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RESEARCH ARTICLE OPEN ACCESS

Absorbed Dose Rate of Some Body Organs in Diete-Koki Memorial Hospital, Opolo, Yenagoa, Bayelsa State

*Godwin E. Ogobiri, **Ibuama E. Abule, *Keneke E. Dauseye, **Uzoukwu P. Amanuche

*Department of Physics, Niger Delta University, Bayelsa State, Nigeria

**Department of Physics, Bayelsa Medical University, Bayelsa State, Nigeria

ogobirige@ndu.edu.ng

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Abstract:

The research work was carried out at Diete-koki Memorial Hospital, located at Opolo, Yenagoa, Bayelsa State, Nigeria. The Background Ionizing Radiation (BIR) was measured for five different locations in the Hospital with the aid of radiation device- Radalert x100 where locations such as X-ray room, Walkway, Accident and Emergency room, Reception and waiting room were measured and the mean value obtained for the various locations. The radiological parameters were calculated with an already established conversion factors and formula. The results shows that the Background ionizing radiation exposure (BIR) mean for each location, is indicated in the Bar chart, Background ionizing radiation (BIR) mean values ranges from 0.008±0.001 to 0.013±0.003 mSv/y respectively. The Absorbed dose rate (AbD) mean value ranges from 0.070±0.001 to 0.113±0.002 nGy/h. while the calculated Annual Effective Dose Rate (AEDE) mean values ranges from 0.107±0.001 to 0.411±0.003 mSv/y. The calculated mean values of Excess Life Cancer Risk (ELCR) ranges from 0.294 x10-3 to 0.630 x10-3. The percentage of Radiation Dose distribution rate in respect to different body organs shows that the ovaries recorded the lowest percentage of 13% as against the testes which have the highest percentage with 18%. All radiological parameter values recorded are in comparison with the World Permissible Limits as provided by UNSCEAR 2000.

Keywords — **Radiation, Background Ionization radiation, Dose Distribution, Dose rate, measurement**

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I. INTRODUCTION

Radiation is defined as the release or transfer of energy as waves or particles via space or a material medium. Radiation is the energy that shifts from one place to another as waves or particles. Radiation exposure is a part of daily life, some well-known sources of radiation include the sun, microwave ovens in our kitchens, and radios in cars. Most of this radiation does not represent a health risk to humans, but some does. At smaller dosages, radiation usually poses less of a concern nevertheless, at higher concentrations, it could. When radiation energy is strong enough, it may ionize atoms, or knock electrons out of atoms to create ions. When one electron is removed from an atom's electron shell - also known as "knocked out"—the atom acquires a net positive charge. This process is known as ionization, because this ionization has the potential to harm live cells and, more significantly, the DNA.

Radiation workers may wear dosimeters to track their radiation exposure, and the general public can use them to assess the radiation dosage they get from natural sources or medical treatments. The process of determining the effective dose involves multiplying the equivalent dose by a tissue weighting factor that is specific to the type of tissue exposed to radiation. In the event that multiple organs are exposed to radiation, the total effective dose for all exposed organs is then summed to determine the dosage that is effective for the organ (Biere et al., 2022).

$$Dorgan(\,mSvy^{-1}) = O\ \times AEDE\ \times F \quad (1)$$

where, O is the occupancy, 0.8, $AEDE$ is the annual effective dose equivalent, and F is the conversion factor for organ dose from ingestion inside those cells.

Cancer risks are raised by ionization radiation exposure (Smith 2000). Ionizing radiation is useful in research, medicine, and building, but when handled incorrectly, it may be harmful to one's health. Radiation exposure damages living tissues. High doses can cause acute radiation syndrome (ARS), which manifests as skin burns, loss of consciousness, internal organ failure, and death. All doses can increase the risk of cancer and genetic damage. One type of cancer known as "thyroid cancer" frequently arises from nuclear weapons and reactors as a result of the biological products of the radiative iodine fission product. To now, estimations of the precise risk and likelihood of ionizing radiation-induced cancer in cells are based mostly on population-based data from the atomic bombs, although Dosimeters, which are instruments that measure how this knowledge is still lacking (Hans, 2019).

II. METHODOLOGY

The study was carried out at Diete-koki Memorial Hospital, located at Opolo, Yenagoa, Bayelsa State. The Background Ionizing Radiation (BIR) was measured for different five locations such as X-ray room, walk way, accident and emergency room, the reception, and waiting room. At each location, five points were measured with aid of radiation device-Radalert x100, which was held 1 meter above the ground. At each location, the BIR mean value was obtained and the radiological parameters was calculated as shown in the tables and bar charts below.

Figure 1: Back and Front view of the Radiation Monitoring Device- Radalert x100

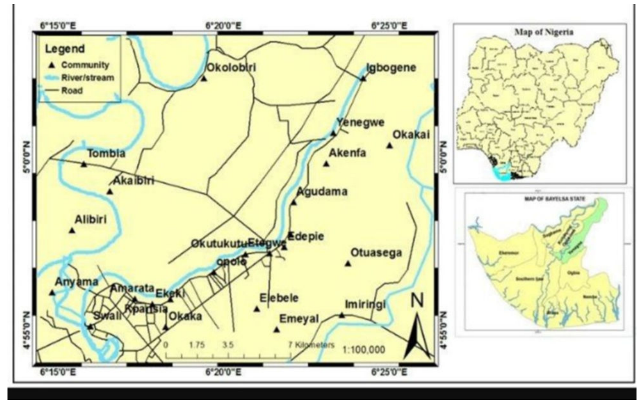

Figure 2: Geological map of the study area

The GPS location of the study area, Diete Koki Memorial Hospital, Opolo Yenagoa, Bayelsa State is Latitude 40 55' 36.30" N and Longitude 6'3.50 E.

III. RESULTS AND DISCUSSIONS

The Background Ionizing Radiation (BIR) measurements and other radiological parameters for the various locations at Diete Koki Memorial Hospital, Opolo, Yenagoa, Bayelsa State, Nigeria is shown below.

Table 1: Reception showing the background ionizing radiation (BIR) measurements and other radiological parameters

LOCATION	BIR (mR/h)	ABD (nGy/h)	EDQ (mSv/y)	AEDE (mSv/y)	ELCR
Location 1	0.011±0.002	0.096	0.964	0.147	0.405
Location 2	0.005±0.001	0.044	0.438	0.067	0.184
Location 3	0.007±0.001	0.061	0.613	0.093	0.258
Location 4	0.011±0.002	0.096	0.964	0.147	0.405
Location 5	0.009±0.002	0.078	0.788	0.120	0.331
MEAN	**0.009±0.002**	**0.075**	**0.753**	**0.115**	**0.317**

Table 1 shows the Background ionizing exposure rate of the reception and other calculated radiological parameters. Location 2 recorded the lowest BIR value of 0.005±0.001 mSv/y as against location 1 and 4 with a BIR value of 0.011±0.002 mSv/y and with a mean value of 0.009±0.002 mSv/y.

Table 2: Waiting room showing the background ionizing radiation (BIR) measurements and other radiological parameters

LOCATION	BIR (mR/h)	ABD (nGy/h)	EDQ (mSv/y)	AEDE (mSv/y)	ELCR
Location 1	0.009±0.002	0.078	0.788	0.120	0.331
Location 2	0.012±0.002	0.104	1.051	0.160	0.442
Location 3	0.001±0.001	0.009	0.088	0.013	0.037
Location 4	0.008±0.001	0.070	0.701	0.107	0.294
Location 5	0.01±0.001	0.087	0.876	0.133	0.368
MEAN	**0.008±0.001**	**0.070**	**0.701**	**0.107**	**0.294**

Table 2 showing the background ionizing exposure rate of the waiting room with other calculated radiological parameters. Location 3 and 5 recorded the lowest BIR value of 0.001±0.001 mSv/y as against location 1 with a BIR value of 0.009±0.002 mSv/y with an average value of 0.008±0.001 mSv/y.

Table 3: X-ray room showing the background ionizing radiation (BIR) measurements and other radiological parameters

LOCATION	BIR (mR/h)	ABD (nGy/h)	EDQ (mSv/y)	AEDE (mSv/y)	ELCR
Location 1	0.016±0.003	0.139	1.402	0.213	0.589
Location 2	0.017±0.003	0.148	1.489	0.227	0.626
Location 3	0.012±0.002	0.104	1.051	0.160	0.442
Location 4	0.013±0.002	0.113	1.139	0.173	0.479
Location 5	0.007±0.001	0.061	0.613	0.093	0.258
MEAN	**0.013±0.002**	**0.113**	**1.139**	**0.411**	**0.630**

Table 3 shows the background ionizing radiation exposure rate of the X-ray room with other calculated radiological parameters. Location 5 with the lowest BIR value of 0.007±0.001 mSv/y as against location 2 with a BIR value of 0.017±0.003 mSv/y with an average BIR value of 0.013±0.002.

Table 4 shows the background ionizing radiation exposure rate of the walkway with other radiological parameters calculated. Location 3 with the lowest BIR value of 0.008±0.001 mSv/y as against location 1 and 3 with a BIR value of 0.013±0.002 mSv/y, with an average BIR value of 0.011±0.002 mSv/y.

Table 4: Walkway showing the background ionizing radiation (BIR) measurements and other radiological parameters

LOCATION	BIR (mR/h)	ABD (nGy/h)	EDQ (mSv/y)	AEDE (mSv/y)	ELCR
Location 1	0.013±0.002	0.113	1.139	0.173	0.266
Location 2	0.011±0.002	0.096	0.964	1.467	2.249
Location 3	0.008±0.001	0.070	0.701	0.107	0.164
Location 4	0.010±0.001	0.087	0.876	0.133	0.204
Location 5	0.013±0.002	0.113	1.139	0.173	0.266
MEAN	**0.011±0.002**	**0.096**	**0.964**	**0.173**	**0.464**

Table 5: Accident and emergency room showing the background ionizing radiation (BIR) measurements and other radiological parameters

LOCATION	BIR (mR/h)	ABD (nGy/h)	EDQ (mSv/y)	AEDE (mSv/y)	ELCR
Location 1	0.0080±0.001	0.070	0.701	0.107	0.294
Location 2	0.010±0.001	0.087	0.876	0.133	0.368
Location 3	0.010±0.001	0.087	0.876	0.133	0.368
Location 4	0.011±0.002	0.096	0.964	0.147	0.040
Location 5	0.013±0.002	0.113	1.139	0.173	0.479
MEAN	**0.010±0.001**	**0.090**	**0.911**	**0.139**	**0.310**

Table 5 shows the background ionizing radiation exposure rate at the accident and emergency room with other parameters calculated. Location 1 with the lowest BIR value of 0.008±0.001 mSv/y as against location 5 with a BIR value of 0.013±0.002 mSv/y, with an average BIR value of 0.010±0.001 mSv/y.

Table 6 shows the radiation exposure rate of selected body organs annually and Excess life cancer rate with the aid of already established conversion factors.

Figure 2 shows the BIR exposure mean for each location, from the bar chart the waiting room recorded the lowest BIR with a mean value of 0.008±0.001 mSv/y as against X-ray room which have the highest BIR mean value of 0.013±0.003 mSv/y.

Table 6: Effective Dose rate for different body organs

BODY ORGANS	CONVERSION FACTOR	CALCULATED AEDE MEAN (mSv/y)	ORGAN EFFECTIVE DOSE (mSv/y)
Lungs	0.64	0.189	0.121
Ovaries	0.58	0.189	0.110
Bone	0.69	0.189	0.130
Testes	0.82	0.189	0.155
Kidney	0.62	0.189	0.117
Liver	0.46	0.189	0.087
Whole	0.68	0.189	0.129

Figure 3 shows the absorbed dose rate (AbD) mean value for each location in the study area, the reception recorded the lowest with a mean value of 0.075±0.001 nGy/h as against the X-ray room which have the highest mean value of 0.113±0.002 nGy/h.

In Figure 4, the calculated Annual Effective Dose Rate (AEDE) mean for each location is shown. The waiting room recorded the lowest mean value of 0.107±0.001 mSv/y as against the X-ray room which have a mean value of 0.411±0.003 mSv/y.

Figure 5 shows the calculated mean values of Excess Life Cancer Risk (ELCR) for each location in the study area, the waiting room with the lowest mean value of 0.294 x10-3 as against the X-ray room which have a highest mean value 0f 0.630 x10-3.

In Figure 6, the pie chart shows the percentage Radiation Dose distribution rate in respect to the different body organs, the ovaries recorded the lowest percentage of 13% as against the testes which have the highest percentage with 18%. All radiological parameter values are in comparison with the World Permissible Limits as provided by UNSCEAR 2000.

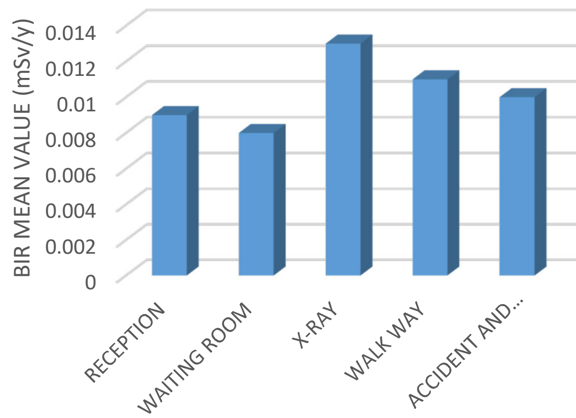

Figure 2: A bar chart of BIR mean values against locations

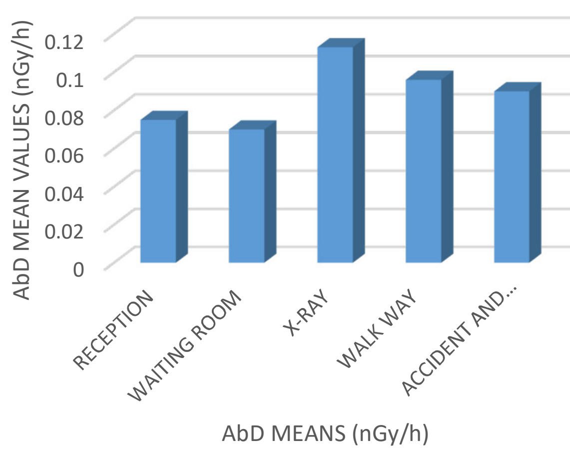

Figure 3: A bar chart of AbD mean values against locations

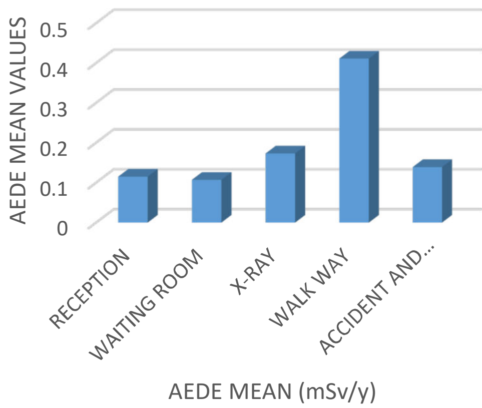

Figure 4: A bar chart of AEDE mean values against locations

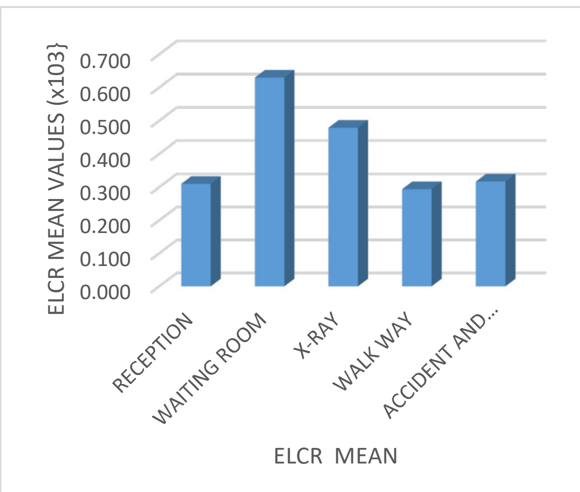

Figure 4: A bar chart of AEDE mean values against locations

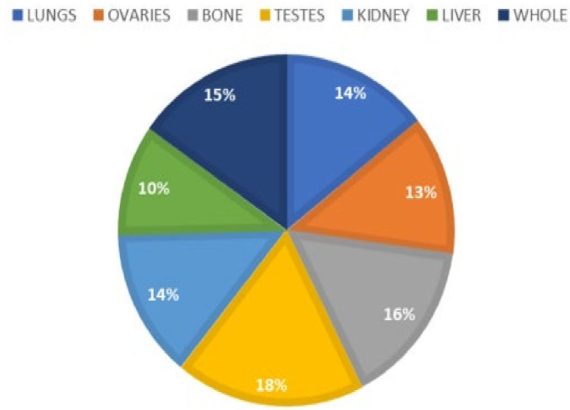

Figure 6: A Pie chart of percentage of Radiation Exposure rate against selected body organs

IV. CONCLUSION

The study was carried out at Diete-koki Memorial Hospital, located at Opolo, Yenagoa, Bayelsa State. The BIR was measured for five different locations such as X-ray room, walkway, accident and emergency room and the reception. The primary goal of this research work was to carry out a radiological risk assessment to determine the likelihood of cancer rate in the Hospital. The Pie chart the shows the percentage of Radiation Dose distribution for the different body organs with the ovaries recording the lowest percentage of 13% as against the testes which have the highest percentage with 18%. All radiological parameter values are in comparison with the World Permissible Limits as provided by UNSCEAR 2000. Hence, the Hospital is encouraged to regularly check or monitor background radiation of their environment in comparison with the world permissible limit.

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