

# Radioactivity Level Measurement of Iloabuchi Electronics Workshops and Market in Diobu Port Harcourt, Rivers State, Nigeria

ONWUKA MADUABUCHI<sup>1</sup>, ANATE, S. GANIYU<sup>2</sup>

<sup>1</sup>*Department of Science Laboratory Technology, Ken Saro-Wiwa Polytechnic, Bori-Khalga, Rivers State, South-South, Nigeria*

<sup>2</sup>*Department of Chemistry, Faculty of Natural and Applied Sciences, Ignatius Ajuru University of Education, Rumuolumeni, Port Harcourt, Rivers State, Nigeria.*

**Abstract -** This work on the radioactivity level at Iloabuchi Electronics Markets and Workshops in Diobu Port Harcourt was carried out using global positioning system (GPS) and nuclear radiation meter [GMC 300E model]. The result obtained from the radioactivity level shows that the mean exposure rate ranged from 0.010 – 0.0205 mR/h with mean of 0.015 mF/h. Again, the computed equivalent Dose showed it ranged from 0.8410 – 1.7236 mSvy<sup>-1</sup> with mean of 0.158 mSvy<sup>-1</sup>. Finally, the ELCR ranged from 0.373 – 0.7650 x 10<sup>-3</sup> with mean of 0.5749 x 10<sup>-3</sup>. These results obtained were higher than world average values; hence cancer could be noticed in due course. There should be awareness on the danger of radiation pollution and its implication communicated to the residents and traders. Finally, environmental monitoring from time to time should be encouraged as we employ NNRA, and be pro-active in carrying public awareness in radiation.

**Keywords:** Radioactivity, Measurement, Workshop, Electronics, Levels

## I. INTRODUCTION

Radiation is a component of natural environment. This is why humans are constantly exposed to ionizing radiation emanating from its natural sources.

Over the years, increased in man's activities has been of a very great concern since it enhances the exposure to higher doses (Ononugbo and Mgbeere, 2016). Main sources of radiation includes cosmic rays that comes from the cosmos into the earth and the naturally occurring radioactive elements of Uranium and thorium series and potassium which is non-series radioactive characterized with half-lives attributed to the age of the earth (Ugbede and Benson, 2018). According to Sadiq & Abga (2011), humans are frequently and inevitably exposed routinely to different doses of ionizing radiation, the level of ionizing radiation depends generally on the

distribution or natural radionuclides within the environment.

Emelue et al 2014 reported that the background ionizing radiation of the environment is a combination of natural and anthropogenic sources which include cosmic rays from outer space and primordity radionuclides that originated from the earth's crust and are distributed around the environment in rocks soils, water, sediments, food and even human body itself.

According to Taskin, et al (2009). Long term exposure to ionizing radiation has severe health implication such as acute leukemia, lung cancer, pancreas, hepatic, skin, kidney cancers, cataracts, sterility and atrophy of the kidney.

According to Sharma, et al (2017), the concentration of gamma radiation from the radioactive includes vary significantly owing to geographical and geological features of the region. These high levels of radiation doses in the environment may be detrimental to humans.

Emelue, et al (2014) reported that ionizing radiations are highly energetic particles with high characteristic penetrating power. This radiation passing through biological cells can cause both excitation and ionization which changes the cells structure.

Chinyere and Atisi (2017), reported that the most radionuclide around man's environment that contributes to high amount of potential lethal dose is radon which is potent in causing lung cancer leading to many deaths. They equally suggested in their work that radiation dose is a function of intensity and energy of the radiation, types of radiation exposure

time, the area exposed and the depth of energy deposition.

Aziz, et al (2017), reported that the earth crust contains various radioactive isotopes such as uranium, thorium, radon, tritium, carbon and potassium among other. This may be why radiation is part of life and of particular concern for outdoor background ionizing radiation.

Estimate has shown that of the  $2.4\text{mSvy}^{-1}$  annual exposure from all ionizing sources, 40% is contributed by internal exposure to radon (Chad-Umuren, et al. 2007).

Materials used for building electronic equipment's are major source of radioactive exposure to the geographical metropolis of Iloabuchi Diobu and its resident population and also a means of migration for the transfer or radionuclides into the environment. Hence, this work is aimed at measuring the radioactive exposure rates around Iloabuch Diobu electronic markets and workshops in Port Harcourt Rivers State. It equally assess the excess life time cancer risk of the entire populace due to exposure to the external gamma dose rate which will help in determining the radiological burden of the area. The results here will serve as radiation baseline data of the area for future studies.

## II. MATERIAL AND METHODS

### Study location

The area of this work is Iloabuchi Diobu Electronics Market and Workshop in Port Harcourt Rivers State Nigeria. It is a densely populated area in the capital city of Rivers State. This area covers miles 1, 2 and 3 (mile 1-3) Port Harcourt. Its coordinates lies within latitude  $4.7721522^{\circ}\text{N}$  and longitude  $6.994514^{\circ}\text{E}$ . This work was centered on mile 2, part of Iloabuchi community, and Ikwere Road to Eagles Island/Iloabuchi waterside. It is a high density, bustling commercial and residential area known for business like Okeson Gas. It is bordered by mile 1 and mile 3 forming part of the major urban hub within Port Harcourt. The residents are mainly traders.

### Materials

The following materials were used;

- Global positioning system (GPS) for knowing the geographical co-ordinates of the study area.

- GMC – 300E (Nuclear radiation Detector) for measuring the radiation exposure rate of the study site

### Methods

An In-situ estimation of the foundation radiological state was performed utilizing a well calibrated radiation meter containing a Gieger miller tube competent of detecting alpha, beta, gamma and X-ray with the temperature range of  $-10^{\circ}\text{C}$  and  $50^{\circ}\text{C}$ , and utilizing to gauge radiation levels. The readings were taken within a long period of 1300 – 1600 hours because presentations rate indicator takes most extreme reaction to ecological radiation inside these period (Sharma et al 2014).

The meter was raised to an altitude of 1.0m over the earth surface with its window confronting first vertically below the global surface and afterward (Ononugbo *et al.*, 2011).

For every point, two estimates spreading over two minutes were completed and these estimated were then averaged to single value. Data obtained or outdoor exposure rate in  $\text{mRh}^{-1}$  was converted. This estimated was converted to  $\text{nGyh}^{-1} = 8.7 \text{mGyh}^{-1} = 8.7 \times 10^{-3} \text{Gy} / (1/8760 \text{yr}) = 76.212 \text{nGyy}^{-1}$  (Muhammed *et al.*, 2018).

### Radiological Parameters

The radiological parameters calculated in this work are as seen below

Radiation Absorbed Dose – is a measure of the energy deposited in a medium by ionizing radiation. It is equal to the energy deposited per unit mass of medium and so has the unit  $\text{J/kg}$  or gray (Gy) where  $1\text{Gy} = 1 \text{J/kg}$ . The absorbed dose rates (D) due to gamma radiation in air at 1m above the ground surface for the uniform distribution of the naturally occurring radionuclides ( $^{238}\text{U}$ ,  $^{232}\text{Th}$  and  $^{40}\text{K}$ ) is calculated using the equation.

$$1\text{URh}^{-1} = 8.7 \text{nGyh}^{-1} \quad (1)$$

According to Anekwe and Onoja (2020).

Equivalent Dose. This is whole body equivalent dose rate over a period of one year, the National Council on Radiation protection and measurement's recommendation was used Ononugbo *et al.*, (2011).

$$1\text{MRh}^{-1} = \frac{0.46 \times 24 \times 365}{100} \text{mSvy}^{-1} \quad (2)$$

The annual effective Dose equivalent for outdoor was computed using

$$\text{Gy} \times 0.2 \quad (3)$$

Excess lifetime cancer risk was calculated using

ELCR ( $\text{mSvy}^{-1}$ ) = AEDE x Average Duration of life (DL) x Risk factor RF (4)  
 The effective dose rate delivered to body organs was computed using the following expression.

Organ/tissue dose ( $\text{mSvy}^{-1}$ ) = O x AEDE x F (5)  
 Where AEDE is annual effective dose. O is the occupancy factor 0.8 and F is the conversion factor of organ dose from ingestion.

### III. RESULTS

Table1: Comparison Of Radiation Exposure Rate With Its Parameters At Iloabuchi Electronics Markets/Workshop

S/N	Mean exp. Rate mG/h	Equivalent ( $\text{mSvy}^{-1}$ )	Dose Absorbed ( $\text{nGyh}^{-1}$ )	AEDE ( $\text{mSvy}^{-1}$ )	ELCR x $10^{-3}$
1.	0.0155	1.042	134.85	0.165	0.5790
2.	0.0170	1.143	147.90	0.181	0.635
3.	0.0135	0.9075	117.45	0.144	0.5043
4.	0.0155	1.042	134.85	0.165	0.5790
5.	0.0115	0.9672	100.05	0.123	0.4290
6.	0.0100	0.841	87.00	0.107	0.373
7.	0.0200	1.682	174.00	0.213	0.747
8.	0.0125	1.0514	108.68	0.133	0.4667
9.	0.0180	1.514	156.5	0.192	0.672
10.	0.0145	1.218	126.15	0.1547	0.541
11.	0.0150	1.26	130.5	0.16	0.560
12.	0.0170	1.143	147.9	0.181	0.635
13.	0.0205	1.7236	178.35	0.2192	0.7650
14.	0.0130	1.093	113.1	0.139	0.485
15.	0.0145	1.218	126.15	0.1547	0.541
16.	0.0150	1.26	130.5	0.16	0.560
17.	0.0175	1.4713	152.25	0.1871	0.652
18.	0.0130	1.093	113.10	0.139	0.485
19.	0.0190	1.5975	165.3	0.2031	0.7090
Mean	0.0154	1.215	133.97	0.158	0.579
Min	0.010	0.8410	87.00	0.107	0.373
Max	0.0205	1.7236	178.35	0.2192	0.7650
World Average ICRP 2020	0.013	1.00	60.0	0.07	0.29

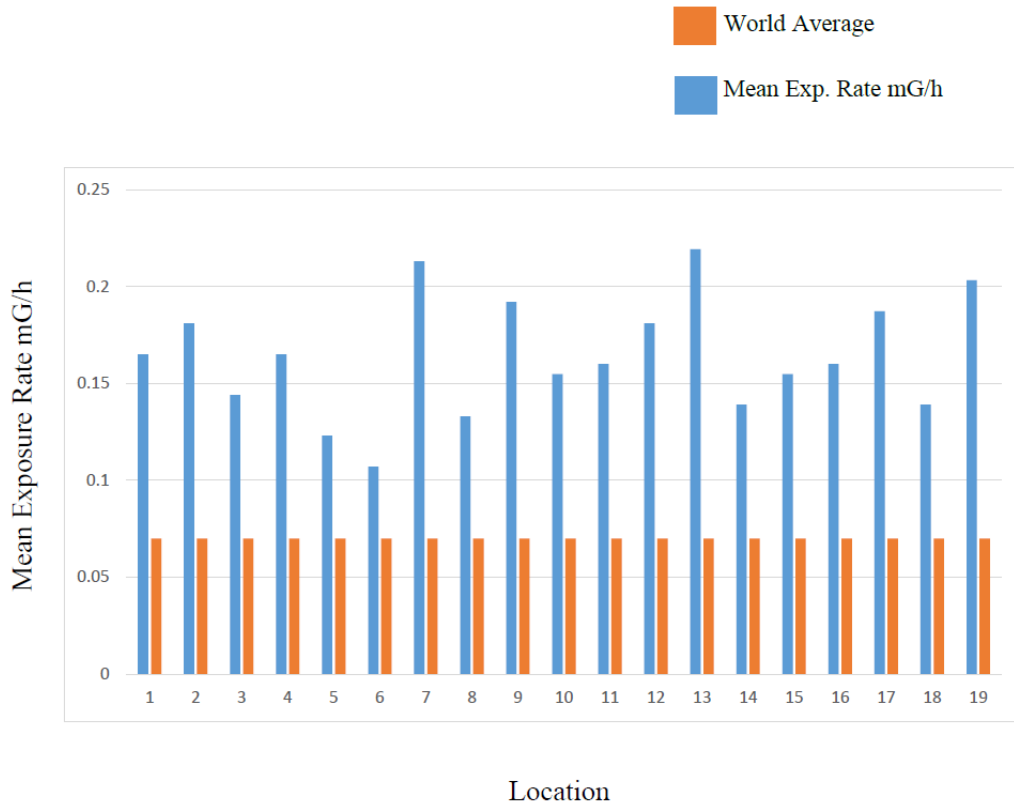


Fig. 1: Comparison of Mean Exposure Rate Vs location

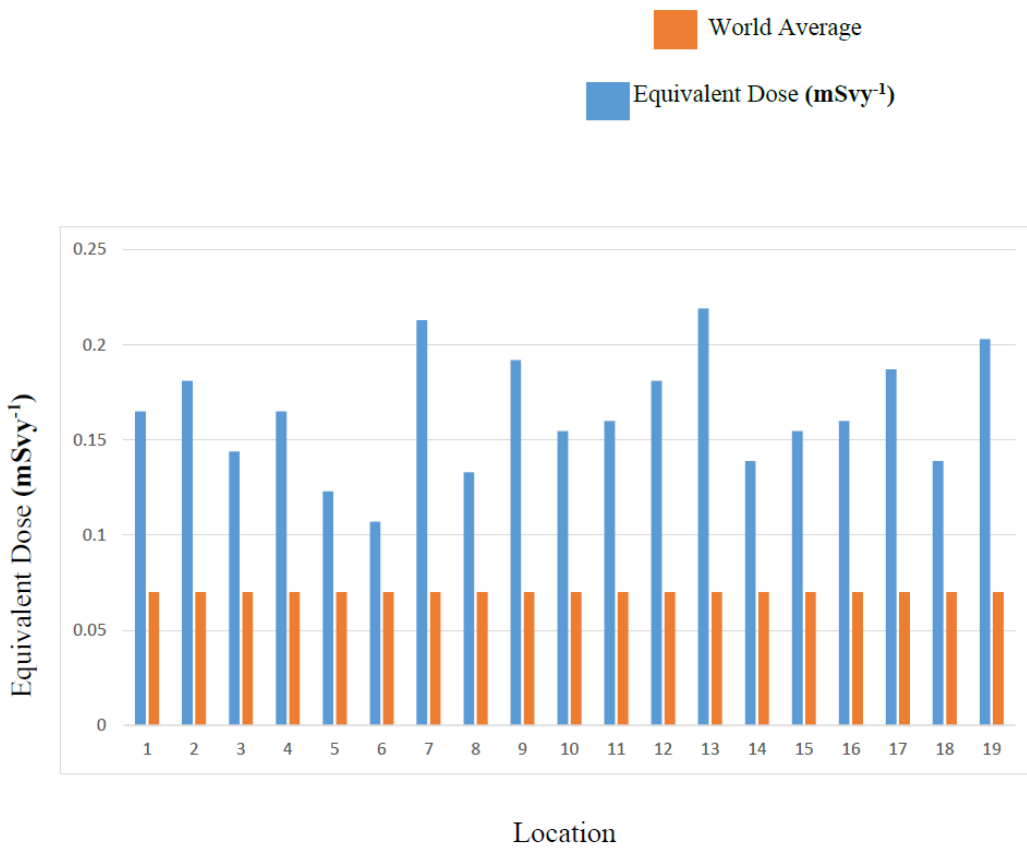


Fig. 2: Comparison of Equivalent Dose Vs location

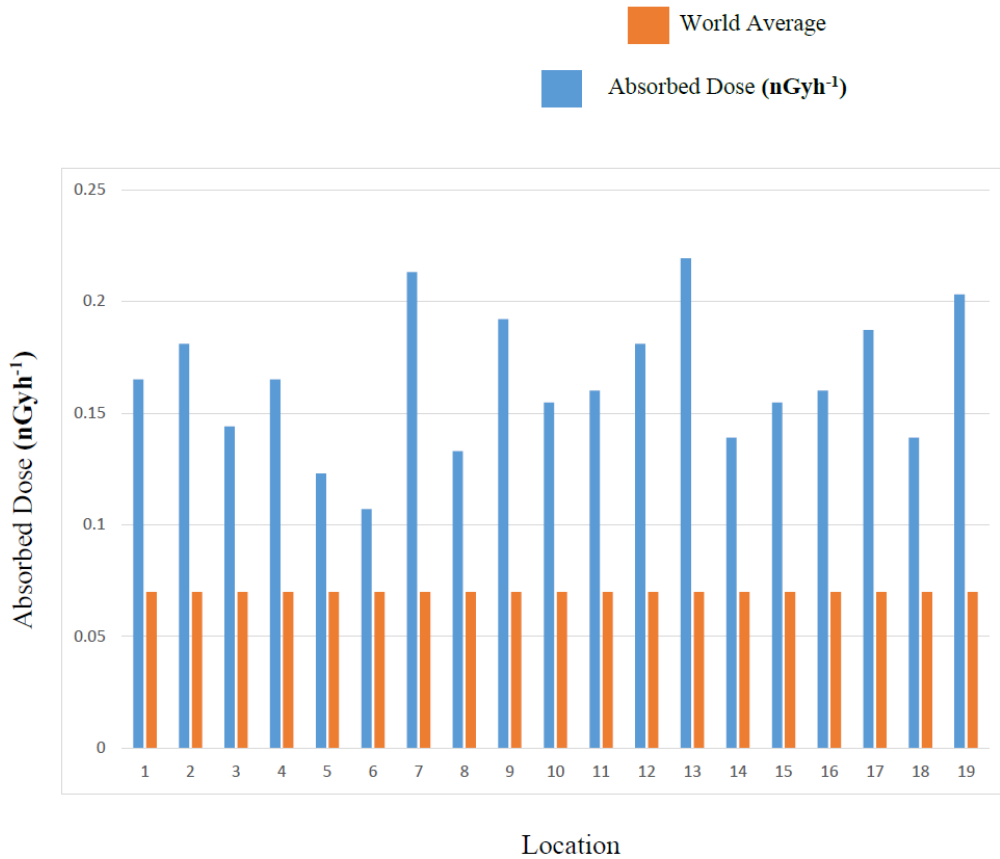


Fig. 3: Comparison of Absorbed Dose Vs location

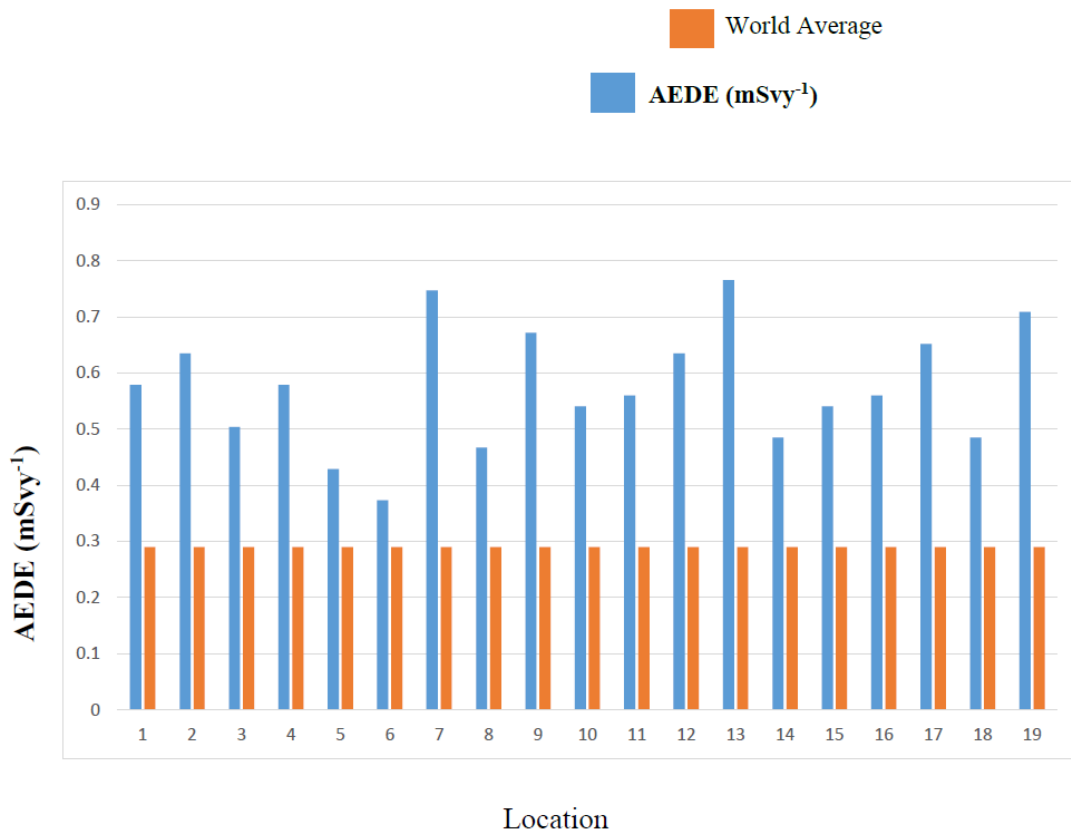


Fig. 4: Comparison of AEDE Vs location

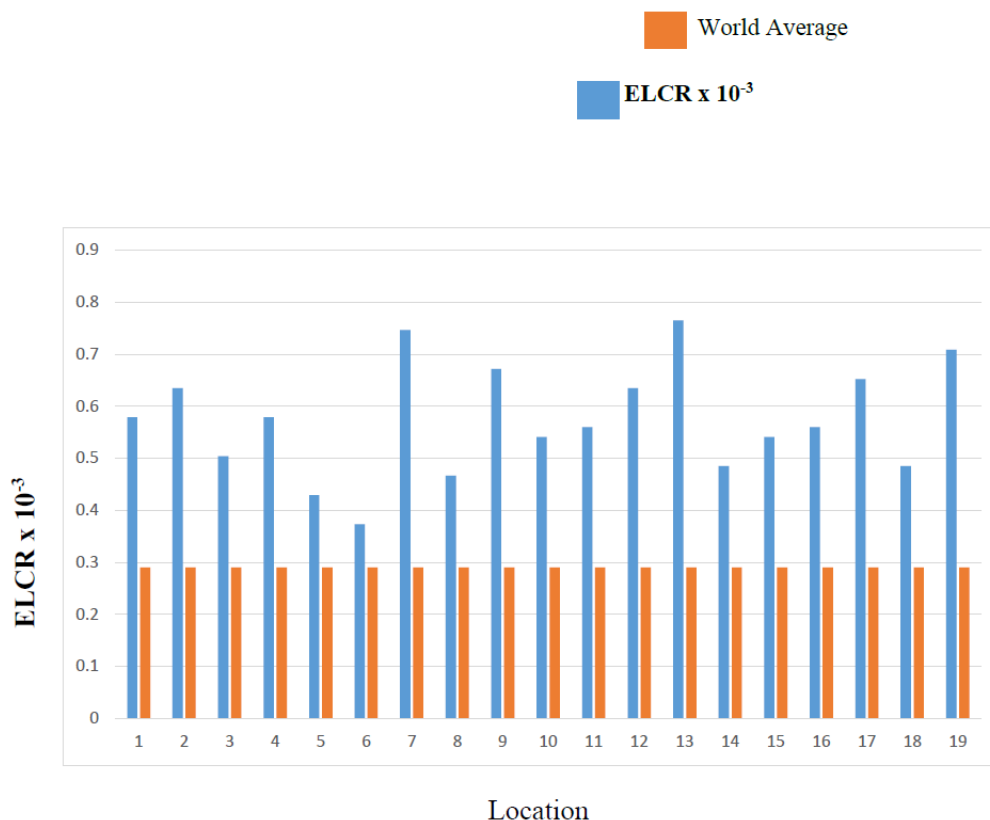


Fig. 5: Comparison of ELCR Vs location

#### IV. DISCUSSION

The result of In-situ radiation exposure rate and its parameters at Iloabuchi Electronics Market and Workshops Diobu Port Harcourt has been presented on table 1 and illustrate in figures 1 – 5. The results showed that the mean exposure ranged from 0.010 – 0.0205 mR/h with the average mean of 0.0154 mR/h<sup>-1</sup>. The equivalent dose computed ranged from 0.841 – 1.7236 mSvy<sup>-1</sup>.

The absorbed dose computed range from 87.0 – 178.35 nGyh<sup>-1</sup> with a mean value of 133.77nGyh<sup>-1</sup>. Similarly, the excess lifetime cancer risk (ELCR) Calculated ranged from 0.5749- 0.158 mSvy<sup>-1</sup>. The radiological risk parameters estimated from the exposure rate when compared with those of other scientists showed a slight upward variation. Sharma *et al.*, (2014) in their work reported absorbed dose 112.7nGyh<sup>-1</sup>, AEDE 0.14 mSvy<sup>-1</sup>, and ELCR as 0.52 x 10<sup>-3</sup>.

Amekudzie *et al.*, (2011) reported in their work 77.0 nGyh<sup>-1</sup> for absorbed dose, 0.09 mSvy<sup>-1</sup> for annual effective dose equivalent (AEDE).

Onwuka (2021) reported in his work for absorbed dose 196.74 nGyh<sup>-1</sup>, AEDE 0.24 mSvy<sup>-1</sup> and ELCR OF 0.72 x 10<sup>-3</sup>.

Aziz *et al.*, (2014) reported absorbed dose 87.47 nGyh<sup>-1</sup>.

Annual effective dose equivalent 0.92 mSvy<sup>-1</sup> and excess lifetime cancer risk 3.21 x 10<sup>-3</sup>.

All the radiation risk parameters computed in this work were higher than world average standard set by ICRP 2007. As such, the radiological status of Iloabuchi Market and Workshops Diobu Port Harcourt has been enhanced. This enhancement may be due to the presence of faulty electronics in the market and the worn out electronics components and circuits with radioactive natural components. Similarly, we can implicate the indiscriminate discharge of Lead and its derivative compounds in the market and workshops. [Lead from batteries and those from solders], which can trigger the background radiation limit.

The dangers of high radiation risk/ or over exposure should not be taken in a light manner. Since these values are higher than normal, there should be need

for proper environmental auditing and awareness to avoid or mitigate radiation pollution in Iloabuchi.

Furthermore, considering figure 5, impotency or male infertility is significant with time, since testes absorb much radiation than any other organ or tissue. Residence and traders ought to have this orientation so as to be guided, and visitation to hospital to check for fertility should be encouraged.

## V. CONCLUSION

The radioactivity levels at Iloabuchi Electronics Market and Workshops in Diobu Port Harcourt has been carried out using radiation nuclear meter [GMC 300E model] in order to quantify the radiological risk resulting from gamma radiation. The following conclusions were deduced from the research.

1. The study showed that the exposure rate has a mean of  $0.0154\text{mRh}^{-1}$ . with this, Iloabuchi Electronic Market and Workshop has been impacted by faulty electronics and workshop lead (Pb) metal waste.
2. All the radiation parameter computed/or estimated exceeded their radiation safety limits.
3. These high health risk values may not pose any immediate health challenge to the residents and traders but long term exposure might be detrimental to their health.
4. Electronics market and electronics workshops in Iloabuchi have enhanced the background radiation level of the place. Hence routine monitoring of this area is necessary to help reduce/mitigate exposure level as low as reasonably practicable.

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