Academia Open
Vol 9 No 1 (2024): June
DOI: 10.21070/acopen.9.2024.9154 . Article type: (Medicine)

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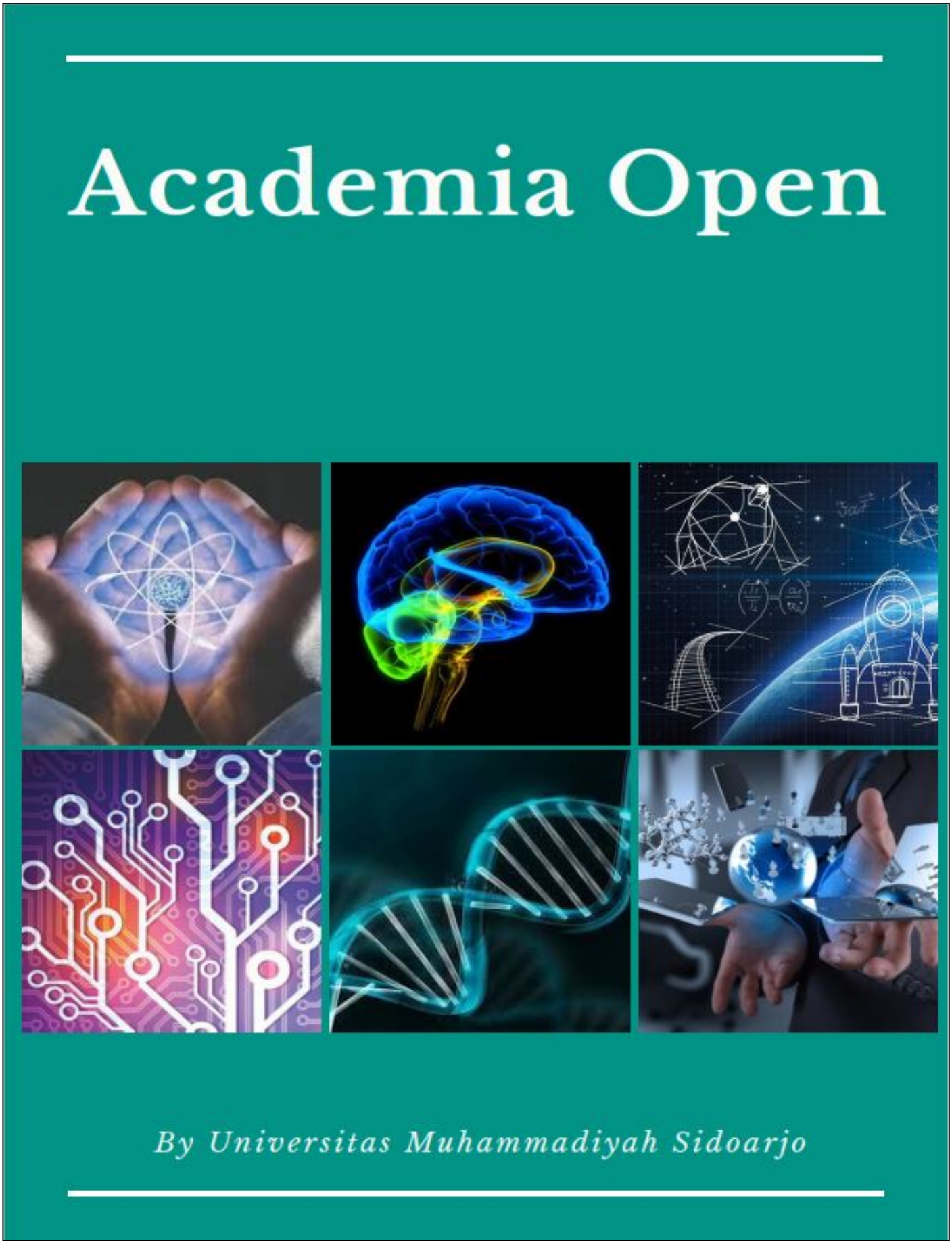

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Radiology Safety in Iraq Exposes Critical Gaps in Training and Knowledge

Keselamatan Radiologi di Irak Mengungkap Kesenjangan Kritis dalam Pelatihan dan Pengetahuan

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Abstract

Ionizing radiation, with 18% from man-made sources, is widely used in medical imaging, posing significant hazards. This study assessed the knowledge, attitude, and practice of 125 radiology staff in Basrah, Iraq, using a cross-sectional design from February to June 2023. Data were collected via structured questionnaires and analyzed with SPSS version 26. Results showed 66.4% of respondents had good knowledge, with higher scores among males and those with higher education, particularly doctors. Positive attitudes were seen in 95.2% of participants, but correct practices varied significantly, and 88.8% had not undergone training on radiation hazards. The study underscores the need for improved training and education to enhance radiation safety awareness and practices.

Highlights:

1. Knowledge Levels: 66.4% showed good radiation hazard knowledge.
2. Training Gaps: 88.8% lacked radiation safety training.
3. Education Impact: Higher education, especially doctors, improved knowledge and practices.

Keywords: Ionizing Radiation, Radiation Hazards, Radiology Staff, Knowledge Assessment, Safety Practices

Published date: 2024-06-20 00:00:00

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Introduction

Ionizing radiation (IR) is a constant threat to everyone alive today, and around 18% of that radiation comes from man-made sources. For the safety of themselves, the patients, and those around the patients, all healthcare professionals (HCPs) should be educated about radiation protection. Only 15% of all radiation exposures are caused by medical X-rays and nuclear medicine, according to the United States National Council on Radiation Protection and Measurement [1]. Ionizing radiation (IR) is now widely used in medical imaging for diagnostic and therapeutic applications [2].

If medical personnel dealing with IR lack radiation protection skills, they put themselves in a position where they cannot protect themselves as efficiently as others [3]. The World Health Organization (WHO) promotes ongoing education and frequent refresher courses and states that, in addition to fundamental training, specialized education in interventional radiology is necessary [4]. Radiation is the movement of energy through matter or space as a wave or particle [5].

The radiological workers exposed to various radiography waves cause interference in normal DNA functioning, which leads to both short-term symptoms (dermatitis, mucositis, and hair loss) and long-term complications (cataracts, skin issues, genetic issues, and cancer). Comparatively to patients and other groups, the proportion of radiological workers who get cancer is around 40% or higher [6]. To reduce these dangers to their absolute minimum, radiation safety procedures are required [7]. According to an IR report, there is a one in 100 lifetime probability of developing radiation-induced cancer with exposure to a radiation dose of 100 mSv, in addition to tissue reactions [8].

The radiation's main effects include a failure of embryo implantation, an early abortion, or no further consequences after 14 days of conception. The organogenesis phase, from the end of the second to the eighth week after conception, is when the fetus is most vulnerable to the teratogenic effects of IR, which have a specific negative impact on the central nervous system (CNS). The fetus becomes very radiosensitive between the eighth and fifteenth week of pregnancy [9].

Free radicals are produced as a result of IR, which causes oxidative stress in the cell or tissue and significant damage to cellular macromolecules and nuclear DNA. As a result, cancer will develop. When a cell is exposed to large doses of radiation, cell division becomes uncontrolled, leading to the development of cancer. Additionally, the patient will have acute radiation sickness, including coagulopathy, diarrhea, immune system problems, burns, fever, and changes in coordination and equilibrium [9]. Also, genetic effects include alterations in the structure and number of chromosomes and gene mutations, which increase the incidence of inherited diseases in the offspring [10].

Method

This is a descriptive cross-sectional study carried out to assess the knowledge, attitude, and practice of the radiological staff in the diagnostic radiology department in the hospitals at the center of Basrah, Iraq. The data was collected for the period from the 1st of February to the 30th of June 2023. The sample chosen for this study was a random sampling technique which is a suggested technique for sampling in this type of research. Steven K. Thompson Formula was used for sample size calculation: [11], the population size was obtained from Al-Basrah health directorate, statistical department. So, the sample size was calculated accordingly, and it was 104 of the radiology staff, this sample size was adjusted to 125 to overcome the non-responders.

The data was collected from the diagnostic radiology department in the hospitals at the center of Basrah, which includes 8 hospitals. A total of 125 radiology staff working in the diagnostic radiology departments in the hospitals of the center of Basrah governorate. Using a special questionnaire form, data for the study was collected from diagnostic radiology department employees. The questions were taken from other research studies and adjusted by the researcher for the needs of the study. Each survey form required 10 to 15 minutes to complete, at a rate twice/week. Before the interview, the participants were informed of the study's objectives and given their verbal consent to participate. The questionnaire consisted of four parts: socio-demographics, knowledge, attitudes, and practice of the participants.

For statistical analysis of the data obtained, Excel and SPSS version 26 software were used. The answers were shown in frequencies and percentages. Quantitative data were tested for normality of distribution and shown as mean± standard deviation and median with minimum and maximum values. To explore relationships, Spearman's correlations, Mann-Whitney U, and Kruskal Wallis tests were used. A relationship of p-value less than 0.05 was considered statistically significant. Also, we calculate the overall percentage for knowledge, attitudes, and practices by summation of the highest score and the lowest score, then divide the value by two.

Result and Disscusion

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The results of this study showed that the mean age of the study population was 41.9 years and males were slightly more than females (57.6%). Most of the sample were married and more than half (54.4%) of them were bachelor's degree holders. showed that the highest number (32.8%) of respondents work at the x-ray unit and then at the CT scan unit. The highest number of them were radiographers and machine operators. The highest number of participants had a work experience between 10 and less than 15 years. Most of this sample (88.8%) had not enrolled in training courses about the hazards of radiation. showed that only one respondent failed to answer 50% of the questions correctly, while 66.4% of the respondents answered between 70% and 89.9% of the questions correctly.

The results showed that there was a statistically significant difference in the median of pass marks between male and female groups; the score was higher in males. Also, there was an increasing trend in the median of pass marks as the level of education increased. Significantly, doctors scored higher, followed by machine operators and radiographers. showed that the directions of attitude among the respondents, all of them had positive attitudes more than negative ones. About 96.8% of the respondents' attitudes were positive. showed that there was a statistically significant difference in the median of pass marks between male and female groups and a difference according to marital status. Testing for the probably associated factors showed that there was a significant statistical association between the marks of practice with the type of job and history of training.

Age	Mean± SD	Median (Min.-Max.)
	41.94±9.89	42 (23-62)
Gender	Frequency	Percent
Male	72	57.6
Female	53	42.4
Marital status		
Single	21	16.8
Married	102	81.6
Divorced	2	1.6
Education		
Less than preparatory school	15	12.0
Preparatory school	11	8.8
Bachelor's	68	54.4
Diploma/ Master	23	18.4
PhD/ Board	8	6.4
Total	125	100.0

Table 1. ***Sociodemographic characteristics of the study population***

Place of work		Frequency	Percent
	X-ray	41	32.8
	CT-scan	36	28.8
	Ultrasound	25	20.0
	MRI	23	18.4
Occupation			
	Radiographer	37	29.6
	Machine Operator	34	27.2
	Doctor	27	21.6
	Reception	14	11.2
	Medical record staff	8	6.4
	Nurse	4	3.2
	Ward assistant/cleaner	1	0.8
Work experience			
	> 1 year	13	10.4
	1--<5 year	25	20.0
	5--< 10 years	17	13.6
	10--<15 year	32	25.6
	15--<20 years	24	19.2
	20--<25 year	14	11.2
Any training course about radiation hazards?			

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	Yes	14	11.2
	No	111	88.8
	Total	125	100.0

Table 2. ***Work characteristics of the study population***

Level of knowledge	Frequency	Percent
Excellent (Score from 90 -100.0)	0	0.0
Very good (Score from 80 -89.9)	26	20.8
Good (Score from 70 -79.9)	57	45.6
Intermediate (Score from 60 -99.9)	30	24
Fair (Score from 50 -59.9)	11	8.8
Week (Score less than 50)	1	0.8
Total	125	100

Table 3. ***Distribution of knowledge levels of the study population***

Variable		Pass marks
Age:	N	125
	R	-0.031-
P-value*		0.735
Sex:		
Male	N	72
	Mean± SD	73.76±7.75
	Median (Min.- Max.)	75(51.3-86.8)
Female	N	53
	Mean± SD	70.26±9.18
	Median (Min.- Max.)	71.1(48.7-85.5)
P-value**		0.027
Less than preparatory school	N	15
	Mean± SD	61.57±8.48
	Median (Min.- Max.)	60.5(51.3-76.3)
Preparatory school	N	11
	Mean± SD	69.62±9.31
	Median (Min.- Max.)	71.1(48.7-80.3)
Bachelor's	N	68
	Mean± SD	74.15±6.52
	Median (Min.- Max.)	73.7(59.2-86.8)
Diploma/ Master	N	23
	Mean± SD	71.97±7.81
	Median (Min.- Max.)	75(53.9-84.2)
Ph. D/ Board	N	8
	Mean± SD	80.91±6.74
	Median (Min.- Max.)	83.55(67.1-86.8)
P-value***		0.0001
Occupation:		
Doctor	N	27
	Mean± SD	78.315±6.67
	Median (Min.- Max.)	80.3 (63.2-86.8)
Nurse	N	4
	Mean± SD	67.750±8.12
	Median (Min.- Max.)	65.8 (60.5-78.9)
Radiographer	N	37
	Mean± SD	72.086±5.89
	Median (Min.- Max.)	72.4 (59.2-80.3)
Machine Operator	N	34

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	Mean± SD	75.238±5.24
	Median (Min.- Max.)	73.7 (65.8-86.8)
Medical record staff	N	
	Mean± SD	65.288±8.63
	Median (Min.- Max.)	66.45 (53.9-76.3)
Ward assistant/cleaner	N	1
	Mean	52.600
	Median (Min.- Max.)	52.6 (52.6-52.6)
Reception	N	14
	Mean± SD	60.621±8.48
	Median (Min.- Max.)	60.5 (48.7-73.7)
P-value***		0.0001

Table 4. ***The associations of sociodemographic factors with the results of knowledge***

* Spearman's correlations, ** Mann-Whitney U Test, *** Kruskal Wallis Test

Level of positive attitudes	Frequency	Percent
Excellent (Score from 90 -100.0)	54	43.2
Very good (Score from 80 -89.9)	35	28.0
Good (Score from 70 -79.9)	32	25.6
Intermediate (Score from 60 -99.9)	0	0.0
Fair (Score from 50 -59.9)	4	3.2
Week (Score less than 50)	0	0.0
Total	125	100

Table 5. ***Distribution of attitude directions of the study population***

Variable		Pass marks
Age:	N	125
	R	0.067
P-value*	0.459	
Sex:		
Male	N	72
	Mean± SD	12.36± 1.56
	Median (Min.-Max.)	13 (7-14)
Female	N	53
	Mean± SD	11.79± 1.31
	Median (Min.-Max.)	12 (7-14)
P-value**	0.008	
Marital status:		
Single	N	21
	Mean± SD	11.19± 1.78
	Median (Min.-Max.)	12 (7-14)
Married	N	102
	Mean± SD	12.3± 1.34
	Median (Min.-Max.)	12 (8-14)
Divorced	N	2
	Mean± SD	12.5± 2.12
	Median (Min.-Max.)	12.5 (11-14)
P-value***	0.005	

Table 6. ***The associations of sociodemographic factors with the results of attitude***

* Spearman's correlations, ** Mann-Whitney U Test, *** Kruskal Wallis Test

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Type of practice	Frequency	Percent
Excellent (Score from 90 -100.0)	12	9.6
Very good (Score from 80 -89.9)	42	33.6
Good (Score from 70 -79.9)	60	48
Intermediate (Score from 60 -69.9)	10	8
Fair (Score from 50 -59.9)	1	0.8
Week (Score less than 50)	0	0.0
Total	125	100

Table 7. ***Distribution of practice type of the study population***

Variable		Pass marks
Occupation:		
Doctor	N	27
	Mean± SD.	74.44± 5.94
	Median (Min.-Max.)	75 (65-90)
Nurse	N	4
	Mean± SD.	85± 4.08
	Median (Min.-Max.)	85 (80-90)
Radiographer	N	37
	Mean± SD.	76.89± 7.2
	Median (Min.-Max.)	75 (65-90)
Machine operator	N	34
	Mean± SD.	73.24± 6.4
	Median (Min.-Max.)	75 (55-85)
Medical record staff	N	8
	Mean± SD.	79.38± 6.23
	Median (Min.-Max.)	80 (70-90)
Ward assistant/cleaner	N	1
	Mean	90
	Median (Min.-Max.)	90 (90-90)
Reception	N	14
	Mean± SD.	85± 5.55
	Median (Min.-Max.)	85 (75-90)
P-value***	0.006	
Trained about hazards:		
Yes	N	14
	Mean± SD.	72.86± 5.79
	Median (Min.-Max.)	75 (65-85)
No	N	111
	Mean± SD.	77.3± 7.5
	Median (Min.-Max.)	75 (55-90)
P-value**	0.029	

Table 8. ***The associations of sociodemographic factors with the results of practice***

* Spearman's correlations, ** Mann-Whitney U Test, *** Kruskal Wallis Test

Discussion

Our study was designed to assess the knowledge, attitudes, and practices of different levels of staff working at radiology departments in some Basrah general hospitals. The study showed that the correct answers to the knowledge questions ranged from 100% to 3.2%. The overall level of knowledge percentage was about 51.6%. The positive attitude extended from 95.2% to 4%. The range of right practice ranged from 90.4% to 3.2%. Also, we found that 88.8%of the participants had not enrolled in training courses about hazards of radiation, and only 11.2% were engaged in training courses. The overall level of knowledge percentage was about 51.6%, the overall positive attitudes were 49.6% and the overall right practice was about 46.8 %, such low levels of the overall percentages of

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the three parameters are due to the presence of some extremely low values. On the other hand, we found that 66.4% of the sample answered between 70% to 89.9% of the knowledge questions correctly when we studied the levels of knowledge, also we found that 96.8% of the sample attitudes were positive when we studied the levels of attitudes, and about 91.2% of the respondents, their practice was correct when we study the levels of practices.

A study in KSA done on medical staff found that a total of 73% of participants revealed many gaps in knowledge and the overall knowledge score ranged from 89.5% to 11.3%, while our medical staff had a higher level of knowledge, and the knowledge ranged from 98.4% to 8% and we found in our study that the overall knowledge was 54%. In the KSA study, they found that only 28.5% of the respondents indicated that they had attended local, regional, or international radiation protection courses, which is more than our study where in our study only 11.2% were engaged in training courses. The correct responses to knowledge questions were 30.02%, our study was 51.6%. Regarding radiation safety for patients and workers respectively, correct responses to questions were 13.1% and 25.2% respectively. The rate of correcting responses to all questions was ranged between 4.3% and 55.6%. while in our study the overall right practice was about 46.8 % which is more than that in the KSA study [12].

Our study is similar to the Sokoto, Nigeria study, where the males more than female worker staff and in marital status, also similar in that they had good knowledge of radiation hazards, but they had poor radiation hazard practices, which is also similar to our study [13]. Another study done in Jordon found that an excellent level of knowledge was found among (91.7), which is better than our study. which is similar to our study regarding attitude. This study was different from our study regarding practice, the Jordanian sample had a good level of right practice while our study practice was poor [14]. Another study done in Iran found that more than half (50%) of the participants had average knowledge, and 60% of the participants had a positive attitude, but they had average practice regarding radiation protection, which is different from our study. Also, about 70% of the Iranian sample had engaged in training courses which is different from our study where the training courses represent 11.2 % of our sample [6].

A study conducted at the Main Assuit University Hospital and South Egypt Cancer Institute aimed to assess the knowledge and practice of healthcare teams about radiation hazards found that the health team had poor knowledge about radiation hazards and most of them had satisfactory practice about safety measures and most of them had satisfactory practice about safety measures, where they are better than our study [15]. Another study also done in Egypt found that more than 90% of the study participants had good knowledge about radiation hazards, and 87% of participants had good knowledge of personal protective equipment, which is also better than the knowledge of our sample [16]. A study done in Nepal found that the overall awareness and knowledge of radiation was satisfying, i.e., the knowledge within the acceptable range which is also better than our results regarding knowledge [17]. A study done in India found that the knowledge, attitudes, and practices of healthcare workers to protect them against radiation were reasonable, which is also better than the knowledge of our sample [18]. In Turkey, the study found that the healthcare personnel, who participated in this research and worked with ionizing radiation sources, did not have adequate knowledge about radiation safety, which is similar to our study [19].

Conclusion

Males were slightly more than females, and about half of the participants had bachelor's degrees. The overall level of knowledge was more than half, the overall positive attitude was less than half and the overall right practice was less than half. Knowledge (two-thirds) of the respondents answered between seventy and ninety percent of the questions correctly. There was a statistically significant difference in the median of pass marks between males and females; the score was higher in males. There was an increasing trend in the median of pass marks as the level of education increased. Significantly, doctors scored higher. The attitude was excellent at forty and fair at less than five percent. The right practice ranged from ninety to less than five percent. There was a significant statistical association between marks of practice with type of job and history of training. Most of the sample had not enrolled in training courses about the hazards of radiation.

References

1. A. R. B. Britos, "Mediating Role of Self-Concept on the Relationship between Interpersonal Relationships and Anger Management of Radiologic Technologists in the Selected Hospitals in Davao City," DDC Professional Journal, vol. 2023, p. 160, 2023.
2. S. Rai, "Study of Knowledge on Radiation Hazards and Radiation Protection among Medical College Students in Coastal Karnataka," Int. J. Cur. Res. Rev., vol. 13, p. 74, 2021.
3. B. Mawphlang and W. Hrangkhawl, "Assessment of Radiation Hazards among Healthcare Professionals and Patients in Civil Hospital, Shillong," Int. J. Recent Sci. Res., vol. 13, pp. 776-779, 2022.
4. F. Shabani, H. Hasanzadeh, A. Emadi, M. Mirmohammadkhani, A. Bitarafan-Rajabi, and A. Abedelahi, et al., "Radiation Protection Knowledge, Attitude, and Practice (KAP) in Interventional Radiology," Oman Medical Journal, vol. 33, p. 141, 2018.
5. H. A. S. Qutbi, T. M. J. Taher, and S. A. Mahdi, "Knowledge about Risk and Protective Measures Related to

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Diagnostic Radiation among Medical Staff in Teaching Hospitals (Wasit Province)," Wiad Lek, vol. 74, pp. 2345-2351, 2021.
6. R. Behzadmehr, M. Doostkami, Z. Sarchahi, L. Dinparast Saleh, and R. Behzadmehr, "Radiation Protection among Health Care Workers: Knowledge, Attitude, Practice, and Clinical Recommendations: A Systematic Review," Reviews on Environmental Health, vol. 36, pp. 223-234, 2021.
7. S. Lawal, M. Z. Ibrahim, J. B. Igashi, and H. Muhammad, "Radiation Protection: An Initial Assessment of Level of Knowledge and Compliance amongst Radiation Workers in Ahmadu Bello University Teaching Hospital Zaria, Nigeria," 2019.
8. M. N. Alreshidi, D. Alshubrmi, F. Alreshidi, K. Soliman, and I. Alrashidi, "Knowledge about Imaging Modalities, Risks, and Protection in Radiology among Medical Students at the University of Hail," Avicenna Journal of Medicine, vol. 10, pp. 15-21, 2020.
9. N. F. A. Bakar, S. A. Othman, N. F. A. N. Azman, and N. S. Jasrin, "Effect of Ionizing Radiation Towards Human Health: A Review," in IOP Conference Series: Earth and Environmental Science, 2019, p. 012005.
10. I. B. Mosse, "Genetic Effects of Ionizing Radiation–Some Questions with No Answers," Journal of Environmental Radioactivity, vol. 112, pp. 70-75, 2012.
11. M. G. Ranalli, S. K. T. S. T. Edition, and C. Samii, ""I Have No Data Yet. It is a Capital Mistake to Theorize Before One Has Data. Insensibly One Begins to Twist Facts to Suit Theories, Instead of Theories to Suit Facts." [Sherlock Holmes to Watson: Sir Arthur Conan Doyle; A Scandal in Bohemia (1891)]," ed, 2012.
12. M. K. Saeed, H. Al-shaari, M. M. Almarzooq, S. A. Alsareii, S. A. Aljerdah, and M. S. Al-ayed, "Radiation Awareness among Physicians about the Hazards of Radiological Examinations on the Health of Workers and Their Patients in Saudi Arabia," Journal of Radiation Research and Applied Sciences, vol. 11, pp. 299-304, 2018.
13. K. Awosan, M. Ibrahim, S. Saidu, S. Ma'Aji, M. Danfulani, E. Yunusa, et al., "Knowledge of Radiation Hazards, Radiation Protection Practices and Clinical Profile of Health Workers in a Teaching Hospital in Northern Nigeria," Journal of Clinical and Diagnostic Research: JCDR, vol. 10, p. LC07, 2016.
14. M. Alakhras, D. Al-Mousa, B. Al Mohammad, and K. Spuur, "Knowledge, Attitude, Understanding and Implementation of Evidence-Based Practice among Jordanian Radiographers," Radiography, vol. 29, pp. 760-766, 2023.
15. M. S. Ahmed, H. D. Fahmy, and S. A. Sharkawy, "Assessment of Knowledge and Practices of Health Team Toward Radiation Hazards and Its Safety Measures at Assiut University Hospitals," Assiut Scientific Nursing Journal, vol. 4, pp. 12-24, 2016.
16. S. A. Bolbol, M. F. Zaitoun, A. El-Magd, A. Sahar, and N. A. Mohammed, "Knowledge and Practice of Healthcare Workers in Diagnostic Radiology Department Towards Ionizing Radiation," Malaysian Journal of Medicine & Health Sciences, 2021.
17. S. Maharjan, "Radiation Knowledge among Radiographers and Radiography Students," Radiography Open, vol. 3, pp. 17-17, 2017.
18. P. A. Tawiah, A. Baffour-Awuah, E. S. Effah, G. Adu-Fosu, M. E. Ashinyo, R. K. Alhassan, et al., "Occupational Health Hazards among Healthcare Providers and Ancillary Staff in Ghana: A Scoping Review," BMJ Open, vol. 12, p. e064499, 2022.
19. I. Erkan, A. Yarenoglu, E. Yukseloglu, and H. Ulutin, "The Investigation of Radiation Safety Awareness among Healthcare Workers in an Education and Research Hospital," International Journal of Radiation Research, vol. 17, pp. 447-453, 2019.

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