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RESEARCH ARTICLE

EVALUATION OF BACKGROUND IONIZING RADIATION LEVELS IN SOME X-RAY CENTRES IN OWERRI, IMO STATE, NIGERIA

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ABSTRACT

The background ionizing radiation in some selected hospitals and diagnosticcentres in Owerri, Imo State, South-eastern Nigeria was measured using a portable Geiger Muller counter model GCA-04. The measured background radiation in all the environments considered ranged from 0.092±0.02-0.225±0.01 μSv/hr. The measured values were observed to be lower than the world average of natural background radiation of 0.2741 μSv/hr. This shows that the areas have low natural background radiation.

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INTRODUCTION

The health effects of ionizing radiations cannot be overemphasized; many human activities such as the different stages in the nuclear fuel cycle, scientific research, oil exploration, the use of radioactive sources in nuclear medicine, use of x-ray in medicine and handling of materials containing enhanced sources of naturally occurring radioactive materials can lead to occupational and public exposure of individuals to ionizing radiations. There has been an extensive research on radiation as a carcinogen, but despite the amount of studies, the effects of low doses are still somewhat uncertain. Estimates are usually based on the assumption that small doses of radiation can cause cancer. If there is no threshold then diagnostic X-rays will induce some cancers (Upton, 2003). Diagnostic X-rays have been found to be one of the largest man-made sources of radiation exposure to the general population, this has been estimated to contribute about 14% of total worldwide exposure from man-made and natural sources (González and Darby, 2004). In the UK about 0·6% of the cumulative risk of cancer to age 75 years was found to be attributable to diagnostic X-rays. This percentage was found to be equivalent to about 700 cases of cancer per year (González and Darby, 2004). In a study carried out in some parts of Nigeria by (Olowookere *et al*., 2009); they sampled 22 hospitals in 8 different states. Their result showed that 9.1% of the diagnostic centreshave never used any dose monitoring device and 9.1% have never calibrated their equipment, while patient dose calculation has never been done by81.8% of the sampled hospitals as required by international regulatory bodies. Also, in north-western part of Nigeria, study showed that out of 124 institutions using ionizing radiation, 253X-ray installations were found with only 90 sealed radiation sources (Oluwafisoye, *et al*., 2009). In hospitals and many diagnostic centres, x-rays have been found to be the major contributor to the effective dose of both the patient and the personnel (Muhogora and Nyanda, 2001). It is pertinent to know the background radiations in these centres as any increment of exposure above natural background levels will produce a linear increment of risk (Wall, *et al*., 2011). The purpose of this study is to measure the background radiation in various locations in selected medical centres in the city of Owerri, Imo state, South-eastern Nigeria. This will help in quality control and

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assessment in the various centres during prognosis of x-ray contribution to the total ionizing radiation in the centres.

MATERIALS AND METHODS

The indoor and outdoor background radiation for five different X-ray centres was carried out using a well calibrated Geiger Muller counter. The GM counter used was Digital Geiger Counter, model GCA-04. The GM counter was placed with the end window facing the area where count rates were taken and at a height of 1m above the ground (Ebong and Alagoa, 1992). The architecture of the various hospitals and diagnostic centres considered was the determinant of the locations where measurements were taken. The values measured with the GM counter were converted to Sievert using the relation $1CPM = 0.01\ \mu Sv/\ r$ (radlart-100 user's manual, 2007).

RESULTS AND DISCUSSION

Tables 1-5 shows the background dose rates in $\mu Sv/\ r$ and the associated annual dose rates inmSv/yr. Table 1 shows the background ionizing radiation measured within the Federal University of Technology, Owerri (FUTO) medical centre. The values ranged from 0.089±0.02-0.225±0.01$\mu Sv/\ r$, while the annual dose rate from the background radiation ranged from 0.78±0.18-1.97±0.09mSv/yr. From the obtained result, the maximum average dose rate was measured in the Power Generating house, which the average dose rate was measured to be 0.225±0.01$\mu Sv/\ r$., this was in agreement with the work of (Okoye and Avwiri, 2013) and (Avwiri *et al*., 2009). Table 2 shows the result for various locations within the Radiology Unit of the Federal Medical Centre, Owerri.

Table 1. Average background radiation at the FUTO medicalcentre

Location	Average dose rate (µSv/hr)	Annual dose rate (mSv/yr)
Reception	0.1846±0.02	1.62±0.18
Treatment room	0.1786±0.02	1.56±0.18
Female ward	0.1990±0.02	1.74±0.18
Male ward	0.1470±0.02	1.29±0.18
Medical Laboratory	0.1616±0.02	1.42±0.18
X-ray unit	0.0890±0.02	0.78±0.18
Generator house	0.2250±0.01	1.97±0.09
Outside the facility	0.1470±0.02	1.29±0.18

Table 2. Average background radiation at the Radiology unit, Federal medical centre, Owerri

Location	Average dose rate (µsv/hr)	Annual dose rate (msv/yr)
Reception	0.1440±0.01	1.26±0.09
X-ray room1	0.1360±0.02	1.19±0.18
X-ray room2	0.1382±0.01	1.21±0.09
X-ray room3	0.2114±0.02	1.85±0.18
Waiting room	0.1210±0.02	1.06±0.18
Outside the facility	0.1536±0.02	1.35±0.18

Table 3. Average dose rate at the DalzonMedical Diagnostics, Owerri

Location	Average dose rate (µsv/hr)	Annual dose rate (msv/yr)
Reception	0.1642±0.03	1.44±0.26
X-ray room	0.1866±0.02	1.63±0.18
Clinical Chemistry unit	0.2110±0.02	1.85±0.18
Haematology unit	0.1560±0.01	1.37±0.09
Store unit	0.1300±0.02	1.14±0.18
Outside the facility	0.1410±0.02	1.24±0.18

Table 4. Average background dose rate at the Kenikon Diagnostics, Owerri

Location	Average dose rate (µsv/hr)	Annual dose rate (msv/yr)
Reception	0.0988±0.02	0.87±0.18
X-ray room	0.2110±0.02	1.85±0.18
Scan room	0.1642±0.01	1.44±0.09
Dark room	0.1990±0.01	1.74±0.09
Director's office	0.1295±0.02	1.13±0.18
Outside the facility	0.2055±0.02	1.80±0.18

Table 5. Average background radiation dose rate at the Umezuruike Hospital

Location	Average dose rate (µSv/hr)	Annual dose rate (mSv/yr)
Reception	0.1240±0.02	1.09±0.18
Female ward	0.1180±0.02	1.03±0.18
Male ward	0.1112±0.01	0.97±0.09
X-ray unit	0.0920±0.02	0.81±0.18
Outside the facility	0.1383±0.02	1.21±0.18

The values ranged from 0.1210±0.02-0.2114±0.02$\mu Sv/ r$, which corresponds to an annual dose rate of 1.06±0.18-1.85±0.18mSv/yr. The background radiation level was comparable to the result of (Faraj, Ali, and Saeed, 2013) but are far less than the results of (Oluwafisoye *et al.*, 2009) for the measurements within the x-ray room.

Table 3 shows the result for various locations within the Dalzon Medical Diagnostics, Owerri. The values ranged from 0.13±0.02-0.211±0.02 μSv/hr, corresponding to 1.14±0.18-1.85±0.18mSv/yr. These are also comparable to the works of (Okoye and Avwiri, 2013). Table 4 shows the result as obtained from the various measured location of the Kenikon Diagnostics, Owerri. The values ranged from 0.0988±0.02-0.2110±0.02μSv/hr, corresponding to 0.87±0.18-1.85±0.18mSv/yr. Table 5 also shows the result as obtained at the Umezurike Hospital, Owerri. The values ranged from 0.092±0.02-0.1383±0.02 μSv/hr corresponding to 0.83±0.18-1.21±0.18mSv/yr. These values were in general less than the world average of the natural background radiation of 0.274 μSv/hr(UNSCEAR, 2008). The results were significantly low when compared with the works of (Jwanbot *et al.*, 2012, Oluwafisoye, *et al.*, 2009). Generally, the results of the background ionizing radiation of the various medical and diagnostic centres in Owerri considered in this study show a relatively low level of background ionizing radiation. But from radiation protection point of view, these values were above some recommended values by some international organizations on radiation protection. The IAEA, EU, and ICRP recommend a $\leq 1\ mSv/yr$ dose limit to the general public under normal operation (Smith, 2011). The work of (Oluwafisoye, *et al.*, 2009), suggests that the operation of the x-ray machines can raise the radiation burden of an environment to magnitudes that ranged from 9-40 of the background radiation which calls for a constant monitoring of the diagnostic centres especially when the machines are operational.(Daniels and Kubale, 2005) also observed that work related x-ray exposure can result in a significant fraction of the total dose;this was due to the workers being likely to be subjected to x-ray exposure from routine medical monitoring. Historically, there has been little or no available literature on the background ionizing radiation around the diagnostic and medical centres in Owerri, Imo state, Nigeria. This makes it difficult to measure the radiation burden of the environments where this centres are sited. In this work, we were able to establish the background ionizing radiation levels of some of these centres. This result will help future radiation monitors for radiation prognosis. The levels of background radiation found in these centres were comparable to what was found elsewhere around the country.

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