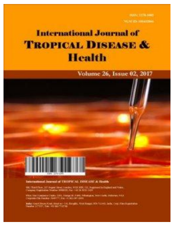

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Radiation Protection: What do the Nigerian Paediatric Residents Know?

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Authors' contributions

This work was carried out in collaboration between both authors. The author IOE designed and analyzed the manuscript while the author EOF interpreted and prepared the manuscript. Both authors read and approved the final manuscript.

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ABSTRACT

Knowledge of radiation protection is pertinent to the paediatric doctor as some radiological investigations requested for a sick child use ionizing radiation with some deleterious effect in the future. A sound knowledge will help the doctor to make the right and appropriate choice of radiological investigations in this age group.

This was a questionnaire-based prospective study involving 89 paediatric resident doctors who came for an update course at the University of Benin Teaching Hospital. Thirty-nine (43.8%) of the 89 were males and 50 (56.2%) were females.

The mean age of the study population was 34.0 ± 4.6 years (range 25 - 51 years). Majority of the study participants 78 (87.6%) had been in residency training for at least 6 years. Eighty (90.0%) of the respondents had poor knowledge of radiation protection, 7 (8.0%) had the fair knowledge, 1 (1.0%) each had good knowledge and excellent knowledge respectively. A lower proportion of male residents (36, 45%) demonstrated a lower level of knowledge of radiation protection compared to their female counterparts (44, 55%) although the difference was not statistically significant. Those younger in the residency training had poorer knowledge of radiation protection compared with the older residents. The level of knowledge was not associated with the previous lecture on radiation protection or the geopolitical location of the resident doctor.

In conclusion, this study has documented the level of knowledge of radiation protection among resident doctors training in paediatrics in Nigeria.

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Keywords: Radiation protection; paediatric resident.

1. INTRODUCTION

The use of radiological investigations and interventions has become an integral part of Medicare such that the quality of healthcare in any country today is accessed by the sophistication of the radiological input. The paediatric age, more often than none, requires radiological investigation as part of the management of one ailment or the other as it is more difficult to clinically elicit signs and symptoms from them. It is also worthy of note that some of these imaging modalities make use of ionizing radiation which has a deleterious effect on the human cell. The effects of radiation on health are deterministic effects which occur in high doses and stochastic effects which occur at low doses of radiation [1,2].

The paediatric age group is at greater risk to ionizing radiation for reasons which include having more rapidly proliferating tissues that are highly sensitive to radiation, having longer life expectancy that make them more likely to develop radiation-induced cancers and radiological equipment are poorly adapted to the small size of the paediatric age group hence increases the effective dose of ionizing radiation to them [3,4]. The latter is of prime importance in our environment as most available radiological equipment is not purposely built to suit the paediatric age group. More often than not, irradiating the chest of the neonate will include the abdomen thereby getting undue exposure to these areas because the collimator of the x-ray is not adapted to the neonate.

There may be adequate knowledge of radiation protection in paediatric imaging amongst radiologists and radiographers but not so with the paediatricians who prescribe radiological investigations for the patients. Salerno et al. [5] opined that the knowledge of radiation protection was poor among paediatric residents in a survey done in Italy. They further discovered that attendance in a radiation protection lesson during residency training increased the percentage of correct answers to questions on radiation protection to 76% while exposure to knowledge of radiation protection in medical school increased the same percentage to 67% making it explicitly clear that proper education can adequately reduce radiation protection knowledge gap amongst clinicians [5]. In a Nigerian study by Famurewa et al. [6] it was noted that the paediatrician's knowledge on the principle of radiation protection referred to as ALARA (as low as reasonably acceptable) and the radiation doses from the common radiological procedure were low. Hence, the need to educate the paediatrician, especially during residency training cannot be underscored. This study is aimed at assessing the knowledge of radiation protection amongst resident doctors in paediatric in Nigeria.

2. STUDY PARTICIPANTS AND METHODS

A descriptive cross-sectional study which was carried out during the Intensive Update Course of the National Postgraduate Medical College of Nigeria, Faculty of Paediatrics from Monday the 19th February. to Friday 3rd March 2017. This was a two-week course which has been taken place in University of Benin Teaching Hospital Benin City in the last ten years. Participants were paediatric resident doctors drawn from the different institutions in the six geopolitical zones of Nigeria.

There were a total of 153 registered participants and comprised of all the levels of training namely Primary, Part One and Part Two. A total of 125 participants were available at the time of research and 100 received the questionnaire giving a response rate of 80.0%. It was a self-administered questionnaire where the participants are allowed to fill in the questionnaire at their own time but within a specific time during the break. This is to discourage possible seeking for the answers to the questions elsewhere. Completed questionnaires were returned to the research assistants.

The questionnaire was in two sections A and B. Section A contained the socio-demographic characteristics of the study participants including a number of years post-graduation, a period of years in training as a paediatric resident. Section B comprised of 13 questions to test the knowledge of radiation protection by paediatric residents. These questions were obtained from the literature search and were modified and adapted for the purpose of this research in the study locale. Each correct answer given to a question attracted one mark except for questions 6 and 10 which were awarded 4 marks each giving a total of 19 marks for the 13 questions. Percentage knowledge score was obtained by manual calculation of total score obtained by respondents divided by the total score of 19 marks multiplied by 100. Percentage score less than 50.0% were graded as Poor, 50–59% was Fair, 60–69 was Good and ≥70% was regarded as Excellent.

Informed consent was obtained from each study participants and Ethical exemption for this study was obtained from the Research and Ethics Committee of University of Benin Teaching Hospital Benin City.

2.1 Data Management

Data were entered into Microsoft Excel for Windows 2010 and was analysed using the Statistical Package for Social Sciences (SPSS) version 21.0. (Chicago,IL, United State of America). Quantitative variables such as age, number of years post-graduation and practice as paediatrics residents were analyzed in means, standard deviations and appropriate comparison made an independent-t-test. The number of years post-graduation was further classified according to the Medical and Dental Council of Nigeria category as a young medical doctor (post-graduation year less than 10 years) and old medical doctor (post-graduation years ≥ 10 years). Chi-square Test was used to test the association between non-parametric variables such as that between percentage knowledge score of protection radiation and socio-demography of the study participants such as gender, post-graduation category, a period of years in residency training, status, geographical location of practice, type of training institutions and level of training. The statistical tool was also used to calculate the association between percentage knowledge and other parameters such as post-graduation and residency training number of years and level of training. The level of significance for each variable was set at $p < 0.05$ and confidence level at 95%.

3. RESULTS

Of the 100 who participated in the research, 11 questionnaires were incomplete and unanalyzable while 89 were completed and had analyzable data. Thirty-nine (43.8%) of the 89 were males and 50 (56.2%) were females. Their mean (±) age of the study participants was 34.0 ± 4.6 years (range 25–51 years).; mean (±) a number of year post-graduation from medical school was 7.6 ± 4.0 years (1–28 years); and period of years in residency training was 4.0 ± 3.0 years (range 1–16 years).

Table 1. shows the socio-demographic characteristics of the study participants. Majority of the study participants (59.6%) aged 25–34 years, married (71.9%), junior residents 52 (58.4%) and young graduates 75 (84.3%). Majority of the study participants 78 (87.6%) had been in residency training for at least 6 years and were part one candidates; 54 (60.7%).

Table 1. Socio-demographic characteristics of the 89 study participants

Socio-demographiccharacteristics	N = 89
Gender	
Male	50 (56.2)
Female	39(43.8)
Age (Years)	
25 - 34	53 (59.6)
35 – 44	33 (37.1)
45 - 54	3 (3.3)
Marital status	
Single	24 (27.0)
Married	64 (71.9)
Separated	1 (1.1)
Level of Training	
Primary	6 (6.7)
Part One	54 (60.7)
Part Two	29(32.6)
Status of the study Participants	
Senior House officers	4 (4.5)
Junior Resident	52 (59.1)
Senior Resident	33(37.5)
Post-graduate Years Category	
Young	75 (84.3)
Old	14 (15.7)
Period of years in Residency Training	
6 years	78 (87.6)
More than 6 years	11 (12.4)
Type of Training Institution	
Teaching Hospitals	76 (85.4)
Federal Medical Centres	52 (9.0)
State Specialists/ General Hospitals	1(1.1)
Others (Mission Hospitals, Corporate private hospitals, etc)	4 (4.5)
Geographical Location of Practice	
Northern Region	42 (47.2)
Sothern Region	45 (50.6)
No Response	2 (2.2)

The proportion of the respondents who had received lectures on radiation protection was 25 (28.1%); most of which 21 (84.0%) were the lectures given to them during their undergraduate medical school; 3 (12.0%) received at their postgraduate level while 1(4.0%) were personal studies.

Table 2 shows the responses of the study participants on the questions inquired of them concerning radiation protection. Most of the respondents gave an appropriate response to questions regarding shielding materials for radiation especially as regards to the lead apron by 71 (79.8%) and questions on a dose which was answered appropriately by 65 (73%) participants.

Fig. 1. shows the percentage knowledge score of the study participants on radiation protection. Eighty (90.0%) of the respondents had poor knowledge of radiation protection, 7 (8.0%) had the fair knowledge, 1 (1.0%) each had good knowledge and excellent knowledge respectively. The percentage knowledge score of the respondent was not significantly associated with the respondents' previous lectures on radiation (χ^2 = 6.25, p = 1.00, 95%CL 0.04, 0.16) and neither did it depend on geographical location of practice in Nigeria ie northern region 42 (49.4%) and southern region 45 (50.6%) (χ^2 = 2.57, 95%CL = 0.51, 0.71, p = 0.46).

Table 3 shows the association between percentage knowledge score of the study participants on radiation protection and such factors as` gender, post-graduation year category, a period of years in residency training, level of training, the status of the respondent, geographical location of practice and type of training institution. The most poor performances was observed significantly among female participants 44(55.0%) than their male counterparts 36 (45.0%). Those younger in the residency training had poorer knowledge of radiation protection compared with the older residents; same observation was made based on the level of training. The part one candidates had poor knowledge of radiation protection comparatively to the part two candidates.

4. DISCUSSION

Literature has shown a reduction in the use of conventional x-ray but a substantial increase in the use of computed tomographic scan with a greater level of exposure to ionizing radiation [7]. Multi-detector computed tomography (MDCT) alone accounts for about 50% of medical

Table 2. Responses of the study participants on basic questions concerning radiation protection

Questions on radiation protection	Appropriate response N = 89 (%)
Radiation sources that affect normal population	21 (23.6)
Ten day rule of WHO about radiation protection in pregnancy	26 (29.2)
Distance from the x-ray source to the skin	14 (15.7)
Point of view of radiation safety	46 (51.7)
Essence of warning sign in a radiation environment	33 (37.1)
Shielding materials in radiation protection include	
- Barium board	20 (22.5)
- Lead aprons	71 (79.8)
- Lead gloves	44 (49.4)
- Eye goggles	28 (31.5)
Meaning of medical exposure	30 (33.7)
Expected normal radiation exposure limit per day	2 (2.2)
Basic principles for radiation protection	16 (18.0)
Features of radiation protection	
- Justification	17 (19.1)
- Optimization	10 (11.2)
- Dose limit	43 (48.3)
- Shielding	65 (73.0)
More important organ to be protected against radiation in head/neck	48 (53.9)
MRI of the spine of 45 minutes duration equivalence	24 (27.0)
Annual radiation dose limit for the general public	1 (1.1)

Table 3. Association between knowledge score of radiation protection and Socio-demography of the respondents

	Knowledge Score – Radiation Protection				
	Poor	**Fair**	**Good**	**Excellent**	**Total**
Socio-demography	**n = 80 (%)**	**n = 7 (%)**	**n = 1 (%)**	**n = 1 (%)**	**n = 89 (%)**
Gender					
Male (n = 39)	36 (45.0)	2 (28.6)	1 (100.0)	0 (0.0)	39 (43.9)
Female	44 (55.0)	5 (71.4)	0 (0.0)	1 (100.0)	50 (56.1)
	χ^2 = 2.78, 95%CL = 0.28, 0.48, p = 0.43				
Post-graduation status					
Young graduate	67 (83.8)	6 (85.7)	1 (100.0)	1 (100.0)	75 (84.3)
Old graduate	13 (16.2)	1 (14.3)	0 (0.0)	0 (0.0)	14 (15.7)
	χ^2 = 0.40, 95%CL = 0.98, 1.0, p = 0.94				
Period of years in pediatrics					
6 years in residency	70 (87.5)	6 (85.7)	1 (100.0)	1 (100.0)	78 (87.6)
More than 6 years	10 (12.5)	1 (14.3)	0 (0.0)	0 (0.0)	11 (12.4)
	χ^2 = 0.31, 95%CL = 0.98, 1.00, p = 0.31				
Level of Training					
Primary	4 (17.5)	1 (14.2)	1 (100.0)	0 (0.0)	6 (6.7)
Part One	50 (50.0)	3 (42.9)	0 (0.0)	1 (100.0)	54 (60.7)
Part Two	26 (32.5)	3 (42.9)	0 (0.0)	0 (0.0)	29 (32.6)
	χ^2 = 16.08, 95%CL = 0.03, 0.15, p = 0.01				
Status of the respondents					
Senior House Officer	3 (3.7)	1 (14.2)	0 (0.0)	0 (0.0)	4 (4.5)
Junior Resident	47 (58.8)	3 (42.9)	1 (100.0)	1 (100.0)	52 (58.4)
Senior Resident	30 (37.5)	3 (42.9)	0 (0.0)	0 (0.0)	33 (37.1)
	χ^2 = 3.37, 95%CL = 0.46, 0.67, p = 0.76				
Type of Training Institution					
Teaching Hospital	67 (83.8)	7 (100.0)	1 (100.0)	1 (100.0)	76 (85.4)
Federal med Centre	8 (10.0)	0 (0.0)	0 (0.0)	0 (0.0)	8 (9.0)
State Specialist/ General Hospitals	1 (1.2)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.1)
Others – Mission Hospital	4 (5.0)	0 (0.0)	0 (0.0)	0 (0.0)	4 (4.5)
	χ^2 = 1.71, 95%CL = 0.68, 0.85, p = 1.00				

radiation exposure [8]. About 7% of CT studies are performed on children in the United States, 4.5% in Japan, 2% in Switzerland and 1% in Germany [9,10,11,12]. These figures are rather alarming considering the deleterious effect of ionizing radiation. It is also a known fact that children are more at risk of ionizing radiation due to their growing tissues and also because of the longer lifespan that makes them prone to developing malignancies in later life. Brenner et al. [13] opined that for the year 2000 from the 600,000 abdominal and head CT examinations in children under the age of 15 years in the USA, 500 fatal cancers attributable to computed tomographies will occur in these children during their lifetime. In another study, it was estimated that the risk of cancer due to diagnostic x-rays in the UK and the USA are 500 and 5700 deaths per year, respectively [14]. A good knowledge of radiation protection is, therefore, important to the paediatrician as much as it is to the radiologist. Adequate knowledge of radiation protection should be at the disposal of the paediatrician in so far as he prescribes radiological investigations for patients and the deleterious effects of such exposure may have to be managed by the paediatrician and other clinicians.

In this study, designed to appraise the adequacy of knowledge of radiation protection amongst paediatricians in training, the mean age of the study population was 34.0 ± 4.6 years. This is similar to that of Salerno et al. [5] who had a mean age of 36 years in their study in Italian paediatric resident doctors. Yakassai et al. [15] puts the mean age of junior residents at 32.6±3.7 years, while that of senior residents was 35±4 years in a study done in northern Nigeria.

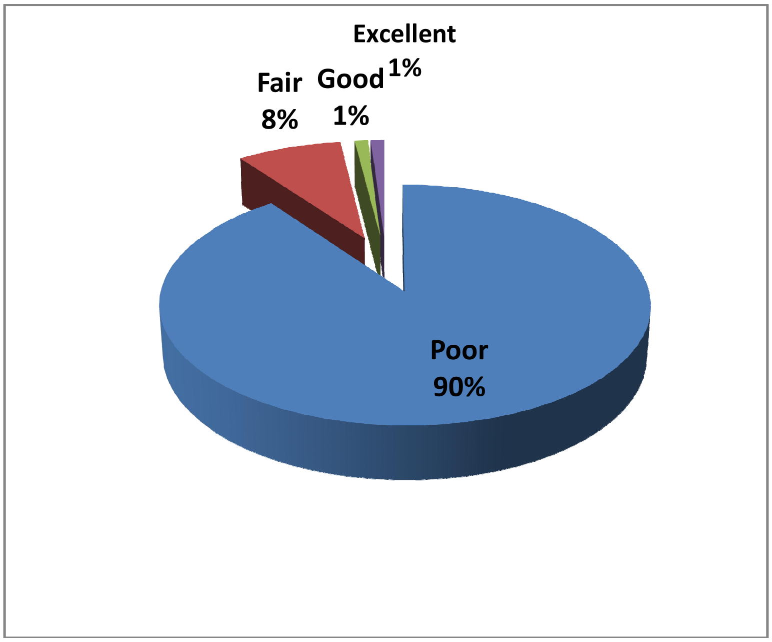

Fig. 1. Shows the percentage knowledge score of the study participants on radiation protection

The mean number of years in paediatric residency training was 4.0 ± 3.0 years (range 1 – 16 years) in this study. We also observed that those younger in the residency training had poorer knowledge of radiation protection compared with the older residents; same observation was made based on the level of training. The junior residency candidates had poorer knowledge of radiation protection compared to senior residency candidates. The number of years of experience in training may also influence the choice of radiological imaging by a clinical practitioner. Salerno et al. [5] showed that clinical experience significantly influences the choice of MDCT in paediatric imaging. They observed that emergency doctors with broader clinical experience and more number of years of practice were less likely to prescribe MDCT for use in children despite their poor knowledge of risk associated with radiation. Contrariwise, Salerno et al. [5] also documented no difference in the knowledge of radiation protection in relation to years of training. It was observed that younger residents had a higher percentage of correct responses and were highly significant. This latter observation was buttressed by a study in Turkey were younger paediatricians were found to be more knowledgeable on the ALARA principle than older paediatricians who had more years of clinical practice [16]. The younger doctors are seen to have grown up in an environment where medical radiation is in the frontiers of issues being discussed, and they are not oblivious of the contemporary rapidity in CT usage and this is seen as encouraging for this generation [16].

Despite this above documentation, paediatricians are still seen to be poorly knowledgeable on radiation protection [16]. Our study showed that over 90% of the respondents had poor knowledge of radiation protection and it was irrespective of the number of years post graduation and number of years in residency. Only 79.8% and 73.0% of residents gave appropriate responses to the usage of the lead apron as protective means and to the ALARA principle respectively. The score on the appropriate response to other questions regarding radiation protection was abysmal as documented in the result above. Therefore, there is a need for this knowledge gap to be corrected. It is common knowledge that radiation safety is not adequately taught in medical school and in postgraduate training except in radiology residency [17]. Hence, there is need to introduce didactic lectures on radiation protection and perhaps on radiobiology and appropriate choice of imaging modality for every clinical condition to the basic medical school curriculum and same extended to residency training in all aspects of clinical practice that requests radiological imaging. Assessment tools should be employed to determine the adequacy of the impact of such lectures on the paediatric residents.

5. CONCLUSION

In conclusion, this study has shown the poor knowledge of radiation protection among paediatric resident doctors in Nigeria. Hence, there is need to bridge this gap by training and retraining of doctors during residency training and even after residency to ensure the knowledge is concretized. Such training should also be extended to paediatric surgery resident doctors as they are also gullible of this knowledge gap and they make a similar request, if not more, as the paediatricians.

CONSENT

As per international standard or university standard, patient's written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standard or university standard, written approval of Ethics committee has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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