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Original Research Article

Radio Frequency Radiation Exposure from Selected Mobile Transceiver Stations in Minna, Nigeria

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Abstract: Lately, there has been massive development in the use of mobile phones especially in developing countries. But electromagnetic radiation (EMR) emissions from various mobile transceiver stations (MTS) have raised debates on whether they are hazardous to human or not. In this study, we aim at presenting an assessment of human exposure to RF radiation from mobile transceiver stations in Minna. The power flux densities radiations (W/m^2) on residential buildings around the MTS were measured using a handheld Extech RF EMF strength meter. The highest mean power flux density value recorded for Minna, was $69.17mW/m^2$ while the least value was $2.11mW/m^2$. The result shows that the measured mean power flux density from mobile transceiver stations in Minna, have been compared with standard limit set by International Commission on Non-Ionizing Radiation Protection (ICNIRP). The measured value is far below the threshold limit. Therefore, RF emission from MTS in this study area may pose no known health hazards to the general public within the chosen vicinity.

Keywords: RF radiation, Power flux density, Mobile transceiver stations, Minna.

INTRODUCTION

As a result of modern technology, there has been an enormous amount of development in recent years, including cellular phones, microwave ovens, televisions, wireless communications, computers, power transmission lines, and high voltage transformers, which generate electromagnetic fields (EMFs) [1]. As a result of these sources of electromagnetic radiation, human beings are exposed to them. As far as the general public is concerned, mobile phones and cell tower radiation is harmful because it contains electromagnetic radiation (EMR). A person exposed to RF radiation above the ICNIRP set limit of $10W/m^2$ for the general public and $50W/m^2$ for occupational exposure may suffer health problems [2].

A cellular phone transmits 1 to 2 Watt of power in the frequency range of 824-849 MHz (CDMA), 890-915 MHz (GSM900), 1710-1780 MHz and 1805-1880MHz (GSM 1800). In Nigeria, the Specific Absorption Rate (SAR) limit for cell phones is about 1.6W/kg, which is estimated for 5-6 minutes per day usage [3]. The safety margin is 3 to 4, so a person should not use a cell phone for more than 18 to 24 minutes per day. Unfortunately, this information is not commonly known in Nigeria, so people use cell phones for more than an hour per day without realizing the potential health risk [4]. To determine the impact of EMF radiation on residents of Elekahia and Choba communities in Rivers State, Nigeria, a broad band RF meter was used to characterize RF power flux density. According to their findings, RF power flux densities were high near the MBSs [5]. For the study of the levels of RF power flux density around MBSs in Lagos city, Nigeria, a measurement based on assessment approach was presented in 2010. Based on their results, the measured power flux density values were below the recommended value, and they did not cause any serious health effects to those who lived at least 6 meters away from the antenna [6]. The research of Carl Blackman has shown that weak electromagnetic fields release calcium ions from cell membranes [7]. According to an Australian study [8], children living close to television and FM broadcast towers are more likely to develop leukemia. Laboratory findings have shown that short-term exposure to high levels of RF radiation (100-200 mW/cm^2) can cause cataracts in rabbits [9].

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Study Area

The research work was carried out in Minna (lat. $9^0 36' 50"$N and long. $6^0 33' 24"$E) Niger State, according to the 2007 population census, Minna, has a total population of 304,113. The tele density of Minna is considerably high due to the communication demands by its large population. Highly populated residential areas were selected for this research as shown in Figure 1.

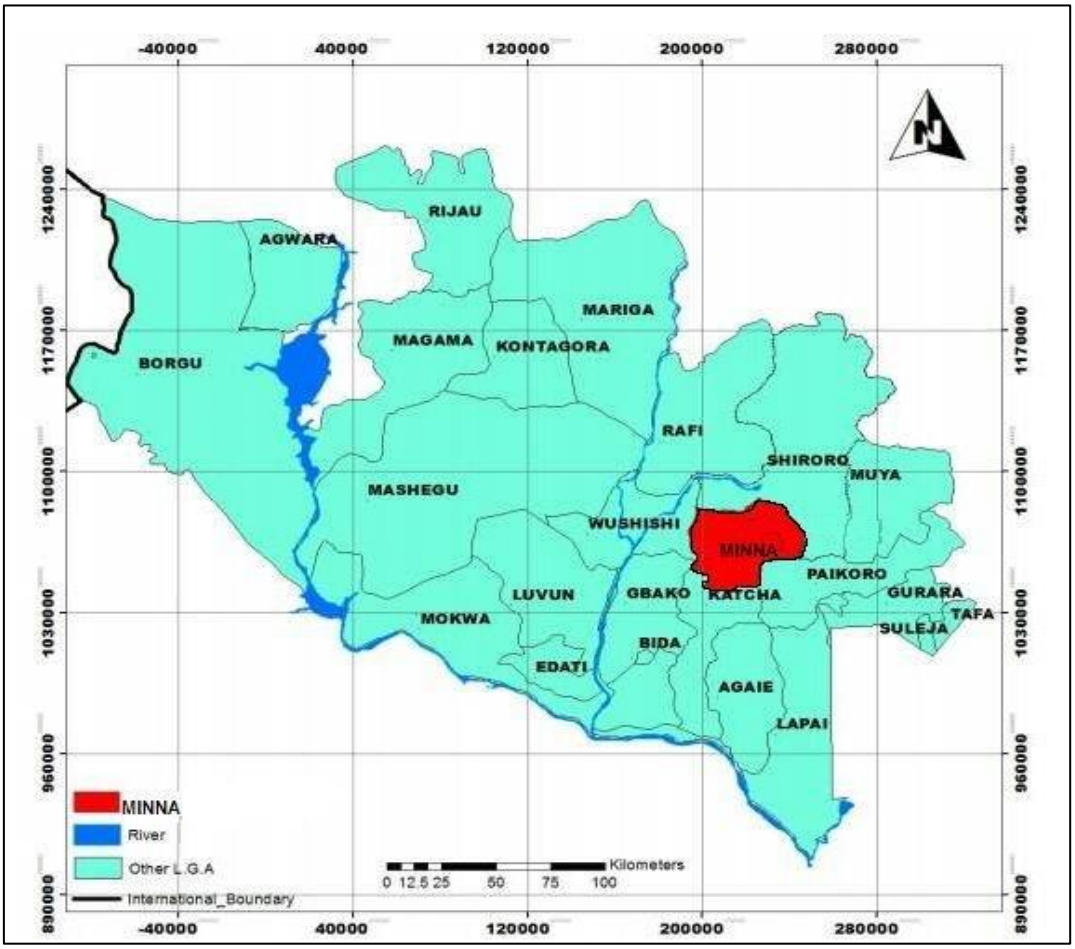

Figure 1: The Study Area

MATERIALS AND METHODS

Measurement of Electromagnetic radiation was carried out with the Extech RF EMF strength meter. This meter is a frequency-weighted broadband device for monitoring high-frequency radiation in the specific ranges of 900MHz, 1800MHz, and 2.7GHz. Other measurements can be made, for reference purposes only, using the entire range of 50MHz to 3.5GHz. The meter measures the value of electric field $\vec{E}$ and converts it into magnetic field $\vec{H}$and the power density **S** using Poynting theorem [10]:

$$P_d = \vec{E} \times \vec{H} \quad (1)$$

where P_d is power flux density expressed in watt per meter squared (W/m^2); E, electric field strength in volt per meter (V/m); H, magnetic field strength in ampere per meter (A/m).

The magnitude of the power flux density based the sinusoidal nature of the EM wave is expressed by:

$$|P_d| = \frac{|E|^2}{\eta} = \eta |H|^2 \quad (2)$$

where η is the impedance of the free space defined by:

$$\eta = \sqrt{\frac{\mu_o}{\varepsilon_o}} \quad (3)$$

where

$$\mu_{o=4\pi \times 10^{-7} Tm/A} \quad (4)$$

$$\varepsilon_{o=\frac{10^{-7}}{36\pi} C^2/Nm^2} \quad (5)$$

Then $\eta = 120\pi = 377\Omega$

Considering equations (3), (4) and (5) in (2) we have

$$P_d = \frac{E^2}{120\pi} \quad (6)$$

Equation (6) shows that the power flux density is directly proportional to the square of electric field strength.

The meter can also measure E along different axis, but readings can also be taken in all Es at the same time (Triaxial) using

$$E^2 = E_x^2 + E_y^2 + E_z^2 \quad (7)$$

Measurement of radiation power flux densities was made by simply pointing the meter to the source of RF radiation. A maximum of about 15 m distance from the base was considered and measurements were taken at 1.5 m interval from each base station. Each measurement was made by holding the meter away from the body, at 1.5 m above the ground level as suggested by [11].

RESULTS AND DISCUSSION

Absolute power flux density of the radio frequency radiation from selected mobile transceiver stations were measured with the aid of Extech RF Meter at different selected areas with their proximity to the residential buildings. The measured values of mean power flux densities at different locations are given in Figure 2. We observed that the mean power flux density of MTS5 was considerably high with contribution of 69.17 mW/m^2 when compared with others. MTS14, have the least contributions with 2.11 mW/m^2. We observed significant fluctuation in data collection during measurement. One would have expected that the variation of the power flux density obeys inverse–square-law ($P_t/4\pi R^2$) as you move farther away from the reference mobile transceiver station, the measured power flux densities however deviated as observed in figure 3. This deviation was as a result of integration of wave interference from other sources of EMR around reference mobile transceiver stations such as TV, Radio antennas and receivers. The graph shows that power flux density decreases exponentially with distance. That is at distance, $x = 0$, the power flux density P_d is maximum and for $x > 0$, the power flux density decreases exponentially.

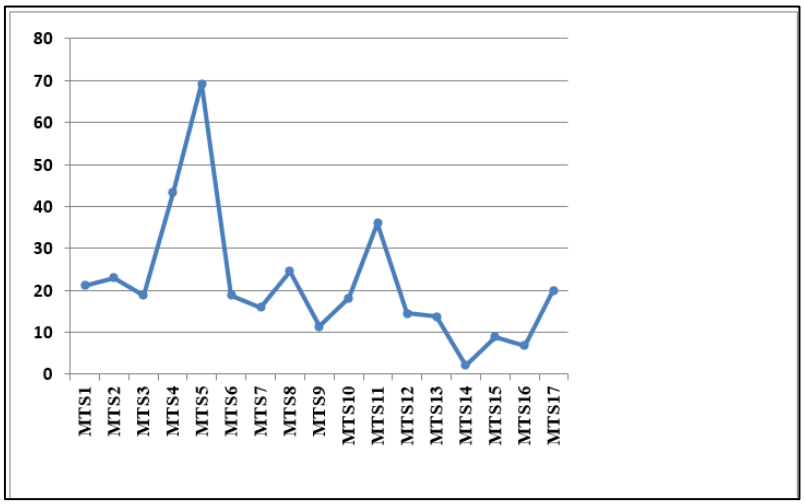

Figure 2: Mean power flux density for all locations

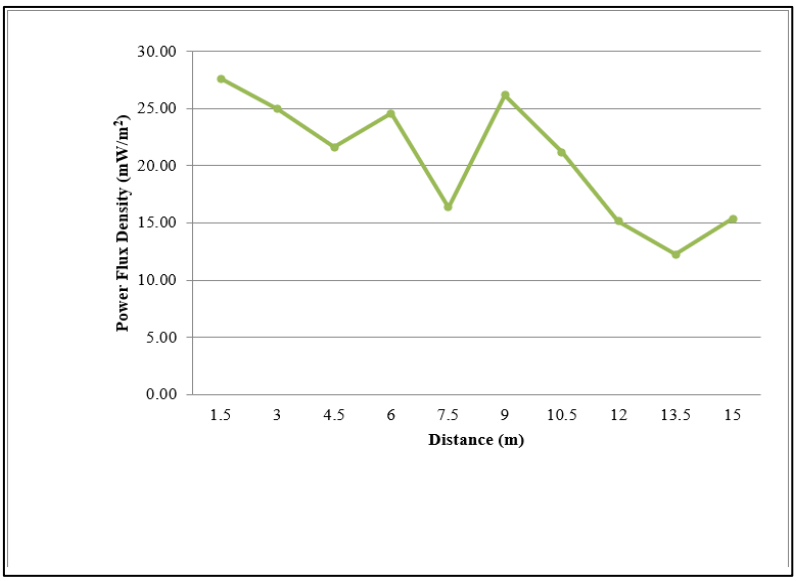

Figure 3: Mean Power Flux Density Vs Distance Plot (Minna)

CONCLUSION

The present study was carried out with the sole aim to assess the RF radiation exposure from mobile transceiver stations. From the findings it has been observed that the measured values of power flux densities across all the sites are well below the RF radiation exposure safety limit set by ICNIRP for the general public and occupational exposure when compared with the findings in this study. Thus, RF radiation exposure from MTSs in Minna, may pose no health risk to the people living within the areas. However, mobile network providers should site mobile transceiver stations at least 15 m distance away from residential building areas.

REFERENCES

1. Shankar, P. M. (2002). *Introduction to wireless systems* (pp. 22-52). New York: Wiley.
2. Salford, L. G., Brun, A. E., Eberhardt, J. L., Malmgren, L., & Persson, B. R. (2003). Nerve cell damage in mammalian brain after exposure to microwaves from GSM mobile phones. *Environmental health perspectives*, *111*(7), 881-883.
3. International Commission on Non-Ionizing Radiation Protection. (1998). Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz). *Health physics*, *74*(4), 494-522.
4. Adekunle, A., Ibe, K. E., Kpanaki, M. E., Umanah, I. I., Nwafor, C. O., & Essang, N. (2015). Evaluating the effects of radiation from cell towers and high tension power lines on inhabitants of buildings in Ota, Ogun state. *Communications in Applied Sciences*, *3*(1).
5. Jokela, K. (1988). Theoretical and measured power density in front of VHF/UHF broadcasting antennas. *Health physics*, *54*(5), 533-543.
6. Asiegbu, A. D., & Ogunlaja, O. O. (2010). Preliminary Investigation of RF Exposure levels from Mobile Telephone Base Stations in Abia, south east Nigeria. *International Journal of Current Research*, *11*, 47-53.
7. Blackman, C. F., Benane, S. G., Kinney, L. S., Joines, W. T., & House, D. E. (1982). Effects of ELF fields on calcium-ion efflux from brain tissue in vitro. *Radiation Research*, *92*(3), 510-520.
8. Hocking, B., Gordon, I. R., Grain, H. L., & Hatfield, G. E. (1996). Cancer incidence and mortality and proximity to TV towers. *Medical Journal of Australia*, *165*(11-12), 601-605.
9. Park, Robert, L. (2002). Voodoo Science: The road from foolishness to fraud. Oxford UK and NY; Oxford University press.
10. Isabona, J., & Odesanya, I. (2015). Quantitative Estimation of Electromagnetic Radiation Exposure in the Vicinity of Base Transceiver Stations via in-situ Measurements Approach. *Journal of Applied Science and Research*, *3*(2), 28-40.
11. Ismail, A., Din, N. M., Jamaludin, M. Z., & Balasubramaniam, N. (2010). Mobile phone base station radiation study for addressing public concern. *American journal of engineering and applied sciences*, *3*(1), 117-120.

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