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Original Article

Estimation of the number of 900MHz GSM Antennae and the Field Intensities of their Ray Emissions in Minna Metropolis, Nigeria

Oluwajobi[1, 3], A. O., Falusi[1], O. A. and Oyedum[2], O. D.

[1] Department of Biological Sciences, Federal University of Technology, Minna, Nigeria
[2]Department of Physics, Federal University of Technology, Minna,
[3]Biology Department, Institute of Applied Sciences, Kwara State Polytechnic, Ilorin, Nigeria

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ABSTRACT

An estimation of the number of 900MHz Global System for Mobile (GSM) Telecommunications antennae and the field intensities of their ray emissions was carried out between October 2013 and March 2014 in Minna Metropolis, Nigeria. Three locations were chosen for the study and an RF meter (Acoustimeter), was used for the measurements of the field intensities while the numbers of the antennae were estimated by visual counting. The measurements were conducted at specific points at distances of 100 m, 200 m, 300 m and 400 m from the chosen masts for a period of twenty-four weeks. The results showed that there were a total of One hundred and fifteen (115) GSM masts mounted around Minna metropolis. The intensities of EMF in location A showed that the mean values were 0.66 V/m (or 1.16 mW/m^2) at 100 m, while at 200 m it was 0.70 V/m (1.30 mW/m^2); 300m (1.02 V/m or 2.76 mW/m^2) and at 400 m (0.94 V/m or 2.34 mW/m^2). For location B the values were 100 m (0.4 V/m or 0.42 mW/m^2); 200 m (0.54 V/m or 0.77 mW/m^2); 300 m (0.71 V/m or 1.34 mW/m^2) and at 400 m (0.68 V/m or 1.23 mW/m^2). In Location C, the values were 100 m (0.72 V/m or 1.38 mW/m^2), 200 m (0.82 V/m or 1.78 mW/m^2); 300 m (0.99 V/m or 2.60 mW/m^2) and at 400 m (1.01 V/m or 2.71 mW/m^2). Significant differences were observed in the intensities of the ray emissions with distance from the mast in each location, the peak being mostly around 300 metres then, the intensities reduced towards 400 metres. These observations are in agreement with several reports across the globe. These results showed that the GSM mast radiations do not exceed the recommendation made by the International Commission for Non-Ionizing Radiation Protection (ICNIRP) as safety guidelines for exposure to base-station radiation.

Key words: Masts, Antennae, emission, intensity.

*Corresponding Author: ooluwajobi0@gmail.com

INTRODUCTION

The advent of mobile phones no doubt has made life a lot better for man. It is now easier to communicate with families and friends from far and near thus, saving man the risks of travelling several kilometres just to source for information or exchange pleasantries with a loved one. The huge transport fares, stress, risks and even time to be wasted travelling can now be diverted to more productive use. However, the advent of mobile telephony has led to the proliferation of transmission masts/antennae even in residential areas.

Daniel (2007) reported that there are about 47,000 masts in the UK and such phone masts have provoked protests throughout Britain, with thousands of people objecting each week to mast-planting applications. This was because there have been numerous health-related complaints from people living in close proximity to phone masts.

Reports of bio effects and the kinds of some adverse health reactions as a result of exposure to emissions from GSM Base-stations include sleeping disorders/chronic fatigue syndrome, memory/concentration problems (cognitive tests), headaches and eye problems, anxiety, seizures (in pre-adolescent children) who already suffer from epilepsy. Others are nose bleeding by children in schools close to GSM Base-stations, clusters of human cancers in vicinity of Base-stations, much reduced neutrophil counts, which reverse in the absence of exposure and reduce value of houses near masts (Kewney, 2003; Anonymous, 2003; Wolf and Wolf, 2004; Hutter *et al.*, 2006; Daniel, 2007).

There have been reports on the impact of the emissions from GSM antennae on both man, animals and plants (Santini *et al.*, 2003; Panogopoulos and Margaritis, 2006; Haggerty, 2010; Oluwajobi *et al.*, 2015).

Although the advent of GSM and the digital revolution in recent years have impacted almost in every aspect of the national life including various business opportunities, ease of communication, online information gathering and research, e-learning, e-commerce, e-banking, increase in social awareness and many other beneficial impacts, there are also increasing controversies on the ill-effects of these emissions on all life forms including plants, animals and man.

In his submission on how exposure to mobile phone base-station signals can adversely affect humans, Hyland (2000) queried the International Commission for Non-Ionizing Radiation Protection (ICNIRP) safety guidelines for exposure to Base-station radiation. The ICNIRP guidelines pegged the maximum emissions to 4.1mW/m^2 to avoid adverse body heating and not to exceed what the body's thermoregulatory mechanism can cope with. However, intensities around Base-stations are many thousands of times below the ICNIRP levels (for whole body exposure of the general public) such that the possibility of body overheating can be totally ruled out.

The mobile phone operation is based on the principles of electromagnetic waves which are primarily non ionizing radiations. They are characterized by a number of particularly well defined frequencies and are regarded as weak, non-thermal, electromagnetic radiations. Yet, there are growing tensions on the potential negative impacts of emissions from GSM masts despite the fact that the transmission power of about 0.43V/m (0.49mW/m^2) of GSM mast is very much lower than the permissible limit of 4.1mW/ m^2 recommended by International Commission for Non-Ionizing Radiation Protection (ICNIRP).

The GSM was launched in Nigeria in August, 2001, leading to the increasing installation of masts and towers in various places. In 2008, the Punch Newspaper reported that mobile phone operators have close to 8000 masts across Nigeria. In 2011, during the celebration of 10 years of GSM in Nigeria, the Nigeria Communication Commission (NCC) was reported by The Nation Newspaper to have over 106 million connected lines and over 90.5 million subscribers, with a penetration rate of 64.6% and an investment of over $18 billion within the period, Thus, Nigeria was taken as the fastest growing telecommunications market in Africa and one of the fastest in the world. Nigeria also has the highest mobile broadband connections in Africa. Nigeria specifically uses the 900MHz GSM system.

Ibitoye and Aweda (2011) in their report on the assessment of radio frequency power density distribution of GSM and broadcast antenna masts in Lagos city, Nigeria observed that the power densities of the RF radiation from telecoms transmitting and receiving antenna were far below the international standard limits. They concluded that the values observed were not likely to be capable of inducing significant hazardous health effects among people that are at least 6m away from the antennae. They took their measurements within 200 – 250 meters from selected antennae and obtained range of results from 0.219 – 3.40mW/m^2.

In view of the above, this study is aimed at estimating the number of GSM antennae and the field intensities of the ray emissions from the antennae around Minna metropolis of Niger State, Nigeria.

MATERIALS AND METHODS

The intensities of the ray emissions from the GSM masts were measured in three separate locations (Figure 1) around Minna metropolis between October 2013 and March 2014. The locations were named A (06^o 31' 36.9″E and 09^o 39' 17.8″N), B (06^o 27' 35.2"E and 09^o 32' 15.9"N) and C (06^o 32' 16.7″E and 09^o 37' 13.6″N). Measurements were also taken at specific distances (100 m, 200 m, 300 m and 400 m) from the masts considered for the experiment using a modified method of Viel *et al.* (2009). The instrument used was the Acoustimeter (RF meter), Model AM-10,

manufactured by EMFields, U.K, with a sensitivity of 0.02 – 6.0V/m (1–100,000μW/m^2).

An average power density and peak hold (measured as the average of 1024 samples in 0.35secs) were recorded for each study spot on weekly basis. Measurements were taken for consecutive 24 weeks in all the study locations. The number of GSM masts mounted within Minna metropolis was estimated by visual counting in July, 2014. Data obtained were analyzed using the Duncan's multiple range tests.

RESULTS

A total of about One hundred and fifteen (115) GSM masts were mounted around Minna metropolis. The intensities of EMF in Location A showed that the mean values were 0.66 V/m (or 1.16 mW/m^2) at 100 m, while at 200 m it was 0.70 V/m (1.30 mW/m^2); 300m (1.02 V/m or 2.76 mW/m^2) and at 400 m (0.94 V/m or 2.34 mW/m^2). These results are presented in Table 1.

In location B, the mean EMF values were at 100 m (0.4 V/m or 0.42 mW/m^2); 200 m (0.54 V/m or 0.77 mW/m^2); 300 m (0.71 V/m or 1.34 mW/m^2) and at 400 m (0.68 V/m or 1.23 mW/m^2). In Location C, the values were 100 m (0.72 V/m or 1.38 mW/m^2), 200 m (0.82 V/m or 1.78 mW/m^2); 300 m (0.99 V/m or 2.60 mW/m^2) and at 400 m (1.01 V/m or 2.71 mW/m^2).

In locations A and B, the intensities of the EMF increased as distance from the masts increased but highest around 300 m, then at 400 m, the value dropped. However, in location C, the intensity further increased at 400 m. Thus, there are significant differences between the intensities of the ray emissions with distance from the mast

0.44V/m to 0.59V/m. In this experiment, the field intensities are still much below the internationally recommended value.

DISCUSSION

The increase in intensities of the ray emissions from the GSM masts as distance from the mast increases, reaching the peak at 300 m and the value reduces afterwards are in agreement with the reports of Viel *et al*. (2009) who reported from France that the field strength from the 900 MHz GSM antennae peaked at around 280 m away from the mast.

Earlier, Ibrani-Pllana *et al*. (2008) had reported 0.24 to 0.76 V/m range of field strength for GSM mast ray emissions in Kosovo. The range in this study (0.40 to 1, 01 V/m) is higher, but Ibrani-Pllana *et al*. (2008) did not state the number of GSM masts in the study area.

The field strength of the ray emissions of the GSM masts in this study were very low and in compliance with the safe public exposure limit recommended by the ICNIRP. This agreed with the reports of Ibrani-Pllana *et al*. (2008), Viel *et al*. 2009) and that of Ibitoye and Aweda in Lagos city, Nigeria in 2011.

CONCLUSION

The residents of Minna metropolis, Niger State are exposed to ray intensities from the GSM antennae ranging from 0.40 to 1.01 V/m, values much less than the internationally approved safety limit. The intensities of the ray emissions increased with increased distance from the masts, the climax obtained at around 300 m. This peak points should be avoided since there are still controversies on the health implications of the ray emissions from the GSM mast.

These assessments are important in order to check compliance to the exposure limit in view of the increasing agitations on the health effects of the ray emissions from GSM mast, more so the GSM play prominent roles on our daily lives, leading to daily increase in the number of the masts in our neighbourhood

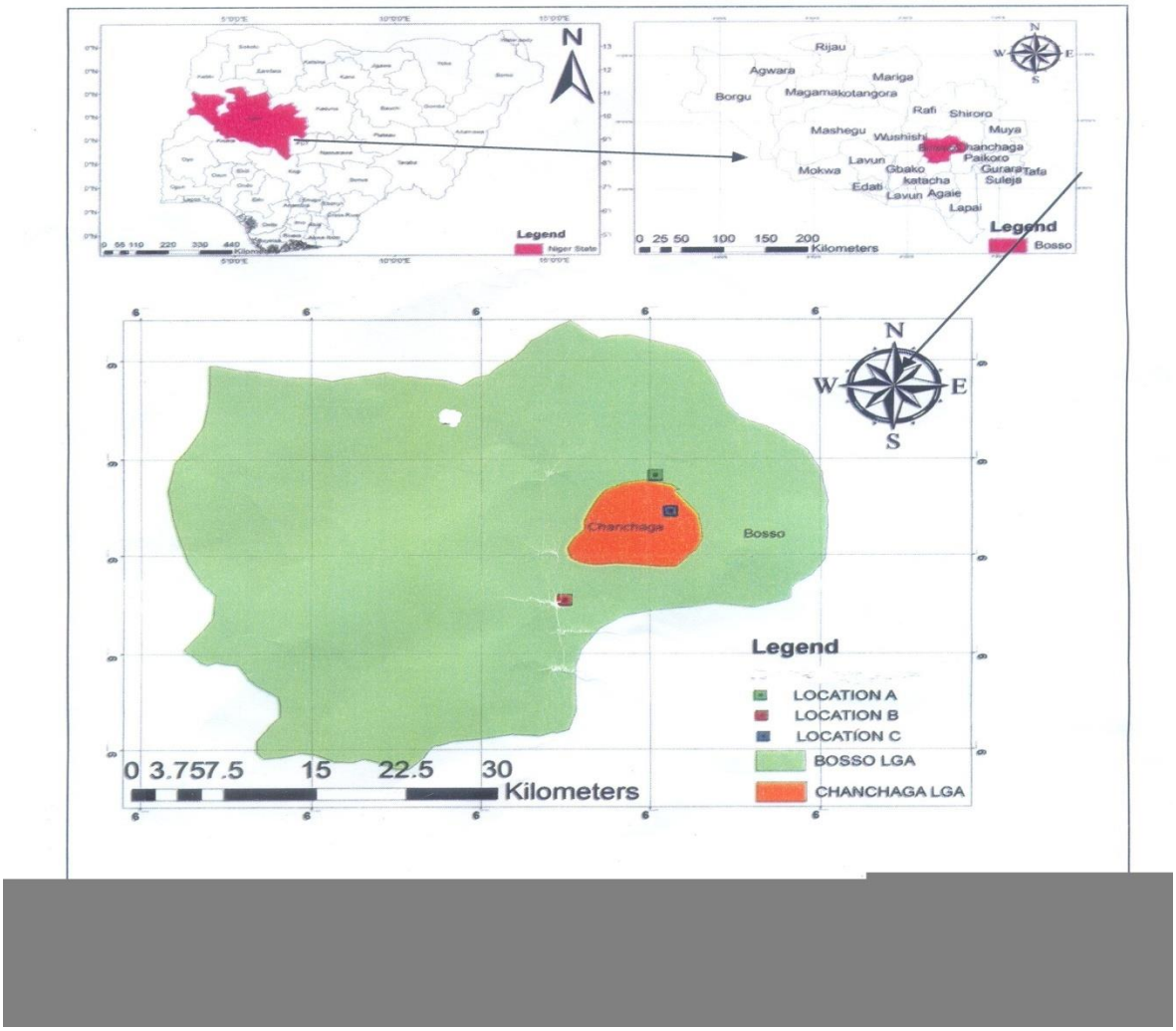

Figure 1: Description of the Study Area

Table 1: EMF Intensities (V/m) at study locations in relation to distance from the 900MHz GSM masts, in Minna, Nigeria

	Distance			
Locations	100 m	200 m	300 m	400 m
A	0.66 ± 0.14^{c}	0.70 ± 0.13^{c}	1.02 ± 0.31^{a}	0.94 ± 0.26^{b}
B	0.40 ± 0.15^{c}	0.54 ± 0.22^{b}	0.71 ± 0.25^{a}	0.68 ± 0.23^{a}
C	0.72 ± 0.19^{c}	0.82 ± 0.18^{b}	0.99 ± 0.50^{a}	1.01 ± 0.45^{a}

*Means in the same row with different superscripts are significantly different ($p < 0.05$)

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