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Research Article

Assessment of Physicians' Awareness of Radiation Exposure and Patient Radiation Protection in Mogadishu, Somalia

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Abstract

Objectives: Diagnostic investigations using radiation have become a critical feature of medical practice in recent times, and the possibility of doctors' underestimation of over-exposure risks to patients from diagnostic radiation is a matter of concern. Therefore, this study aimed to evaluate medical doctors' awareness of radiation exposure in selected diagnostic radiology centers in Mogadishu, Somalia.

Methods: Online questionnaires were distributed to 200 medical doctors working in 3 state and seven private hospitals in Mogadishu. In addition, the level of radiation awareness and its relationship with other variables was analyzed.

Results: There were 200 participants. Sixty-two % had no formal training on radiation exposure. Eighty-six % of the respondents had no idea regarding the radiation dose of commonly performed diagnostic studies.

Conclusions: Therefore, basic principles of diagnostic imaging, including radiation exposure associated with frequently performed imaging studies, radiation-related risks, and cautions that should be taken during these studies, should be taught during medical training and residency training.

Keywords Awareness of radiation; radiation protection; radiation exposure; patient safety; Somalia

Introduction

Medical diagnostic radiation has been the fastest-growing source of human exposure to ionizing radiation in the last three to four decades (1).

Diagnostic studies that involve radiation have become a critical part of standard medical practice over the last 100 years (2,3). Studies such as X-rays or mammograms are frequently used to diagnose and treat medical conditions before they become clinically evident (4).

Unrestricted exposure to ionizing radiation has been scientifically demonstrated to cause harm to healthy tissues, such as skin burns and radiation sickness, at high doses (deterministic effects) and to increase the risk of cancer and genetic damage at low doses (stochastic effects) (4).

Clinicians are expected to have full knowledge of the potential benefits and drawbacks associated with medical radiation exposure to justify exposure, according to the 2007 International Commission on Radiological Protection recommendations (5). Medical procedures utilizing radiation represent the most rapidly increasing radiation source (6). The primary medical procedures utilizing radiation are related to diagnostic radiology, nuclear medicine, and radiation therapy. Diagnostic radiology includes simple radiographic procedures, fluoroscopic procedures, diagnostic computed tomography (CT) scans, and fluoroscopically or CT-guided interventional procedures. The administration of unsealed radioactive medicines for diagnostic or therapeutic purposes is known as nuclear medicine. It involves using either external radiation or internal placement of sealed radioactive sources to treat cancer or benign conditions.

According to recent surveys, the radiation dose has not been given the importance it deserves by clinicians when referring patients for diagnostic radiological exams (7). As a result, doctors frequently underestimate the dangers of diagnostic radiation exposure to patients (8).

The significance of these findings stems from the fact that clinicians with a poor understanding of the radiation risk associated with diagnostic radiology examinations will be unable to counsel their patients and consider alternative diagnostic studies based on the benefits outweighing the risks principle.

It should also be considered that pediatric patients should be exposed to the tiniest radiation dose possible since their tissues are highly radiosensitive. It is known that they may also pass on radiation-induced genetic abnormalities to future generations as future parents. Even in well-developed countries, the education of medical professionals in radiation safety has been a persistent challenge (9).

In this study, we aimed to examine the physicians' knowledge of radiation doses in Mogadishu, Somalia.

Methods

Subject Selection

A total of 200 health professionals were enrolled in the study. Online questionnaires about radiation exposure in diagnostic radiology investigations in Somalia were distributed to 200 volunteer participants between July 2021 and December 2021. The questionnaires were distributed selectively through various online platforms to increase visibility among our respondents.

Interns, general practitioners, resident physicians, consultants, and physicians and surgeons working at public or private hospitals in Mogadishu were included. Nurses and other allied health professionals were excluded. Ethical approval was obtained from the Ethical Review Committee of Somalia Turkiye Training and Research Hospital (02.11.2020, MSTH/4781). Confidentiality of the participants was maintained as the names, and other identifying data were not required during the data collection process. A self-reported questionnaire was used as the assessment method, and it was based on three previously published relevant studies (11-13). The survey comprised 30 questions about clinicians' awareness of diagnostic radiation exposure in Somalia. For awareness scoring, one point was awarded for each correct answer.

Statistical Analysis

All statistical analyses were performed using SPSS v23.0. Scores of less than 50% were judged poor, those between 50% and 75% were considered fair, and scores of more than 75% were regarded as good awareness. Due to the non-normal distribution of the sample, Kruskal–Wallis tests were used to compare the responses among groups. The characteristics of the participants were obtained through descriptive analysis using frequencies and percentages, and Fisher's exact test was performed to determine the relationship between doctors' demographic characteristics and their awareness of diagnostic radiation exposure. The cut-off point of significance level was set at a p-value of less than 0.05.

Results

In this study, we found that 62% of the physicians had no formal training in radiation exposure. The quantity of radiation a patient absorbs during a CXR (0.02 mSv) was only correctly estimated by 14% of respondents, whereas more than 46% still needed to learn. Nearly 40% of our respondents still needed to learn about the effective dose received by a patient in a two-view CXR (Tables 1 and 2).

Table 1: Distribution of physicians' awareness of exposure to diagnostic radiation.

Parameters	Frequency	%
Have ever had any formal training about ionizing radiation?		
Yes	122	62.2
No	74	37.8
Average natural background radiation is in the range?		
0.2–0.3 mSv	23	11.9
2–3 mSv	33	17
20–30 mSv	24	12.4
200–300 mSv	6	3
I don't know	108	54.3
Comparison of the radiation dose from a chest X-ray to the annual dose a person receives from background radiation?		
1/100	34	17.6
1/10	23	11.9
Equal	22	11.4
10 Times	20	10.4
I don't know	94	48.7
Quantity of radiation a patient absorbs during a chest X-ray is?		
0.02 mSv	27	14
0.2 mSv	40	20.7
2 mSv	23	11.9
20 mSv	13	6.7
200 msV	1	0.5
I don't know	89	46.1
Approximate effective dose received by a patient in a two-view chest X-ray is?		
Almost equal to single view chest X-Ray	32	16.4
Twice the single view chest X-Ray	69	35.4
Five times the single view chest X-Ray	14	7.2
10 times the single chest X-Ray	6	3.1
I don't know	74	37.9

Table 2: Distribution of physicians' awareness of exposure to diagnostic radiation doses.

Parameters	Frequency	%
Effective dose from a single-view AXR is equivalent to ?		
0-1CXR	31	16
1-10 CXR	42	21.6
10-50 CXR	12	6.2
50-100 CXR	6	3.1
I don't know	103	53.1
CT abdomen single phase gives a dose of ?		
1 mSv	16	8.3
10 mSv	38	19.7
100 mSv	29	15
I don't know	100	51.8
None	10	5.2
Dosage from a two-view unilateral mammogram is?		
Almost equal to single-view chest X-ray	33	17
Twice the single-view chest X-ray	27	13.9
10–20 times the single-view chest X-ray	25	12.9
50–100 times the single-view chest X-ray	5	2.6
I don't know	104	53.6

Regarding radiation safety, more than 68% of physicians agreed that children are the most vulnerable patient population, while over 10% thought elderly patients were relatively more sensitive. (Figure 1).

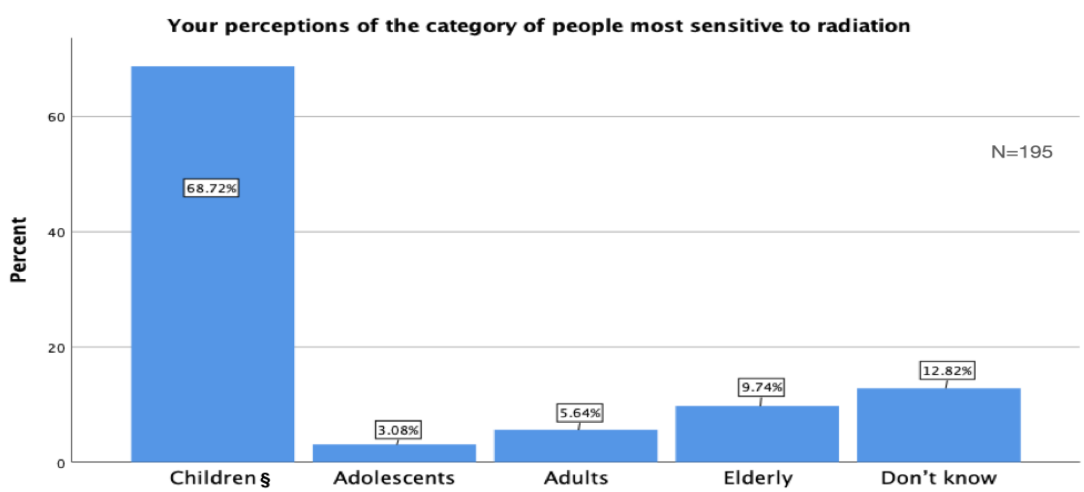

Figure 1. Physicians' perceptions of which members of the populations are most sensitive to radiation.

According to the American College of Radiology (ACR) guidelines, in a situation where a pregnant woman had already undergone CT abdomen and pelvis with contrast without the radiologist's knowledge of her pregnancy, the most commonly recommended actions were to perform an MRI of the fetus to look for central nervous system (CNS) anomalies (11-13). However, in our study, only 8.4% of the participants responded to the relevant question correctly (Figure 2).

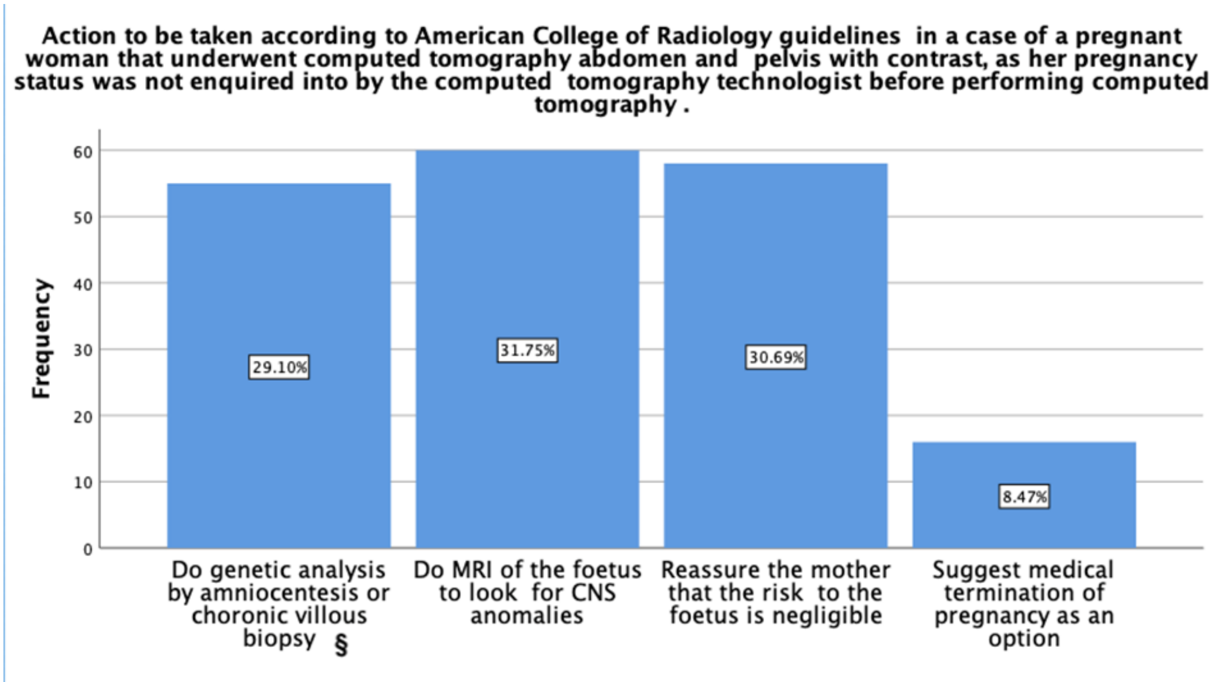

Figure 2. Physicians' awareness of action to be taken in case a pregnant woman needed a contrast abdominal computed tomography.

Around 62.4% of the respondents had no idea of the doses of radiation absorbed during intravenous urography (IVU). Only 13.9% of the doctors correctly stated that the doses of radiation absorbed during intravenous urography were equivalent to 10–50u. Furthermore, more than 62% of the attendees were unaware of the radiation dose during a ventilation/perfusion scan (V/Q). More than 50% of participants did not know about the dose of abdominal ultrasound (US). Likewise, 57% of our respondents did not know the radiation dose of non-contrast magnetic resonance imaging (MRI) of the brain. Nearly 55% of the respondents did not know the dose of radiation absorbed during the abdomen CT with intravenous (IV) contrast. Only 11% of the participants correctly estimated the radiation dose of the abdomen CT with IV contrast (Table 3).

Table 3: Distribution of physicians' awareness of radiation exposure using different imaging modalities.

Parameters	**Frequency**	**%**
How confident are you in your knowledge of the ionizing radiation dose of common diagnostic imaging techniques?		
Not at all confident	16	8
Not really confident	56	28.1
Somewhat confident	81	40.7
Very confident	46	23.1
How often do you discuss radiation-related issues, including long-term risks, with patients when offering radiological investigations?		
Always	38	19.5
Never	19	9.7
Often	47	24.1
Sometimes	91	46.7

Our analysis also revealed that, due to their lack of knowledge of ionizing radiation, more than 36% of participants have low confidence while ordering diagnostic imaging procedures (Table 4).

Table 4: Confidence and knowledge levels of physicians during referral of patients to the imaging procedures.

Parameters	Frequency	%
How confident are you in your knowledge of the ionizing radiation dose of common diagnostic imaging techniques?		
Very confident	46	23.1
Somewhat confident	81	40.7
Not really confident	56	28.1
Not at all confident	16	8
How often do you discuss radiation-related issues, including long-tern risks, with patients when offering radiological investigations?		
Always	38	19.5
Often	47	24.1
Sometimes	91	46.7
Never	19	9.7
Do you inform the patients you refer for imaging studies the risks of use ionizing radiation Very frequently?		
Frequently	62	32
Occasionally	57	29.4
Rarely	50	25.8
Never	25	12.9
Do you think knowledge of ionizing radiation in the different radiological exams you request for is important for your practice?		
Very important	88	46.1
Important	60	31.4
Moderately important	15	7.9

Least importance	9	4.7
Not importance at all	19	9.9
Which of the following educational methods do you think would help to raise awareness of radiation related issues?		
Lectures	39	20.4
Tutorials and workshops	40	20.9
Web-based learning modules	16	8.4
All above	96	50.3
How important would you rate having knowledge of the radiation dose of common radiological investigations?		
Very important	128	66
Somewhat important	36	18.6
Not really important	12	6.2
Not importance at all	18	9.3

Nearly 46.7% of our respondents stated that they rarely discussed radiation-related issues with their patients, including long-term risks, when offering radiological investigations. However, most (77%) of our respondents agreed that knowledge regarding ionizing radiation is essential for their practice. Approximately 40% of the respondents agreed that tutorials, lectures, and workshops were the optimal educational methods that would help raise doctors' awareness about radiation-related issues. Almost 30% of the respondents reported that they occasionally referred their patients for imaging, although they knew it would not impact their management.

More than half of the participants had no idea about the ALARA principle, which stands for "as low as reasonably achievable" and is one of the principles of radiation protection (Figure 3) (n= 191).

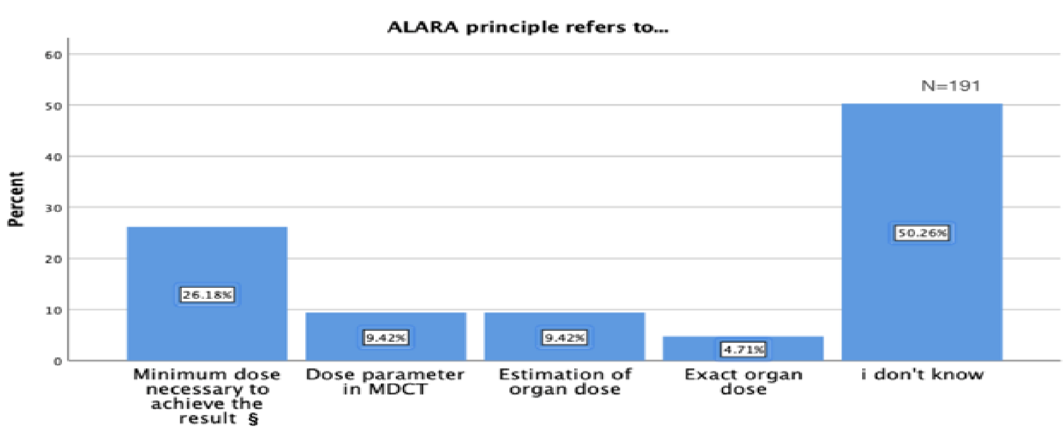

Figure 3. Physicians' knowledge of "As Low As Reasonably Achievable" (ALARA) principle.

Forty-seven % of our respondents did not know that radiologists were legally responsible for unnecessary exposure to ionizing radiation (Figure 4) (n=189).

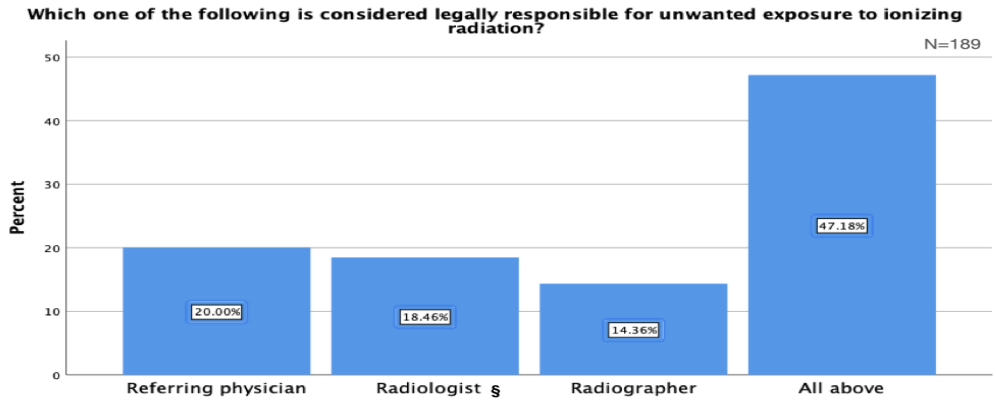

Figure 4. Physicians' knowledge of unwanted exposure to ionizing radiation.

Also, 47% of our respondents correctly stated that the thyroid gland was the most radiation-sensitive organ, followed by the gonads (Figure 5).

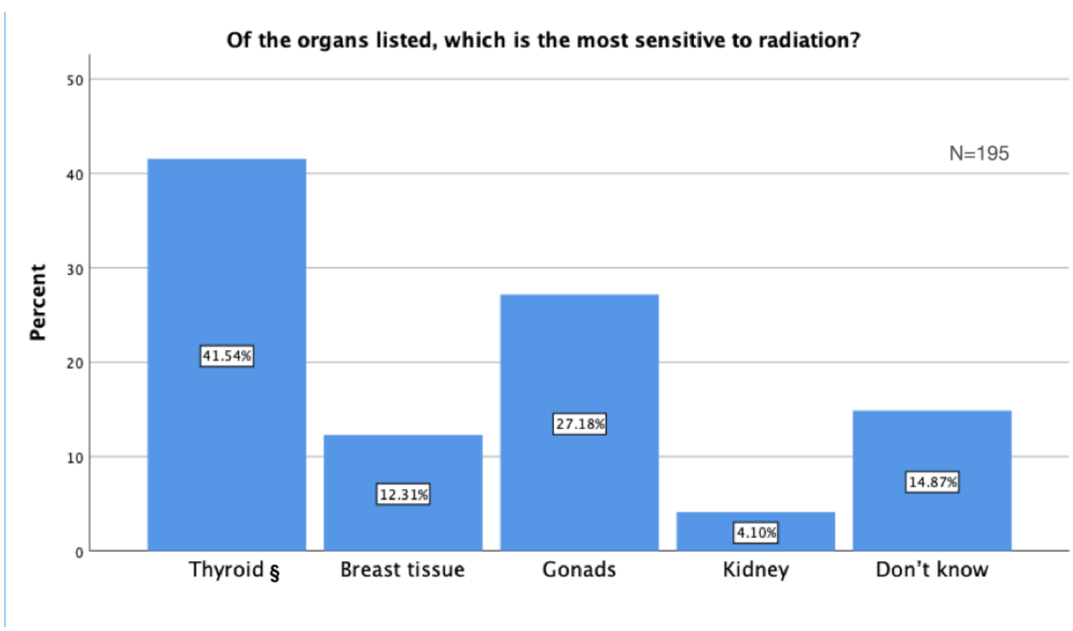

Figure 5. Physicians' knowledge of the most sensitive organs to radiation

Almost all participants (96.10%) demonstrated poor awareness regarding radiation risks (Figures 6-8).

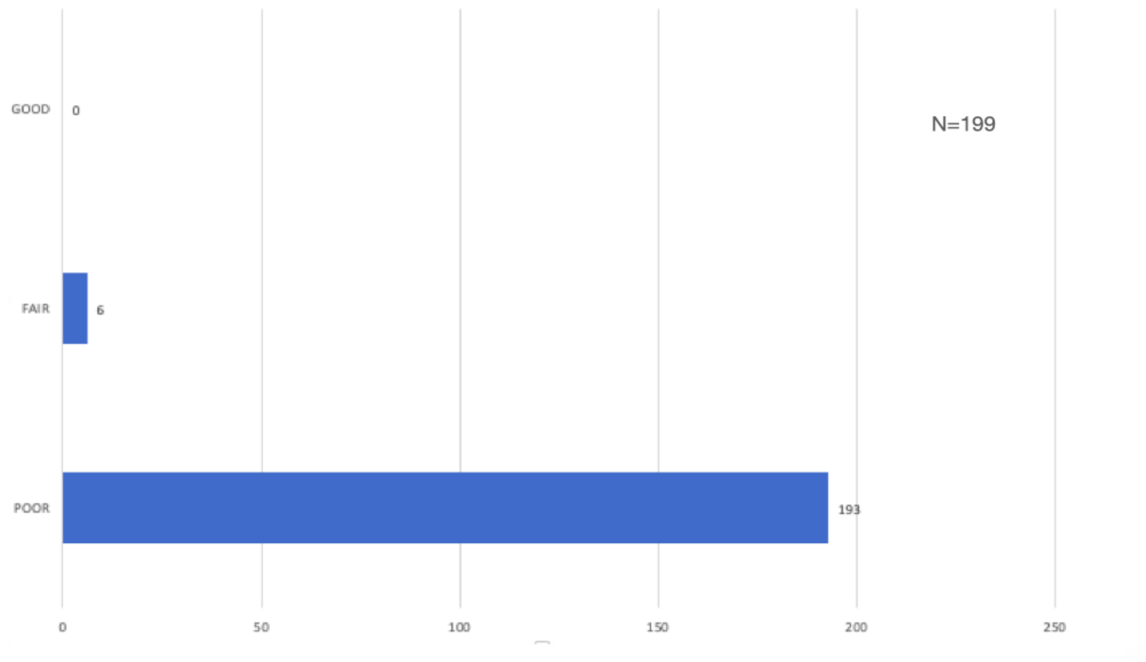

Figure 6. Physicians' awareness of radiation risk in diagnostic imaging.

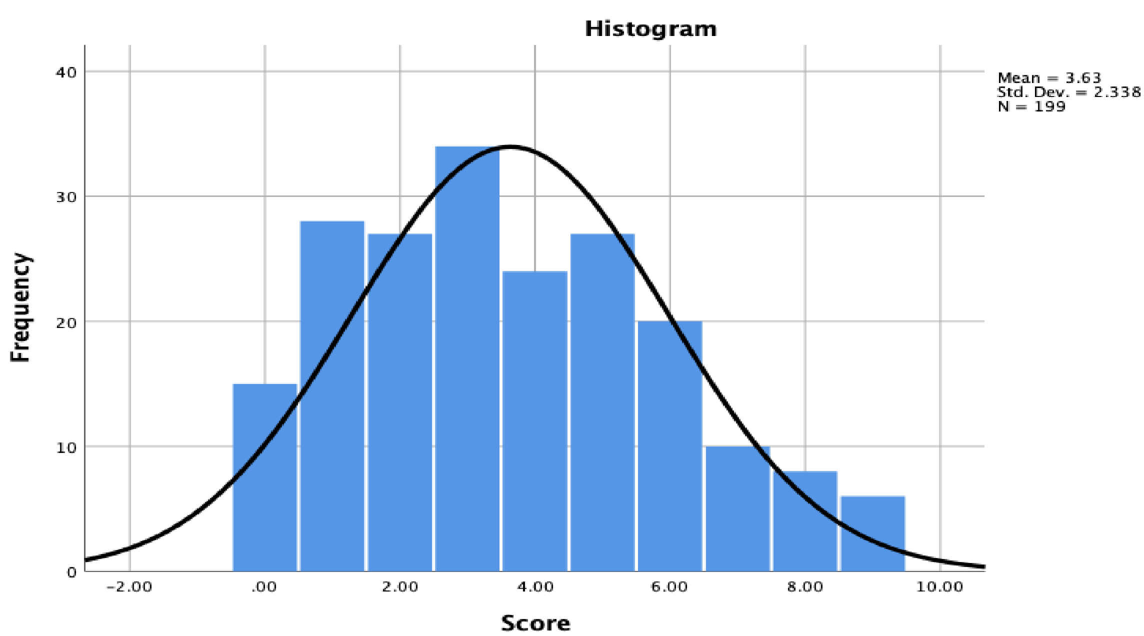

Figure 7. Distribution of physicians based on their awareness of exposure to radiation.

Confidence Level (n=199)	Mean Score	Standard Deviation	*p-value*
Very confident (n=46)	4.56	1.86	
Somewhat confident (n=81)	4.06	2.49	p<0.0001
Not really confident (n=56)	3.01	1.92	
Not at all confident (n=16)	0.93	1.43	

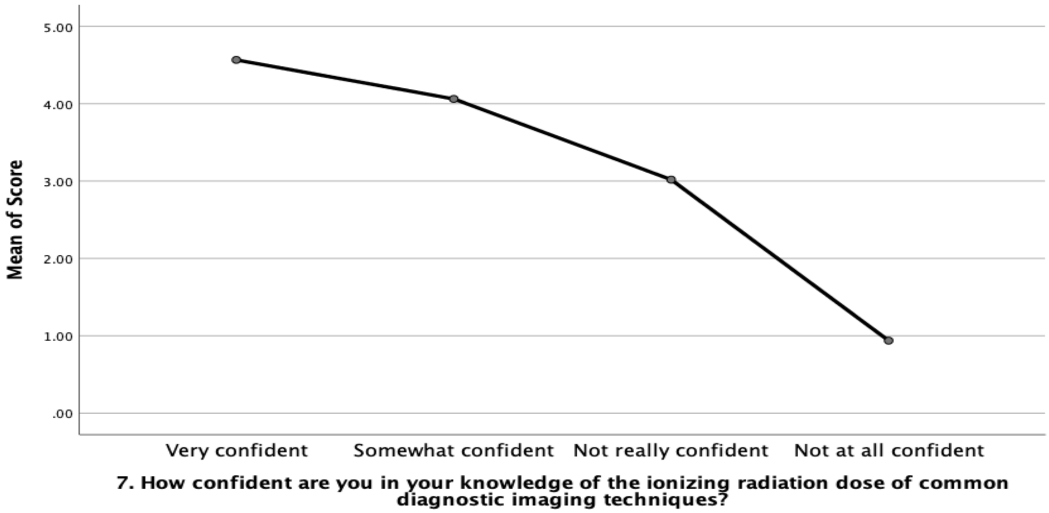

Figure 8. Physicians' confidence in awareness of exposure to diagnostic radiation.

We did not find a significant association between respondents' awareness of exposure to diagnostic radiation and gender, clinical experience, residency program, and area of expertise (Table 5). However, there was a significant association between the respondents' awareness of exposure to diagnostic radiation and age. Respondents aged between 25 and 29 had significantly poor awareness of exposure to diagnostic radiation compared to the older participants (p<0.01).

Table 5: Correlations between respondents' characteristics and their awareness of exposure to diagnostic radiations

Parameters	Variables	Awareness				Test of Significance P value
		Poor		Fair		
		n	%	n	%	
Gender						
	Male (n=140)	135	96.4	5	1.2	0.626
	Female (n=56)	55	98.2	1	1.8	
Age						
	25-29 (n=111)	111	100	0	0	
	30-34 (n=48)	44	91.7	4	8.3	0.008*
	35-40 (n=20)	19	95	1	5	
	>40 (n=17)	16	94.1	1	5.9	
Years of clinical practice						
	<5 (n=107)	106	99.1	1	0.9	
	5-10 (n=61)	57	93.4	4	6.6	0.067
	11-20 (n=19)	19	100	0	0	

	>20 (n=10)	10	90	1	10	
Residency Program						
	Family medicine (n=25)	24	96	1	4	
	Medical specialties (n=82)	79	96.3	3	3.7	0.732
	Surgical specialties (n=38)	38	100	0	0	
	Other specialties (n=46)	45	97.8	1	2.2	
Departments of Participants						
	Radiology (n=31)	27	87.1	4	12.9	
	Pediatrics (n=21)	20	95.2	1	4.8	
	Urology (n=5)	5	100	0	0	
	Anesthesiology (n=6)	6	100	0	0	
	Cardiology and cardiovascular (n=7)	6	85.7	1	14.3	
	ENT(n=3)	3	100	0	0	0.167
	Ophthalmology (n=7)	7	100	0	0	
	Emergency unit (n=10)	10	100	0	0	
	General surgery (n=15)	15	100	0	0	
	Orthopedics (n=5)	5	100	0	0	
	Internal medicine (n=24)	24	100	0	0	
	Gynecology and Obstetrics (n=23)	23	100	0	0	
	Others (n=39)	39	100	0	0	

Discussion

In this study, we examined the physicians' awareness of radiation exposure and found that over 62% of physicians had never had formal training on ionizing radiation. In a study from South Africa, this rate was calculated as 80% (13). In addition, our respondents' knowledge regarding the radiation doses of primary diagnostic studies such as CXR was also in line with the literature (14-16). Finally, most of our respondents stated that children were more sensitive to radiation than other patient populations. This finding is also consistent with the literature (17).

In addition, our participants' approach to the pregnant patients inadvertently exposed to radiation due to an abdominal CT scan was also in line with the previous studies (18,19).

In our study, 96.1% of the respondents showed poor awareness of radiation exposure. This finding was also consistent with the literature (20,21). In our cohort, male and female participants showed similar awareness levels. However, Kamble et al. reported that female physicians had a significantly higher level of awareness than their male colleagues (22).

Although some studies reported that physicians working in radiology departments had a higher awareness regarding radiation and associated risks, this finding was not confirmed in our study (23). This difference can be due to the fact that because of terrorism and war-related conditions, there are no structured residency curricula in radiology or other residency programs in Somalia. In addition, there are no organizations, such as the atomic energy agency, which could manage all radiation-related activities in the country.

Conclusions

We conclude that the awareness regarding radiation exposure and related risks is poor among the health professionals in Somalia. Therefore, basic principles of diagnostic imaging, including radiation exposure associated with frequently performed imaging studies, radiation-related risks, and cautions that should be taken during these studies, should be taught during medical training and residency training.

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Consent to participate: The purpose of the study was explained to the subjects by the examiner, and a voluntary informed consent form was obtained from the participants.

Author contributions: All authors have contributed to the research design and interpretation of data and the drafting and revising of the manuscript. All authors have read and approved the final submitted manuscript.

References

1. Chenot C, Robiette R, Collin S. First evidence of the cysteine and glutathione conjugates of 3-sulfanylpentan-1-ol in hop (Humulus lupulus L). . Journal of agricultural and food chemistry. 2019 Mar 15;67(14):4002-10.
2. Martin R, Barnhart S. Global laboratory systems development: needs and approaches. Infectious Disease Clinics. 2011 Sep 1;25(3):677-91.
3. European Society of Radiology 2009 communications@ myESR. org. The future role of radiology in healthcare. Insights into imaging. 2010 Jan 16;1(1):2-11.
4. Dauda AM, Ozoh JO, Towobola OA. Medical doctors' awareness of radiation exposure in diagnostic radiology investigations in a South African academic institution. SA Journal of Radiology. 2019 Jan 1;23(1):1-7.

5. Cléro E, Vaillant L, Hamada N, Zhang W, Preston D, Laurier D, Ban N. History of radiation detriment and its calculation methodology used in ICRP Publication 103. Journal of Radiological Protection. 2019 Aug

21;39(3):R19.

6. Mettler Jr FA, Bhargavan M, Faulkner K, Gilley DB, Gray JE, Ibbott GS, Lipoti JA, Mahesh M, McCrohan JL, Stabin MG, Thomadsen BR. Radiologic and nuclear medicine studies in the United States and worldwide: frequency, radiation dose, and comparison with other radiation sources—1950–2007. Radiology. 2009 Nov;253(2):520-31.
7. Sadigh G, Khan R, Kassin MT, Applegate KE. Radiation safety knowledge and perceptions among residents: a potential improvement opportunity for graduate medical education in the United States. Academic radiology. 2014 Jul 1;21(7):869-78.
8. Balaban B, Yakin K, Alatas C, Oktem O, Isiklar A, Urman B. Clinical outcome of intracytoplasmic injection of spermatozoa morphologically selected under high magnification: a prospective randomized study. Reproductive biomedicine online. 2011 May 1;22(5):472-6.
9. Famurewa OC, Obiajunwa PO, Elusiyan JB, Ibitoye BO. Radiation dose and radiation protection principle awareness: a survey among Nigerian paediatricians. The Nigerian Postgraduate Medical Journal. 2014 Mar 1;21(1):28-33.
10. Soye JA, Paterson A. A survey of awareness of radiation dose among health professionals in Northern Ireland. The British journal of radiology. 2008 Sep;81(969):725-9.
11. Lee JH, Kim K, Lee KH, Kim KP, Kim YJ, Park C, Kang C, Lee SH, Jeong JH, Rhee JE. Perception of radiation dose and potential risks of computed tomography in emergency department medical personnel. Clinical and experimental emergency medicine. 2015 Jun;2(2):123.
12. Azmoonfar R, Faghirnavaz H, Younesi H, Morovati E, Ghorbani ZH, Tohidnia M. Physicians' knowledge about radiation dose in radiological investigation in Iran. Journal of biomedical physics & engineering. 2016 Dec;6(4):285.
13. Radiological Society of North America. Radiation Dose in X-Ray and CT Exams. (April 2012). 2012.
14. Azmoonfar R, Faghirnavaz H, Younesi H, Morovati E, Ghorbani ZH, Tohidnia M. Physicians' knowledge about radiation dose in radiological investigation in Iran. Journal of biomedical physics & engineering. 2016 Dec;6(4):285.
15. Smith-Bindman R, Lipson J, Marcus R, Kim KP, Mahesh M, Gould R, De González AB, Miglioretti DL. Radiation dose associated with common computed tomography examinations and the associated lifetime attributable risk of cancer. Archives of internal medicine. 2009 Dec 14;169(22):2078-86.
16. Ramanathan S, Ryan J. Radiation awareness among radiology residents, technologists, fellows and staff: where do we stand?. Insights into imaging. 2015 Feb;6(1):133-9.
17. Doll R, Wakeford R. Risk of childhood cancer from fetal irradiation. The British journal of radiology. 1997 Feb;70(830):130-9.
18. Wang PI, Chong ST, Kielar AZ, Kelly AM, Knoepp UD, Mazza MB, Goodsitt MM. Imaging of pregnant and lactating patients: part 1, evidence-based review and recommendations. American Journal of Roentgenology. 2012 Apr;198(4):778-84.

19. Lee CI, Haims AH, Monico EP, Brink JA, Forman HP. Diagnostic CT scans: assessment of patient, physician, and radiologist awareness of radiation dose and possible risks. Radiology. 2004 May;231(2):393-8.
20. Arslanoglu A, Bilgin S, Kubali Z, Ceyhan MN, İlhan MN, Maral I. Doctors' and intern doctors' knowledge about patients' ionizing radiation exposure doses during common radiological examinations. Diagnostic and Interventional Radiology. 2007 Jun 1;13(2):53.
21. Gulbins H, Malkoc A, Ennker IC, Ennker J. Preoperative platelet inhibition with ASA does not influence postoperative blood loss following coronary artery bypass grafting. The Thoracic and Cardiovascular Surgeon. 2009 Feb;57(01):18-21.
22. Kamble V, Mitra K, Ratnaparkhi C, Dhote S. Consultants knowledge and awareness about radiation exposure in diagnostic radiology in Central India. Int J Biomed Res. 2015;6(1):14-8.
23. Chun-sing W, Bingsheng H, Ho-kwan S, Wai-lam W, Ka-ling Y, Tiffany CY. A questionnaire study assessing local physicians, radiologists and interns’ knowledge and practice pertaining to radiation exposure related to radiological imaging. European journal of radiology. 2012 Mar 1;81(3):e264-8.