RADIATION LEVELS AROUND SOME X-RAY DIAGNOSTIC CENTRES IN OWERRI, IMO STATE, NIGERIA

M. Chijioke Amakom[1,*], E. Chikwendu Orji[1], U. Amarachi Nkwoada[2], C. Daniel Nnonah[1] and C. Miriam Umunnakwe[1]

[1]Radiation and Health Physics Research Group, Federal University of Technology, Owerri, Imo state, Nigeria
[2]Department of Chemistry, Federal University of Technology, Owerri.
*Corresponding Author: camakom@gmail.com

ABSTRACT

Radiation levels were measured around eight diagnostic centres in Owerri, Imo State Nigeria using a portable Geiger Muller counter model GCA-04. The measurements were taken when the radiation sources (x-ray machines) were operational and non-operational. When the machines were non-operational, the background radiation ranged from 0.63 to 1.48 mSv/yr. When the machines were operational, the radiation levels ranged from 0.82 to 24.28 mSv/yr; this adds between 0.19 to 23.14 mSv/yr to the existing background radiation. The diagnostic centres used in this work have background radiation level below the world average dose limit of 2.16 mSv/yr for natural background radiation. Seven centres had annual dose rates that were below the 1.25mSv/yr dose limit for the public when the radiation source is not on and only one centre had a value still below the dose limit for the public when the radiation source was on. The other centres had higher values of annual dose rate when the safety of the general public is considered both for the cases when the radiation source was operational and non-operational.

Keywords: *X-ray, Geiger Muller counter, Radiation, Diagnostic centres, Owerri.*

1. INTRODUCTION

Since the discovery of radioactivity, it's military and medical application has been on the increase. Soon after its discovery by Roentgen in 1895, ionizing radiation was exploited in medicine as a diagnostic and therapeutic tool, leading to the inadvertent exposure of medical staff. In the early years of the 20th century, exposures to medical personnel tended to be large, sometimes leading to deterministic effects such as epilation and skin burns. The first substantial epidemiological evidence for the carcinogenic effects of radiation was obtained from observations on radiologists. The use of radiation in medicine grew throughout the last century and currently includes a variety of diagnostic techniques (e.g. fluoroscopy and cardiac catheterization), dental radiography, radionuclides used for organ imaging in nuclear medicine, radiotherapy and other uses such as biomedical research.

As reported by [1], medical workers who were occupationally exposed to ionizing radiation for different periods of time showed highly significant increases in levels of DNA damage compared with controls. A conclusion was also drawn that even at low levels of exposure; X-rays may have oxidizing effect on erythrocytes, which must be taken into account for workers operating on X–ray equipments. An enhanced frequency of chromosome aberrations in workers occupationally exposed to diagnostic X-rays was also reported. It was also found that workers in the protection department which are exposed to low level ionizing radiation below permissible limit of 50 mGy/yr for the whole body have higher frequency of dicentrics and acentrics than in those in the control group. Such increment in chromosomal aberration in lymphocytes of medical personnels who are occupationally exposed to about 20 mSv of the effective dose was also reported.

The health effects resulting from exposure to ionizing radiation are of two categories: stochastic (Probalistic) and deterministic. After exposure to high doses of ionizing radiations, the stochastic effects may take several years to develop (e.g.: cancer appearing several years later after exposure), while deterministic effects (e.g.: cataract induction, hematologic deficiencies, erythema, damage to skin and fertility impairment) are manifested with certainty above a threshold. On the other hand, radiation injury refers to the acute or delayed consequences of exposure of a small part of the body to high doses of ionizing radiation resulting in severe burns, induction of cataract, pneumonia and hypothyreosis [2]. Damage to the DNA due to ionizing radiation is the most important factor in cell death. It is followed by altered cell division, depletion of stem cells, organ system dysfunction and, if the radiation is sufficiently high, the organism will die. Exposure to high amount of ionizing radiation will also result in damage to the hematopoietic, gastrointestinal, central nervous systems, reproductive systems, depending on radiation dose.

In Nigeria, the use of X-rays and CT scans have been on the increase, there are many such centres all over the nation that we cannot speak of medical procedures without the mention of the use of these sources of ionizing radiation.

Some recent studies have shown that most of these centres do not take into consideration the protective measures against the sources and effects of ionizing radiation, while others are in compliance with the recommended standards. A study conducted by [3] suggests an increase in radiation burden of a diagnostic centre to the public and their study also observed lack of protective measures against ionizing radiation on the part of the workers. Likewise the study of [1] also showed lack of safety facilities in the hospitals where their studies were carried out. [4] sampled 22 hospitals in 8 different states in Nigeria. Their result showed that 9.1% of the diagnostic centres have never used any dose monitoring device and 9.1% have never calibrated their equipment, while patient dose calculation has never been done by 81.8% of the sampled hospitals as required by international regulatory bodies. In lieu with this, this study was designed to assess the level ionizing radiations around x-ray diagnostic centres in Owerri, Imo State, Nigeria.

2. MATERIALS AND METHODS

The ionizing radiation levels at eight diagnostic centres in Owerri were measured using a digital Geiger Muller counter model GCA-04. The GM counter was placed with the end window facing the area where count rates were taken in μSv/hr at a height of 1m above the ground [5]. Due to structural differences, a 4-m perimeter away from the exposure room was chosen for measurement, this distance was considered as the average distance for the public exposure from the x-ray room. Measurements were taken at 10 different locations around the exposure rooms and the average value was taken.

3. RESULTS AND DISCUSSIONS

The background radiation and radiation level during routine x-ray exposures were measured in eight diagnostic centres within the Owerri environment, using a hand held portable Geiger Muller counter. The background dose rates measured are presented in table 1. The average background dose rates ranged from 0.07—0-16 μSv/hr. The average background dose rates measured for all the centres were found to be lower than the world average background dose rate of 0.27μSv/hr as given by [6]. From table 1, it can be seen that Royal Image Diagnostic centre has the lowest value of the average background radiation level of 0.0724±0.03 μSv/hr when compared with the other diagnostic centres while Kenikon Medical diagnostic has the highest background dose rate of 0.1689±0.06 μSv/hr. The measurements were in agreement with the work of [7] on the background dose rates of diagnostic centres in Owerri environment.

Table 2 depicts the average annual dose rates measured around the diagnostic centres during x-ray exposures. The dose rates during exposure ranged from 0.09—2.77 μSv/hr, thereby giving an annual dose 0.82-24.29 mSv/yr. From the measurements, it was observed that the x-ray exposures contributed to the radiation burden of the environment; this contribution is shown in table 3. The difference between the radiation level during routine x-ray exposures and the background radiation level ranged from 0.19-23.17 mSv/yr. Amongst all the centres where measurements were carried out, only one centre has a lead laden wall in the exposure room; and that is where the least measurement was recorded during x-ray exposure.

The results of our study were seen to be higher than what was obtained in Kenya by [8] for medical radiation workers and also higher than what was obtained in Pakistan by [9] for people working in a Nuclear Institute for Medicine and Radiotherapy. But was in agreement with the results of [3] and [10] for workers working in radiological diagnostic centres in Nigeria. This suggests a gross inadequacy in taking adequate precautions for radiation protection of the workers and the general public.

[11] recommends the risk of fatal cancer to the public who receive up 1 mSv/yr to be 5 in every 100,000, this accounts for about 0.005%. In this study, except for one centre, the radiation dose measured in the other centres were found to be above 1 mSv/yr. This could lead to cancer development to the public who visit the diagnostic centres. The result of this study was also found out to be higher than what was recorded by [3] in large hospital in Nigeria.

4. CONCLUSION

The results obtained from this study shows that most diagnostic centres in Owerri have radiation dose in excess of 1 mSv/yr. This level of radiation poses danger to the general public who visits the centres for diagnostic centres for diagnostic purposes. Royal Image Diagnostic centre was observed to have the least ambient radiation during radiation exposure of patients-this was largely due to lead laden walls of the x-ray room.

Table 1: Average and Annual background radiation level of the diagnostic centres.

Name of diagnostic centre	**Average background dose rate (μSv/hr)**	**annual background dose rate (mSv/yr)**
St. John's medical imaging	0.0725±0.02	0.6357±0.20
Royal image diagnostic centre	0.0724±0.03	0.6348±0.24
Federal medical centre, Owerri.	0.1305±0.06	1.1261±0.46
Ezem medical centre	0.1174±0.05	1.0292±0.44
Kenikon medical diagnostics	0.1689±0.06	1.4817±0.52
Dalzon medical diagnostics	0.1089±0.06	0.9548±0.55
Digital imaging diagnostics	0.1257±0.04	1.1550±0.39
Image diagnostics	0.1175±0.05	1.0481±0.42

Table 2: Average ambient radiation levels of 8 diagnostic centres in Owerri.

Name of diagnostic centre	**Average ambient dose rate (μSv/hr)**	**Annual ambient dose rate (mSv/yr)**
St. John's medical imaging	0.0940±0.05	0.8241±0.41
Royal image diagnostic centre	0.4612±0.53	4.0429±4.67
Federal medical centre, Owerri.	2.7715±1.62	24.2916±14.23
Ezem medical centre	1.6681±1.00	14.6224±8.76
Kenikon medical diagnostics	1.9738±2.37	17.3025±20.77
Dalzon medical diagnostics	0.4690±0.51	4.1112±4.51
Digital imaging diagnostics	0.2545±0.15	2.2319±1.32
Image diagnostics	0.5606±0.55	4.9132±4.84

Table 3. Average and Annual background radiation level of the diagnostic centres.

Name of diagnostic centre	annual background dose rate (mSv/yr)	Annual ambient dose rate (mSv/yr)	Difference in annual background dose rate (mSv/yr)
St. John's medical imaging	0.64±0.20	0.82±0.41	0.19±0.21
Royal image diagnostic centre	0.63±0.24	4.04±4.67	3.41±4.43
Federal medical centre, Owerri.	1.13±0.46	24.29±14.23	23.17±13.77
Ezem medical centre	1.03±0.44	14.62±8.76	13.59±8.32
Kenikon medical diagnostics	1.48±0.52	17.30±2.77	15.82±2.33
Dalzon medical diagnostics	0.95±0.55	4.11±4.51	3.17±3.96
Digital imaging diagnostics	1.16±0.39	2.23±1.32	1.08±0.93
Image diagnostics	1.05±0.42	4.91±4.84	3.87±4.42

References

[1]. K. A. Faraj, R. T. Ali, & A. O. Saeed. Quality Control and Radiation Dose Rates Measurment from Diagnostic X-Ray Examination at Different Places of Hospitals in Sulaimania. *IJRRS; Vol.* 16 (2013)

[2]. K. Yamini, & V. Gopal. Natural radioprotective agents against ionizing radiation–an overview. *International Journal of PharmTech Research*, *2*(2), 1421-1426 (2010)

[3]. P. A. Oluwafisoye, C. J. Olowookere, R. I. Obed, H. O. Efunwole, & J. A. Akinpelu. Environmental survey and quality control tests of X-ray diagnostic facility of a large Nigerian hospital. *International Journal of Research and Reviews in Applied Sciences*, *1*(2), 157-162 (2009)

[4]. P. Afisoye, C.J. Olowookere, R. I. Obed, H. O. Efunwole, H., & Akinpelu, J. Environmental Survey and Quality Control Tests of X-ray Diagnostic Facility of Hospitals. *International Journal of Research and Reviews in Applied Sciences*, *1*(2), 157-162 (2009)

[5]. I.D.U. Ebong, & K. D. Alagoa. Estimates of gamma-ray background air exposure at a fertilizer plant. *Discovery and Innovation*, *4*(4), 25-28 (1992)

[6]. United Nations Scientific Committee on the Effects of Atomic Radiation. UNSCEAR 2008. *Sources and effects of ionizing radiation*. (2010)

[7]. C. E. Orji, B. C. Eke, C. M. Amakom, E. O. Nwoko & C. C. Okafor, "Evaluation of background ionizing radiation levels in some X-ray centres in Owerri, Imo State, Nigeria*", International Journal of Current Research, 8, (03), 28527-28529* (2016)

[8]. G. K. Korir, J. S. Wambani, & I. K. Korir. Estimation of annual occupational effective doses from external ionising radiation at medical institutions in Kenya. *SA Journal of radiology*, *15*(4), 116-119 (2011)

[9]. S. A. Memon, S. T. Qureshi, N. A. Laghari, & N. M. Khuhro. Radiation Workers' Occupational Doses: Are We Really Careful or Overconscious. *Radiology*, *1*(1.73), 8-7 (2013)

[10]. A. O. C. Ohagwu, & J. Njoku. Evaluation of personnel radiation monitoring in radiodiagnostic centres in South Eastern Nigeria. *African Journal of Basic & Applied Sciences*, *2*(1-2), 49-53 (2010)

[11]. C. Streffer, The ICRP 2007 Recommendations. *Radiation protection dosimetry*, *127*(1-4), 2-7 (2007).