Asian Journal of Medicine and Health

18(10): 99-109, 2020; Article no.AJMAH.56522
ISSN: 2456-8414

Assessment of Patients' Knowledge of Radiation Exposure during Medical Imaging Procedures at Private Medical Radiography Centres in Ogun State, Nigeria

Adedapo A. Adejumo[1*], U. Enebeli, Ugo[2] and Olaolu O. Bilewu[1]

[1]Department of Public Health, Kwara State University, Malete, Ilorin, Nigeria.
[2]Department of Community Medicine, University of Port Harcourt Teaching Hospital, Rivers State, Nigeria.

Authors' contributions

This work was carried out in collaboration among all authors. Author AAA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author UEU managed the analyses of the study. Author OOB managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJMAH/2020/v18i1030257
Editor(s):
(1) Dr. Raouf Afifi, SA Consultancy & Training, Health Research Institute, Egypt.
(2) Dr. Ashish Anand, GV Montgomery Veteran Affairs Medical Center, USA.
(3) Dr. Janvier Gasana, Kuwait University, Kuwait.
Reviewers:
(1) Kavita Nagar, Rajiv Gandhi University of Health Sciences, India.
(2) Hyacienth Uche Chiegwu, Nnamdi Azikiwe University, Nigeria.
(3) Wiseman Bekelesi, Hiroshima University, Japan.
Complete Peer review History: http://www.sdiarticle4.com/review-history/56522

Original Research Article

Received 06 April 2020
Accepted 11 June 2020
Published 31 October 2020

ABSTRACT

Introduction: Radiological examinations are commonly requested for patients to aid clinical diagnosis. However, many doctors do not realize how much radiation dosage their patients are exposed to during radiological aim. The main objective of this study was to assess the level of knowledge of radiation exposure and safety practices among patients undergoing medical imaging in Ado-Odo Local Government Area, in Ogun State of Nigeria.
Methodology: A self-administered questionnaire was used for the study.
Results: More than half of the respondents 216(69.7%) were female, more than one-quarter 153(49.4) of the respondents were aged 20-29 years, More than half 186(60.0%) of the respondent are single. More than half 204(66.4%) of the respondents have heard about radiation exposure.

**Corresponding author: E-mail: dhapsyn@gmail.com;*

Majority 232(74.8%) of the respondents agree that radiation hazard do come only from medical radiations. More than half 21(68.7%) of the respondents agree that they do take note of radiation warning sign, majority 236(76.1%) of the respondents agree that they know the wrong use of dose of ionizing radiation can lead to mortality, 217(70.0%) of the respondents agree that inappropriate safety measure on ionizing radiation can result into cancer

Conclusion: This study notes that majority of the literature on awareness and knowledge of the effects of ionizing radiation was carried out among health workers, whereas there is limited information from patients who undergo the procedure. This accounts for the paucity of local studies to compare our results with. In future, studies could compare the radiation awareness among patients presenting at health facilities from public and private, as well as differences in awareness levels of self-presenting and prescribed patients

Keywords: Radiation; attitude; medical imaging; protective measures.

1. INTRODUCTION

Radiological examinations are commonly requested for Patients to assist clinical diagnosis. However, many doctors do not realize how much radiation dosage their Patients are exposed to during radiological investigations. Although radiological examinations play an important role in daily practice within the hospital setting, patients are not properly informed about the radiation dose they are exposed to when undergoing a radiological examination [1] that nearly all Patients undergoing Computed tomography (CT) scans were not informed about the radiation risk. This may be partly explained by improper knowledge among referring doctors concerning the radiation dose of commonly performed examinations, [2] regardless of years of clinical experience [3]. Ionizing radiation from medical applications represents the majority of radiation doses from artificial sources to which the general population is exposed. This is the consequence of a steadily increasing demand for radiological examinations with particular reference to multidetector computed tomography (MDCT), which alone accounts for about 50% of the overall medical radiation exposure (Hricak et al.,2011). Though this has been paralleled by a dramatic evolution of imaging technology over the last decade, it is often worsened by a lack of appropriateness and optimization criteria by both referring physicians and radiological staff (Brenner et al., 2007). As shown by several authors, this increasing use of medical radiation are often partly explained by the wrong and sometimes improper knowledge among professionals about radiation protection issues and radiation doses of commonly performed imaging procedures [4]. Such lack of awareness about radiation risk are often extremely dangerous when high dose examinations like multiphase MDCT studies are conducted without optimization, leading to a potentially significant biological lifetime risk for Patients. Long-term exposure to small amounts of radiation can lead to gene mutation and increase the risk of cancer, while exposure to large doses within a short time can lead to radiation sickness (Rehani et al., 2010). According to Uguwuanyi et al., 2017, There are records of numerous radiation damages caused by mainly improper use of radiation and accidental exposures. Some of this effect of radiation is life-threatening while some causes congenital abnormalities which directly or indirectly cause pain and financial burden to the family. Epidemiological reports posited that in the UK, 100 to 250 deaths occur each year from cancers directly related to medical exposure to radiation (Bury et al. 2004). The use of ionizing radiation in diagnostic radiography could lead to hazards such as somatic and genetic damages. Compliance with safe work and radiation protection practices could mitigate such risks. Moreover, several papers have recently shown a small, but significant increase of cancer risk in children and young Patients with previous exposure to CT scans [5], paralleled by a measurable increasing radiation-induced DNA damage following several radiologic examinations that correlate with radiation dose (Kuefner et al., 2015). In all situations, a full awareness of radiation protection issues and a proper knowledge of the radiation doses delivered by the various imaging modalities are essential to make sure that all involved professionals adhere to up-to-date appropriateness and optimization criteria [6]. These risks are now minimized because of the development of advanced technologies that makes these applications safer. Several regulations were released to raise awareness about radiation hazards and the techniques to be followed for the protection of Patients undergoing medical treatment or examination. Therefore this

study aim to assess the level of knowledge of radiation exposure and safety practices among patients undergoing medical imaging atprivate medical radiography centres in Ogun State, Nigeria.

2. METHODOLOGY

2.1 Sample Size Determination

The minimum sample size for the study was determined using the formula for sample size determination where the population less than 10,000 [7] stated below:

$$Nf = \frac{n}{1+(n)/N}$$

nf= desired sample size when the population is less than 10,000
N= estimate of the total population
If N=1000

$$nf = \frac{384}{1+\frac{384}{1000}}$$

$$= 277.45$$
$$=277$$

To compensate for non response

$$Nf = n/ e$$

Where,

nf = desired sample size
n = the minimum required sample size
e = expected response rate set at 90% or 0.9

Substituting, therefore
=277/0.9
=307.78
=308

2.2 Study Design

This study was a descriptive cross-sectional survey to determine the knowledge and awareness of radiation exposure and safety practice among patients undergoing medical imaging at private medical radiography centres in Ogun State, Nigeria. A self-administered questionnaire was used for the study. A total of 310 questionnaires were administered of which 308 was returned, which makes 99.4 percent response rate of the respondents. Anonymity and confidentiality of the information obtained was assured and maintained.

2.3 Inclusion Criteria

This study includes all Patients undergoing medical imaging who are willing to participate in the study at private medical radiography centres in Ogun State.

2.4 Exclusion Criteria

This study excludes all Patients undergoing medical imaging who are not willing to participate in the study at private medical radiography centres in Ogun State.

2.5 Sampling Technique

- A systematic random sampling technique was used to recruit all eligible patients for this study
- A simple random system was use to recruit the first participants
- Subsequent participants were recruited by using the sampling interval.

2.6 Data Analysis

The questionnaires were collected and thoroughly checked for completeness and consistency. The data collected from the field was organized and coded for analysis. The data were then analyzed with the use of Statistical Package for Social Sciences (SPSS) version 21 and results was presented using descriptive statistics such as mean, frequencies, and percentages, and by the use of frequency table. Chi-square test was used to describe association between categorical variables and level of significance was set at $p<0.05$.

3. RESULTS

Three hundred and ten (310) copies of questionnaires were administered to the respondents of which 308 was satisfactorily completed, giving a response rate of 99.4%. The analysis was based on data from the 308 respondents in the study.

More than half of the respondents 216(69.7%) were female, more than one-quarter 153(49.4) of the respondents were aged 20-29years, More than half 186(60.0%) of the respondent are single.

More than half 59% of the respondents were of the Yoruba tribe, 25% of the respondents were Hausa, 11% of the respondents were Igbo and 5% of the respondents were others.

16% of the respondents had no formal education; 18% of the respondents had primary level of education; 20% had secondary level of education; while 46% had tertiary level of education.

Majority 68% of the respondents were not medically related, while 32% were medically related.

More than half (50.30%) of the respondents chose x-ray has the radiologist diagnostics modality that use ionizing radiations, more than one-quarter (37.40%) of the respondents chose CT scan has the radiologist diagnostics modalities that use ionizing radiation,(3.20%) of the respondents chose Ultrasound has radiologist diagnostics modalities that use ionizing radiation. (7.10%) of the respondents chose MRI has radiologist diagnostics modalities that use ionizing radiation, (1%) of the respondents chose Fluoroscope has radiologist diagnostics modalities that use ionizing radiation and (1.0%) of the respondents chose Mammography has radiologist diagnostics modalities that use ionizing radiation.

More than half 204(66.4%) of the respondents have heard about radiation exposure, more than half 167(53.9%) of the respondents know there are two types of radiation (ionizing and non-ionizing). Majority 232(74.8%) of the respondents agree that Radiation hazard do come only from medical radiations, more than half 199(64.2%) of the respondents agree that they do receive radiological education before undergoing any of the investigation and 209(68.4%) of the respondents agree that it important to wear proactive lead shield each time a radiological investigation is being carried out.

Table 1. Respondents' socio demographic characteristics (n = 308)

Variable	Number	Percentage (%)
Gender		
Male	94	30.3
Female	216	69.7
Age		
20-29	153	49.4
30-39	85	27.4
40-49	66	21.3
50-59	6	1.9
Marital status		
Single	186	60.0
Married	91	29.4
Divorced	21	6.8
Widowed	12	3.9

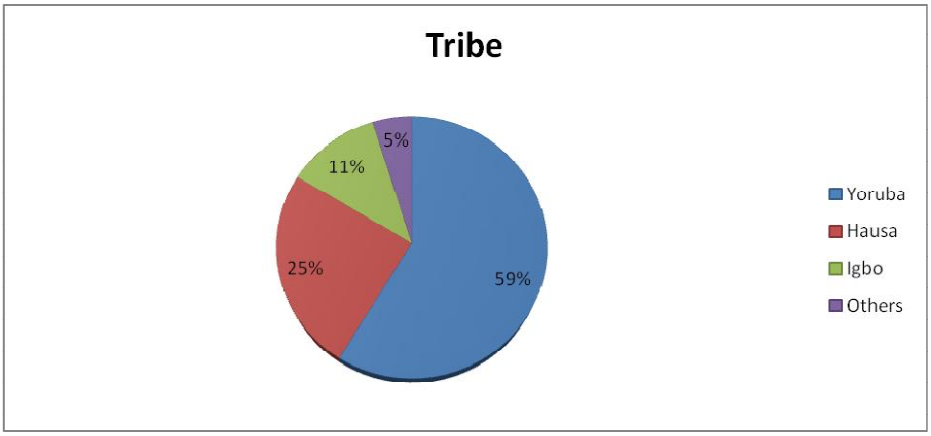

Fig. 1. The respondent's tribe by radiation exposure

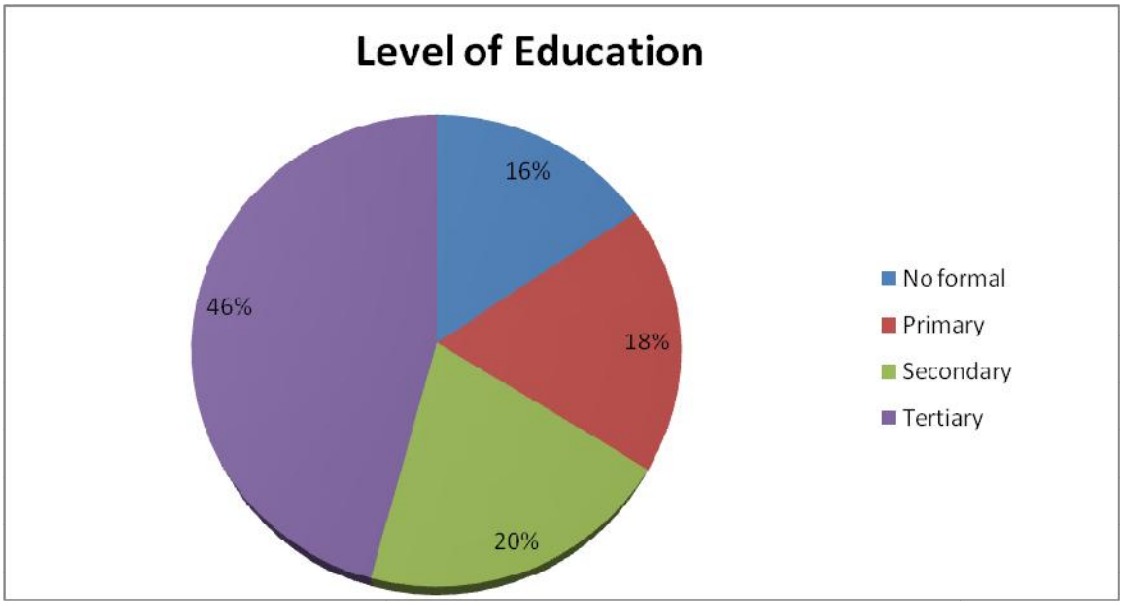

Fig. 2. The respondent's level of education

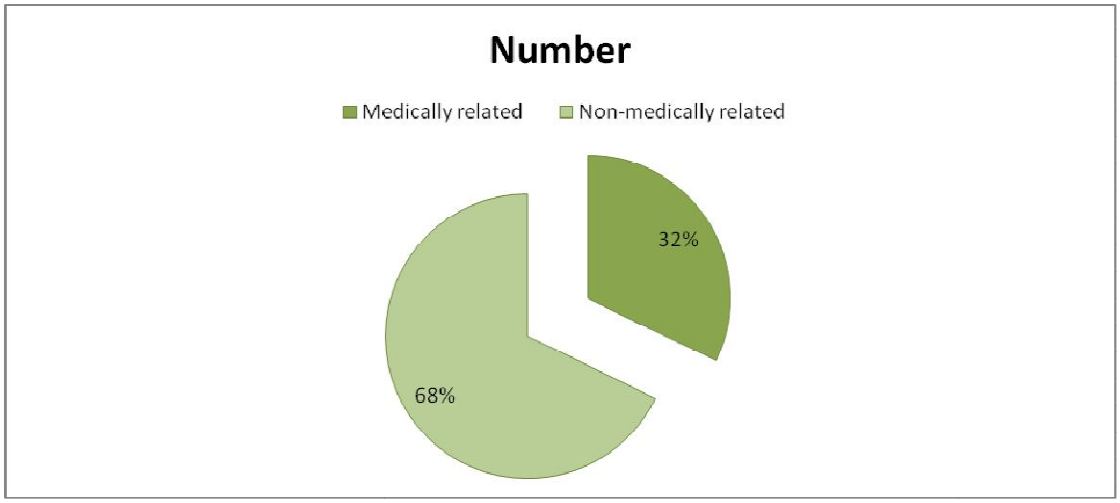

Fig. 3. The respondent's occupation

Table 2. Respondents knowledge of radiation

Variables	Frequency	Percentage %
Ever heard of radiation exposure?	204	66.4
Knowledge of the two types of radiation (ionizing and non ionizing)	167	53.9
Radiation hazard do come only from medical radiations?	232	74.8
Exposure to radiations can induce cancer in a patient?	218	70.3
Received radiological education before undergoing any of the investigation	199	64.2
Is it important to wear proactive lead shield each time a radiological investigation is being carried out?	209	68.4

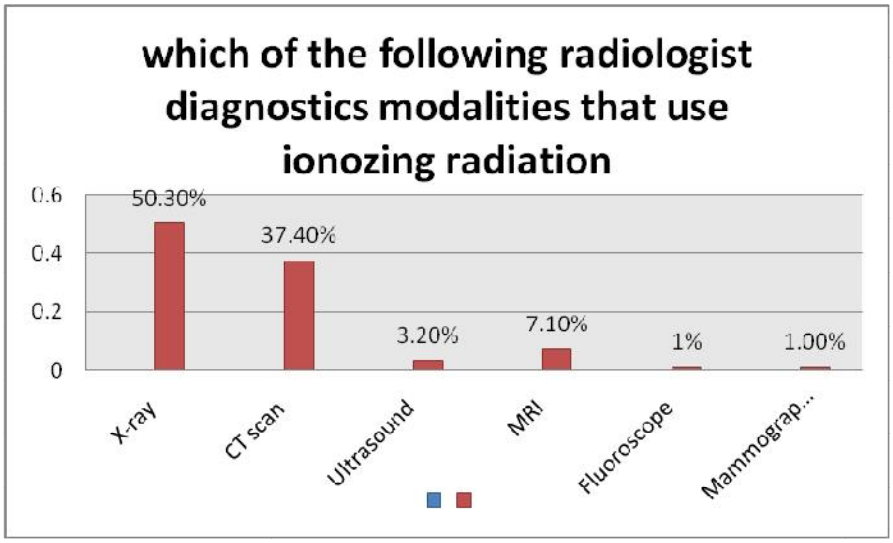

Fig. 4. The respondent's knowledge of radiation exposure

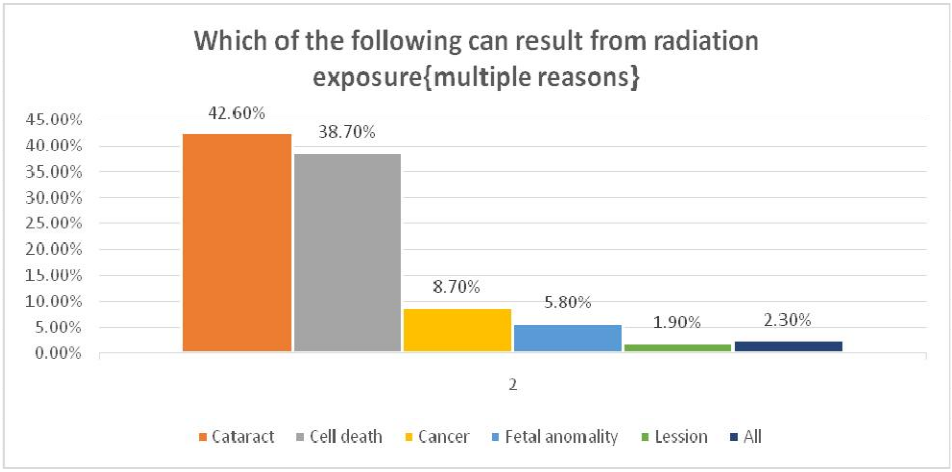

Fig. 5. Respondent's knowledge of radiation exposure

Table 3. Respondents attitude of radiation exposure

Items	frequency	Percentage (%)
Treatment by radiological staff in a friendly and courteous manner?	229	73.9
Ever received a brief education before undergoing radiation exposure?	231	74.5
Are your opinions being accepted by radiology staff?	233	75.2
Welcomed by radiology staff in a friendly manner?	206	66.5
Are you aware of the protective measure of radiation exposure?	213	68.7
Thoughts on X-ray diagnosis being harmful?	192	61.9
Abide with radiation signs and directions ensured by the department?	209	67.4
Ever realized that radiation exposure you are being exposed to causes effect?	202	65.2
Thoughts on repeating the radiological test within 6 months causes harm to the body?	173	55.8
Thoughts on if the radiation received stays in your bones and tissue for a long period of time?	183	59.0

More than one-quarter of the (42.60%) of the respondents posited that radiation exposure can result to cataract also more than one-quarter (38.70%) of the respondents claim that radiation exposure can leads to cell death, (8.70%) of the respondents claim that radiation exposure can result to cancer, (5.80%) of the respondents claim that radiation exposure can lead to fetal abnormality, (1.90%) of the respondents claim that radiation exposure can lead to lesion.

Majority 229(73.9%) of the respondents agree that radiology staff treat in a friendly and courteous manner, almost all 249(80.3%) the respondents agree that radiologist/MRT or radiographer act business liken and impersonal. 231(74.5%) of the respondents agree that they do receive a brief education before undergoing radiation exposure, more than half of the respondents 206(66.5%) agree that radiology staff accept their opinion, 221(71.3%) of the respondents agree that radiology staff support them during and after examination, more than half 213(68.7%) of the respondents agree that are aware of the protective measure of radiation exposure. 192(61.9%) of the respondents agree that X-ray diagnosis is harmful, 209(67.4%) of the respondents agree that they do obey/abide with radiation signs and directions ensured by the department,202(65.2%) of the respondents agree that they know that the radiation exposure that they are being exposed to causes effect, more than half 173(55.8%) of the respondents agree that repeating the radiological test within 6 months causes harm to the body and 183(59.0%) of the respondents agree that the radiation they received stays in your bones and tissue for a long period of time.

More than half (50.6) of the respondents feels normal when they undergo the radiation exposure, more than one-quarter of the (31.9%) of the respondents feels scared when they undergo the radiation exposure, (4.8%) of the respondents feels never when they undergo the radiation exposure and (12.6%) of the respondents thought about it when they undergo the radiation exposure.

More than half 21(68.7%) of the respondents agree that they do take note of radiation warning sign, 220(71.7%) of the respondents agree that they educate them before carrying out exposure on them. Majority 256(82.6%) of the respondents agree that radiation workers seek their consent before exposing them to radiation likewise 243(78.4%) agree that they know that they need a minimum position in order to keep radiation exposure active, majority 236(76.1%) of the respondents agree that they know the wrong use of dose of ionizing radiation can lead to death, 217(70.0%) of the respondents agree that inappropriate safety measure on ionizing radiation can result into cancer. Majority 236(76.1%) of the respondents agree that they use protective device during exposure, more than half 202(65.2%) of the respondents agree that radioactive materials and radiation producing device are secured to prevent unauthorized access, 202(65.2%) of the respondents agree that they know if the state regulations for protection against radiation is available and 192(61.9%) of the respondents agree that they know if the instrument for radiation detection and measurement such as crystal dosimeter, ionization are provided.

Using Chi-Square set at level of significance $p<0.05$, df= degree of freedom, there is no significant relationship between socio-demographic characteristics and use of safety measure against radiation exposure among Patients undergoing medical imaging in private medical centers, Sango Ota, Ado Odo LGA, Ogun State.

More than half 55(58.5%) of the respondents that are male agree that they know if there are protective measures for protection against radiation is available. While 147(68.1%) of the respondent who are female agree that they know there are protective measures for protection against radiation are available. P. value = 0.105>0.05. There is no significant relationship between Gender and use of safety measure against radiation exposure among Patients undergoing medical imaging at private medical centers in Sango Ota, Ado Ota LGA, Ogun State.

More than half of the respondents 99(64.7%) in the age group (20- 29 years) agree they know there are protective measures for protection against radiation is available, 49(57.6%) in the age group (30-39years) of the respondents also agree they know the stated regulations for protection against radiation is available. Majority 51(77.3%) of respondents in the age group (40-49 years) agree they know the stated regulations for protection against radiation is available. 3(50.0%) of the respondents in (50- 59 years) years category agree that they know the stated regulations for protection against radiation is available. P= 0.072>0.05. There is no significant relationship between Age and use of safety measure against radiation exposure among

Patients undergoing medical imaging at private medical laboratory centers in Sango-Ota, Ado-Odo LGA of Ogun State. The null hypothesis is accepted.

More than half of the respondents that are Yoruba 104(57.1%) agree that they know the stated regulations for protection against radiation is available, 56(72.7%) of respondents that are Hausa agree they know the stated regulations for protection against radiation is available, 30(83.3%) of the respondent that are Igbo agree that they know the stated regulations for protection against radiation is available. P=0.003<0.05. There is significant relationship between Tribe and use of safety measure against radiation exposure among Patients undergoing medical imaging at private medical centers in Sango Ota, Ado Odo LGA, Ogun State. The null hypothesis is rejected, and alternative is accepted.

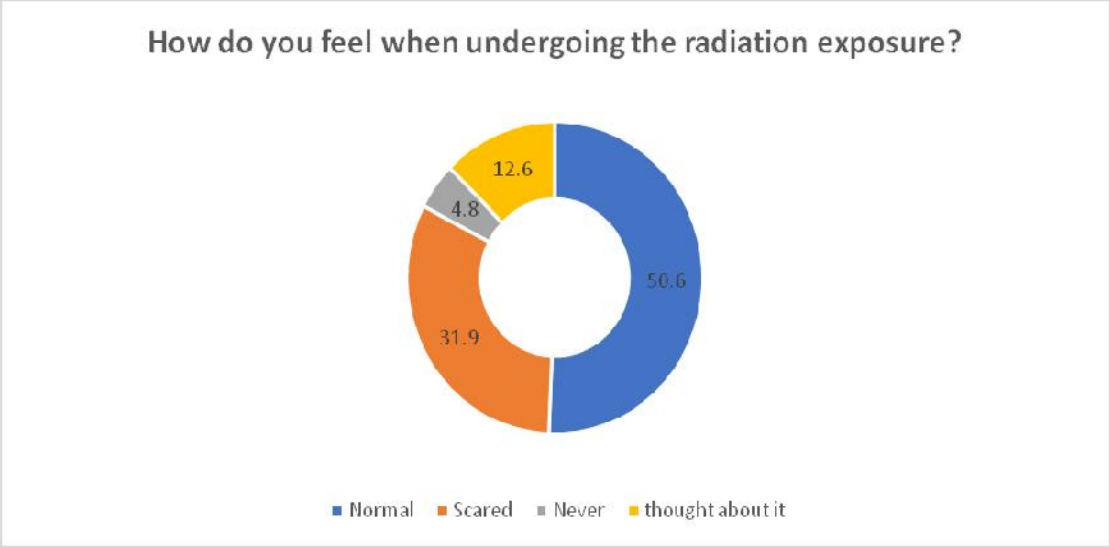

Fig. 6. Respondents attitude of radiation exposure

Table 4. Respondents knowledge on preventive measure

Variables	Frequency	Percentage%
Ever observed radiation warning sign?	21	68.7
Briefed before carrying out exposure on you?	220	71.7
Consent being sought by radiological staff before exposing you to radiation?	256	82.6
Aware that you need a minimum position in order to keep radiation exposure active?	243	78.4
Aware that the wrong use of dose of ionizing radiation can lead to death?	236	76.1
Aware that inappropriate safety measure on ionizing radiation can result into cancer?	217	70.0
Usage of protective device during exposure?	236	76.1
Are radioactive materials and radiation producing device secured to prevent unauthorized access?	202	65.2
Knowledge on if the state regulations for protection against radiation is available?	202	65.2
Knowledge on the instrument for radiation detection and measurement such as crystal dosimeter, ionization are provided?	192	61.9

Table 5. Relationship between socio-demographic characteristics and use of safety measure against radiation exposure

Socio-demographic data	Use of protective measure among respondents		Total
	Yes	No	
Gender			X^2 =2.629
Male	55(58.5%)	39(41.5%)	df =1
Female	147(68.1%)	69(31.9%)	P value = 0.105
Age			
20-29	99(64.7%)	54(35.3%)	X^2 = 7.000
30-39	49(57.6%)	36(42.4%)	df =3
40-49	51(77.3%)	15(22.7%)	P value =0.072
50-59	3(50.0%)	3(50.0%)	
Tribe			
Yoruba	104(57.1%)	78(42.9%)	X^2 = 13.788
Hausa	56(72.7%)	21(27.3%)	df =3
Igbo	30(83.3%)	6(16.7%)	P value = 0.003
Others	12(80.0%)	3(20.0%)	
Marital status			
Single	120(64.5%)	66(35.5%)	X^2 =0.991
Married	58(63.7%)	33(36.3%)	df =3
Divorced	15(71.4%)	6(28.6%)	P value = 0.804
Widowed	9(75.0%)	3(25.0%)	
Occupation			X^2 = 7.054
Medically related	74(75.5%)	24(24.5%)	df =3
Non medically related	125(60.7%)	81(39.3%)	p-value = 0.029

Majority of the respondents that are single 120(64.5%), Married 58(63.7%), divorced 15(71.4%) and widowed 9(75.0%) agree that they know the stated regulations for protection against radiation is available. P value = 0.804>0.05. There is no significant relationship between Marital status and use of safety measure against radiation exposure among Patients undergoing medical imaging at private medical centers in Sango Ota, Ado Odo LGA, Ogun State. The null hypothesis is accepted.

Majority of the respondents that are medically related 74(75.5%)agree that they know if the state regulations for protection against radiation is available, while the respondents that are not medically related 125(60.7%) agree that they know the stated regulations for protection against radiation is available. P value = 0.029<0.05. There is significant relationship between educational levels and use of safety measure against radiation exposure among Patients undergoing medical imaging at private medical centers, Sango Ota. The null hypothesis is rejected while the alternative is accepted.

4. DISCUSSION

As similarly reported by other studies including the systematic reviews by Ribeiro et al. [8] and Lam et al. [9], we found that overall patients are generally lacking awareness about radiation exposure. In this study, only66.4% of respondents have heard about radiation exposure hazards from medical imaging. This is lower than 87.9% patient awareness reported in China by Sin, Wong & Huang in 2013, possibly due to the higher levels of education in China. However, the awareness level reported in this study is higher than the findings in another State in Nigeria in which only 13.3% had ever heard of radiation related health hazards [10]; as well as in Ethiopia with only 52.6% [11], in Jordan with only 50% (Alhassan et al., 2015), Uganda with 43% [12], Oman with 36.3% [13] and Iraq with 18% [14] of patients ever hearing of radiation related hazards. These lower reported proportion of patients aware of radiation hazards could be due to data collection from private facilities in this study, wherein it is assumed that private facility health workers could be more proactive in information dissemination than in public facilities as in majority of the other studies.

Further on, this study found that 42.60% of the respondents mentioned that radiation exposure can result to cataract, 38.70% reported that radiation exposure can lead to cell death, for 8.70% it could result to cancer, for 5.80% of the respondents radiation exposure can lead to fetal

abnormality, and for 1.90% of respondents, radiation exposure can lead to lesions. According to Ashefa et al. (2016), among Ethiopian patients aware of health hazards of radiations, 74.9% mentioned infertility, 64.0% indicated cancer, 26.6% mentioned cataract followed by 10.3% who mentioned short life span as radiation related health hazards. In China, 17.8% of the patients were aware of the cancer risk of radiations from medical imaging [15]. These further buttress the poor and inadequate awareness of health effects of radiation exposures among patients for medical imaging.

This lack of awareness of radiation exposure from medical imaging bring to the fore a lack of communication on radiation exposure between healthcare workers and patients as this study reports that as much as 35.8% of the respondents did not receive radiological education before undergoing any of the investigations. This is as much as 80% in Schuster et al. [16]'s study. Consequently, Schuster et al. [16] reports time limitation and concern of dissuading the patient from radiological investigation as common obstacles for discussing risks. Additionally, the argument on whose responsibility it is to communicate the patient on radiation exposure and associated risks has become heated, as local practice across institutions vary and can influence discussion of radiation exposure. However, it is generally agreed that referring physicians will discuss the clinical need for the imaging procedure but the discussion about radiation exposure is more likely to occur at the point of imaging, this alongside the referring physician's knowledge about radiation exposure will determine what is conveyed to patients [9,17].

Not surprisingly, this study found that there was a significant relationship between answering questions on use of safety measure against radiation exposure against radiation correctly and having higher educational level or being medically related, similar to Repplinger et al. [18]'s study. However, the study also report a significant relationship between tribe and use of safety measure against radiation exposure among patients undergoing medical imaging. This might in part be explained by the significant difference in literacy levels between tribes recorded by the national surveys in Nigeria (NDHS, 2018).

The researchers in this study note that majority of the literature on awareness and knowledge of the effects of ionizing radiation were carried out among health workers, whereas there is limited information from patients who undergo the procedure. This accounts for the paucity of local studies to compare our results with. In future, studies could compare the radiation awareness among patients presenting at health facilities from public and private, as well as differences in awareness levels of self-presenting and prescribed patients.

5. CONCLUSION

In conclusion, there is poor and inadequate patient awareness and knowledge of the effects of ionizing radiation in medical imaging. Thus physicians, radiographers, technicians and all health care professionals need to provide better patient education to enable patients and the general population make informed decisions regarding their health care. There is also need for comprehensive programs aimed at raising awareness of individuals as well as the community, public and private institutions.

ETHICAL APPROVAL AND CONSENT

A written permission was obtained prior to the study from the chief radiographers of the private medical centers used, the research instruments were checked well and anonymity of the participant was maintained. As per international standard or university standard, respondents' written consent has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Lee. Awareness level concerning radiation dose and possible risk associated with Computed Tomographic (CT) Scan among Patients, Emergency Department (ED) physicians, and radiologist; 2004.
2. Shiralkar S, Rennie A, Snow M, et al. Doctors' knowledge of radiation exposure: questionnaire study. BMJ. 2003;327:371e2.
3. Mubeen SM, Abbas Q, Nisar N. Knowledge about ionising and non-ionising radiation among medical students. J Ayub Med Coll Abbottabad. 2008;20:118e21.
4. Yurt A, Cavuşoğlu B, Günay T. Evaluation of awareness on radiation protection and knowledge about radiological examinations

in healthcare professionals who use ionized radiation at work. Mol Imaging Radionucl Ther. 2014;23:48–53.
5. Miglioretti DL, Johnson E, Williams A, Greenlee RT, Weinmann S, Solberg LI, et al. The use of computed tomography in pediatrics and the associated radiation exposure and estimated cancer risk. JAMA. 2013;167:700–707.
6. Shaw PV, Croüail P, Paynter R, Coeck M. Education and training in radiation protection: Improving ALARA culture, J. Radiol. Prot. 2015;35:223227. Available:http://www.dx.doi.org/10.1088/0952-4746/35/1/223
7. Araoye MO. Research methodology with statistics for health and social sciences. 2004;115- 121.
8. Ribeiro A, Husson O, Drey N, Murray I, May K, Thurston J, Oyen W. Ionising radiation exposure from medical imaging: A review of Patient's (un) awareness, Radiography. 2019;1016(10):1–6.
9. Lam DL, Larson DB, Eisenberg JD, Forman HP, Lee CI. Communicating potential radiation-induced cancer risks from medical imaging directly to patients. Am. J. Roentgenol. 2015;205(5):962–970.
10. Briggs-Kamara MA, Polycarp C, Okoye PC, Omubo-Pepple VB. Radiation safety awareness among patients and radiographers in three hospitals in Port Harcourt. Am. J. Sci. Ind. Res. 2013;4(1): 83–88.
11. Asefa G, Getnet W, Tewelde T. Knowledge about Radiation Related Health Hazards and Protective Measures among Patients Waiting for Radiologic Imaging in Jimma University Hospital, Southwest Ethiopia. Ethiopian Journal of Health Sciences. 2016;26(3):227–236.
12. Kiguli-Malwadde E, Matovu PD, Kawooya MG, Byanyima RK. Radiation safety awareness among radiation workers and clients at Mulago Hospital, Kampala, Uganda. East and Central African Journal of Surgery. 2006;11(1).
13. Al-Mallah A, Vaithinathan AG, Al-Sehlawi M, Al-Mannai M. Awareness and Knowledge of Ionizing Radiation Risks Between Prescribed and Self-Presenting Patients for Common Diagnostic Radiological Procedures in Bahrain. Oman Medical Journal. 2017;32(5):371–377.
14. Haider NA, Ibms F, Mrd D. Patient's awareness of cancer risk from radiation in computerized tomography. Kufa Med Journal. 2011;14(1).
15. Sin Ho-Kwan, Wong Chun-Sing, Huang, Bingsheng, Yiu Ka-Ling, Wong Wai-Lam, Chu Yiu. Assessing local patients' knowledge and awareness of radiation dose and risks associated with medical imaging: A questionnaire study. Journal of Medical Imaging and Radiation Oncology. 2013;57:38–44.
16. Schuster AL, Forman HP, Strassle PD, et al. Awareness of radiation risks from CT scans among patients and providers and obstacles for informed decision-making. Emerg Radiol. 2018;25:41–49.
17. Busey JM, Soine LA, Yager JR, Choi E, Shuman WP. Patient knowledge and understanding of radiation from diagnostic imaging.JAMA Intern Med. 2013;173(3): 239–241.
18. Repplinger MD, Li AJ, Svenson JE, Ehlenbach WJ, Westergaard RP, Reeder SB, Jacobs EA. Emergency department patients' perceptions of radiation from medical imaging. WMJ: official publication of the State Medical Society of Wisconsin. 2016;115(1):22–28.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/56522