Radiofrequency Power Density Measurements of Telecommunication Masts around Some Selected Areas in Delta State

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Abstract
The health implication associated with exposure from telecommunication masts is demanding attention due to the expansion of networks and base station installation. This study measures the power density from various telecommunication masts of the different network providers using a radiofrequency meter, an Electrosmog from LESSEMF, USA at a radial distance of 360m around some selected areas in Delta State. The readings obtained ranges from 0.03 $\mu W/m^{-2}$ to 5.66 $\mu W/m^{-2}$ .Comparing the result with the recommended international maximum permissible exposure limit of $10^7 \mu W/m^2$ reveals that the exposure levels in these areas are low and as such not able to produce significant health risks among the people of these areas.
Keywords: Power density, Health risks, exposure

1. Introduction

Wireless telecommunication technologies have experienced a boost in its application over the past years with a corresponding increase in the background radiation from its sources (Electromagnetic Radiation). This has become a universal subject over time and has received much attention from the public with regards to its health implications. The exposure from telecommunication masts can be classified as near field or far field depending on its position to the antenna. Near field is the region in the field of the antenna that is located close to the antenna and the electric and magnetic fields do not have a substantial plane wave character but varies from point to point. On the other hand, the far field is that region of the antenna in which the angular field distribution does not depend on the distance from the antenna (Dina, 2000) and this field is used for assessing public exposure level and the radiation intensity reduces with distance thus obeying the inverse square law (Bolaji and Idowu, 2012). Radiofrequency (RF) refers to all frequencies within the range 3 kHz to 300GHz carrying radio signals. The transmission of these signals is rooted in Maxwell's and Hertz work that was established in1873 at the Maxwell's equation for electromagnetic wave (EMW). The frequency from the antennas in the mast is related to wavelength by the relation;

$$v = f\lambda$$

Where V = Speed of light through which the signals travel, f = frequency of antenna and λ= wavelength used in considering antenna type. This equation shows the relationship between frequency and wavelength such that as the frequency increases the wavelength reduces (Ushie et. al,). The amount of radiofrequency energy absorbed by the body is measured using a dosimetric quantity called specific absorption rate (SAR) which is given as

$$S = \frac{\sigma}{\rho}|E|^2$$

Where S = Specific absorption rate in W/Kg, σ = Conductivity, ρ = Density and E = Electric field strength in V/m. Several research work have been carried out regarding the assessment of radiofrequency power density of telecommunication base stations in different cities and their findings are as follows; Jagbin and Dhamin (2012) carried out an orientation studies of a cell phone mast to assess electromagnetic radiation exposure level and came up with the findings that there are maximum and minimum exposure zones around a cell phone mast and also described how power density changes with distance for different antennas with the peak power density observed at a distance of 40m for most antenna orientations. Also, Ibitoye and Aweda (2011) conducted a research on the assessment of radiofrequency power density distribution around GSM and broadcast antenna mast in Lagos and observed that the power density varies between $0.219 mW/m^2$ to $302.40 mW/m^2$. Comparing their result with international standard limits; it was noticed that their values were far below the limits.

Baltrenas and Buckus (2011) carried out a study on indoor measurement of the power density close to mobile station antenna and observed that the values obtained were well below the maximum permissible exposure limits. Bolaji and Idowu (2012) showed that low level exposure from mobile phone base stations are usually less than most international guidelines and so should not be overlooked. Hence, despite the low exposures obtained from the various studies carried out, the effect of radiation from telec1ommunication base stations and other electromagnetic radiation sources should not be left unattended to. In 2013, Victor et.al carried out a research on the assessment of radiofrequency radiation exposure levels from selected mobile base station in Lokoja and came up with the findings that the RF exposure hazard index in the town of Lokoja was below the permitted RF exposure limit to the general public recommended by ICRNIP. Therefore, the main objective of this study is to measure and evaluate the radiofrequency power density distribution of some selected telecommunication masts in Delta State.

2. Material and method

We used a random survey method to gather the data from the selected mast in each town. In this study, a radiofrequency electrosmog from LESSEMF, USA with frequency ranging from 50 MHz – 3.5 GHz was used at distances of 60m, 120m, 180m, 240m and 360m from the base of each mast to measure the power density readings which was given in $\mu W/m^2$. Four towns and five network providers (MTN, GLO, AIRTEL, ETISALAT and MULTILINKS) were considered for this study based on the proximity of residential buildings to the telecommunication mast giving us a total of twenty-two base stations.

3. Result and discussion

The radiofrequency power density measured from different telecommunication masts are presented in tables below;

Table 1: Measured power density in $\mu W/m^2$

DIFFERENT TELECOMMUNICATION MAST	60.00m	120.00m	180.00m	240.00m	300.00m	360.00m
MAST1 (MTN)	3.52	4.27	4.16	2.64	1.49	1.01
MAST2 (GLO)	0.85	0.84	0.65	0.62	0.61	0.59
MAST3 (AIRTEL)	2.96	1.45	1.22	1.18	1.22	1.05
MAST4 (ETISALAT)	0.65	5.66	3.08	2.84	1.42	1.09
MAST5 (MULTILINKS)	0.14	0.05	0.06	0.44	0.25	0.27
MAST6 (MULTILINKS)	4.84	4.64	2.87	1.21	0.06	0.05
MAST7 (AIRTEL)	5.05	4.91	4.97	5.04	4.97	4.98
MAST8 ((ETISALAT)	0.14	0.25	0.14	0.10	0.11	0.09
MAST9 (GLO)	2.12	1.32	1.06	1.47	1.34	1.04
MAST10 (MTN)	4.11	1.78	1.97	2.72	2.17	3.62
MAST11 (ETISALAT)	4.85	3.36	0.58	0.38	0.44	0.57
MAST12 (AIRTEL)	1.36	2.95	2.77	2.26	1.50	1.39
MAST13 (GLO)	1.24	1.02	0.94	0.59	0.58	0.54
MAST14 (MTN)	2.98	3.08	2.20	1.92	1.72	1.47
MAST15 (MTN)	2.30	1.05	1.88	2.70	1.54	1.00
MAST16 (GLO)	0.05	0.06	0.06	0.05	0.03	0.04
MAST17 (AIRTEL)	0.50	0.54	0.46	0.30	0.28	0.18
MAST18 (ETISALAT)	0.32	0.46	0.57	1.63	1.50	1.26
MAST19 (MTN)	0.78	0.76	0.72	0.71	0.64	0.64
MAST20 (GLO)	1.51	4.70	1.69	2.27	1.07	1.00
MAST21 (ETISALAT)	0.35	0.38	0.48	0.85	0.84	0.53
MAST22 (MTN)	4.58	4.58	5.66	2.84	1.09	1.03

Table 2: Average power density of telecommunication masts classified based on the different network providers.

TELECOMMUNICATION MAST BASED ON NETWORK PROVIDERS	60m	120m	180m	240m	300m	360m
MTN	3.05	2.59	2.77	2.26	1.44	1.46
GLO	1.15	1.59	0.88	1.00	0.75	0.64
AIRTEL	2.47	2.46	2.36	2.20	1.99	1.98
ETISALAT	1.26	2.02	0.97	1.16	0.66	0.71
MULTILINKS	2.49	2.35	1.47	0.83	0.16	0.16

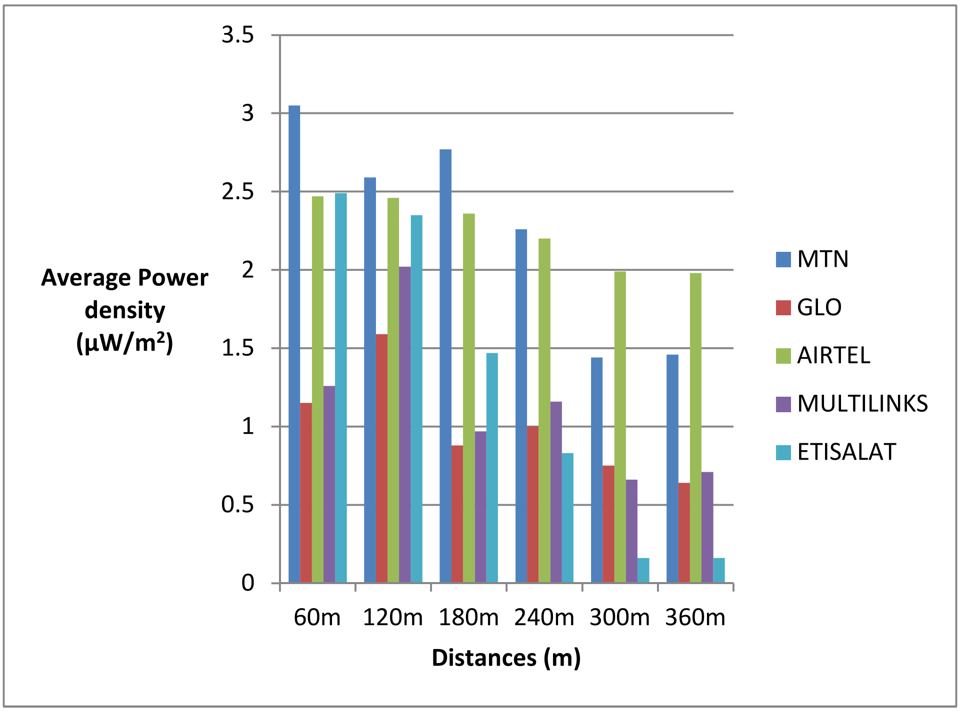

Fig. 1: A plot of average power density against distance.

From the figure above, Etisalat has the lowest power density at distances 300m and 360m while Mtn has the highest value of power density at distances 60m and 180m respectively. It is also observed that the power density decreases as the distance increases for all masts except for the following; Mtn at 180m,Glo and Multilink at 120m and 240m respectively. This variation is caused by influences from external radiation sources around. The power density obtained in this study is found to be below the international commission for non ionizing radiation protection (ICNIRP) which is given as 10^7 µ W/m^{-2}.

4. Conclusion

In this study, the measured power density is found to be below the set limit by ICNIRP and so no health implication is feared but still caution has to be applied by those living close to telecommunication masts as increasing the distance from the masts reduces radiation and also its threat to life when it falls accidentally as this is becoming rampant nowadays.

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