KNOWLEDGE OF NIGERIAN PAEDIATRIC RESIDENTS ON IONIZING RADIATION

DU NWANERI[1], FO EHIGIAMUSOE[2]*

ABSTRACT

Introduction:Radiological investigations are common in paediatric practice. Paediatric age group is known to be ten times more susceptible to the effects of ionizing radiation than the adult population. These have increased lifetime risk of organ dose of radiation and most importantly, have longer lifespan that make them susceptible to developing radiation induced cancers such as leukemia and brain tumors in later life. In view of this, there is need to evaluate knowledge of paediatric residents on ionizing radiation.

Methods:A descriptive cross sectional study carried out during the Intensive Update Course of the National Postgraduate Medical College of Nigeria, Faculty of Paediatrics which took place in University of Benin Teaching Hospital Benin City from 19th February to 3rd March 2017. A self-administered questionnaire was used to obtain data. A total of 153 registered participants at the 2017 edition of the update course and 100 of these participated in the research giving a response rate of 80.0%. Data were analyzed using statistical package for social sciences version 16.0.

Results: Of the 100 participants, 89 had completely filled questionnaires were analyzed, mean (±) age was 34.0 ± 4.6 years (range 25 – 51 years) and mean (±) number of year of post-graduation from medical school was 7.6 ± 4.0 years (1 – 28 years); number of years in residency training 4.0 ± 3.0 years (range 1 – 16 years). Thirty-nine (43.8%) were males and 50 (56.2%) were females. About half of the respondents had poor knowledge of ionizing radiation, 21 (24.0%) had fair knowledge, 17 (19.0% had good knowledge and only 7 (8.0%) had excellent knowledge. The percentage knowledge score of the respondents was not significantly associated with if the respondents had received lecture on ionizing radiation ($\chi^2 = 4.29$, $p = 0.23$, 95%CL 0.20, 0.39).

Conclusion: Percentage knowledge score of paediatric residents on ionizing radiation is poor. There is need for regular lectures or continuing medical education on ionizing radiation for Nigerian paedriatic residents.

Keywords: *paediatrics, resident doctor, ionizing radiation.*

INTRODUCTION

Radiation is the transfer of energy in forms of waves or particles through space or matter[1, 2]. As this transfer occurs, some of these energies are high enough to remove electrons from the atoms of structures traversed thus producing energetic free radicals as well as breaking chemical bonds[2,3]. These free radicals are chemically reactive having unpaired electrons[4]. Radiations with high energy that are able to produce the above effects are described as ionizing radiation. Some of the ionizing radiations are often used in medical imaging as they can transverse the human body and produce different shades of shadow of structures on their paths based on the attenuating capabilities of these structures. These shades of shadow are then interpreted by the Radiologist as pathologies. Ionizing radiations used in medical imaging include x-rays, gamma rays and positron emission. X-rays are used in imaging modalities such as plain radiography, computed tomographic scan, fluoroscopy,

DU NWANERI[1*], FO EHIGIAMUSOE[2]
[1]Institute of Child Health, College of Medical Sciences,University of Benin,Benin City.
[2]Department of Radiology,School of Medicine,University of Benin,Benin City.
Correspondence to:*Dr.DamianUchechukwu Nwaneri, Institute of Child Health, College of Medical Sciences, University of Benin,Benin City.*
E-mail: damiannwaneri@yahoo.com, uchechukwu.nwaneri@uniben.edu

mammography and conventional angiography while gamma rays are used in radionuclide imaging with gamma camera. Positron emission is used in positron emission tomography. Gamma imaging and positron emission tomography are forms of radionuclide imaging. The non-ionizing radiations will not produce free radicals or break chemical bond in tissues they transverse, thus they are regarded as not harmful to human tissues. Ultrasonography and magnetic resonance imaging fall into the category of non-ionizing radiation.

Furthermore, the paediatric age group is known to be ten times more susceptible to the effects of ionizing radiation than the adult population; has increased lifetime risk of organ dose of radiation and most importantly, has longer lifespan that make them susceptible to developing radiation induced cancers such as leukemia and brain tumors in latter life[5, 6]. Therefore, it is pertinent that paediatricians should be aware of the type of radiation emitted by the different radiological equipment as this will greatly influence the choice of investigation requested. Justification is one of the principles of radiation protection and should be brought to focus especially in paediatric imaging as the referring physician should weigh the benefit of any requested investigation against the risk of inherent radiation effect[6]. Unfortunately, this is not so as a large number of clinicians inclusive of paediatricians have great knowledge gap in this aspect[6].

This knowledge gap creates a high level of inappropriate radiological requests from the peadiatrician resulting in exposure to cancer and resource wastage in the health sector[7]. Hence, there is need to stop this trend and bridge the knowledge gap responsible for this inappropriate observation. In this study, we set out to assess the knowledge of ionizing radiation among the resident doctors training in paediatric in some health institutions across the six geo-political zones in Nigeria. The resident doctors rather than fellow/consultant paediatricians were targeted because we felt that educative material to correct any negative trend deduced from the study can be structured into the residency program.

STUDY PARTICIPANTS AND METHODS

This was a descriptive cross sectional study. The study was carried during the Intensive Update Course of the National Postgraduate Medical College of Nigeria, Faculty of Paediatrics which took place in University of Benin Teaching Hospital Benin City from 19th February to 3rd March 2017. The Intensive Course is a two weeks programme and had been taken place every year in Benin City in the last ten years. In attendance were paediatric residents from different institutions in Nigeria drawn from all the six geopolitical zones of Nigeria. It was a total sampling of all the participants from different training institutions in Nigeria irrespective of level of training ie primary, part one and part two candidates.

There were a total of 153 registered participants at the 2017 edition of the update course. In full attendance at the time of the study were 125 of which 100 participated in the research giving a response rate of 80.0%. Participants were given questionnaires to be filled within a specific time during the break and questionnaires were retrieved as soon as the participants were done with filling in the correct answers on the questionnaire. There were 89 completely filled and analyzable questionnaire returned.

The questionnaire was in two sections A and B. Section A contained the socio-demographic characteristics of the study participants including number of years post-graduation, period of years in training as paediatric resident. Section B comprised of 13 questions to test the knowledge of the participants on ionizing radiation. These questions were obtained from literature search and was modified and adapted for the purpose of this research in the study locale. Apart from questions 1 and 12 which had scores of 2 and 5 respectively, the other 11 questions had scores of one each. One mark score was assigned to every correct answer given by the respondent giving a total of 18 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 18 multiplied by 100. Percentage score less than 50.0% was graded as Poor, 50 – 59% was Fair, 60 – 69 was Good and ≥ 70% was regarded as Excellent.

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

Data Management

Data were generated from study questionnaire were coded and 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 young medical doctor (post-graduation year less than 10 years) and old medical doctor (post-graduation years ≥ 10 years). Chi-square was used to test association between non-parametric variables 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 levelof significance for each variable was set at $p < 0.05$ and confidence level at 95%.

RESULTS

Of the 89 participants whose questionnaires were analyzed, mean (±) age was 34.0 ± 4.6 years (range 25 – 51 years); 39 (43.8%) were males and 50 (56.2%) were females. Mean (±) number of year of post-graduation from medical school was 7.6 ± 4.0 years (1 – 28 years); number of years in residency training 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)
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 ionizing radiation was 51 (57.3%); most of which 42 (82.4%) were the lectures given to them during their undergraduate medical school; 6 (11.8%) received at their postgraduate level while 3 (5.8%) were personal studies.

Table II shows the responses of the study participants on the questions inquired of them concerning ionizing radiation. Most appropriate response was given on questions concerning modalities that use ionizing radiation such as chest x-ray and computed tomography; followed by type of cells susceptible to radiation 71 (79.8%) and most common neoplasm following radiation exposure 62 (69.7%).

Table II: Responses of the study participants on basic questions concerning ionizing radiation

Questions on ionizing radiation	Appropriate response N = 89 (%)
Identification of ionizing radiation	35 (39.3)
Ionizing radiation that can be stopped by a piece of paper	18 (20.2)
Measurement of ionizing radiation	48 (53.9)
Organ more sensitive to ionizing radiation	26 (29.2)
Interaction of ionizing radiation with matter is by?	46 (51.7)
Most resistant tissue to ionizing radiation	25 (28.1)
Most common neoplasm following radiation exposure	62 (69.7)
Mode of radiation cellular injury	50 (56.2)
Type of cells susceptible to radiation	71 (79.8)
Radiation sources that affects normal people the most	18 (20.2)
Radiological investigation that cannot be used in pregnancy	46 (51.7)
Modalities that use ionizing radiation such as	
- Chest X-ray	77 (86.5)
- Computed Tomography	72 (80.9)
- Fluoroscopy	25 (28.1)
- Mammogram	43 (48.3)
- Angiography	26 (29.2)

Figure 1 shows the percentage knowledge score of the study participants. About half 44 (49.0%) of the respondents had poor knowledge of ionizing radiation, 21 (24.0%) had fair knowledge, 17 (19.0%) had good knowledge and only 7 (8.0%) had excellent knowledge. The percentage knowledge score of the respondents was not significantly associated with if the respondents had received lecture on ionizing radiation ($\chi^2 = 4.29$, $p = 0.23$, 95%CL 0.20, 0.39). However, the participants from the southern part of the country had better percentage knowledge score than their counter-part from the northern region as shown in Table III.

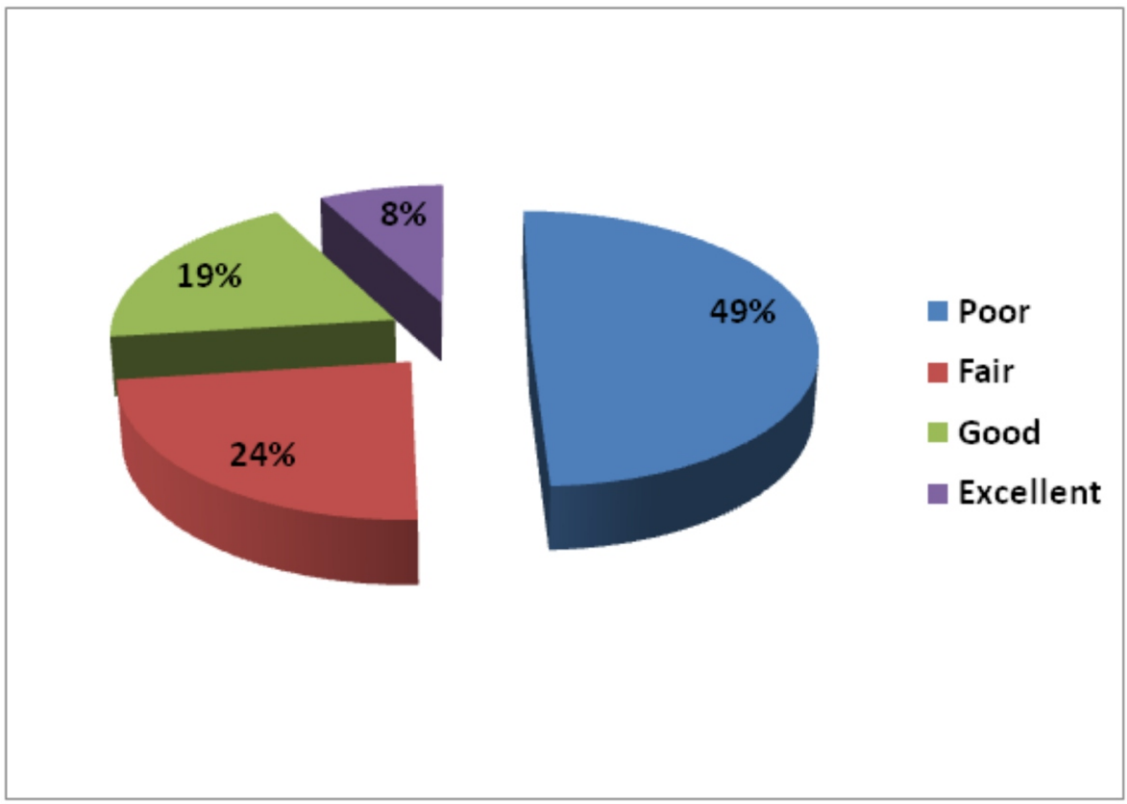

Figure 1: Percentage knowledge score of the 89 study participants

Table III: Percentage knowledge score of the respondents and their geographical region of practice

Socio-demography	Knowledge Score			
	Poor	**Fair**	**Good**	**Excellent**
Northern Region (n = 42)	26 (61.9)	7 (16.7)	4 (9.5) 5	(11.9)
Southern Region (n = 45)	17 (37.8)	13 (28.9)	13 (28.9)	2 (4.4)
	$\chi^2 = 9.64$, 95%CL = 0.00, 0.03, $p = 0.02$			

Table IV shows the association between percentage knowledge score of the study participants 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 30(68.2%) than their male counter-parts 14 (31.8%).

Table IV: Association between knowledge score and Socio-demography of the respondents

Socio-demography	Knowledge Score: Poor n = 44 (%)	Fair n = 21 (%)	Good n = 17 (%)	Excellent n = 7 (%)	Total n = 89 (%)
Gender					
Male	14 (31.8)	9 (42.9)	11 (64.7)	5 (71.4)	39 (43.8)
Female	30 (68.2)	12 (57.1)	6 (35.3)	2 (28.6)	50 (56.2)
	$\chi^2 = 7.76$, 95%CL = 0.00, 0.05, $p = 0.05$				
Post-graduation Status					
Young graduate	35 (79.5)	20 (95.2)	14 (82.3)	6 (85.7)	75 (84.3)
Old graduate	9 (20.5)	1 (4.8)	3 (17.7)	1 (14.3)	14 (15.7)
	$\chi^2 = 2.71$, 95%CL = 0.34, 0.54, $p = 0.44$				
Period of years in pediatrics					
6 years in residency	39 (88.6)	19 (90.5)	14 (82.4)	6 (85.7)	78 (87.6)
More than 6 years	5 (11.4)	2 (9.5)	3 (17.6)	1 (14.3)	11 (12.4)
	$\chi^2 = 0.66$, 95%CL = 0.88, 0.99, $p = 0.88$				
Level of Training					
Primary	1 (2.2)	1 (4.8)	3 (17.7)	1 (14.3)	6 (6.7)
Part One	27 (61.4)	12 (57.1)	10 (58.8)	5 (71.4)	54 (60.7)
Part Two	16 (36.4)	8 (38.1)	4 (23.5)	1 (14.3)	29 (32.6)
	$\chi^2 = 6.74$, 95%CL = 0.29, 0.50, $p = 0.35$				
Status of the respondents					
Senior House Officer	1 (2.2)	1 (4.7)	1 (6.3)	1 (14.3)	4 (4.5)
Junior Resident	27 (61.4)	9 (42.9)	11 (64.7)	5 (71.4)	52 (58.4)
Senior Resident	16 (36.4)	11 (52.4)	5 (29.4)	1 (14.3)	33 (37.1)
	$\chi^2 = 5.89$, 95%CL = 0.32, 0.53, $p = 0.44$				
Type of Training Institution					
Teaching Hospital	40 (90.9)	16 (76.2)	14 (82.4)	6 (100)	76 (85.4)
Federal med Centre	2 (4.5)	4 (19.0)	2 (11.8)	0 (0.0)	8 (9.0)
State Specialist/ General Hospitals	1 (2.3)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.1)
Others – Mission Hospital	1 (2.3)	1 (4.8)	1 (5.8)	0 (0.0)	4 (4.5)
	$\chi^2 = 7.56$, 95%CL = 0.41, 0.62, $p = 0.58$				

DISCUSSION

The acquisition of adequate knowledge on ionizing radiation by paediatric resident doctors is of prime importance in the quest to reduce exposure of the child to unjustifiable and inappropriate radiation. Assessing this level of knowledge among those in training in our country will help to identify the areas of knowledge gap so that measures to correct such gaps can be introduced into the training programs.

Out of the 89 respondents in this study only 35 (39.3%) could identify all radiological sources of ionizing radiation. Identification of the radiological sources of ionizing radiation by clinicians is a major step towards curbing the menace of undue exposure to radiation. Some studies have shown that many clinicians are deficient in this aspect. In a study done by Lee *et al*[8], one-third of non-radiologists (inclusive of 12 paediatricians; 8%) were oblivious of the absence of radiation in MRI and also thought that positron emission tomography (PET) and radio isotope imaging were devoid of radiation. Another study showed that 42% of

subjects had good knowledge that PET involves the use of ionizing radiation while 27% thought that MRI had ionizing radiation[9]. In some other studies that were paediatrician-specific, 70% of respondents were of the opinion that MRI uses ionizing radiation and that this radiation was thought to be 300 times higher than that of chest x-ray[6].

In our study, 77 respondents (86.5%) knew that chest x-ray was a source of ionizing radiation to the child. This seems encouraging as chest x-ray is one of the commonest radiological requests made by the paediatrician. Bartley and colleagues opined that chest x-ray exposure formed a modest risk association between radiation and the development of leukemia in childhood[9]. They observed that most children with acute myelocytic and lymphocytic leukemia had history of chest x-ray exposure more than x-ray of any other part of the body. The reason for this observation has not been ascertained and calls for more research.

A good percentage of respondents, 72 (80.9%) also knew that computed tomographic (CT) scan is a source of ionizing radiation. This is an appreciable number as CT scan is now known to be the highest source of ionizing radiation to both paediatric and adult population[6]. CT scan currently account for over 50% of radiation burden from medical exposure [10]. Though, the advent of CT scan has revolutionized medical practice as structures of the human body are seen better and it is also very rapid in image acquisition but this is not without its attendant burden of higher radiation exposure. Some authors have documented association of brain tumor and leukemia with exposure to radiation from CT scan at early age in life[10, 11]. Thus, this level of acknowledgement of CT scan as a source of ionizing radiation among paediatric resident doctors in Nigeria is therefore commendable. One can postulate that those who have this knowledge would opt for the non-ionizing imaging methods like MRI and ultrasound except in cases where the benefit of CT scan outweighs the risk of radiation exposure.

Quite disheartening is the low number of respondents who are aware that fluoroscopy (25, 28.1%) makes use of ionizing radiation. Fluoroscopy is quite important in the radiological workup of paediatric patients with gastrointestinal tract and genitourinary tract pathologies. Though, same low level of knowledge was observed with mammography 43 (48.3%) and angiography 26 (29.2%) as sources of radiation in our study but this is not too worrisome as mammography is not prescribed for the paediatric age group. Furthermore, conventional angiography is not a common radiological procedure in Nigeria and would rarely be prescribed for children.

A good percentage of respondents (71, 79.8%) knew the type of cells most susceptible to radiation damage but those who had good knowledge of organ most sensitive to radiation was quite low (26, 29.2%). These two points appear incongruent with each other as one cannot have a good knowledge of type of cells most susceptible to radiation and same time have poor knowledge of organ most sensitive to radiation. A study done among general practitioners showed that most of them placed gonads as the most sensitive organ to radiation[13]. However, the breast is seen as the most sensitive organ to radiation in this present dispensation as proposed by the international committee on radiation protection (ICRP)[14].

The Nigerian paediatric resident doctor is also seen to have good knowledge about neoplasms most common with radiation exposure which are mainly leukemia and brain tumours[15,16].

On the overall assessment of the paediatric resident knowledge on ionizing radiation, this is seen as being average as 51.0% of the respondents had knowledge on ionizing radiation ranging from fair to excellent while 49.0% had poor knowledge on ionizing radiation. Despite this average knowledge level, the respondents showed scores above average in only five points out of the sixteen points that were asked in the questionnaire. There is still much work to be done in

improving the knowledge base of the paediatric resident regarding ionizing radiation in radiological imaging.

CONCLUSION

The Nigerian paediatric resident has been assessed in terms of knowledge of ionizing radiation associated with radiological imaging and found to be at average level (51.0%). This is worrisome for our society as a reasonable number of radiological requests will still be inappropriately made due to this knowledge gap.

RECOMMENDATION

Lectures on radiation protection which encompasses ionizing radiation and safety measures against it should be included in the update courses for all cadres of resident doctors and such lectures must be given by radiologists. Furthermore, paediatric clinic-radiologic meetings should be strengthened such that discussions regarding appropriate radiological investigations can be made.

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CONFLICT OF INTEREST

There is none to declare.

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