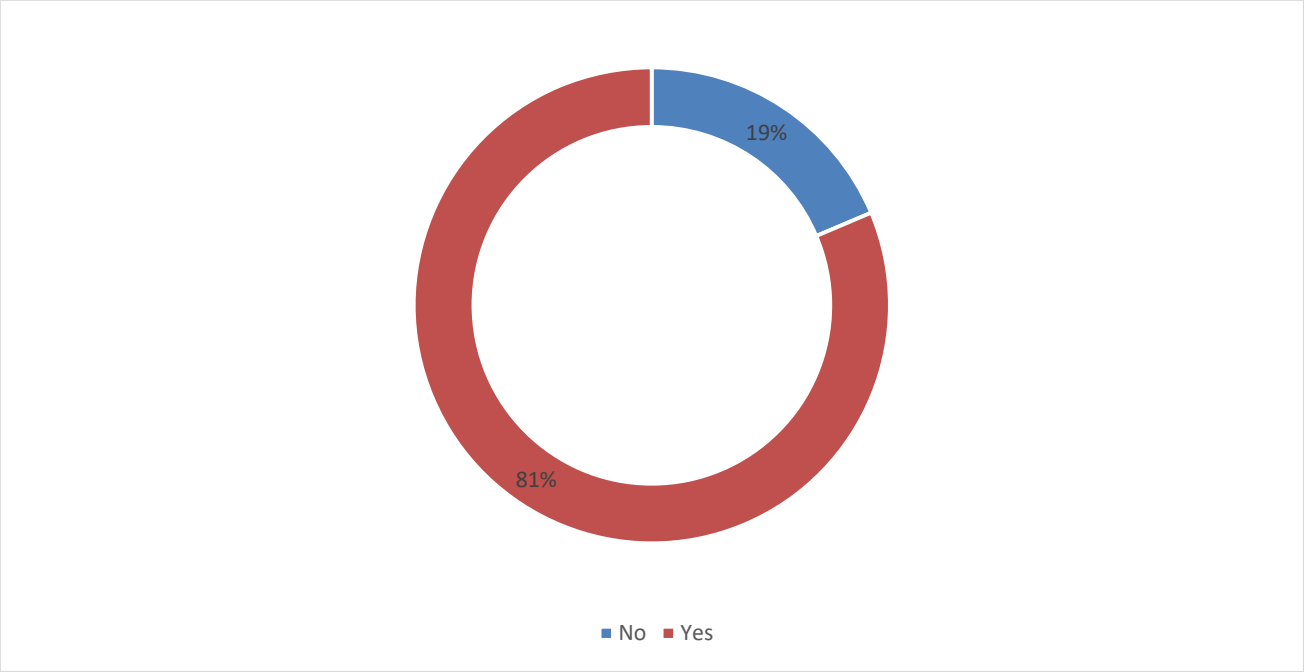

Table 3 represents perceptions and knowledge of 874 respondents about the scope of procedures being performed by interventional radiologists, and there are huge variances in what anyone believed was being done, further demonstrating the lack of communication within the radiology department. An impressive 81.4 percent recognized that an interventional radiologist performs cardiac angioplasty or stenting; i.e., a relatively high level of awareness. In contrast, familiarity with certain techniques, such as vertebroplasty and tumoral radiofrequency ablation, seemed limited as only 60.0 percent and 56.2 percent of participants reported not knowing these procedures. That would indicate a possible gap in education when it concerns more advanced interventional methods. Additionally, participants' primary source of information appeared to be lectures from interventional radiologists highlighting the need for direct engagement and educational efforts to improve knowledge. An area of further development is the

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enormous percentage of individuals (35.5%) that deny any exposure to interventional radiology.

Table (3): Participants' thoughts about procedures performed by interventional radiologists (n=874).

Parameter		***No.***	***Percent (%)***
An Interventional Radiologist performs cardiac angioplasty or stenting	No	163	18.6
	Yes	711	81.4
An Interventional Radiologist performs Femoral-popliteal arterial bypass	No	275	31.5
	Yes	599	68.5
An Interventional Radiologist performs Venous access procedures (e.g., Hickman line)	No	216	24.7
	Yes	658	75.3
An Interventional Radiologist performs Arteriovenous fistulas for dialysis	No	303	34.7
	Yes	571	65.3
An Interventional Radiologist performs Uterine artery embolization for fibroids	No	221	25.3
	Yes	653	74.7
An Interventional Radiologist performs Lower limb angioplasty and stenting	No	214	24.5
	Yes	660	75.5
Are you familiar with Vertebroplasty?	No	524	60.0
	Yes	350	40.0
Are you familiar with Tumoral radiofrequency ablation?	No	491	56.2
	Yes	383	43.8
Are you familiar with EVAR treatment of abdominal aortic aneurysm?	No	442	50.6
	Yes	432	49.4
Are you familiar with Percutaneous nephrostomy?	No	429	49.1
	Yes	445	50.9
Are you familiar with Image-guided core biopsy?	No	329	37.6
	Yes	545	62.4
Are you familiar with the procedure called angioplasty?	No	240	27.5
	Yes	634	72.5
What has provided you with the most information about interventional radiology? *	Radiology elective	201	22.9
	Lectures from interventional radiologists	351	40.2
	Problem-based learning tutorials	132	15.1
	Self-directed research	287	32.8
	Ward rounds in the hospital	167	19.1
	Multidisciplinary meetings	113	12.9
	I have had no exposure to interventional radiology.	310	35.5
	Others	179	20.5

****Results may overlap***

Table 4 presents some very useful data regarding a large number of 874 participants: how they preferred to learn about interventional radiology. Of note, "Ward Rounds" was ranked highest by preference as

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16.7 percent of respondents ranked it first, demonstrating the importance of experiential learning through real time learning in clinical settings. On the other side, although "Elective in Interventional Radiology" received a substantial 38.6% as the most preferred option, it was still a considerable percentile drop since this same item ranked a strong and significant 8th (35.4%). The drop is significant in the metric, but it still represents clearly a viable option for the learners. A commendable 22.4% of the least preferred category demonstrates that while didactic instruction is appreciated, it is perhaps not received as strongly by participants as are interactive or hands on learning approaches. Additionally, "Self-Directed Learning Websites" and "Multidisciplinary Meetings" received considerable support, with first choice percentages of 7.6 and 4.7, respectively.

Table (4): Methods considered favourite to learn about interventional radiology by the participants (from 1 (best) to 8 (worst)) (n=874).

Parameter		***No.***	***Percent (%)***
The preferred method to learn about interventional radiology by the participants is Ward rounds	1	47	5.4
	2	56	6.4
	3	119	13.6
	4	146	16.7
	5	132	15.1
	6	142	16.2
	7	100	11.4
	8	132	15.1
The preferred method to learn about interventional radiology by the participants is Radiology department	1	39	4.5
	2	24	2.7
	3	72	8.2
	4	65	7.4
	5	84	9.6
	6	120	13.7
	7	183	20.9
	8	287	32.8
The preferred method to learn about interventional radiology by the participants is Elective in interventional radiology	1	33	3.8
	2	38	4.3
	3	58	6.6
	4	99	11.3
	5	85	9.7
	6	108	12.4
	7	116	13.3
	8	337	38.6
The preferred method to learn about interventional radiology by the participants is Lectures from interventional radiologists	1	51	5.8
	2	37	4.2
	3	83	9.5
	4	110	12.6
	5	102	11.7
	6	157	18.0
	7	138	15.8

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	8	196	22.4
The preferred method to learn about interventional radiology by the participants is Multidisciplinary meetings	1	41	4.7
	2	54	6.2
	3	98	11.2
	4	185	21.2
	5	177	20.3
	6	130	14.9
	7	87	10.0
	8	102	11.7
The preferred method to learn about interventional radiology by the participants is Self-directed learning websites	1	66	7.6
	2	48	5.5
	3	91	10.4
	4	153	17.5
	5	163	18.6
	6	159	18.2
	7	81	9.3
	8	113	12.9
The preferred method to learn about interventional radiology by the participants is Tutorials Clinical research projects	1	44	5.0
	2	55	6.3
	3	108	12.4
	4	120	13.7
	5	195	22.3
	6	145	16.6
	7	107	12.2
	8	100	11.4
The preferred method to learn about interventional radiology by the participants is Problem-based learning	1	67	7.7
	2	79	9.0
	3	104	11.9
	4	154	17.6
	5	147	16.8
	6	120	13.7
	7	94	10.8
	8	109	12.5

The data from Table 5 shows a huge knowledge and awareness gap regarding interventional radiology (IR) clinical practice among participants. Although IR techniques have shown important clinical relevance and have made progress in the area of IR, only 11.8% of the participants had a high level of knowledge and awareness in these techniques. 15.8% had moderate knowledge of IR and 72.4% had low, concerning awareness of IR.

Table (5): Shows knowledge and awareness of IR clinical practice score results.

	Frequency	**Percent**

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High knowledge and awareness level of IR	103	11.8
Moderate knowledge and awareness	138	15.8
Low knowledge and awareness of IR	633	72.4
Total	874	100.0

Table 6 depicts varying levels of how people perceive and understand the procedures done by interventional radiologists. In particular, only 24.7% of participants showed high level of awareness or correct thoughts about IR procedures, and 32.3% – moderate. Unfortunately, 43.0% had little to no understanding.

Table (6): Shows thoughts about procedures performed by interventional radiologists score results.

	Frequency	**Percent**
High level of thoughts about procedures	216	24.7
Moderate level of thoughts	282	32.3
Low level of thoughts of procedures	376	43.0
Total	874	100.0

Table (7) shows that knowledge and awareness of IR have statistically significant relation to gender (P value=0.0001), residential area (P value=0.0001), year of study (P value=0.0001), current GPA (P value=0.0001), rate of knowledge of IR (P value=0.0001), seeing a patient treated with IR (P value=0.0001), and completing an elective in radiology (P value=0.0001). It also shows statistically insignificant relation to considering a career in diagnostic radiology. Participants of male gender, residing in central region, enrolled in preclinical years, having an excellent GPA were found to have better knowledge and awareness towards IR.

Table (7): Relation between knowledge and awareness of IR and sociodemographic characteristics.

Parameters		***Knowledge and awareness***		***Total (N=874)***	***P value****
		High or moderate knowledge and awareness level of IR	**Low knowledge and awareness of IR**		
Gender	Female	126	437	563	0.0001
		52.3%	69.0%	64.4%	
	Male	115	196	311	
		47.7%	31.0%	35.6%	
Residential area	Northern region	11	15	26	0.0001
		4.6%	2.4%	3.0%	
	Southern region	101	153	254	
		41.9%	24.2%	29.1%	
	Center region	39	140	179	
		16.2%	22.1%	20.5%	
		33	55	88	

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	Eastern region	13.7%	8.7%	10.1%	
	Western region	57	270	327	
		23.7%	42.7%	37.4%	
Which year are you currently in	Clinical years	138	447	585	0.0001
		57.3%	70.6%	66.9%	
	Pre-clinical years	103	186	289	
		42.7%	29.4%	33.1%	
Current GPA	Excellent	146	322	468	0.0001
		60.6%	50.9%	53.5%	
	Very good	76	244	320	
		31.5%	38.5%	36.6%	
	Good	8	63	71	
		3.3%	10.0%	8.1%	
	Satisfactory	11	4	15	
		4.6%	0.6%	1.7%	
How would you rate your knowledge of interventional radiology as compared to other subjects?	• Excellent	79	50	129	0.0001
		32.8%	7.9%	14.8%	
	• good	59	151	210	
		24.5%	23.9%	24.0%	
	• adequate	48	196	244	
		19.9%	31.0%	27.9%	
	• poor	38	178	216	
		15.8%	28.1%	24.7%	
	• no knowledge	17	58	75	
		7.1%	9.2%	8.6%	
Have you seen patients who were treated by an interventional radiologist?	No	102	455	557	0.0001
		42.3%	71.9%	63.7%	
	Yes	139	178	317	
		57.7%	28.1%	36.3%	
Have you completed or do you plan to complete an elective in radiology (diagnostic or interventional)?	• Yes	121	115	236	0.0001
		50.2%	18.2%	27.0%	
	• No	65	272	337	
		27.0%	43.0%	38.6%	
	• Not sure	55	246	301	
		22.8%	38.9%	34.4%	
Would you consider a career in diagnostic radiology?	• Yes	51	131	182	0.940
		21.2%	20.7%	20.8%	
	• No	90	231	321	
		37.3%	36.5%	36.7%	
	• Not sure	100	271	371	
		41.5%	42.8%	42.4%	

P value was considered significant if ≤ 0.05.

Table (8) shows level of thoughts of procedures has statistically significant relation to residential area (P value=0.009), year of study (P value=0.0001), rate of knowledge of IR (P value=0.0001), seeing a

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patient treated with IR (P value=0.0001), and completing an elective in radiology (P value=0.0001). It also shows statistically insignificant relation to gender, current GPA, and considering a career in diagnostic radiology.

Table (8): Level of thoughts of procedures in association with sociodemographic characteristics.

Parameters		***level of thoughts of procedures***		***Total (N=874)***	***P value****
		High or moderate level of thoughts of procedures	**Low level of thoughts of procedures**		
Gender	Female	320	243	563	0.910
		64.3%	64.6%	64.4%	
	Male	178	133	311	
		35.7%	35.4%	35.6%	
Residential area	Northern region	18	8	26	0.009
		3.6%	2.1%	3.0%	
	Southern region	150	104	254	
		30.1%	27.7%	29.1%	
	Center region	93	86	179	
		18.7%	22.9%	20.5%	
	Eastern region	63	25	88	
		12.7%	6.6%	10.1%	
	Western region	174	153	327	
		34.9%	40.7%	37.4%	
Which year are you currently in	Clinical years	360	225	585	0.0001
		72.3%	59.8%	66.9%	
	Pre-clinical years	138	151	289	
		27.7%	40.2%	33.1%	
Current GPA	Excellent	257	211	468	0.084
		51.6%	56.1%	53.5%	
	Very good	193	127	320	
		38.8%	33.8%	36.6%	
	Good	36	35	71	
		7.2%	9.3%	8.1%	
	Satisfactory	12	3	15	
		2.4%	0.8%	1.7%	
How would you rate your knowledge of interventional radiology as compared to other subjects?	• Excellent	90	39	129	0.0001
		18.1%	10.4%	14.8%	
	• good	135	75	210	
		27.1%	19.9%	24.0%	
	• adequate	147	97	244	
		29.5%	25.8%	27.9%	
	• poor	92	124	216	
		18.5%	33.0%	24.7%	

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	• no knowledge	34	41	75	
		6.8%	10.9%	8.6%	
Have you seen patients who were treated by an interventional radiologist?	No	283	274	557	0.0001
		56.8%	72.9%	63.7%	
	Yes	215	102	317	
		43.2%	27.1%	36.3%	
Have you completed or do you plan to complete an elective in radiology (diagnostic or interventional)?	• Yes	162	74	236	0.0001
		32.5%	19.7%	27.0%	
	• No	183	154	337	
		36.7%	41.0%	38.6%	
	• Not sure	153	148	301	
		30.7%	39.4%	34.4%	
Would you consider a career in diagnostic radiology?	• Yes	110	72	182	0.268
		22.1%	19.1%	20.8%	
	• No	172	149	321	
		34.5%	39.6%	36.7%	
	• Not sure	216	155	371	
		43.4%	41.2%	42.4%	

P value was considered significant if ≤ 0.05.

Discussion:

This study sought to determine what Saudi medical students know, and what they feel about interventional radiology (IR) and where there may be educational enhancement needed to reach the desired level of knowledge and capability. There is a significant gap in awareness and understanding of IR among the participants which is in line with other conducted studies in several areas, such as Saudi Arabia. For example, one study reported that 52% of medical students who attended Majmaah University had poor knowledge of interventional radiology (IR), similar to what we found, in that 24.7% of these students rated their understanding of surgical interventional radiology as poor [13]. What is unique about this Saudi Arabia is that no study has found such a high rate of lack of awareness about IR; the highest rate of such lack of awareness is international and it can be observed in Ireland in which studies have shown that 62% of medical students had little knowledge about IR and in England that number was 55.5% in studies. The findings like these do have a way of bringing to the forefront another pervasive issue in medical education that does indeed need immediate attention.

Our results indicate that a remarkable 63.7% of participants lacked previous contact with patients treated by interventional radiologists, clearly making their relative unfamiliarity with the specialty. Again, this agrees with Alnajjar et al. who indicated that students were not often aware of the privileges and responsibilities of interventional radiologists, including performing ward rounds and looking after patients in outpatient clinics [14]. Abohimed highlighted a critical barrier to interest in this specialty: the lack of exposure to IR during medical training [13] and stressed that the increased visibility and educational outreach to medical students is needed. The results of the current study indicate that despite interest in electives in IR among 49.3% of respondents considering a two-weeks elective, actual exposure remains alarmingly low. In addition, specific IR procedure knowledge between participants was significantly different. Of those who knew that interventional radiologists perform cardiac angioplasty or stenting, 81.4% knew, far less so aware of other advanced procedures such as vertebroplasty with 60.0% and tumoral radiofrequency ablation at 56.2%. Such a discrepancy, however,

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points to the need for education on specialized interventional methods. Similarly, at the University of Hail another study revealed that there was little knowledge of various IR topics and consequently bolstered the case for further educational campaigns [15]. Such a gap in knowledge was accounted for by the fact that the primary source of information for participants in our study was lectures from interventional radiologists, giving rise to the notion that although some efforts toward education have been made, perhaps they are not enough to completely overcome this knowledge gap.

The study also noted what certain medical students prefer when it comes to learning about IR, with 'Ward Rounds' being the most preferred method and then electives they are interested in. Consistent with other studies, this preference in favor of experiential learning is reinforced by the findings that hands-on experiences are important in medical education [16]. Nevertheless, didactic instruction is not as highly ranked as might be expected compared to traditional lecture based approaches in engaging students in this specialty. Indeed, it concurs with an observation made by Abohimed who identified that, interactive learning methods were more effective in stimulating interest and comprehension in the students [13]. Luckily, the study also points to a way that could help fill these alarming knowledge and awareness gaps. Knowledge of IR is highly correlated with a number of factors including gender, housing area, year in study, GPA, and IR exposure, and these disparities, particularly in the context of enrollment in STEM classes, suggest that educational interventions targeted toward these groups could be developed. For instance, male students, as well as those from the central region, showed better knowledge and self-reported awareness of IR implying it might be beneficial to implement tailored educational strategies to increase the IR knowledge of the underrepresented groups [16].

The present study is, however, limited. Using the cross-sectional design may restrict the capacity to draw causal inferences regarding the causative factors of knowledge and attitudes about IR. In addition, self reported data might have a also bias towards the participants who might over report his knowledge and his interest in IR. Additionally, the scope of the study is to a single geographical region, and the extent to which the findings are generalizable to additional geographic areas in Saudi Arabia or globally is unknown. Longitudinal designs and qualitative approaches to medical students' perceptions of IR should be examined further in future research.

Conclusion:

Finally, the results from this study highlight the importance of upgrading the educational strategies of medical students and exposing them to interventional radiology. The student's high level of interest in pursuing electives in IR, combined with significant gaps in knowledge and awareness often result in students shying away from an area that is so critical to the clinic. In medical education programs, understanding and exposure barriers to interventional radiology can be addressed and future healthcare professionals can be better prepared to appreciate the role of interventional radiology in patient care.

Acknowledgement:

We thank the participants who all contributed samples to the study.

Ethical approval

An informed consent was obtained from each participant after explaining the study in full and clarifying that participation is voluntary. Data collected were securely saved and used for research purposes only.

Funding

The study did not receive any external funding.

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Conflict of interests
The authors declare that there are no conflicts of interest.

Informed consent:
Written informed consent was obtained from all individual participants included in the study.

Data and materials availability
All data associated with this study are present in the paper.

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