

Original Research Article

Radiation Protection: What Do The Nigerian Paediatric Residents Know?

Abstract

Background: Knowledge of radiation protection is pertinent to the paediatric doctor as some radiological investigations requested for a sick child uses 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.

Aim: To document the level of knowledge of radiation protection among paediatric resident doctors training in Nigeria.

Design: A questionnaire based prospective study.

Setting: Paediatric Department, University of Benin Teaching Hospital, Benin, Edo, Nigeria.

Subjects: Subjects were 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.

Results: 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 and were part one candidates; 54 (60.7%). Eighty (90.0%) of the respondents had poor knowledge of radiation protection, 7 (8.0%) had fair knowledge, 1 (1.0%) each had good knowledge and excellent knowledge respectively. Poor performance was observed among female participants 44(55.0%) in comparison to their male counter-parts 36 (45.0%). 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 previous lecture on radiation protection or the geopolitical location of the resident doctor.

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

Keywords:-Knowledge radiation, paediatric resident doctors

INTRODUCTION

The use of radiological investigations for diagnosis as well as interventions has become an integral part of Medicare such that the quality of healthcare in any country today is assessed by the sophistication of the radiological input. The paediatric age, more often than none, requires radiological investigation as part of management of one ailment or the other as it is

34 more difficult to clinically elicit signs and symptoms from them. It is also worthy of note that
35 some of these imaging modalities uses ionizing radiation which have deleterious effect on the
36 human cell. The effects of radiation on health are deterministic effects which occur in high
37 doses and stochastic effects which occur at low doses of radiation.^{1,2}

38 The paediatric age group is at a greater risk to ionizing radiation for the for reasons which
39 include having more rapidly proliferating tissues that are highly sensitive to radiation, having
40 longer life expectancy that make them more likely to develop radiation induced cancers and
41 radiological equipment are poorly adapted to the small size of the paediatric age group hence
42 increases the effective dose of ionizing radiation to them.^{3,4} The latter is of prime importance
43 in our environment as most available radiological equipment are not purposely built to suite
44 the paediatric age group. More often than none, irradiating the chest of the neonate will
45 include the abdomen thereby getting undue exposure to these areas because the collimator of
46 the x-ray is not adapted to the neonate.

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

61 **STUDY PARTICIPANTS AND METHODS**

62 A descriptive cross sectional study which was carried out during the Intensive Update Course
63 of the National Postgraduate Medical College of Nigeria, Faculty of Paediatrics from
64 Monday the 19th February to Friday 3rd March 2017. This was a two-week course which has
65 been taken place in University of Benin Teaching Hospital Benin City in the last ten years.

66 Participants were paediatric resident doctors drawn from the different institutions in the six
67 geopolitical zones of Nigeria.

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

75 The questionnaire was in two sections A and B. Section A contained the socio-demographic
76 characteristics of the study participants including number of years post-graduation, period of
77 years in training as paediatric resident. Section B comprised of 13 questions to test the
78 knowledge of radiation protection by paediatric residents. These questions were obtained
79 from literature search and was modified and adapted for the purpose of this research in the
80 study locale. Each correct answer given to a question attracted one mark except for questions
81 6 and 10 which were awarded 4 marks each giving a total of 19 marks for the 13 questions.
82 Percentage knowledge score was obtained by manual calculation of total score obtained by
83 respondents divided by the total score of 19 marks multiplied by 100. Percentage score less
84 than 50.0% was graded as Poor, 50 – 59% was Fair, 60 – 69 was Good and $\geq 70\%$ was
85 regarded as Excellent.

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

89 **Data Management**

90 Data were entered into Microsoft Excel for Windows 2010 and was analysed using the
91 Statistical Package for Social Sciences (SPSS) version 21.0. (Chicago, IL, United State of
92 America). Quantitative variables such as age, number of years post-graduation and practice as
93 paediatrics residents were analyzed in means, standard deviations and appropriate
94 comparison made an independent-t test. The number of years post-graduation was further
95 classified according to the Medical and Dental Council of Nigeria category as young medical
96 doctor (post-graduation year less than 10 years) and old medical doctor (post-graduation
97 years ≥ 10 years). Chi-square Test was used to test association between non-parametric
98 variables such as that between percentage knowledge score of protection radiation and socio-

demography of the study participants such as gender, post-graduation category, 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%.

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 ($\pm$) age of the study participants was 34.0 ± 4.6 years (range 25 – 51 years); mean ($\pm$) 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 I shows the socio-demographic characteristics of the study participants. Majority of the study participants (59.6%) were ages 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 I: Socio-demographic characteristics of the 89 study participants

Socio-demographic characteristics	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)

140		
141	Level of Training	
142	Primary	6 (6.7)
143	Part One	54 (60.7)
144		
145	Part Two	29(32.6)
146		
147	Status of the study Participants	
148	Senior House officers	4 (4.5)
149	Junior Resident	52 (59.1)
150	Senior Resident	33(37.5)
151		
152	Post-graduate Years Category	
153	Young	75 (84.3)
154		
155	Old	14 (15.7)
156		
157	Period of years in Residency Training	
158	6 years	78 (87.6)
159		
160	More than 6 years	11 (12.4)
161		
162	Type of Training Institution	
163	Teaching Hospitals	76 (85.4)
164		
165	Federal Medical Centres	52 (9.0)
166	State Specialists/ General Hospitals	1(1.1)
167	Others (Mission Hospitals, Corporate private hospitals, etc)	4 (4.5)
168		
169	Geographical Location of Practice	
170	Northern Region	42 (47.2)
171		
172	Sothern Region	45 (50.6)
173	No Response	2 (2.2)
174		
175		

176 The proportion of the respondents who had received lectures on radiation protection was 25
 177 (28.1%); most of which 21 (84.0%) were the lectures given to them during their
 178 undergraduate medical school; 3 (12.0%) received at their postgraduate level while 1(4.0%)
 179 were personal studies.

180

181 Table II shows the responses of the study participants on the questions inquired of them
 182 concerning radiation protection. Most of the respondents gave appropriate response to
 183 questions regarding shielding materials for radiation especially as regards to lead apron by 71
 184 (79.8%) and questions on dose which was answered appropriately by 65 (73%) participants.

Table II: 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)

Figure 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 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 ($\chi^2 = 6.25$, $p = 1.00$, 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%) ($\chi^2 = 2.57$, 95%CL = 0.51, 0.71, $p = 0.46$).

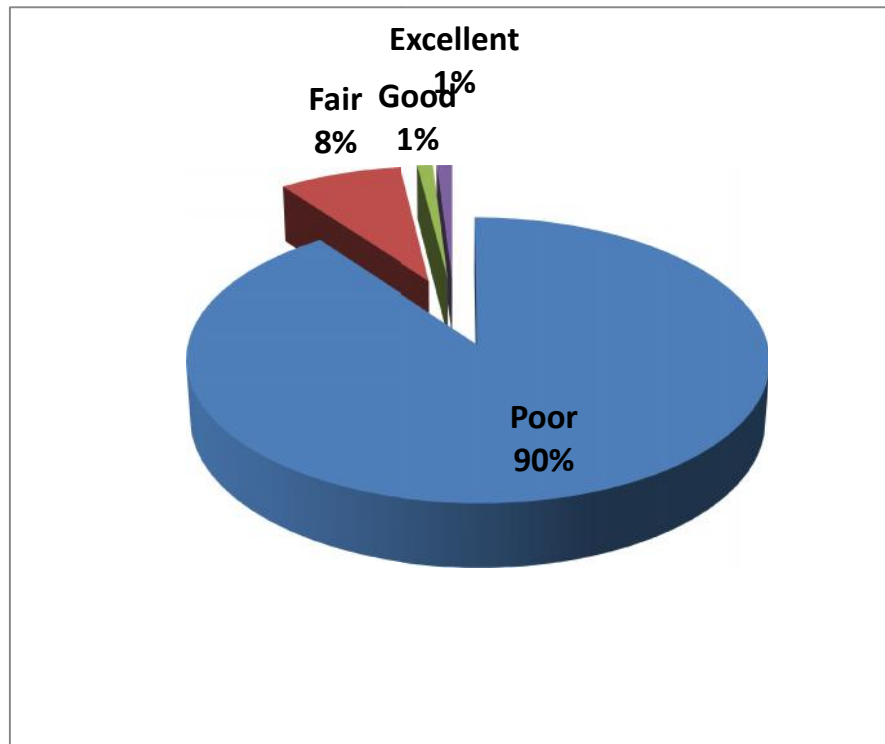


Figure 1 shows the percentage knowledge score of the study participants on radiation protection

Table III shows the association between percentage knowledge score of the study participants on radiation protection and such factors as gender, post-graduation year category, period of years in residency training, level of training, status of the respondent, geographical location of practice and type of training institution. Most poor performance was observed significantly among female participants 44(55.0%) than their male counter-parts 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.

Table III: Association between knowledge score of radiation protection and Socio-demography of the respondents

Socio-demography	Knowledge Score – Radiation Protection				Total n = 89 (%)
	Poor n = 80 (%)	Fair n = 7 (%)	Good n = 1 (%)	Excellent n = 1 (%)	
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)
$\chi^2 = 2.78, 95\%CL = 0.28, 0.48, p = 0.43$					
Post-graduation Sstatus					
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)
$\chi^2 = 0.40, 95\%CL = 0.98, 1.0, p = 0.94$					
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)
$\chi^2 = 0.31, 95\%CL = 0.98, 1.00, p = 0.31$					
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)
$\chi^2 = 16.08, 95\%CL = 0.03, 0.15, p = 0.01$					
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)
$\chi^2 = 3.37, 95\%CL = 0.46, 0.67, p = 0.76$					
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)

276	State Specialist/					
277	General Hospitals	1 (1.2)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.1)
278	Others – Mission					
279	Hospital	4 (5.0)	0 (0.0)	0 (0.0)	0 (0.0)	4 (4.5)

$$\chi^2 = 1.71, 95\%CL = 0.68, 0.85, p = 1.00$$

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282

283 DISCUSSION

284 Literature has shown a reduction in the use of conventional x ray but a substantial increase in
 285 the use of computed tomography scan with a greater level of exposure to ionizing radiation⁸.
 286 Multi-detector computed tomography (MDCT) alone accounts for about 50% of medical
 287 radiation exposure⁹. About 7% of CT studies are performed in children in the United States,
 288 4.5% in Japan, 2% in Switzerland and 1% in Germany^{10, 11, 12, 13}. These figures are rather
 289 alarming considering the deleterious effect of ionizing radiation. With relative increase
 290 availability of CT scans in our environment our children are now increasly being exposed. It
 291 is a known fact that children are more at risk to ionizing radiation due to their growing tissues
 292 and also because of the longer life span that make them prone to developing malignancies in
 293 later life. Brenner *et al*¹⁴ opined that for the year 2000 from the 600,000 abdominal and head
 294 CT examinations in children under the age of 15 years in the USA, 500 fatal cancers
 295 attributable to computed tomographies will occur in these children during their lifetime. In
 296 another study it was estimated that the risk of cancer due to diagnostic x-rays in the UK and
 297 the USA are 500 and 5700 deaths per year, respectively¹⁵. A good knowledge of radiation
 298 protection is, therefore, important to the paediatrician as much as it is to the radiologist.
 299 Adequate knowledge of radiation protection should be at the disposal of the paediatrician in
 300 so far as he prescribes radiological investigations for patients and the deleterious effects of
 301 such exposure may have to be managed by the paediatrician and other clinicians.

302 In this study, designed to appraise the adequacy of knowledge of radiation protection
 303 amongst paediatricians in training, the mean age of the study population was 34.0 ± 4.6 years.
 304 This is similar to that of Salerno *et al*⁵ who had a mean age of 36 years in their study in
 305 Italian paediatric resident doctors. Yakassai *et al*⁶ puts the mean age of junior residents at
 306 32.6 ± 3.7 years, while that of senior residents was 35 ± 4 years in a study done in northern
 307 Nigeria.

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 influence 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 higher percentage of correct responses and was highly significant. This latter observation was buttressed by a study in Turkey where younger paediatricians were found to be more knowledgeable on the ALARA principle than older paediatricians who had more years of clinical practice¹⁶. 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 generation¹⁶.

Despite this above documentation, paediatricians are still seen to be poorly knowledgeable on radiation protection¹⁶. 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 usage of lead apron as protective means and to the ALARA principle respectively. The score on appropriate response to other questions regarding radiation protection were abysmal as documented in the result above. Therefore, there is 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 residency¹⁷. 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 impact of such lectures on the paediatric residents.

In terms of gender, only one male had a good score and one female had an excellent score on knowledge about radiation protection. There is no documentation about sex bias in the literature regarding knowledge of radiation protection among paediatrician⁵. However, Sundaran Kada documented a significantly higher knowledge of ionizing radiation among male general practitioners than their female counterparts in a study done in Norway¹⁸. This documentation on knowledge of ionizing radiation can be extrapolated to that of radiation protection as they are closely related. However, no reason was given to support this observation.

In conclusion this study has shown the poor knowledge on radiation protection among paediatric resident doctors in Nigeria. Hence, there is need to bridge this gap by training and retraining of doctors on radiation protection by the Post Graduate Medical Colleges during residency training.

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