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RADIATION AWARENESS AMONG CLINICAL PHASE MEDICAL SCHOOL STUDENTS IN QASSIM REGION, SAUDI ARABIA

Running Title: Radiation Awareness Among Clinical Phase Medical School Students

Dr. Ziyad Abdulaziz Almushayti[1], Sael Nasser Almishrafi[2], Muteb Eid Almutairi[2], Saud Madallah Alhumud[2], Abdulrahman Fahad Alsaykhan[2], Ammar Nahes Almutairi[2], Bader Marshad Alharbi[2], Layan Sultan Alsuhaibani[2], Nada Abdulmohsen Almutairi[2], Hana Abdullah Alazzmi[2]

[1] Assistant Professor, Department of Radiology, College of Medicine, Qassim University, Buraydah, Saudi Arabia

[2] Medical intern, Qassim University, Qassim, Saudi Arabia

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Abstract:

Background and objective: *Despite the importance of imaging in diagnosing many conditions in clinical practice, it has side effects on the patients and the radiologist. This study aimed at assessing awareness among medical students in their clinical years towards the risk of radiation on healthcare workers.*

Methods: *A cross-sectional study was conducted employing an electronic survey with pretested questionnaire on clinical phase medical students and interns in the Qassim region, Saudi Arabia. A convenience sampling technique was used to recruit the participants. All collected data were subjected to statistical analysis using Statistical Package for the Social Sciences (SPSS) software.*

Results: *Only 4.4% and 16.3% of the participants reported using medical radiation 'always' and 'frequently,' respectively. Only 1.2% of self-assessed radiation dosage knowledge was at the expert level. About 6.3% of participants knew the permissible radiation dosage. The most popular methods for learning radiation safety were workshops (42.9%) and offline courses (42.5%).*

Conclusion: *The study findings highlight the need for comprehensive protection against radiation education and training for medical students.*

Keywords: *Radiations, medical students, radiologist, imaging, awareness, knowledge, Qassim region.*

Corresponding author:

Ziyad Abdulaziz Almushayti,

Assistant Professor, Department of Radiology, College of Medicine, Qassim University, Buraydah, Saudi Arabia

QR code

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INTRODUCTION:

Radiological examinations are critical in identifying many medical diseases, and their use has expanded globally in recent years [1]. As a result, these studies require the patients to be exposed to either ionizing or non-ionizing radiation [2]. CT scans account for 13% of all diagnostic exposure in the United States but are cconsidered to account for more than 70% of the total radiation dose delivered to patients [3]. In addition, this exposure is associated with an increased risk of cancer, especially at higher concentrations [4,5]. The awareness of the patients about the dangers of radiation has increased. Doctors are the primary source of information during medical radiation exposure from examinations. To deliver an appropriate explanation to their patients, they must be prepared and informed of the risks, advantages, and dosage. Physicians justify requests for diagnostic imaging based on their experience and knowledge of the radiation doses associated with these procedures. Faculty staff responsible for undergraduate medical students have expressed worry about this, as this information should have been gained at the undergraduate level [6–8]. A general lack of awareness and training in computed tomography [CT] examinations of radiology specialists has been noted, and careful monitoring and training are urgently needed [9]. This lack was also shown in a cohort study conducted on fourth-year medical students at King Abdul-Aziz University, KSA (Kingdom of Saudi Arabia) [10]. In a Norwegian study, final-year medical students reported having little knowledge of the radiation dose and dangers associated with IR imaging examinations [11]. In a study done in South Korea, practitioners' understanding of patient radiation exposure in the emergency department was assessed, and it found that physicians and radiologists were unaware of radiation exposure dosages and cancer risks [12]. Another study of 346 Saudi Arabian medical interns revealed that 69.7% of the participants had an insufficient knowledge of radiation protection. Among local and national healthcare professionals and medical students, there needs to be more knowledge about radiation and safety. Despite the importance of imaging in diagnosing many conditions in clinical practice, it has side effects on patients and healthcare workers. Therefore, this study was conducted on medical students in their clinical years to assess their awareness of the students' radiation risk to healthcare workers. This study's results will help identify the level of students' awareness and correct any misunderstandings.

SUBJECTS AND METHODS:

A cross-sectional study was carried out in an electronic format using a pretested questionnaire. The questionnaire was distributed through social media platforms. Calculations were performed on 231 participants to achieve a minimum calculated sample size of ±5% accuracy and a 95% confidence interval. All clinical phase medical students and Interns in the Qassim region were included in the study. Non-medical students, basic year medical students, graduated medical students, and students outside the Qassim region. A validated anonymous electronic self-administrated survey was used previously in a similar study that included demographic data and items related to radiology knowledge and practices [13,14]. The survey questionnaire was initially conducted on a sample of 25 participants of the target demographic. After that, the data was evaluated to ensure that the questionnaire was clear and to identify any gaps in the project plan. The res pilot research results were included in the final analysis. Ethical clearance to conduct the study was obtained from the Institutional Review Board and Ethics Committee. After the interpretation of the study, informed consent was obtained from each participant. Confidentiality was assured to all participants who agreed to participate in the study. All the participants were allowed the freedom to withdraw from the study at any time during the study. The projected and expected data of the research were kept confidential. Parents' approval was taken for females less than 18 years old to participate in the study. IBM Statistical Package for the Social Sciences (SPSS) Version 23.0 was used for the statistical analysis. The sample means were compared using an ANOVA and an independent samples t-test. The total knowledge mean scores from surveys were compared using a paired sample T-test and Analysis of Variance (ANOVA). The threshold of significance (P-value) was set at 0.05, with a 95 percent confidence interval (CI). An independent biostatistician performed all the statistical analyses.

RESULTS:

Our survey received responses from 252 clinical phase medical students from the Qassim region. The demographic characteristics showed that 148 (58.7%) were males, and 114 (45.2)% belonged to the 4th year of the course. In addition, students from three colleges participated, were 119 (47.2%) belonged to Almulaida college and Qassim University (Table 1). About 4.4% and 16.3% reported that they have radiation use in medical practice 'all the time and 'often,' respectively. At the same time, 14.7% only used it. When we assessed the prescribing imaging studies that use radiation, 4.4% reported they have it

all the time, 16.3% mentioned it as 'often,' and 19.0% had it more than half the time, whereas 14.7% reported no use at all (Figure 1).

Table 1: Baseline characteristics of the participants

Baseline characteristics of the participants		N	%
Gender	Female	104	41.3
	Male	148	58.7
Year of study	4th year	114	45.2
	5th year	84	33.3
	Intern	54	21.4
College of study	Almulaida - Qassim University	119	47.2
	Alrajhi college	69	27.4
	Unaizah College of Medicine - Qassim University	64	25.4

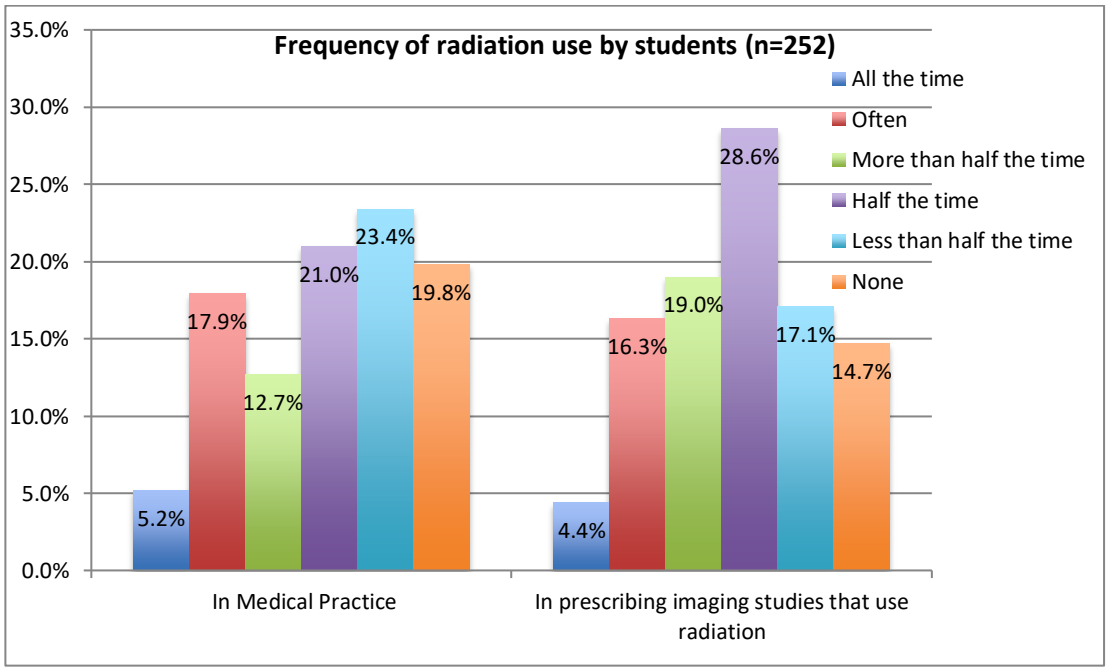

Figure 1: Frequency of radiation use by students.

When we asked the students about their self-assessed knowledge about f radiation safety, only 2.4% and 3.2% mentioned it as 'expert' and 'almost expert,' respectively. In comparison, 11.5% and 8.7% have 'almost no idea' and 'no idea at all, respectively. The self-assessed knowledge about radiation doses was also poor, where only 1.2% mentioned they had expert-level knowledge. About 31.7%, 32.5%, and 22.2% reported that they have 'have an idea but not very well, 'almost no idea,' and 'no idea at all" (Figure 2). The awareness regarding radiation safety among participants is given in Table 2. It was found that only 6.3% of the students understood the milliSieverts (mSv) average radiation exposures allowed (20-30 mSv). However, most learners were conscious that the most vulnerable to radiation risks is the 'fetus' (78.6%). Only 43.3% and 6.3% knew that Magnetic Resonance Imaging (MRI) and Nuclear Imaging have no radiation risks, respectively. Only 6.0% knew that 0.02 mSv is the radioactivity dose recommended during posteroanterior chest x-rays. We assessed the students' awareness about radiation dose absorbed during CT abdomen, CT lumber spine, MRI brain, X-ray spine, and Ultrasound kidney. It was found that about 13.5%, 20.6%, 43.7%, 24.5%, and 54.8% knew about this, respectively. Only 9.1% were aware of the risk of a patient having an oncological complication from an abdominal CT scan (1/2000), and a very small percentage knew (4.8%) about yearly entire bodY Dosage limited to patients in the mSv unit. It was observed that only 5.2%, 2.8%, and 4.0% knew an appropriate dosage acceptable to abdomen x-ray (AXR) in an mSv unit, appropriate dosage acceptable to Computed abdominal tomography in an mSv unit, as well as the potential for deadly cancers exposed via brain Computed tomography respectively.

Table 2: Knowledge and awareness related to radiation

Knowledge and awareness related to radiation		N	%
Are you aware of the average radiation doses permissible in milliSieverts?	0.2-0.3 mSv	11	4.4
	2-3 mSv	18	7.1
	20-30 mSv*	16	6.3
	200-300 mSv	10	4.0
	I don't know	197	78.2
Who are the most vulnerable to the radiation risks?	Elderly	5	2.0
	Adult(including pregnant)	28	11.1
	Teenager	6	2.4
	Children	15	6.0
	Fetus*	198	78.6
Which one of these imaging modalities has no radiation risks?	Magnetic Resonance Imaging (MRI)*	109	43.3
	Ultrasound	197	78.2
	CT-scan	23	9.1
	Abdominal X-Ray	29	11.5
	Nuclear Imaging*	16	6.3
Are you aware of the radiation doses a patient should be exposed during a PA Chest X-ray in mSv unit?	0.02 mSv*	15	6.0
	0.2 mSv	18	7.1
	2 mSv	13	5.2
	20 mSv	13	5.2
	I don't know	193	76.6
If the exposure to PA chest were taken as 1 unit, how many units would a patient absorb during CT abdomen in mSv unit?	0-20	67	26.6
	21-80 mSv	67	26.6
	81-200 mSv	50	19.8
	201-500 mSv	34	13.5
	>500* mSv	34	13.5
If the exposure to PA chest were taken as 1 unit, how many units would a patient absorb during CT lumber spine in mSv unit?	0-20	72	28.6
	21-80*	52	20.6
	81-200	57	22.6
	201-500	30	11.9
	>500	41	16.3
If the exposure to PA chest were taken as 1 unit, how many units would a patient absorb during MRI brain in mSv unit?	0-20*	110	43.7
	21-80	51	20.2
	81-200	48	19.0
	201-500	23	9.1
	>500	20	7.9
If the exposure to PA chest were taken as 1 unit, how many units would a patient absorb during X-ray spine in mSv unit?	0-20	92	36.5
	21-80*	62	24.6
	81-200	59	23.4
	201-500	26	10.3
	>500	13	5.2
If the exposure to PA chest were taken as 1 unit, how many units would a patient absorb during Ultrasound kidney in mSv unit?	0-20*	138	54.8
	21-80	38	15.1
	81-200	38	15.1
	201-500	28	11.1
	>500	10	4.0
What is the risk for a patient to have an oncological complication from abdominal CT scan?	1/200.000	26	10.3
	1/20.000	25	9.9
	1/2000*	23	9.1
	1/200	18	7.1

	I do not know	160	63.5
What is the annual whole-body dose limit for a patient in mSv unit?	5 mSv	6	2.4
	20 mSv	5	2.0
	50 mSv*	12	4.8
	100 mSv	15	6.0
	200 mSv	5	2.0
	2 Gy	3	1.2
	According to the weight	15	6.0
	No limit doses	3	1.2
	I do not know	188	74.6
Are you aware of the effective dose permissible for a plain abdominal X-ray (AXR)in mSv unit?	0-1*	13	5.2
	1-10	11	4.4
	10-50	21	8.3
	100-500	11	4.4
	I do not know	196	77.8
Are you aware of the effective dose permissible for a CT-scan abdomen in mSv unit?	0-1	7	2.8
	1-10*	7	2.8
	10-50	27	10.7
	100-500	12	4.8
	I do not know	199	79.0
Are you aware of the risk of fatal cancer exposed from brain computed tomography?	<1/1000	6	2.4
	1/1000	10	4.0
	1/10.000*	10	4.0
	1/100.000	13	5.2
	1/500.000	9	3.6
	1/1000.000	6	2.4
	I do not know	198	78.6

* correct answers

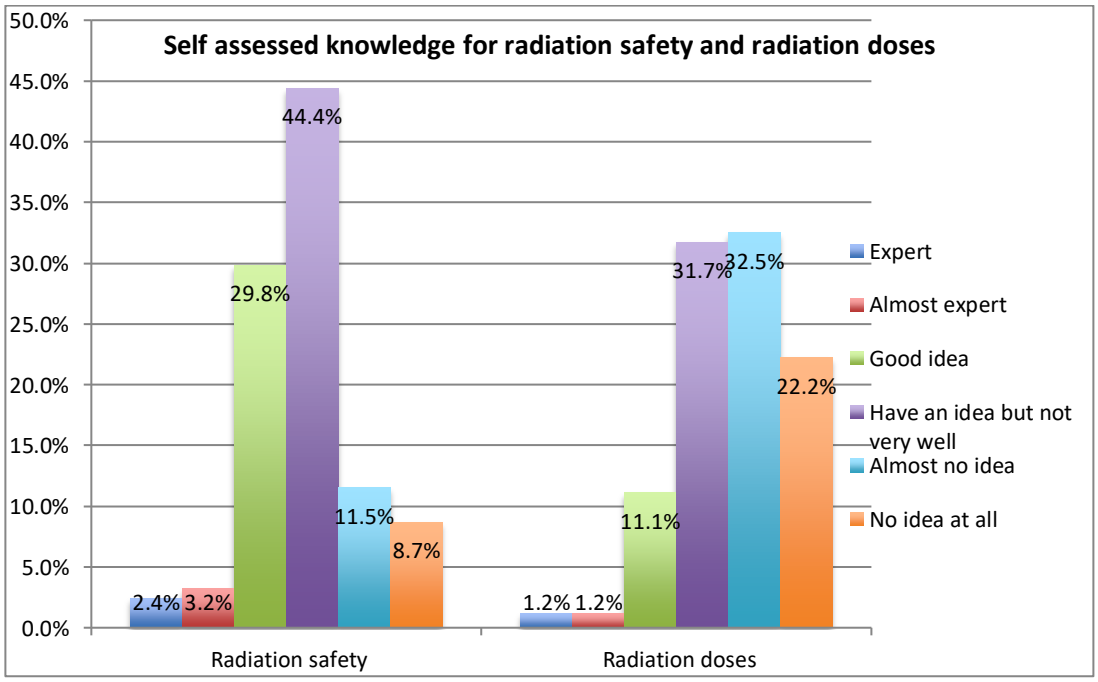

Figure 2: Self assessed knowledge for radiation safety and radiation doses

We calculated a total knowledge score by adding the score of all 15 items, in which a grade of 1 is assigned for each accurate response and a grade of 0 for wrong answers. Thus the maximum score one student could get was 15, and the minimum was 0. The mean total knowledge score was found to be 3.12 ± 1.43, whereas the maximum score of the students was found to be 7. The comparison of total knowledge based on gender, study year, and college are given in Table 3. Only the study year showed statistically significant differences; interns showed comparatively higher scores than other students (p=0.002).

Table 3: Comparison total knowledge score-based demographics of students

		N	Mean	SD	Minimum	Maximum	P value
Gender	Female	104	3.0865	1.36254	.00	6.50	0.749
	Male	148	3.1453	1.48147	.00	7.00	
Year of Study	4th year	114	2.7982	1.25282	.00	6.50	0.002
	5th year	84	3.2619	1.49392	.00	6.50	
	Intern	54	3.5833	1.54416	.00	7.00	
College of Study	Almulaida - Qassim University	119	3.1975	1.38426	.00	6.50	0.565
	Alrajhi College	69	3.1377	1.57621	.00	7.00	
	Unaizah College of Medicine - Qassim University	64	2.9609	1.36074	1.00	6.50	

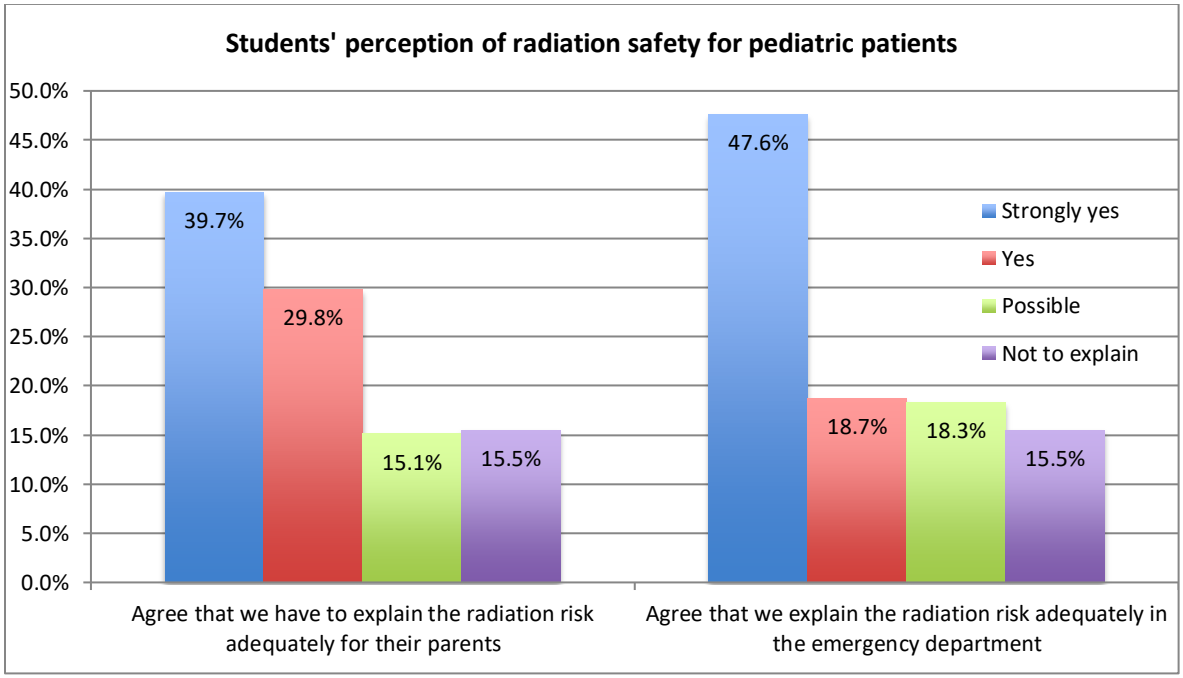

Figure 3: Students' perception of radiation safety for pediatric patients

When we asked students how often radiation safety measures they practice, about 12.7% and 8.3% mentioned it as 'all the time and 'often,' respectively. At the same time, about 34.9% didn't practice it. It was found that Workshops (42.9%) and offline courses (42.5%) were the most commonly preferred methods for learning radiation safety. When we asked about the suitable period to teach classes on radiological safety, about 60.3% and 59.9% mentioned it as during College/Undergraduate and Clinical Training, respectively (Table 4).

Table 4: Practices and attitudes towards radiation safety

Radiation safety measures practiced	All the time	32	12.7
	Often	21	8.3
	More than half the time	24	9.5
	Half the time	42	16.7
	Less than half the time	45	17.9
	None	88	34.9
Preferred learning methods for radiation safety	Offline Courses	107	42.5
	Online courses	98	38.9
	Tutorials	80	31.7
	Workshops	108	42.9
	Seminar	51	20.2
Most appropriate time to have radiation safety lectures.	College/Undergraduate (Medicine, Radiology Technology)	151	59.9
	Clinical Training (Clinical rotations, Residency, Fellowship)	152	60.3
	Clinical Practice (Attending Physician/Dentist, Radiology Technologist	71	28.2

The students' perceptions of radiation safety for pediatric patients are depicted in Figure 3. About 39.7% and 29.8% mentioned 'strongly yes' and 'yes' to explaining the radiation risk adequately to their parents, whereas 15.5% had the opinion not to explain at all. Also, it was observed that about 47.6% and 18.7% mentioned 'strongly yes' and 'yes' to explaining radiological hazards in the emergency unit effectively, whereas 15.5% had the opinion not to explain at all.

DISCUSSION:

Our study included clinical phase medical students in Qassim province who have been requested to fill out a questionnaire to assess their level of familiarity, expertise, and adherence to radiological safety measures, as well as to highlight the necessity for med students to have a good training who interact with such forms of radiations, and to encourage responsible use of such devices to try to reducing radiation exposure. When conducting radiological examinations, it is vital to stress the need to adhere to safe practice, which requires an extensive understanding of ionized and non-ionized radiation sources, exposure, and healthcare concerns when taking educational classes. A good understanding of radiation exposure allows students to better protect themselves, their colleagues, and the patients they care for from unnecessary radiation exposure. The findings of our study showed poor awareness and knowledge among medical students regarding radiation safety measures. Our findings are similar to the studies conducted on medical students in Australia, Ireland, and Iran [15-17]. In our study, only a small percentage of students mentioned that they often use radiation, which could explain their poor performance. Also, they may need to be more trained or use radiation more than they should. Alternatively, medical instructors may ignore the importance of teaching radiation exposure and risk while teaching disease diagnosis techniques. The library's lack of medical diagnostics textbooks, pamphlets, and digital materials contributed to their lacking information regarding radiation exposure and hazards.

In the Kingdom of Saudi Arabia, the Saudi Food and Drug Authority (SFDA) organized all ionizing and non-ionizing radiation practices and interventions. Users of medical devices releasing ionizing or non-ionizing radiation must adhere to these key guidelines in their practices [18]. On the other hand, medical students receive only a limited amount of information on radiation safety from various courses they attend during their studies. Medical radiation safety education and practice guidelines must be developed and included throughout the module with enough specificity if medical professionals are better prepared to safeguard themselves, their patients, and the communities from needless radiation exposure. This knowledge gap will likely persist when medical students become interns or practitioners. Even though medical radiation dose, exposure, and risk are poorly understood, studies reveal that even physicians' expertise is lacking [19,20]. Our findings showed that the majority (93.7%) were unaware of the average radiological dosage acceptable in milliSieverts. It was also found that most students needed help

differentiating between ionizing and non-ionizing imaging modalities. Surprisingly, even medical radiologists and radiographers lack sensitivity to protective safety and precautions involving ionizing radiation [21]. A previous study in Saudi Arabia reported increased med students' knowledge of medical radiation after receiving a three-hour lecture [22]. A study in the United States reported that med students improved their knowledge of medical radiation exposure and safety drastically following a session on radiation oncology [23]. Another study in Canada reported that med students who demonstrated high knowledge of radiation exposure and risk mentioned the primary source of their education as medical training during their course of study [24]. This suggests an inadequate knowledge of med students in the present studies could be mostly attributable to a lack of training [2,6]. Students needing more understanding of the risks of medical radiation may cause them to repeatedly subject patients to high-dose radiation tests as they train to become doctors. Once the source of the issue has been identified as this poor knowledge, different strategies can be planned to address it, such as developing a multidisciplinary "dose team" and routine audits of practices to ensure the necessary steps are taken. Dosimetry principles and optimization measurements, dosage references level, radiation protection standards, updated study findings, and related articles are the primary topics that should be regularly covered in training sessions conducted by qualified experts [25]. The best way to ensure that daily radiological examinations are both acceptable and optimal is to work together in a group effectively and cooperatively so that no mistakes are made. Finally, the study had few limitations. Despite attempts to minimize its potential impact, social desirability bias may have influenced the result of this self-reported study. The inability to illustrate a cause-and-effect relationship is a limitation of cross-sectional studies, making it challenging to determine the true determinants of knowledge in the present research.

CONCLUSION:

The study findings revealed that the awareness and knowledge related to radiological protections are not satisfactory among the study participants. This could be attributed to insufficient participation in practice sessions or refresher courses related to radiation safety and protection. Generally., our research findings emphasize A desire for further comprehensive education and practice of medical students in radiation safety and protection.

List of Abbreviations

ANOVA Analysis of Variance
CI Confidence Interval
KSA Kingdom of Saudi Arabia
SPSS Statistical Package for the Social Sciences

Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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Consent to participate:

Written informed consent was obtained from all the participants.

Ethical approval: The ethical approval for the current study was obtained from the Committee of Research Ethics, Deanship of Scientific Research, Qassim University, Ref # 21-23-02, dated: July 19, 2022.

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