

## **A COMPARATIVE STUDY OF RADIOFREQUENCIES FIELD LEVELS OF SOME BASE STATIONS IN MAKURDI AND ITS ENVIRONS IN BENUE STATE, NORTH CENTRAL NIGERIA**

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### **ABSTRACT**

*A comparative study of radiofrequencies field levels of some base stations in Makurdi and its environs was carried out in Makurdi, Benue State, North central Nigeria. Electromagnetic field tester (EMF 827 Lutron) was used for measurement at distances ranging from 5.00, 10.00, 15.00 and 20.00 meters away from the base stations at the North, South, West and East directions. Electric field intensity and specific absorption rate (SAR) were calculated with reference to the human tissues. The result indicates that the average magnetic field levels of GLO and ZAIN base stations ranged between 0.10 $\mu$ T to 0.16 $\mu$ T. The mean electric field values for eye, brain and muscles ranged between 20.90 $\text{Vm}^{-1}$  to 35.20 $\text{Vm}^{-1}$ . The specific absorption rate (SAR) ranged between 0.22 $\text{Wkg}^{-1}$  to 1.17 $\text{Wkg}^{-1}$ . The GSM base stations under study conform to the standards set by regulatory agencies which pose no threat to residents located within the base station areas.*

**Keywords:** Base stations, Electric field intensity, Environs, Specific absorption rates, Human tissue, Nigeria.

### **1. INTRODUCTION**

Mobile communications have turned out to be the most important and most valued way of conversation (E.g mobile phones, radio transmission towers, cordless phones etc) in the country today. However, the beneficial aspect of the base stations have been overshadowed by the potential adverse effects. Carl, et al. [1]. In Nigeria, the situation is becomes knotty by the indiscriminate installation of base stations close to residential areas and those with large volumes of human activities around the masts. It is the closeness of these base stations to where people live and work that expose people to the hazards associated with them. Such hazards include: death, injuries caused by the felling of some telecommunication masts, oil spillage from base station generators which can lead to pollution of water sources. Studies have also shown that exposure levels of about 3KHz-5MHz generates painful nerves impulses, while 100KHz-3GHz

leads to temperature rise of the body as it absorbs energy faster than its thermoregulatory system. Also, at frequencies of 300GHz can change the cellular DNA and initiates a carcinogenic transformation [2].

In medicine for instance, radiofrequencies are used for the treatment of ailments like: Vision correction, liver cancer, sleep Apnea, snoring, cosmetic surgery, enlarged prostate, rapid heartbeat syndrome, tightening loose joints etc [3]. In view of the above, a comparative study of radiofrequencies field levels of GLO and ZAIN base stations in Makurdi and its environs is to be assessed.

## 2. MATERIALS AND METHOD

### 2.1. Description of Study Area

Makurdi town was chosen for this study. Makurdi the capital of Benue State, Nigeria lies between latitude  $7^{\circ} 15'$  to  $7^{\circ} 45'$  N and longitude  $8^{\circ} 15'$  to  $8^{\circ} 40'$  E. The town lies in the guinea savanna vegetative belt and on the bank of the second largest river in Nigeria, River Benue [4]. The areas selected for this study were Wurukum, High-Level and North-Bank areas all in Makurdi. Three each of GLO and ZAIN base stations were randomly selected at study site of Wurukum, High-Level and North-Bank areas of Makurdi town. An electromagnetic field tester (EMF 827, Lutron) was used for measurement of the base stations (GLO and ZAIN) at distances of approximately 5m, 10m, 15m and 20m away from each base station in the North, South, West and East directions. The Sensor was placed in both the vertical and horizontal directions, and the values of the magnetic field intensity (B) were displayed. Also, the mean values of each of the distances were determined. The velocity of electromagnetic (EM) wave in tissue were calculated from  $V=Cn^{-1}$ . Where n is the refractive indices of tissues, C is the velocity of EM wave in vacuum ( $3 \times 10^8 \text{ms}^{-1}$ ) Table 1. The electric field intensity values E were obtained using the measured values of magnetic field intensity B and calculated values of velocity of EM waves V, using the relation:  $E=VB$

The specific absorption rate (SAR) of the human tissues was obtained using:

$$\text{SAR} = \frac{\sigma E^2}{2\rho}$$

$\sigma$  = Electrical conductivity of tissue, E = Electric field Intensity and

$\rho$  = Density of tissue. Mimoza, et al. [5]

### 3. RESULT AND DISCUSSION

The results of GLO and ZAIN base stations shows that the average magnetic field levels range between  $0.10\mu\text{T}$  to  $0.16\mu\text{T}$  and  $0.10\mu\text{T}$  to  $0.15\mu\text{T}$  respectively (Table 2.). The magnetic field strength was inversely proportional to the distance for both GLO and ZAIN networks, with ZAIN base stations having higher magnetic field strength than GLO base stations. Although these values of both networks were found to be below the threshold limit of  $0.2\mu\text{T}$  as reported by Vecchia [6]. Indicating that the presence of GLO and ZAIN networks has no adverse health effects on residence within these study area exposed to their magnetic fields.

The mean electric field values for eye, brain and muscle for GLO ranged between  $22.00\text{vm}^{-1}$  to  $35.20\text{vm}^{-1}$ ,  $20.90\text{vm}^{-1}$  to  $33.44\text{vm}^{-1}$  and  $21.00\text{vm}^{-1}$  to  $33.60\text{vm}^{-1}$  respectively. While that of ZAIN ranged between  $22.00\text{vm}^{-1}$  to  $33.00\text{vm}^{-1}$ ,  $20.90\text{vm}^{-1}$  to  $31.35\text{vm}^{-1}$  and  $21.00\text{vm}^{-1}$  to  $31.50\text{vm}^{-1}$  respectively. There are variations in the values of mean magnetic and electric field levels emitted by both networks. This difference could be due to the propagation parameters used by different GSM network providers. And the fact that, base station requires different power levels in order to cover a particular geographical location. The magnitude of the electric fields calculated for human head tissues were found also to be below the threshold value of  $61\text{vm}^{-1}$  reported by Vecchia in 2007.

Table 3 shows that the averaged specific absorption rates(SAR) values for the Eye, Brain and muscle for GLO base station range from  $0.46\text{Wkg}^{-1}$  and  $1.17\text{Wkg}^{-1}$ ,  $0.22\text{Wkg}^{-1}$  to  $0.57\text{Wkg}^{-1}$  and  $0.26\text{Wkg}^{-1}$  to  $0.66\text{Wkg}^{-1}$ , while Zain SAR values ranged from  $0.46\text{Wkg}^{-1}$  to  $1.0\text{Wkg}^{-1}$ ,  $0.22\text{Wkg}^{-1}$  to  $0.50\text{Wkg}^{-1}$  and  $0.26\text{Wkg}^{-1}$  to  $0.58\text{Wkg}^{-1}$  for eye, brain and muscle respectively. Based on the result of the study, GLO base stations were slightly higher than those of MTN. Generally, Specific absorption rate (SAR) vary across the various frequency bands, and also depends on the tissue parameters of human head tissue (i.e conductivity, permittivity and density) since these parameters are distinct for each test target. [Introduction Commission on Non-ionizing Radiation Protection Guidelines \[7\]](#) guidelines as reported by [Cember and Johnson \[2\]](#), set that the localized SAR limit is  $2.0\text{Wkg}^{-1}$ . The study therefore is below the safe limits for both GLO and ZAIN base stations networks.

#### 4. CONCLUSION

The measured values are not likely capable of inducing significant hazardous health effect among the people and its environs as the values are within the safe limits.

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**Table- 1.** Refractive Indices, Velocity of EM Wave and tissue Parameters

Types of tissue	Refractive Index	Velocity of EM Waves ( $ms^{-1}$ )	Density( $Kgm^{-3}$ )	Conductivity ( $sm^{-1}$ )
Muscle	1.431	$2.10 \times 10^8$	1070	1.26
Eye	1.336	$2.20 \times 10^8$	1000	1.90
Brain	1.433	$2.09 \times 10^8$	1030	1.05

Source: [8, 9]

**Table- 2.** Magnetic and electric field for human head tissues from GLO and ZAIN Base Stations

	5m		10m		15m		20m	
	GLO	ZAIN	GLO	ZAIN	GLO	ZAIN	GLO	ZAIN
Magnetic field B( $\mu T$ )	0.16±0.03	0.15±0.03	0.12±0.02	0.11±0.02	0.11±0.02	0.11±0.03	0.10±0.03	0.10±0.02
Eye E( $\nu m^{-1}$ )	35.20±0.03	33.00±0.03	26.40±0.02	24.20±0.02	24.20±0.02	24.20±0.03	22.00±0.03	22.00±0.02
Brain E( $\nu m^{-1}$ )	33.44±0.03	31.35±0.03	25.08±0.02	22.99±0.02	22.99±0.02	22.99±0.03	20.90±0.03	20.90±0.02
Muscle E( $\nu m^{-1}$ )	33.60±0.03	31.50±0.03	25.20±0.02	23.10±0.02	23.10±0.02	23.10±0.03	21.00±0.03	21.00±0.02

**Table- 3.** Mean specific absorption rate (SAR) for human tissue from GLO and ZAIN Base Stations

	5m		10m		15m		20m	
	GLO	ZAIN	GLO	ZAIN	GLO	ZAIN	GLO	ZAIN
Eye ( $Wkg^{-1}$ )	1.17	1.03	0.66	0.56	0.56	0.56	0.46	0.46
Brain ( $Wkg^{-1}$ )	0.57	0.50	0.32	0.27	0.27	0.27	0.22	0.22
Muscle ( $Wkg^{-1}$ )	0.66	0.58	0.37	0.31	0.31	0.31	0.26	0.26

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