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The Hazards of Non-Ionizing Radiation of Telecommunication Mast in an Urban Area of Lagos, Nigeria

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ABSTRACT: The health hazards of non-ionizing radiation from telecommunication mast on the exposed community were assessed using a descriptive cross-sectional survey. The socio-demographic pattern and hazard profile of the respondent were documented. The results of the data showed that majority of respondents (60.8%) were youth within age range of 20 – 30 years. Hazard profile showed majority (62%) having different symptoms with headache being the most frequent (51.6%), similar to other established findings. There is a significant synergistic relationship between high voltage cable and telecom mast on the health effect, with p value < 0.05. It was also shown that proximity and duration of exposure to mast radiation is directly proportional to hazard effect, with p value < 0.05. This study therefore establishes that there are health implications of exposure to mast radiation and minimizing them will go a long way to improve healthy living.

Keywords: *Hazard, non-ionizing radiation, telecommunication, mast, electromagnetic radiation, radio-frequency radiation, exposure, wireless telephone, antenna.*

INTRODUCTION

The world and particularly Nigeria is becoming a global village due to great advancement in telecommunication. A major break-through is the wireless telephone system especially Global System of Mobile Communication (GSM) which currently use low intensity, pulsed microwave radiation (Hyland, 2000). The market for mobile telecommunication is very big and it is a major economic driver in many countries including Nigeria. In the U.K alone, over £22 billion was realised on the sale of licences to the mobile phone industry. (Eileen, 2005).

However, this great technology of advanced telecommunication system is not without some demerits and one of the major disadvantages is that of environmental and health hazards of its radiation. At present time, the greatest polluting element in the earth's environment is the proliferation of electromagnetic radiation. It is considered to be greater, on global scale, than warming and chemical element in the environment. (Robert, 2006).

The synergistic hazard effect of high voltage cable and telecom masts erected close to each other due to improper siting can easily be imagined. Although power lines produce majorly electric and magnetic field (EMF) which are non-ionizing radiation but often carry many transient which are in the radio-frequency (RF) part of the spectrum this may result in effects similar to ionizing radiation. Therefore, the challenges of telecommunication radiation should not be left unaddressed.

In this paper, we report the hazard effects of non-ionizing radiation of telecommunication mast on the exposed populace.

MATERIALS AND METHODS

The study was designed to assess the general health hazards of telecommunication mast radiation on the

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people around 500 metres radius of mast sites in Lagos Central Senatorial locations using a descriptive cross-sectional survey. A well structured questionnaire adopted from W.H.O was used as tools for data collection.

This study was carried out at Lagos State Central Senatorial District within the period of 8 weeks beginning from 11th September till 6th of November 2006. Lagos State is divided into 3 Senatorial Districts viz: Central, East and West.

Determination of Study Population: The inclusion criteria are people living, working or schooling around 500 metres radius of all the mast sites in Lagos Central Senatorial district.

The numbers of local government councils in Lagos Central Senatorial district are 5.

The estimated number of telecom mast by the 3 major operating GSM companies in Lagos, namely: Celtel (previously Econet), MTN and Globacom are 1,200 (with average of 400 masts per company). Number of local government in Lagos State is 20. Number of mast per local government is 60

The calculated study population was 1.89million

Determination of Sample Size: For the purpose of this project in which the study population proportion was 1.89 million i.e. greater than 10,000 the formula below was used for calculation of sample size.

$$N = \frac{Z^2 p.q}{d^2}$$

Where

n = the desired sample size

Z = the standard normal deviation (set at 1.96 or 2) corresponding to 95% confidence level

P = the proportion in the target population estimated to have a particular characteristic

q = 1 – p

d = degree of accuracy (set at 0.05)

n = sample size was 384 which was approximated to 400 for convenience sake

Sampling Method: Subject selection

A multi-stage sampling technique was used to select respondent for the questionnaire survey. Selection of all the 5 local government areas (LGAs) in the Lagos central senatorial district to allow for wide representation.

Data Collection: The instrument of data collection was questionnaire. A well structured questionnaire was designed for the purpose of gathering information from the respondents.

The questionnaires were majorly self completed by the respondents but some were completed for some less educated subjects by the investigator and the research assistants.

Measurement of Radiation Exposure by field Power Densities: The power densities at the base of different mast antennas were measured as an indicator for radiation exposure intensity.

The measurements were taken at intervals of 0, 50, 100, 150 and 200m from the base of each mast antennae.

A radiation meter OCD, CDV – 717 Model CM3, KIPPS & ZONNEL. N0 1: SER Victoreen Instrument was used for the measurement.

Data Processing

The results of data were collated and analyzed using EPI-INFO version 6.

RESULTS AND DISCUSSION

The result of this study showed that non-ionizing radiation from telecommunication mast resulted in various hazard effects on the exposed population. Below are tables and graphical representation of the results.

For the socio-demographic characteristics of the respondents, it was shown from the result that the highest age range was 20 – 30 years (60.8%). On the other hand only 1% of respondents fell in the age range above 50 years. This can be explained by the fact that most of the telecom masts were sited in elitist area of the society such as schools, banks, commercial areas, public and private establishments etc and naturally young people usually dominate such environment.

Majority of the respondents were females, this accounting for 65% while males only carried 34.5%. This might not be unconnected with the fact that females are better seeker of health and are more concerned about health.

Furthermore, the presence of high voltage cable was assessed. Majority of respondents had high voltage cable erected in their area, this representing 56%, while 36% were those without high voltage cable.

For the proximity to the mast, 64.5% of people were staying close to the mast, indicating that majority are well exposed to radiation emission. Places of exposure to mast radiation could easily reflect the

siting pattern. Majority of respondents were exposed at school representing 40%, 24% at work place and 19% at home. Some have double exposure at home and school. This can be explained by the fact that most of the masts were sited in civilised communities like schools, super markets, commercial centres and government establishments.

Table 1: Socio-demographic pattern and exposure profile of respondents

Age Distribution of Respondents		
Age (Years)	**Frequency**	**Percentage (%)**
10 – 20	54	13.6
20 – 30	242	60.8
30 – 40	76	19.1
40 – 50	22	5.5
Above 50	4	1.0
Sex Pattern of Respondents		
Male	138	34.5
Female	260	65.0
No response	2	0.5
Presence of High Voltage Cable and Mast		
Yes	198	49.5
No	168	42.0
No response	34	8.5
Place of Exposure to the Mast		
House	76	19
School	160	40
Work place	96	24
House & school	52	13
House & work place	6	1.5
No response	10	2.5
Distance to Mast Exposure		
Distance(meters)		
1 – 50	126	31.5
50 – 100	96	24.0
100 – 1,000	72	18.0
Above 1,000	54	13.5
No response	52	13.0

The table above shows that majority of respondents (60.8%) were youth within age range of 20 – 30 years. Females were 65% and males 35%. Majority of respondents lived in proximity, with 31.5% within 50m interval from the mast.

For the length of distance to mast exposure, most respondents stayed closest distance to the mast in the range of 1 – 50 metres, accounting for 31.5% of respondents. This may be explained by the fact that many of the masts are sited on the roof tops of banks, commercial centres and schools. This is not in total conformity with ICNIRP (1998) Guidelines. Siting showed 24% were in the range of 50 – 100 metres and 18% in the range of 100 – 1000. It should also be noted that more people are concentrated around the mast and the number decreases with increase distance.

For the health hazard profile, as high as 62% of respondents had symptoms relating to radiation hazard while only 38% were symptoms free. Headache, as also reported by Frey (1994, 1998) happened to be most frequently reported hazards accounting for 32% being the highest of the symptoms profile. However, no report at all of low blood level, neck swelling and abnormal growth in the body. The absence of tumour or cancer-like symptoms may not be unconnected with the fact that duration of exposure here is relatively short for cancer initiation to place take because longer period of about 10 years or more is required. This finding compares well with that of Oberfranken Bamberg study (2005) where 356 people with long term radiation exposure were evaluated. Also, similar to the findings is the study of Hamlet of Wilshaw in UK (2001) as reported by Eileen (2005) where hazardous effects of radiation on people in 18 houses surrounding the mast up to 500 metres were evaluated.

Table 2: Health Hazard Profile

	Symptoms	**Frequency**	**Percentage (%)**
1	Multi symptoms	248	62
2	Headache	128	32
3	Memory loss	4	1
4	Dizziness	12	3
5	Anxiety	24	6
6	Sleep disorder	16	4
7	Poor eye sight	12	3
8	Skin irritation	18	4.5
9	Frequent disorder	2	0.5
10	Itching	4	1
11	Weight loss	14	3.5
12	Nose bleeding	6	1.5
13	Low blood level	0	0
14	Neck swelling	0	0
15	Chronic fatigue	8	02
16	Abnormal growth in body	0	0
17	No symptoms	152	38
	TOTAL	400	100

The table above shows majority (62%) having different symptoms with headache being the most frequent which is similar to other established findings.

Although, 77% had health related illnesses compared to 62% in this study the higher percentage in their experiment could be attributed to the fact that there

was a longer exposure period (after 7 years) than in this study (less than 5 years). A local study by Takpatore (2005) also supported headache being the most frequently observed symptoms of the hazard profile. Also no evidence of cancer or tumour was discovered in that study for the above mentioned reason. Possession of GSM mobile phone was very high, the prevalence being 84%, indicating that majority of people living around the mast possessed GSM phone and therefore received double irradiation from both the mast antennae and from mobile handset.

Determining the association between high voltage cable-mast synergy and health effect, it was found that there is a strong statistical significant association between the synergistic relationship of high voltage cable and mast radiation and the outcome of health effect, P value < 0.05. This indicating that more hazardous symptoms were observed where there was co-existence of high voltage cable and mast antennae radiation.

Furthermore, on the association between closeness/duration of exposure to mast radiation and resultant health consequences, it was found that there is a strong statistical significant association between the level of exposure to radiation in terms of proximity and duration of exposure and the enormity of health hazards, p value < 0.05. It was clearly shown that adverse effect decrease with increase in distance (away from mast) and vice versa. This also compared well with study of Hamlet of Wilshaw (2001) in which symptoms disappeared over a time with removal of source of radiation.

Table3: Association between High Voltage Cable-Mast Synergy and Health Effect

	HAZARD PROFILE			
CABLE AND MAST	Multi symptoms	Skin irritation	Sleep disorder	Weight loss
Yes	146 (58.87%)	10 (55.55%)	8 (66.66%)	6
No	86 (34.67%)	8 (44.44%)	2 (16.66%)	8
No response	16 (6.45%)	0 (0%)	2 (16.66%)	0
	248 (200%)	18 (100%)	12 (150%)	14
PROXIMITY TO MAST	1	2	3	4
Yes	142 (57.72%)	12 (66.66%)	14 (87.5%)	10 (71.42%)
No	74 (29.83%)	4 (22.22%)	2 (14.28%)	4 (28.57%)
No response	32 (12.9%)	2 (11.11%)	0 (0%)	0 (0%)
	248 (200%)	18 (100%)	16 (100%)	

The table above shows a significant synergistic relationship between high voltage cable and presence of telecom mast on the health effect, with p value < 0.05. The result also revealed that the more the proximity and duration of exposure to the telecom mast radiation the more the hazard effect, with p value < 0.05.

Table 4: Association between Closeness/Duration of Exposure to Mast Radiation and Resultant Hazard Profile

	HAZARD PROFILE			
DISTANCE TO MAST	Multi symptoms	Skin irritation	Sleep disorder	Weight loss
1 – 50	68 (27.41%)	4 (22.22%)	8 (50%)	6 (42.28%)
50 – 100	56 (22.58%)	10 (55.55%)	4 (25%)	4 (28.85%)
100 – 1000	36 (14.51%)	0 (0%)	4 (25%)	2 (14.28%)
Above 1000	42 (16.93%)	2 (11.11%)	0 (0%)	0 (0%)
No response	46 (18.54%)	2 (11.11%)	0 (0%)	2 (14.28%)
	248 (200%	18 (100%)	16 (100%)	14 (100%)
DURATION (Year)	1	2	3	4
Less than 1	34 (13.70%)	6 (33.33%)	0 (0%)	2 (14.28%)
1 – 3	98 (39.51%)	8 (44.44%)	10 (62.5%)	0 (0%)
3 – 5	34 (13.70%)	2 (11.11%)	4 (25%)	2 (14.28%)
Above 5	20 (8.06%)	2 (11.11%)	2 (12.5%)	6 (42.28%)
No response	62 (25%)	0 (0%)	0 (0%)	4 (28.85%)
	248 (200%)	18 (100%)	16 (100%)	14 (100%)

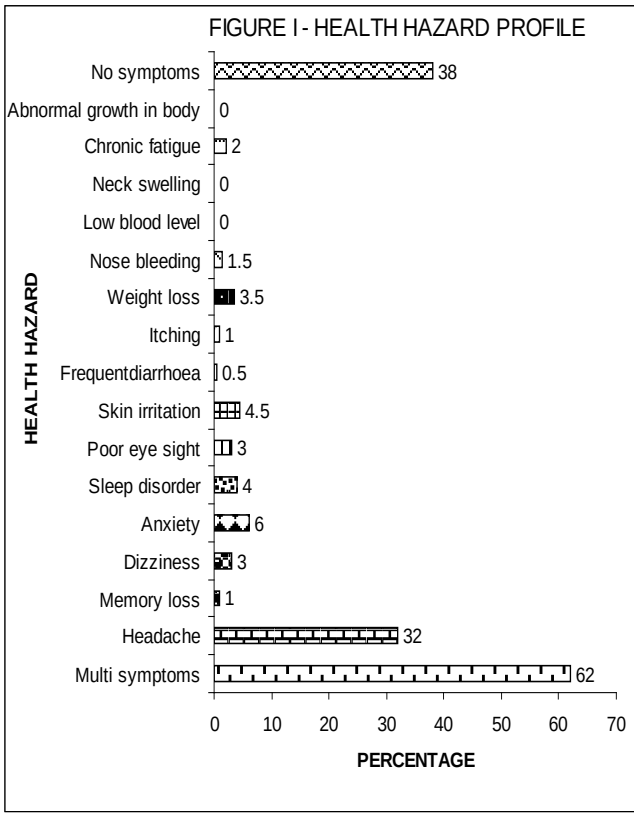
Using chi-square test of statistical significance, p value = 0.000001
The result of the above table shows that there is a statistical significant association between the level of exposure to radiation in terms of proximity and duration and the enormity of health hazards. It was clearly shown that adverse effect decreases with increase in distance and vice versa.

Table 5:
Radiation Power Densities Measurement at Different Intervals around Various Telecom Masts

	POWER (Radiation/Hour)		DENSITIES
DISTANCE (Meters)	IDI-ARABA	AKOKA	AVERAGE (X)
0	1.3	1.5	1.40
50	1.4	1.4	1.40
100	1.2	1.4	1.30
150	1.1	1.4	1.25
200	1.1	1.4	1.25

The measured radiation power density within 200m distance was 1.32 $\pm$ 0.075 mW/cm^2

Figure1:
Health Hazard Profile



Measuring the power densities of radiation emission around the mast antennae installation, it was found that the mean power density at the base of the mast was 1.40 mW/cm^2 while the mean power density within 200m from the base of mast station was 1.32 $\pm$ 0.075.

Compared with the work of Peterson (1997) who found the maximum power density on the ground at the base of mast antenna to be 0.002 mW/cm^2. While he found that within 300ft of base station the average power density was 0.001 mW/cm^2.

According to Peterson, the radiation density was observed to be maximum at the base of the tower, this compared well with the findings in this project. However, in terms of level, radiation density was much higher here than that obtainable in Peterson's experiment. This simply indicates that people are more exposed to higher level radiation here.

Conclusion

There is no doubt that GSM telecommunication technology is beneficial, however, the EMF radiation emanating from its mast antennae constitute major health hazards and environmental pollution as experienced by exposed individuals.

Therefore, more concerted efforts should be made to minimize the menace of radiation exposure in the name of GSM technology.

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