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MEASUREMENT OF BACKGROUND GAMMA RADIATION DOSE LEVELS OF DIFFERENT TELECOMMUNICATION MASTS IN UYO, NIGERIA.

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Abstract:
Every inhabitant on earth is exposed to different amount of doses of radiation at all times from natural sources known as natural background radiation and artificial sources such as transmission of telecommunication signals. The work is aimed at assessing the level of the background gamma radiation dose rate around different telecommunication mast in Uyo. A radiation survey meter (Radalert) model 100x was used to measure the radiation surface dose rate and annual effective dose of the different locations around the telecommunication masts. The mean values for the gamma dose rate for the MTN, GLO, Airtel and 9mobile masts were 0.026 mR.hr^{-1} , 0.017 mR.hr^{-1} , 0.018 mR.hr^{-1} and 0.017 mR.hr^{-1}, respectively. These values are higher than the recommended value of 0.013 mR.hr^{-1}. The annual effective dose (AED) of the gamma radiation around the telecommunication masts ranged from 1.40 mSv.yr^{-1} to 1.93 mSv.yr^{-1}, 1.05 mSv.yr^{-1} to 1.75 mSv.yr^{-1}, 1.14 mSv.yr^{-1} to 1.58 mSv.yr^{-1} and 1.23 mSv.yr^{-1} to 1.58 mSv.yr^{-1} for MTN, GLO, Airtel and 9mobile respectively. The mean values for the AED for the different locations around the masts were 1.62 mSv.yr^{-1} (MTN), 1.40 mSv.yr^{-1} (GLO), 1.34 mSv.yr^{-1} (Airtel) and 1.42 mSv.yr^{-1} (9mobile). The mean values for all the locations around the telecommunication masts are all above the world recommended values of 1 mSv.yr^{-1}. MTN mast has the highest mean value of the gamma absorbed dose rate while Airtel mast has the least. The gamma radiation absorbed dose around the masts per annum is far more than the recommended value therefore continuous stay around the telecommunication mast can result to short and long term health effects associated with the excessive exposure to radiation.

Keywords: Radiation, telecommunication mast, effective dose, health effects, Uyo.

I. INTRODUCTION

Radiation occurs when energy is emitted by a source and then travels through a medium such as air, until it is absorbed by matter [1]. People use and are exposed to non-Ionizing radiation sources every day. This form of radiation does not carry enough energy to ionize atoms of molecules. Micro wave ovens, global positioning systems, cellular telephones, television stations, frequency modulation (FM) and amplitude modulation (AM) radio, baby monitors, cordless phones, garage-door openers and ham radios all make use of non-Ionizing radiation [2]. Other forms include the earth's magnetic field, as well as magnetic field exposure from closeness to transmission lines, household wiring and electric appliances. These are defined as Extremely Low-Frequency (ELF) waves [1].

Every living and non-living things on earth has been exposed to different amount of doses of radiation at all times from these natural sources known as natural background radiation. Apart from natural radioactivity, manmade sources of radiation exist and these include radioactive materials injected into the body either for treatment or for medical diagnosis, fallout from nuclear weapons, radiation from consumer products such as paints, radiation from nuclear power plants and radiation from telecommunication masts. All these mentioned sources can result in either external or internal exposure of living tissue to ionizing radiation [3]. Above certain thresholds, radiation can affect the functioning of tissues or organs and can produce acute effects like radiation burns, acute radiation syndrome, skin redness and hair loss. These effects are more severe at higher instance; the dose threshold for acute radiation syndrome is about 1000 mSv [2]. If the radiation dose is low or delivered over a long period of time, there is great chance for damaged cells to successfully repair each other. However, long term effects may still occur if the cell damage is repaired and also transforms an irradiated cell that still retains its capacity for cell division. This transformation may result to cancer after some years or even decades. Effects of this type may not always happen but the chance of it occurring is proportional to the radiation dose [4]. This risk is higher for children and teenagers, as they are more sensitive to radiation exposure than adults [5]. This research paper is aimed at assessing the background gamma radiation dose levels of different telecommunication masts in Uyo, Nigeria.

II. MATERIALS AND METHOD

2.1. Study Area

Akwa Ibom is located in the coastal southern part of Nigeria, lying between Latitudes 4^o32^oN and 5^o33^oN, and Longitudes 7^o25^oE and 8^o25^oE. It consists of 31 Local Government Areas (L.G.A). It covers an area of about 7,081 km^2. According to the 2016 population census carried out by the National Population Commission of Nigeria [6], its estimated population was 5,450,758. Uyo is the state capital of Akwa Ibom, Nigeria. Uyo's population according to the 2006 Nigerian Census which constitutes Itu and Uyo was about 427,873 while the urban area which include Uruan, was about 554,906. Uyo covers an approximate land mass of 362 km^2 and has a coordinate of 5°2′N 7°55′E.

2.2 Field Measurements and Analysis

An in-situ measurement of the background radiation level was carried out in the different locations where the samples were collected by using a portable Geiger-Mueller tube-based environmental radiation dosimeter (Digilert Nuclear Radiation Monitor). The dosimeter is exclusively designed to serve as a low level survey meter. A radiation survey meter (Radalert) model 100x was used to measure the radiation surface dose rate in $mR.hr^{-1}$ and $Count.min^{-1}$ of the different locations. The instrument is capable of measuring gamma dose rates in the range 0-20 mR/hr. These features make this dosimeter an ideal choice for the measurement of gamma dose rate from environmental radiation and also for geological prospecting for radioactive minerals. At each point, the total count for 20 minute was recorded. Four successive readings were taken for each point. The average total count was converted to count per minute (cpm) by dividing it by 20 minute [7]. For each of the telecommunication mast, the gamma radiation dose rate was measured in four different locations making a total of 16 locations for the MTN, GLO, Airtel and 9mobile masts. The average dose rate (μSv/hr) for each point was obtained by multiplying the average total count (cpm) by a factor of 10^{-2} [8].

1 μSv = 0.001 mSv, 1 year = 8760 hrs

Figure 2.1: A telecommunication mast in Uyo

III. RESULTS AND DISCUSSION

3.1 Results

The gamma radiation surface dose rate in $mR.hr^{-1}$, $Count.min^{-1}$, μSv/hr and the annual effective dose (AED) in mSv/yr for the various telecommunication masts is presented in Table 4.1. The distribution of the radiation surface dose rate in $mR.hr^{-1}$ in the various telecommunication masts from the different localities in the study area is shown in Figure 4.1. Figure 4.2 shows the distribution of the mean annual effective radiation dose (AED) in mSv/yr for the telecommunication masts in different locations in Uyo.

Table 4.1: The gamma radiation surface dose rate of the various telecommunication masts from different locations in Uyo.

Telecommunication masts	Locations	$mR.hr^{-1}$	$Count.min^{-1}$ (cpm)	μSv/hr (cpm × 10^{-2})	AED (mSv/yr)
MTN	Mkpri Nsukara	0.022	19	0.19	1.66
	Mbiaobong	0.024	17	0.17	1.49
	Calabar-Itu	0.028	16	0.16	1.40
	Itam	0.029	22	0.22	1.93
	Mean	0.026	18	0.18	1.62
GLO	Mbak	0.018	12	0.12	1.05
	Ifa atai	0.016	17	0.17	1.49
	Ifa Ikot	0.019	20	0.20	1.75
	Itam	0.016	15	0.15	1.31
	Mean	0.017	16	0.16	1.40
Airtel	Udoumana	0.021	14	0.14	1.23
	Nwaniba	0.016	13	0.13	1.14
	Oron road	0.018	16	0.16	1.40
	Itam	0.017	18	0.18	1.58
	Mean	0.018	15	0.15	1.34
9mobile	Nsidung	0.020	17	0.17	1.49
	Idu Uruan	0.017	16	0.16	1.40
	Nwaniba	0.018	14	0.14	1.23
	Abak road	0.015	18	0.18	1.58
	Mean	0.017	16	0.16	1.42

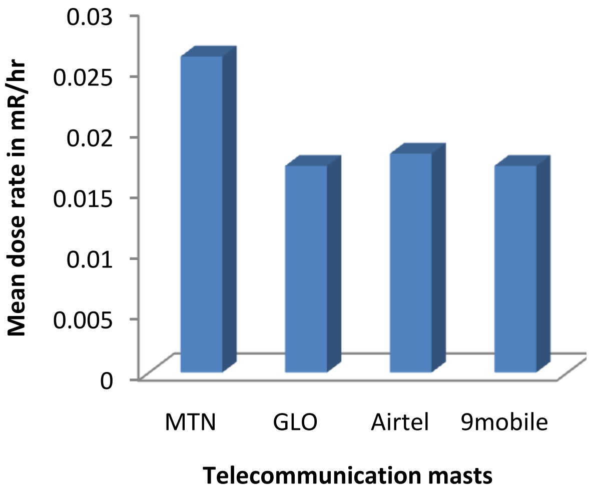

Figure 3.1: Distribution of the mean gamma radiation dose rate in mR/hr for the telecommunication masts in different locations in Uyo.

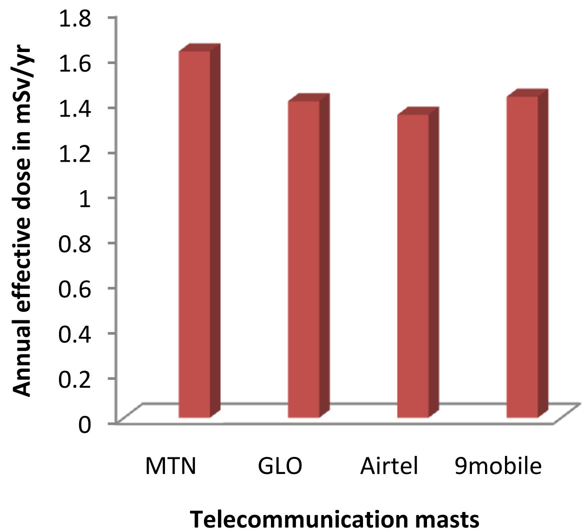

Figure 3.2: Distribution of the mean annual effective radiation dose in mSv/yr for the telecommunication masts in different locations in Uyo.

3.2 Discussion

From Table 4.1, the gamma radiation surface dose rate in $mR.hr^{-1}$ for MTN, GLO, Airtel and 9mobile telecommunication masts in the different locations ranged from 0.022 $mR.hr^{-1}$ to 0.029 $mR.hr^{-1}$, 0.016 $mR.hr^{-1}$ to 0.019 $mR.hr^{-1}$, 0.013 $mR.hr^{-1}$ to 0.021 $mR.hr^{-1}$ and 0.015 to 0.020 $mR.hr^{-1}$, respectively. The mean values for the gamma dose rate for the MTN, GLO, Airtel and 9mobile masts were 0.026 $mR.hr^{-1}$, 0.017 $mR.hr^{-1}$, 0.018 $mR.hr^{-1}$ and 0.017 $mR.hr^{-1}$, respectively. These values are higher than the recommended value of 0.0107 $mR.hr^{-1}$ [8]. The annual effective dose (AED) of the gamma radiation around the telecommunication masts ranged from 1.40 $mSv.yr^{-1}$ to 1.93 $mSv.yr^{-1}$, 1.05 $mSv.yr^{-1}$ to 1.75 $mSv.yr^{-1}$, 1.14 $mSv.yr^{-1}$ to 1.58 $mSv.yr^{-1}$ and 1.23 $mSv.yr^{-1}$ to 1.58 $mSv.yr^{-1}$ for MTN, GLO, Airtel and 9mobile respectively. The mean values for the AED for the different location around the masts were 1.62 $mSv.yr^{-1}$ (MTN), 1.40 $mSv.yr^{-1}$ (GLO), 1.34 $mSv.yr^{-1}$ (Airtel) and 1.42 $mSv.yr^{-1}$ (9mobile). The mean values for all the locations around the telecommunication masts are all above the world recommended values of 1 $mSv.yr^{-1}$[8]. The high values of background gamma radiation exposure is as a result of high natural background radiation which animals or individuals may be exposed to through telecommunication signal transmission, nuclear power plants, medical diagnosis/treatment, and human activities [8].

IV. CONCLUSION

For all the telecommunication masts, MTN mast has the highest value of the gamma radiation dose rate and AED with mean values of 0.012 $mR.hr^{-1}$ and 1.62 mSV. yr^{-1}, respectively. Airtel mast has the lowest values for the gamma dose rate and AED with mean values of 0.017 $mR.hr^{-1}$ and 1.34 mSV. yr^{-1}, respectively. The high value of gamma exposure around the telecommunication masts is as a result of constant transmission of telecommunication signals in the form of electromagnetic radiation from the mast to various mobile phones and other electronic gadgets [8]. According to the 2000 report of the United Nation Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), it is unsafe to stay close to a telecommunication mast for a long time up to a year. This is because the gamma radiation absorbed dose around the masts per annum is far more than the recommended value of 1 $mSv.yr^{-1}$ [8]. Continuous stay around the telecommunication mast can result to short and long term health effects associated with the excessive exposure to radiation.

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