

IMPACT ASSESSMENT OF RADIO FREQUENCIES FIELD LEVELS OF SOME GSM BASE STATIONS IN MAKURDI METROPOLIS

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ABSTRACT

The radio frequency field levels of some Globacom and MTN telecommunications base stations in Makurdi metropolis were measured using electromagnetic field tester (EMF827 Lutron). Measurements were done at distances of 5.00, 10.00, 15.00 and 20.00 metres away from the base stations in the north, south, east and west directions. The electric field intensity and specific absorption rate (SAR) were calculated with references to some human tissues. The results show the average magnetic field levels of MTN and GLO base stations to range between 0.09 μ T to 0.16 μ T. The mean electric field values for eye, brain and muscles ranged between 18.810mV to 35.200mV. The specific absorption rate (SAR) values for the selected human tissue were found to range between 0.18Wkg⁻¹ to 1.17Wkg⁻¹. The results of the research denote that the radiations emitted by GSM base stations conform to the standards set by regulatory bodies, as such; there are no inherent danger to residents found within the base station areas.

Keywords: Electromagnetic field, Electric field, Frequency, Radiation, Base stations, Telecommunications, Makurdi.

1. INTRODUCTION

The development and application of devices that emit radiofrequency (RF) radiations have significantly increased the quality of life throughout the world. Recently, the beneficial aspects of RF technology have been somewhat overshadowed by the potential adverse effects of the radiations emitted by the radiofrequency fields.

The effect of increase in radiofrequency field's radiations (RFR) could be better understood by studying the interaction of these fields with biological systems. Inherent health risks from RFR exposures are directly linked to absorption and distribution which are strongly dependent on size of the material, the frequency and polarization of the incident radiation [1].

The most common applications of radio frequency (RF) fields in the modern society are; communications (mobile phones, cordless phones, local wireless networks and radio transmission towers); Medicine (vision correction, liver cancer, sleep apnea, snoring, cosmetic surgery, enlarged prostate etc, [2]). Exposure to radio frequency fields leads to the absorption of energy by the body however; the absorption depends on many factors, especially time of exposure, distance from the various sources and field strength Scientific Committee on Energy and Newly Identified Health Risks (SCENIHR), [3]. The Global System for Mobile Communications has

turn out to be the most important and most valued way of communication in the country today. However a lot of Nigerians are saddened by the negative effects of telecommunications base stations on their lives and property. The situation is made knotty by the indiscriminate installation of base stations close to residential areas and those with large volumes of human activities. It is the closeness of base stations to where people live and work that exposes people to the hazards associated with them. Apart from death and injuries caused by the felling of some telecoms masts, the noise pollution arising from the generators used in the base stations, oil spillage from the generators, people whose residence are located close to base stations are continuously been exposed to radiations emitted by these stations. Studies have 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 exposure to frequencies level of about 300GHz can change the cellular DNA and initiates a carcinogenic transformation [4].

It is in the light of the above that the present study considered it pertinent to assess the impact of radio frequencies emitted by some MTN and GLO base stations in Makurdi metropolis on the surrounding environment.

2. MATERIALS AND METHODS

Three each of MTN and GLO base stations were randomly selected for the study. The study sites include; North-Bank, Wurukum and High-level areas of Makurdi metropolis. Using an electromagnetic field tester (Model; EMF 827, Lutron) measurements were carried out at distances of approximately 5m, 10m, 15m and 20m away from each station in the north, south, west and east directions. The sensor was positioned in both the vertical and horizontal directions, and the values of the magnetic field intensity (B) were recorded. The mean values at each of the distances were determined. The velocity of electromagnetic (EM) wave in tissue were calculated using the relation $V=Cn^{-1}$. Where n is the refractive indices of tissues and C is the velocity of EM wave in vacuum ($3 \times 10^8 \text{ms}^{-1}$) Table 1.0. The values of the electric field intensity were obtained using the measured values of magnetic field intensity and calculated values of velocity of EM waves V, using the relation: $E= VB$

The specific absorption rate (SAR) of the human tissues was evaluated using the relation:
 $\sigma = \text{electrical conductivity of tissue, } E = \text{electrical field intensity and } \rho = \text{density of tissue.}$

Table-1. Refractive indices, velocity of EM wave and tissue parameters.

Type of Tissue	Refractive Index	Velocity of EM waves(ms^{-1})	Density (kgm^{-3})	Conductivity (sm^{-1})
Muscle	1.431	2.10×10^8	1070	1.26
Eye	1.336	2.20×10^8	1000	1.90
Brain	1.433	2.09×10^8	1030	1.05

Source: (Dirckx, et al. [5], Le-wei, et al. [6])

3. RESULTS AND DISCUSSIONS

Result of the study indicate the average magnetic field levels of MTN and GLO base stations to range between 0.09 μ T to 0.15 μ T and 0.10 μ T to 0.16 μ T respectively (Table 2.0 and Fig 1.0).

The magnetic field strength was found to be inversely proportional to distance for both networks. GLO base stations had higher magnetic field strength than MTN base stations. Although the magnetic field emitted by both networks were found to be below the threshold limit of 0.2 μ T reported by the International Commission on Non-ionising Radiation Protection (ICNIRP) for occupational exposure [7]. The implication is that exposure to magnetic fields emitted by both networks has no adverse health effects on residence within the study area.

Fig-1. The average magnetic field strengths of MTN and GLO base stations.

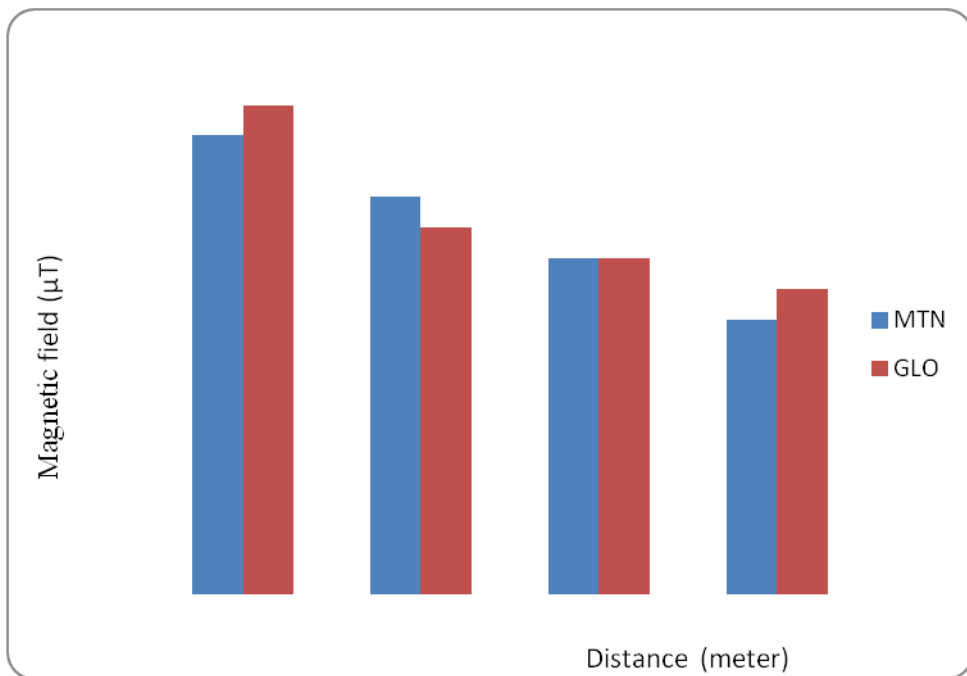


Table-2. Magnetic and electric field for human head tissues from MTN and GLO base stations

	5m		10m		15m		20m	
	MTN	GLO	MTN	GLO	MTN	GLO	MTN	GLO
Magnetic field $\beta(\mu$ T)	0.15±0.03	0.16±0.03	0.13±0.03	0.12±0.02	0.11±0.02	0.11±0.02	0.09±0.02	0.10±0.03
Eye E(vm ⁻¹)	33.00±0.03	35.20±0.03	28.60±0.03	26.40±0.02	24.20±0.02	24.20±0.02	19.80±0.02	22.00±0.03
Brain E(vm ⁻¹)	31.35±0.03	33.44±0.03	27.17±0.03	25.08±0.02	22.99±0.02	22.99±0.02	18.81±0.02	20.90±0.03
Muscle E(vm ⁻¹)	31.50±0.03	33.60±0.03	27.30±0.03	25.20±0.02	23.10±0.02	23.10±0.02	18.90±0.02	21.00±0.03

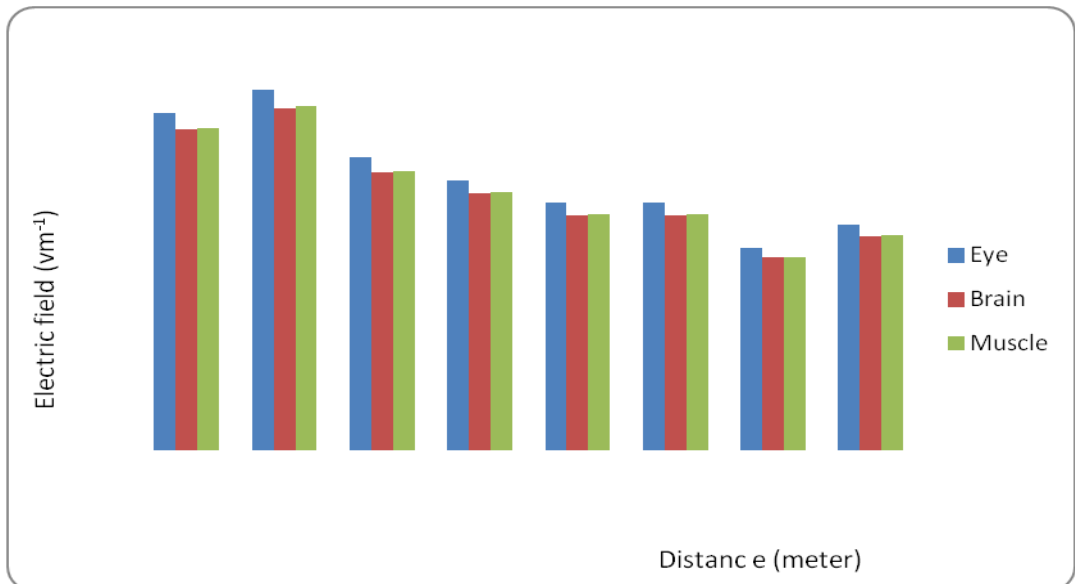
Table-3. Mean specific absorption rate (SAR) for human head tissue from MTN and GLO base stations.

	5m		10m		15m		20m	
	MTN	GLO	MTN	GLO	MTN	GLO	MTN	GLO
Eye (Wkg ⁻¹)	1.03	1.17	0.78	0.66	0.56	0.56	0.37	0.46
Brain (Wkg ⁻¹)	0.50	0.57	0.43	0.32	0.27	0.27	0.18	0.22
Muscle (Wkg ⁻¹)	0.58	0.66	0.44	0.37	0.31	0.31	0.21	0.26

The mean electric field values for eye was found to range between GLO base stations. This is differences could be due to the propagation parameters used by the different GSM network providers (Fig. 2.0). And the fact that, base station requires different power levels in order to cover a particular geographical location. Thus, the further a base station from a cellular phone user, the more the power required to maintain the connection. The magnitude of the electric fields calculated for human head tissues were also found to be below the accepted reference limit of 61vm⁻¹ reported by ICNIRP for occupational exposure [7].

Fig-2. Electric field for human head tissues from MTN and GLO base stations

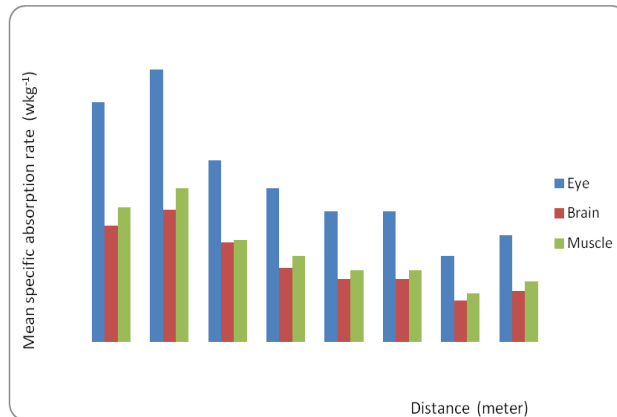
In Table 3.0, it was observed that the averaged specific absorption rate (SAR) values for the



Eye range from 0.37Wkg⁻¹ to 1.03Wkg⁻¹ and 0.46Wkg⁻¹ to 1.17Wkg⁻¹ for MTN and GLO respectively. The mean values recorded for the brain were found to range between 0.18Wkg⁻¹ to 0.50Wkg⁻¹ and 0.22Wkg⁻¹ to 0.57Wkg⁻¹ for MTN and GLO respectively. The average SAR values recorded for muscles were found to range between 0.21Wkg⁻¹ to 0.58Wkg⁻¹ and 0.26Wkg⁻¹ to 0.66Wkg⁻¹ for MTN and GLO respectively. The result of the study revealed that the SAR values for GLO base stations were higher than those of MTN. Generally, SAR vary across the various frequency bands, and also depends on the tissue parameters (i.e. conductivity, permittivity

and density) since these parameters are distinct for each test target. For example, the order of SAR for the tissue was found to be Eye>Muscles>Brain (Fig.3.0). According to Cember and Johnson [4], the localized SAR limit for the human head stipulated by International Commission on Non-ionizing Radiation protection guidelines [8](ICNIRP), guidelines is 2.0 Wkg^{-1} . The radiation thus absorbed by the human head from exposure to fields from the various GSM base stations monitored were below the safe limits.

Fig-3. Average specific absorption rate (SAR) for human tissue from MTN and GLO base stations



4. CONCLUSION

The results of the research denote that the radiations emitted by GSM base stations conform to the standards set by regulatory bodies, as such; there are no inherent danger to residents found within the base station areas.

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