Journal of Innovative Research in Engineering and Science 2(1), March, 2011.
ISSN : 2141-8225
© Global Research Publishing, 2011.

Assessment of Radiation Hazards from Mobile Phones and GSM Base Stations *(pp. 1-9.)*

J.J. Biebuma[1] and E. Esekhaigbe [2]
[1]Department of Electrical/Electronics Engineering,
University of Port Harcourt, Nigeria.
[2]Department of Electrical/Electronics Engineering
Edo State Institute of Technology and Management, Usen, Edo State, Nigeria
Correspondence E-mail: emmaesekhaigbe@yahoo.com

Abstract: The tremendous growth of telecommunication industry results in increase in the number of handset user everyday. To support the growing number of users, base stations can be seen in almost everywhere. This has created uncomfortable feelings in the scientific community due to radiations from GSM devices. This study was designed to ascertain how informed and prepared consumer/users are against the reported health hazards from GSM technology. The work was done in Rivers State, Nigeria. Selected places and BTS sites located at schools, residential areas and worship centres were used for data collection; which was done via questionnaire, oral interview and measurements. The results revealed that GSM operators in Nigeria do not detail consumers the full content of their product and slightly adhere to ICNIRP guidelines. Majority of handset dealers and users have little or no knowledge regarding the hazardous effects currently debated by the scientific community.

Keywords: GSM base stations, mobile phones, radiation hazard, SAR, power flux density.

1 INTRODUCTION

GSM stands for Global System for Mobile communications. It is a digital mobile telephone system used in most parts of the world. GSM uses a time division multiple access which enables more people to communicate simultaneously with a station. The conception of this technology began in 1982 when the European Conference of Postal and Telecommunications Administrations created the *Groupe Special Mobile* (GSM) to develop a standard for a mobile telephone system that could be used across Europe. However, the first GSM network was launched in 1991 by Radiolinja in Finland with joint technical infrastructure maintenance from Ericsson. According to GSM world, there are now more than 3 billion GSM mobile phone users worldwide with China referenced as the largest single GSM market with more than 370 million users, (Friedhelm, 2002).

Evolution of GSM in Nigeria began in August 2001 and this has changed the face of Information and Communication Technology (ICT) in Nigeria. At its inception, there were only two operators: Enonet (now Zain) and MTN. Today, there are seven major operators namely: Zain, MTN, Globacom, Starcom, Visafone, Reltel/Zoom and Etisalat.

Considerable growth in the use of mobile phones has led to increasing demand for land to site telecommunication base stations and associated infrastructures. However, as cell phone use skyrockets, the concern over potential health risks rises as well. This is consequent upon the radiation emitted by handsets and base stations that receive and transmit the signals. Although some scientists and researchers across the globe claim there is no adverse effect from the use of mobile phones and its base stations, others in different countries, in different laboratories are finding disturbing results that point to far greater health implications than anyone is ready for. While about one billion people worldwide smoke tobacco, three times as many now use mobile phones. Smoking is responsible for about five million deaths each year and this implies that hazardous effects from phones and base stations radiation would cause far greater deaths (Gutierrez, 2008).

Increased use of mobile phones has made base stations to be sited in houses, schools, worship centres, markets in densely populated areas. This has raised public concerns regarding safety of population exposed to radiation from these devices. Many studies and researchers have been done to this effect with varying reports from definitive YES (mobile telephony is hazardous to health) to absolute N0 (not hazardous), with most falling somewhere in-between leaning towards but not admitting to potential health hazards, (US GAO, 2001). Consequently, two main schools of thought emerged regarding GSM radiation hazards. While the first maintained that the only effect (thermal effect) associated with mobile phones and base stations has been taken care of by safety guidelines developed by International Commission on Non-lonising Radiation Protection (ICNIRP, 1998), the second school of though argued that GSM radiation has other effects (non thermal and genotoxial) on human health. This is because microwaves, being wave, have properties other than intensity (which is the part regulated by the safety guidelines). From studies and research results, this school of thought came up with a conclusion that cell phones and cell sites are risk factors for the following:

1. Neurological effects including sleep disturbance, learning difficulties, depression and suicide, (Mild, 1998;).
2. Reproductive effects, Cardiac arrhythmia, heart attack and heart disease (Cherry, 2000).
3. Cancer including brain tumor, leukaemia, breast cancer, liver cancer and testicular cancer (Hardell and others, 2002).
4. Viral and infectious disease (Blackman, 1990).

Going by the dichotomies between the schools of thought and considering the lack of conclusive proof from the scientific and medical communities, it behoves on us to put in place now preventive and precautionary measures as advised by the World Health Organization, (WHO, 2000). We should recall that at the advent of some products (such as asbestos and tobacco) it was claimed that no harms to humans were connected with them but today that claim has been disapproved as it is now reiterated in the case of tobacco that smoking is dangerous to health and smoking kills.

The ubiquity of the GSM standard has been an advantage to consumers, network operators and the government. Its launch in Nigeria brought economic growth, economic empowerment and reduction in unemployment. It has also make communications easier and has assisted mobile phone owners to call an ambulance or get help in an emergency situation.

However, beyond these advantages, there are currently conflicting reports from various scientific sources over the health and safety issues of the public exposed to GSM radiation. Our essence is to make the stakeholders (the government, operators and consumers) see the need why precautionary principle, as recommended by WHO, should be invoked today. As a first line of defense in environmental health and safety management, precautionary principle is a risk management policy applied in circumstances with a high degree of scientific uncertainty, reflecting the need to take action for a potentially serious risk without awaiting the results of scientific research, (EEA, 2007). Taking precautionary measures today is necessary because when it is proven tomorrow that GSM radiation is hazardous; lack of full scientific certainty today shall not serve as cogent reason for not taking proactive and cost effective measures to manage the hazards.

1.1 Research Question

1. Do Nigerians know GSM radiation could adversely affects health?
2. Do consumers know different cell phones emit different degree of radiation?
3. Have operators explained the entire content of their product?
4. Are the operators hiding any side effects of their product from the consumers?
5. Do local citizens and communities have a say in the installation of GSM base stations?
6. What is the government position on the safety and health issues of GSM radiation?

1.2 Hypothesis

1. There is no significant health implication of GSM radiation at SAR value not greater than 2W/kg.
2. GSM base stations operating at power flux density not greater than 4.5w/m^2 has no adverse health effects on humans.

2 METHODOLOGY

Study Area: The study was conducted in Rivers state which is located in the South-South geo-political zone of Nigeria. Rivers state is situated on latitude 4.51^{o}N of the equator and longitude 7.01^o E of the Greenwich Meridian. Out of the 23 local government areas of the state, two where selected for the study because a greater percentage of people using handsets and GSM base stations are resident here. The two local government areas are Obio/Akpor and Port Harcourt City.

Sampling Population and Procedure: The study population was GSM providers and consumers in Obio/Akpor and Port Harcourt City local government areas of River State, Nigeria. Respondents were randomly selected and in all 20 GSM providers (Network Operators and Mobile Phone dealers) and 801 consumers offered useful information relevant for analysis.

Method of data collection: Data used in this study involved both primary and secondary data. The secondary data were collected from records of the ICNIRP recommended guidelines while the primary data were collected via questionnaire and measurement. Two sets of questionnaire were administered; the first was on GSM consumers while the second went to network operators and mobile phone dealers. They were administered, especially that of GSM providers, as face-to-face interview to ensure uniformity in the interpretation of concepts and to create room for possible clarification where and when needed.

Analytical technique: The data collected were analysed using descriptive and inferential statistics. The level of awareness, measures to reduce GSM radiation and time spent on calls were analysed using descriptive statistics while the hypothesis were tested using Chi-square to determine the significance of difference between human health and SAR value less than 2W/kg and also power flux density of 4.5W/m^2.

The equations below are the respective formulae for the power flux density, electric field and SAR.

$$S = \frac{P\,G}{4\pi d^2}$$

$$E^2 = S\,Z_V$$

$$SAR = \frac{\sigma/E^2/}{\ell_m}$$

Where
S = power flux density in w/m^2
P = power (in watts) delivered by the antenna
G = the gain of the antenna
d = distance (in metres) from base station
E = electric field in V/m
Z_V = air impedance = 120π
σ = conductivity of body tissue
ℓ_m = mass density of tissue
SAR = Specific Absorption Rate

3 RESULTS AND DISCUSSION

Data obtained were analyzed using frequency counts and percentages. The personal characteristics, level of awareness and precautionary measures (vis-à-vis harmful effects of GSM radiation) of the respondents are as presented in Table 1. The implication of this is

that consumers/users of GSM technology involve all and sundry; children, young, old, educated, uneducated, married and the unmarried.

Table 1: Profile of Respondents

Age Bracket of Respondents	**Frequency**	**Percentage (%)**
Teens/under teens (2-19 years	121	15
Youth (20-39 years)	464	58
Adult 40 and above	216	27
Total	**801**	**100**
Unmarried	471	59
Married	330	41
Total	**801**	**100**
Level of Education		
No formal / Primary Education	145	18
Secondary education	310	39
Tertiary education	346	43
Total	**801**	**100**
GSM Radiation Awareness and Health Effects		
No awareness	264	33
Low level of awareness	320	40
High level of awareness	217	27
Total	**801**	**100**
Measures to Reduce Effects		
No measures applied	584	73
Small measures applied	217	27
Total	**801**	**100**
Time Spent on Calls		
Under – teens (2 – 12 years)	24	3
Teens and Youths (13-39 years)	561	70
Adults 40 and above	216	27
Total	**801**	**100**

The result in figure 1 reveals that one-third of the respondents (33%) indicated not aware of any health implication, 40% indicated low awareness while 27% showed high awareness of health effects. The difference in the level of awareness among users of GSM technology is particularly significant to justify our stand on taking preventive measures now to contain possible hazardous effects in the long-run.

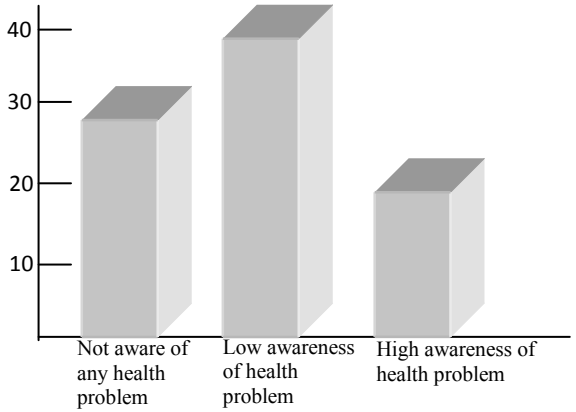


Figure 1: Distribution of Respondents on Awareness of Health Related Problem Of GSM Radiation

The result in figure 2 shows that many respondents (73%) apply no measures for safety of their health from any eventualities regarding GSM radiation; perhaps due to lack of awareness. The implication of this scenario is that should the scientific community concludes that radiation from mobile phones and GSM base stations is hazardous to human, the health of very large population would have already be put at great risk.

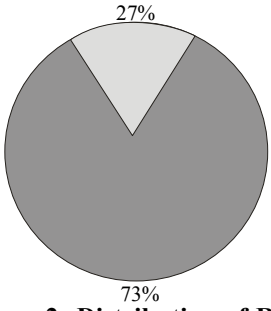


Figure 2: Distribution of Respondents on Measures to Reduce GSM Radiation

From findings, we discovered that the teens and youths spent more time (70%) on calls as against 27% spent by adults. This was attributable to the free night calls offer by network operators. This implies that the younger generation are exposed more to GSM radiation and so there are fears that today's young people may suffer an epidemic of the disease in later life; should it be established that GSM radiation is hazardous. This is depicted in figure 3

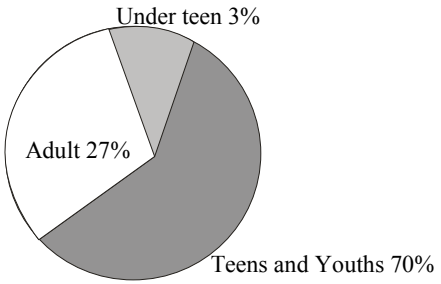


Figure 3: Distributions of the Respondents on the Time Spent While Making Calls

Table 2 shows the result of the test of the null hypothesis that there is no significant health implications of GSM radiation at SAR value not greater than 2W/kg and power flux density of 4.5W/m^2. A Chi-square test was done. From the analysis, x^2 calculated values are greater than x^2-tabulated values. We therefore inferred that the result is significance and thus reject the null hypothesis. The implication of the result shows that the existing safety guidelines, by ICNIRP, governing exposure of the public to GSM radiation may not fully guarantee consumers, adequate protection especially chronic exposure in the long-run.

Table 2: Chi-square test of relationship between human health and SAR value less than 2W/kg and power flux density of 4.5W/m^2

Variable	X^2-calculated	X^2-tabulated	Degree of freedom	Level of significant	Inference
SAR value not greater than 2W/kg	13.07	11.07	5	0.05	Significant
Power flux density of 4.5W/m^2	44.93	11.07	5	0.05	Significant
Power flux density of 4.5W/m^2	44.93	15.09	5	0.01	Significant

4 CONCLUSION

The study did reveal that GSM technology includes the emission of radiation which the public are exposed to. This radiation, which the industry termed mild, enters the body via three primary routes: inhalation (through the rose), absorption (through the skin) and ingestion (through the month). Therefore, its continuous entry into the body may accumulate to a degree that the body thermo-regulatory system may not be able to cope

with. Thus, apparent absence of adverse effects in the short term is no guarantee of immunity against long-term chronic exposure.

Based on the results of the study, the following conclusions and be drawn:

1. Most Nigerians do not take measures to prevent eventualities from GSM radiation in the future.
2. Nigeria government does not have any solid structures in place to ensure safety of her citizens with respect to GSM radiation.
3. The industry does not properly advice consumers of its products to take cautions pending when the scientific community comes up with a conclusive proof.

The GSM technology has satisfied the need of Nigerians for effective and efficient telecommunication system. Notwithstanding, we recommended that the government, industry and the public (consumers) become actively involved in taking appropriate, precautionary and proportionate actions to avoid plausible and potentially serious threats to health from GSM radiation in the long-run. Therefore our recommendation is subdivided into the following.

1. **Advice to government**- the government should enact, as a matter of urgency, effective legislation and solid institutions to help safeguard the health of her citizens vis-à-vis GSM radiation hazards.
2. **Advice to industry:** the industry should address the health risks regarding its products in a more sensitive and informative manner; instead of hiding under the disputed ICNIRP guidelines to deny any hazardous effects.
3. **Advice to the public:** the public should keep a regulation and check on GSM consumption (usage); pending when the scientific community finalizes its research and findings.

5 REFERENCES

Blackman, C.F; (1990): "ELF effect on calcium homeostasis". In "Extremely low frequency electromagnetic fields: The question of cancer", LE Anderson Eds, Publ. Battelle Press Columbus, Pg 187-208.

Cherry N: (2000): Evidence that Electromagnectic Radiation is Genotoxic: The implication for the epidemiology of cancer and cardiac, neurological and reproductive effects. Canterbury, New Zealand Neil.cherry@ecan.govt.nz

EEA, (2007): Late lessons from early warnings: the Precautionary Principle, European Environmental Agency, Copenhagen

Friedhelm, H; (2002) "GSM and UMTS, the Creation of Global Mobile Communications", John Wiley and Sons, Inc., NY

Gutierrez, D (2008): Mobile Phone Radiation to Unleash Epidemic of Brain Tumors, Natural News. www.naturalnew.com

Hardell, L and others, (2002): Cellular and cordless phones and the Risk for Brain Tumors, European Journal of cancer Prevention 11(4), Pg 377-386ICNIRP, (1998): Guidelines for Limiting Exposures to Time Varying Magnetic and

Electromagnetic Fields (up to 300GHz), Health Physics, Vol. 74, No 4, Pg 434-522.

Mild, K.H. and Hauger, (E. (1998): Comparison of symptoms by users of Analogue and Digital Mobile Phones – A Swedish-Norwegian Epidemiological Study. National Institute for working life, Umea, Sweden.

World Health Organization, WHO (2007): "Principles for Evaluating Health Risks in Children Associated with Exposure to Chemicals", Environmental Health Criteria, 237, Geneva.US GAO, (2001): "Telecommunications-Research and Regulatory Efforts on Mobile Phone Health Issues", Report to Congressional Requesters. www.gao.gov/new.items.