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Investigation of Awareness Level Concerning Radiation Dose and Associated Risks among Medical Students in KSA: Cross-Sectional Study

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Abstract

The use of medical imaging has been on the rise in the past few decades, which has brought about concerns and raised questions regarding the dangers of radiation exposure. Although medical imaging is beneficial in the medical sector, the high level of radiation from artificial sources that the patients are exposed to raises many questions, especially considering the risks associated with it. To identify the knowledge and awareness regarding radiation hazards among medical students in KSA. A cross-sectional, descriptive, and analytical survey was conducted among medical students in Saudi Arabia. To collect data for the study, a validated questionnaire survey was distributed to medical students in most schools in Saudi Arabia. In essence, the population engaged in the study was medical students and intern physicians in Saudi Arabia. Out of 412 participants, the results of the study on the awareness level score concerning radiation dose and associated risks among medical students are quite interesting. The study found that out of the total number of participants, 42% had a low awareness level, 21.6% had a moderate awareness level, and 36.4% had a high awareness level. Regarding attitude score, 27.7% of the individuals surveyed have a positive attitude, 61.7% have a neutral attitude, and 10.7% have a negative attitude. In conclusion, the investigation of awareness and attitude levels concerning radiation dose and associated risks among medical students in KSA is crucial for the safety of healthcare workers and patients, as only around one-third of the participants exhibited high awareness and attitude scores.

Keywords: Radiation dose, Awareness, Medical students, KSA

Introduction

Over the past few decades, there has been a rise in the use of medical imaging, raising questions regarding radiation exposure dangers. The expanding importance of imaging in medical decision-making is one reason for the increased usage of diagnostic medical radiation. As is well known, the development of radiography in the medical profession, both in diagnostic and therapeutic techniques, has revolutionized how doctors treat patients, diagnose ailments, and provide therapy for a variety of disorders [1]. Medical procedures like X-rays, computed tomography (CT scans), and mammography expose referred patients to the highest levels of radiation from artificial sources [2]. Radiation exposure has been found to raise the risk of numerous diseases, including cancer, inherited abnormalities, and radiation-associated with non-cancer diseases [3]. The ALARA principle, which states that the radiation dose should be kept as low as reasonably attainable, should be used to enhance public health. Additionally, ALARA's three primary components are reducing the amount of time, extending the distance, and employing protective shielding [4].

Medical imaging has evolved into a critical diagnostic tool in the field of medicine. The radiation dosage is acquired from various imaging techniques [5]. X-rays are electromagnetic

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radiations with a short wavelength and a high frequency that can be used for diagnostic reasons [6]. The frequency of diagnostic imaging investigations involving ionizing radiation has increased during the previous decade. Between 1996 and 2010, the use of computed tomography (CT), magnetic resonance imaging (MRI), ultrasonography, and PET imaging increased by 7.8%, 10.0%, 3.9%, and 57.0%, respectively. This suggests that both patients and healthcare workers may have been exposed to excessively high quantities of radiation [7, 8]. The World Health Organization (WHO) started the Global Initiative on Radiation Safety in Health Care Settings in 2008 intending to teach safe radiation use in medical practice. This was intended to supplement the International Action Plan for Patient Radiological Protection developed by the International Atomic Energy Agency in 2002 [9].

"Even workers in a radiation environment showed a lack of knowledge and awareness regarding radiation safety." This is what Zekioğlu *et al*. (2021) concluded in their study, which aimed to investigate the awareness and knowledge level concerning radiation safety among healthcare professionals [10].

Similarly, Mohammed (2020) concluded that most of the medical students and intern doctors had poor knowledge about the actual dose exposure during common radiological examinations; the study was restricted to the medical students at King Khalid University in Abha [11].

In 2022, Azadbakht *et al*. emphasized that radiology professionals had a better estimate when talking about dose assessment while radiology students had a higher level of understanding about radiation protection [12].

According to Asiri in 2023 he offered online classes and educational courses about radiation risks and protection. he could not hold face-to-face classes which was considered the main limitation of his study. However, the author concluded the educational course successfully increased the knowledge of 90% of participants [13].

Enhancing safety and protection and using dosage limits are the general principles of radiation protection. It is only possible to produce the most accurate and reliable result with the lowest dose in any medical application that uses ionizing radiation if these key guidelines are followed. This is directly tied to how much healthcare practitioners know about the harmful effects of radiation on human health. Therefore, sufficient knowledge will help medical students and workers protect themselves and their patients from unnecessary radiation.

Objectives

Most of the studies investigating the level of knowledge and awareness about radiation hazards and associated risks were conducted among doctors, specialists, and the general public, not among medical students who were willing to learn. The authors noticed that several studies discussed the subject in a specific city or specific hospital. So, we aimed to discuss assess the knowledge and awareness regarding radiation hazards among medical students in Saudi Arabia. The purpose of this study is to evaluate medical students' knowledge of radiation dose, how to protect themselves from radiation, and the hazards of ionizing radiation.

Materials and Methods

Study Design

The study was cross-sectional, descriptive, and analytical, and it involved medical students in Saudi Arabia. A questionnaire survey was conducted to provide a quick glimpse of knowledge and awareness of radiation doses and hazards, a validated questionnaire was distributed to most medical schools in Saudi Arabia.

Study Setting: Participants, Recruitment, and Sampling Procedure

The study's population consisted of medical students and intern physicians in Saudi Arabia.

Inclusion and Exclusion Criteria

The inclusion criteria were met by the medical students who were 18 years and above and intern physicians, females and males in Saudi Arabia; all healthcare personnel who had a background in radiation environment or were younger than eighteen years were excluded.

Sample Size

The Qualtrics calculator was used to determine the sample size, with a confidence level of 95% we estimate a minimum sample size of 377.

Method for Data Collection and Instrument (Data Collection Technique and Tools)

The study design is a cross-sectional study, to assess the awareness of medical students regarding awareness and knowledge of radiation dose and associated risks. The study population consisted of random medical students. The data were collected through a survey questionnaire. The questionnaire has two sections: the demographic information section and the awareness-related section. The questionnaire adhered to ethical principles including informed consent, confidentiality, and voluntary participation.

Scoring System

Overall, nineteen statements were used to assess the level of knowledge and attitude Knowledge score :
Thirteen statements for knowledge scoring, one point given for correct answers, and zero points for incorrect answers or I don't know. The scoring system was divided as follows 10>: for a high level of knowledge, 7-10 for a medium level of knowledge, and 7< for a low level of knowledge. Attitude score:

A total of 6 statements were used to assess the attitude towards Radiation Risk, using five statements for each one. A six-point Likert scale was used and regarded from 5-0 as strongly agree to strongly disagree. A score of 24> considered a positive attitude, 17-24 considered a neutral attitude, and 17 < considered a negative attitude.

Analyzes and Entry Method

The data will be gathered, selected (according to the inclusion and exclusion criteria), and entered "Microsoft Office Excel Software" program. It will then be transferred to Statistical Package for Social Sciences, version 26 (SPSS, Armonk, NY: IBM Corp) for statistical analysis .

Results and Discussion

In **Table 1**, in terms of age, the majority of respondents (73.8%) fall within the 21-30 age range, while a significant portion (19.2%) are aged 18-20. The remaining respondents are spread across the 31-50 age range, with smaller percentages in each category. When it comes to education level, the data shows that the largest group of respondents are senior students (20.1%), followed closely by interns (18.4%). The remaining respondents are distributed across the first through fifth years of their medical education, with each category representing a smaller percentage of the total.

Table 1. Sociodemographic characteristics of participants (n=412)

Parameter		No.	%
Age	18_20	79	19.2
	21_30	304	73.8
	31_40	16	3.9
	41_50	13	3.2
Education Level	Intern	76	18.4
	Senior student	83	20.1
	First-year	49	11.9
	Second year	31	7.5
	Third year	51	12.4
	Fourth-year	61	14.8
	Fifth year	61	14.8

According to the data in **Table 2**, 100 out of 412 respondents (24.3%) have had formal training on radiation protection, while the remaining 312 (75.7%) have not received such training. Furthermore, the average number of patients seen in a typical 8-hour ER shift varies widely among respondents. The majority (38.8%) reported seeing 1-10 patients, while 25.0% reported seeing no patients at all. In addition, the data also provides insights into the number of CT/X-Ray orders requested during an 8-hour ER shift. A significant portion (52.2%) reported ordering 1-10 CT/X-Ray tests, while 27.7% reported not ordering any tests at all.

Table 2. Participants' training on radiation protection and number of radiology patients dealt with (n=412)

Parameter		No.	Percent
Had formal training in radiation protection	Yes	100	24.3
	No	312	75.7
Average number of patients in a typical 8 hours ER shift is:	0	103	25.0
	1_10	160	38.8
	11_20	73	17.7
	21_30	39	9.5
	31_40	12	2.9
	41_60	11	2.7
	more than 60	14	3.4
Average number of CT/X-Ray orders requested in a typical 8 hours ER shift is:	0	114	27.7
	1_10	215	52.2
	11_20	42	10.2
	21_30	21	5.1
	31_40	7	1.7
	41_60	9	2.2
	more than 60	4	1.0

The parameters in **Table 3** are categorized into six ranges: 0-10, 11-50, 51-100, 101-500, more than 500, and I don't know. The imaging tests included in the table are cranial X-ray, pelvic X-ray, abdominal ultrasound, abdominal X-ray, chest CT, abdominal MRI, pelvic CT, cranial CT, and abdominal CT. Looking at the table, it can be seen that the most commonly performed imaging test is abdominal ultrasound, with 28.4% of patients undergoing the test in the 0-10 parameter range. This is followed by abdominal MRI, which was performed on 25.0% of patients in the same parameter range. On the other hand, the least commonly performed test is abdominal X-ray, with only 19.7% of patients undergoing the test in the 0-10 parameter range. It is also interesting to note that as the number of parameters increases, the percentage of patients undergoing imaging tests also increases. For instance, in the more than 500 parameter range, 53.2% of patients underwent cranial CT, which is higher than the percentage of patients who underwent the same test in the 0-10 parameter range (18.0%).

Table 3. Knowledge of participants of radiation doses (n=412)

Parameter	0-10	11-50	51-100	101-500	More than 500	I don't know
Cranial X-ray	77 18.7%	63 15.3%	46 11.2%	22 5.3%	8 1.9%	196 47.6%
Pelvic X-ray	71 17.2%	59 14.3%	45 10.9%	25 6.1%	6 1.5%	206 50.0%
Abdominal US	117 28.4%	57 13.8%	29 7.0%	19 4.6%	5 1.2%	185 44.9%
Abdominal X-ray:	81 19.7%	61 14.8%	42 10.2%	24 5.8%	10 2.4%	194 47.1%
Chest CT	67 16.3%	39 9.5%	41 10.0%	36 8.7%	32 7.8%	197 47.8%

Abdominal MRI	103 25.0%	38 9.2%	24 5.8%	29 7.0%	14 3.4%	204 49.5%
Pelvic CT	70 17.0%	38 9.2%	32 7.8%	36 8.7%	26 6.3%	210 51.0%
Cranial CT	74 18.0%	32 7.8%	29 7.0%	29 7.0%	29 7.0%	219 53.2%
Abdominal CT	70 17.0%	41 10.0%	32 7.8%	34 8.3%	26 6.3%	209 50.7%

The results of **Table 4** indicate that there is a split between those who believe that a one-time abdominal CT in childhood increases the lifetime risk for cancer and those who do not. 46.4% of respondents answered yes, while 50.7% answered no. It is important to note that 2.9% of respondents were unsure. When it comes to notifying patients about the potential side effects of radiation prior to a diagnostic radiological exam, the majority of respondents (68.7%) answered yes, while 31.3% answered no. The survey also asked about the ordering of diagnostic radiological exams for pregnant patients. The majority of respondents (36.9%) answered that they never ordered a diagnostic radiological exam for a pregnant patient. However, it is important to note that 31.6% of respondents followed their obstetrician-gynecologist's suggestions regarding their desired orders. Additionally, 14.8% of respondents observe the pros and cons of such an exam, notify the patient about the potential outcomes, and request a lead vest to be worn by the patient before ordering a diagnostic radiological exam. Finally, the survey asked which radiological imaging modality carries the lowest risk for the fetus. Chest X-ray was the most commonly chosen option, with 57.5% of respondents answering this way. Abdominal X-ray and Pelvic CT were also chosen by a significant number of respondents, with 12.6% and 14.1% respectively.

Table 4. Knowledge of participants of radiation risks (n=412)

Parameter		No.	Percent
One-time abdominal CT in childhood increases the lifetime risk of cancer	Yes	191	46.4
	No	209	50.7
	I don't no	12	2.9
When ordering a diagnostic radiological exam, do you notify your patients about the potential side effects of radiation prior to the examination?	Yes	283	68.7
	No	129	31.3
When ordering a diagnostic radiological exam for a pregnant patient:	I follow the suggestions of the Obstetrics & Gynecology department with regard to the orders I request.	130	31.6
	I follow the suggestions of the Obstetrics & Gynecology department with regard to the orders I request.	2	.5
	I freely order any diagnostic radiological exam knowing there is no side effect.	35	8.5
	I never order a diagnostic radiological exam for a pregnant patient.	152	36.9
	I observe the pros and cons of such an exam, notify the patient about the potential outcomes, and request a lead vest to be worn by the patient before ordering a diagnostic radiological exam.	61	14.8
	I order diagnostic radiological exams on pregnant patients as long as she wear a lead-vest and she is in the appropriate trimester for such an exam.	32	7.8
Which one of the following radiological imaging modalities carries the lowest risk for the fetus?	Abdominal CT	33	8.0
	Abdominal X-ray	52	12.6
	Chest X-ray	237	57.5
	Lumbar vertebrae X-ray	32	7.8
	Pelvic CT	58	14.1

One of the key findings in **Table 5** is that a significant percentage of respondents (30.6%) agreed that they would be less likely to order CT imaging if alternate imaging were more readily available in the ED, especially during evenings, nights, or weekends. Furthermore, the survey revealed that a majority of respondents (48.8%) believe that the overutilization of CT is a significant problem from the perspective of healthcare costs. Another noteworthy result is that a significant percentage of respondents (44.9%) agreed that overutilization of CT is a significant problem from the perspective of radiation and associated cancer risk. Moreover, the survey indicated that a majority of respondents (51.5%) believe that there is a significant opportunity in the ED to reduce CT utilization and associated radiation risks. Additionally, the data shows that a considerable percentage of respondents (46.6%) agreed that malpractice litigation is an important factor in their imaging decisions. Lastly, the survey revealed that a significant percentage of respondents (43.0%) would like to be provided with reminders when patients are at increased risk of cancer from CT imaging, either due to inherently increased risk factors or from the cumulative effects of multiple imaging studies over their lifetime.

Table 5. Participants' attitude towards radiation (n=412)

Parameter	Agree	Neutral Agree	Disagree
I would be less likely to order CT imaging if alternate imaging were more readily available in the ED, especially during evenings, nights, or weekends.	126 30.6%	218 52.9%	68 16.5%

Overutilization of CT is a significant problem from the perspective of healthcare costs.	149 36.2%	201 48.8%	62 15.0%
Overutilization of CT is a significant problem from the perspective of radiation and associated cancer risk.	159 38.6%	185 44.9%	68 16.5%
There is a significant opportunity in the ED to reduce CT utilization and associated radiation risks.	131 31.8%	212 51.5%	69 16.7%
Malpractice litigation is an important factor in my imaging decisions.	157 38.1%	192 46.6%	63 15.3%
Before I order a CT I would like to be provided with reminders when patients are at increased risk of cancer from CT imaging either from inherently increased risk factors (e.g. young patients) or from increased risk of multiple imaging studies over their lifetime.	177 43.0%	169 41.0%	66 16.0%

In **Figure 1**, the results of the study on the awareness level score concerning radiation dose and associated risks among medical students are quite interesting. The study found that out of the total number of participants, 42% had a low awareness level, 21.6% had a moderate awareness level, and 36.4% had a high awareness level.

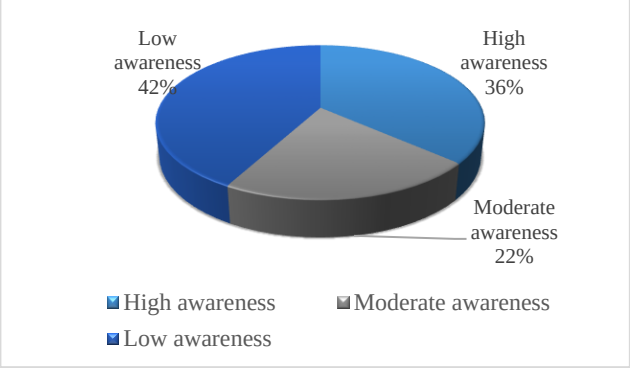

Figure 1. Awareness level score concerning radiation dose and associated risks among medical students

According to **Figure 2**, 27.7% of the individuals surveyed have a positive attitude, 61.7% have a neutral attitude, and 10.7% have a negative attitude.

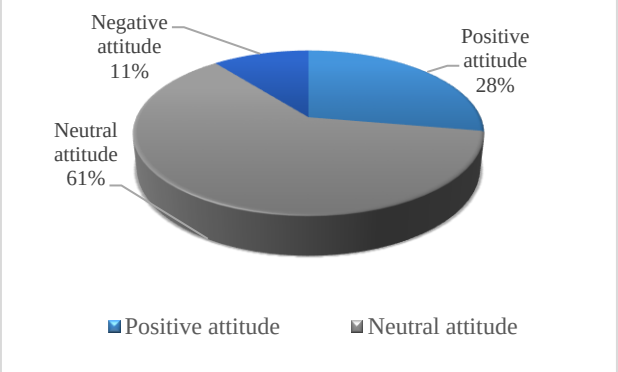

Figure 2. Attitude level score concerning radiation dose and associated risks among medical students

Table 6 shows the following, in terms of age: The table shows that the awareness level for radiation dose and associated risks increases with age. The P-value is 0.011, which is statistically significant. The highest awareness level is observed in the 21-30 age group, with 73.8% having high awareness, followed by the 18-20 age group with 19.2% having high awareness. The lowest awareness level is observed in the 31-50 age group with only 3.9% having high awareness. The highest awareness level is observed in the "no" category (89.6%). The table shows that there is no significant difference in the awareness level between different education levels. The P-value is 0.343, which is not statistically significant. The highest awareness level is observed in the senior student category (20.1%), followed by the intern category (18.4%), and the fifth-year category (14.8%). The table shows that participants who had formal training on radiation protection have a significantly higher awareness level than those who did not have formal training. The P-value is 0.004, which is statistically significant. The highest awareness level is observed in the "yes" category (75.7%)

Table 6. Association between sociodemographic characteristics and awareness level concerning radiation dose and associated risks among medical students (n=412)

		Awareness level score			Total (N=412)	P value
		Low awareness	Moderate awareness	High awareness		
Age	18_20	41	11	27	79	0.011
		10.0%	2.7%	6.6%	19.2%	
	21_30	125	65	114	304	
		30.3%	15.8%	27.7%	73.8%	
	31_50	3	6	7	16	
		0.7%	1.5%	1.7%	3.9%	
	51_50	4	7	2	13	
		1.0%	1.7%	0.5%	3.2%	
		4.1%	2.4%	3.9%	10.4%	

Education Level	Intern	29	19	28	76	0.343
		7.0%	4.6%	6.8%	18.4%	
	First-year	25	13	11	49	
		6.1%	3.2%	2.7%	11.9%	
	Second year	16	6	9	31	
		3.9%	1.5%	2.2%	7.5%	
	Third year	22	5	24	51	
		5.3%	1.2%	5.8%	12.4%	
	Fourth-year	24	15	22	61	
		5.8%	3.6%	5.3%	14.8%	
	Fifth year	24	16	21	61	
		5.8%	3.9%	5.1%	14.8%	
	Senior student	33	15	35	83	
		8.0%	3.6%	8.5%	20.1%	
Had any formal training in radiation protection	Yes	133	56	123	312	0.004
		32.3%	13.6%	29.9%	75.7%	
	No	40	33	27	100	
		9.7%	8.0%	6.6%	24.3%	

Table 7 shows that there is a significant association between age and attitude level concerning radiation dose and associated risks. The P-value is 0.030, which is statistically significant. The highest positive attitude level is observed in the 21-30 age group, with 23.8% having a positive attitude, followed by the 18-20 age group with 3.2% having a positive attitude. The lowest positive attitude level is observed in the 31-50 age group with only 0.5% having a positive attitude. The table shows that there is a significant association between education level and attitude level concerning radiation dose and associated risks. The P-value is 0.001, which is statistically significant. The highest positive attitude level is observed in the intern category (8.0%), followed by the senior student category (7.5%), and the lowest positive attitude level is observed in the third-year category (0.7%). The table shows that there is no significant association between formal training on radiation protection and attitude levels. The P-value is 0.295, which is not statistically significant. However, it is important to note that the positive attitude level is higher in the "yes" category (22.3%) compared to the "no" category (5.3%).

Table 7. Association between sociodemographic characteristics and attitude level concerning radiation dose and associated risks among medical students (n=412)

		Attitude score			Total (N=412)	P value
		Positive attitude	Neutral attitude	Negative attitude		
Age	18_20	13	57	9	79	0.030
		3.2%	13.8%	2.2%	19.2%	
	21_30	98	176	30	304	
		23.8%	42.7%	7.3%	73.8%	
	31_50	2	12	2	16	
		0.5%	2.9%	0.5%	3.9%	
	51_50	1	9	3	13	
		0.2%	2.2%	0.7%	3.2%	
	No	2.7%	6.6%	1.2%	10.4%	
		103	227	39	369	
		25.0%	55.1%	9.5%	89.6%	
Education Level	Intern	33	37	6	76	0.001
		8.0%	9.0%	1.5%	18.4%	
	First-year	10	27	12	49	
		2.4%	6.6%	2.9%	11.9%	
	Second year	6	23	2	31	
		1.5%	5.6%	0.5%	7.5%	
	Third year	3	41	7	51	
		0.7%	10.0%	1.7%	12.4%	
	Fourth-year	14	43	4	61	
		3.4%	10.4%	1.0%	14.8%	
	Fifth year	17	36	8	61	
		4.1%	8.7%	1.9%	14.8%	
	Senior student	31	47	5	83	
		7.5%	11.4%	1.2%	20.1%	
Had any formal training in radiation protection	Yes	92	189	31	312	0.295
		22.3%	45.9%	7.5%	75.7%	
	No	22	65	13	100	
		5.3%	15.8%	3.2%	24.3%	

Radiation is a critical component of medical diagnostics and treatment, but it also poses potential risks to both patients and healthcare workers. Therefore, medical students need to have a strong awareness and a positive attitude toward radiation doses and associated risks to ensure the safety of both patients

and healthcare workers. A study was conducted to investigate the awareness and attitude levels concerning radiation dose and associated risks among medical students in the Kingdom of Saudi Arabia (KSA).

Our study was the first to assess and investigate awareness levels concerning radiation dose and associated risks among medical students in KSA.

Our study showed that only 36.4% of participants exhibited a high awareness score level and 42% of whom exhibited a low awareness score. Similarly, another survey showed that 31% of the participants indicated that they have sufficient knowledge regarding the risks associated with radiation, whereas 11% reported having adequate awareness of radiation protection techniques [5]. On the contrary, a study done among Saudi Medical interns in Eastern Providence showed that medical interns in King Faisal University and Imam Abdulrahman Bin Faisal University have an inadequate knowledge of radiation, radiation protection, health hazards, and the doses employed in radiological procedures [14]. An analysis of previously published studies revealed that health-care providers possess insufficient understanding concerning radiation doses and the corresponding dangers connected with medical imaging tests [15, 16]. Multiple studies have also demonstrated that medical students had an inadequate understanding of radiation exposure and its correlated hazards [17, 18].
Consistent with a descriptive study conducted in Norway among 99 undergraduate medical students revealed that the students exhibited a low level of knowledge, with a mean score of 3.91 out of 11.00. Out of the sample, 54 students, representing 55%, expressed excellent confidence in their knowledge and awareness of radiation dose. On the other hand, 45 students (45%) admitted to having low confidence or being uncertain about their knowledge. Additionally, 96% of the students acknowledged the significance of understanding radiation dose and its associated risks, considering it either very important or moderately important. A separate study was carried out on medical students in their 4th to 6th year at a university in Western Australia. The study found that the average score on a knowledge test was 6.0 out of a maximum possible score of 19. Additionally, 23.0% of the medical students expressed at least moderate confidence in their understanding of ionizing radiation doses, while 11.2% considered knowledge of radiation to be either "not important" or "not important at all" [17].

On the other hand, the study found that the attitude of medical students towards radiation dose and associated risks was generally neutral, as 27.7% had exhibited a positive attitude and 61.7% exhibited a neutral attitude. Most participants recognized the potential harm caused by radiation exposure and acknowledged the importance of taking measures to minimize exposure. This neutral attitude is a promising aspect, as it suggests a willingness among medical students to engage in practices that prioritize safety and minimize risks associated with radiation exposure.

Our study also showed that 31.3% of participants declared that they wouldn't notify patients about potential side effects of radiation before examination. Similarly, a study showed that 29.2% of participants declared the same [10].

In our study we found that age was significantly associated with awareness and attitude level, as participants in the age group 21-30 exhibited the highest awareness and attitude level, with p-values of 0.011, and 0.030, respectively, however, another study showed that occupation had significant associated with knowledge level with p-value=0.011 [10]. Also training on radiation protection was significantly association with awareness level (p-value=0.004). Education level was significantly associated with attitude level (p-value=0.001).

The study's findings underscore the need for improved radiation safety education in medical schools in KSA. Medical students must receive comprehensive and targeted education on radiation safety, including the potential risks associated with radiation exposure and the correct use of radiation protection devices. By enhancing the awareness and understanding of radiation safety principles, medical students can contribute to a safer healthcare environment for both patients and healthcare workers.

Conclusion

In conclusion, the investigation of awareness and attitude levels concerning radiation dose and associated risks among medical students in Saudi Arabia is crucial for the safety of healthcare workers and patients, as only a minority of the participants exhibited high awareness and attitude scores. The results of this cross-sectional study indicate that there is a need for improved radiation safety education in medical schools. It is recommended that medical schools in Saudi Arabia implement comprehensive radiation safety training programs to ensure that medical students are aware of the potential risks associated with radiation exposure and the proper use of radiation protection devices.

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

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