JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Observatory study of bio-physical influence of non-ionizing transverse electromagnetic radiation on human brain System

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Abstracts

The brain system which naturally functions for thinking, emotions and memory is a highly sensitive and complex organ of nervous system that responses to the electromagnetic radiations that uses a wide range of extremely low frequencies (ELF). This study was an observed the bio-physical influence of non-ionizing transverse electromagnetic radiation on human brain system. The oscillatory behavior is however accepted to be in all safe conditions with the adoption of International Commission on Non-Ionizing Radiation Protection (ICNIRP) RF exposure compliance for intake dose of electromagnetic radiation into the body head maintained at < 2.0W/kg for health implications. The method used in the design of mobile cellulose/ portable (electromagnetic) devices for the brain exposure to electromagnetic frequencies 900MHz and 1800MHz on this observatory studies for the tropics are expected with conductivities of 0.7665 $\Omega^{-1}m^{-1}$ and 1.1531 $\Omega^{-1}m^{-1}$ respectively. This realization of the carcinogenicity risk as called for in this latest observatory study is to give impacts awareness of RF intake dose into the human brain system.

Keywords: Non-ionizing radiation, Central nervous system, Radio frequency (RF) radiation, Extreme Low Frequency (ELF), Specific Absorption Rate (SAR)

1. Introduction

The digital cellular radio network in Nigeria, tropical African Nation uses the 900MHz and 1800MHz radio frequencies (Molisch, 2010). At least the GSM-900 band must be supported in order to be compatible with many operators (Cellhire, 2013). Literature reveals that frequency-division multiple accesses is a part involved in the division by frequency of the maximum 25 MHz bandwidth into different carrier frequencies spaced some frequencies apart (Harte et al, 1999). Nonetheless, if these factor are features in our belts of channels, dare consequences had been a protest among the tropics was concentrate to causative to congestion arising from dose responses. The power density of portable devices depend specific absorption rate (SAR) which is the absorbed power per the absorbing mass which is expressed as W/kg. The human brain which naturally functions for thinking, emotions and memory is a highly sensitive and complex organ of nervous system that responds to the electromagnetic radiations that use a wide range of extremely low frequencies (ELF) (Alao OA and Ajayi IR, 2013). The pulsed fields or electromagnetic photons tasked by the excessive exposure to RF radiation has consequent effects on brain radicals and hormones responsible for electrical activity of the brain causing extraversion of albumin contents and decrease in loco motor activity of the sensory organ among others. The brain system is in danger for users of mobile or portable devices without taking to the procedure compliance. Classical concepts of physics are used to explain interactions between external electromagnetic fields and the brain tissue and the activity of the brain. The blood –brain barrier permeability and the cerebellum exposure to continuous long hours RF radiation reveal inactive avoidance behavior, reduce memory functions and spontaneous hippocampal morphology. The possible risks of the excessive exposure of the ear diaphragm to quantum (dose) of electromagnetic photons have been given a significance to agree with standard of radiation protection for heath safety in this work. Decrease in locomotors activity of sensory organ are in the danger of the of users without procedure. The extra high frequencies (EHF) are to be regarded to be users of portable devices unfriendly compared to those with design specification with very low frequencies (VLF). Nonetheless, the International Agency for Research on Cancer (IARC) classified portable devices radiation on the IARC scale into possibly carcinogenic conceptualized with health implications such as ocular, genotoxic, physiological and hypersensitivity (John Wargo et al, 2012). This study was an observed the bio-physical influence of non-ionizing transverse electromagnetic radiation on human brain system.

2. Methodology

The power density of portable devices depends on specific absorption rate (SAR), which is the absorbed power per the absorbing mass which is expressed as W/kg. The human brain which naturally functions for thinking, emotions and memory is a highly sensitive and complex organ of nervous system that responds to the electromagnetic radiations that use a wide range of extremely low frequencies (ELF) (Alao and Ajayi, 2013). SAR is usually defined in terms of electric field or in respect to change in temperature given by

$$SAR = \sigma \frac{E^2}{\rho} = c \frac{dT}{dt}, dt \to 0 \qquad (1)$$

Where E is the electric field, The electric field assumed all the components of the electric field in x, y, z plane which may be further express as

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

Neglecting the temperature effects and the specific heat capacity (c), then the required SAR becomes

$$SAR = \sigma \frac{E^2}{\rho} = \sigma \left[\frac{(E_x^2 + E_y^2 + E_z^2)}{\rho}\right] \qquad (3)$$

The power density - SARs relation is shown in the proportionality variance, given by equation (4)

$$SAR = 377\sigma \frac{P_D}{\rho} \qquad (4)$$

But,

$$P_D = \frac{E^2}{Z_0} = \left[\frac{(E_x^2 + E_y^2 + E_z^2)}{Z_0}\right] \qquad (5)$$

where ,

$$Z_0 = 120\pi = 377\Omega \qquad (6)$$

and

$$E^2 = 377P_D \qquad (7)$$

Equations (6) and (7) validates the expressions of equation (4) where is the peak value of the internal electric field (Vm^{-1}). SAR is also dependent upon the wave type, that is, square, sine of triangular. The average SAR is defined as the ratio of the total power absorbed in the exposed body to the mass in which it is absorbed, which is not necessarily that of the total body. Where E is the electric field, Z_0 is the free space impedance equivalent to 120π or 377Ω. The electric field assumed all the components of the electric field in x, y, z plane which may be further express as (E) To determine the SAR we have to know the values of the electric field, from equation (1), we have equation (3) being the SAR is usually define in terms of electric field or in respect to change in temperature given by (dT) neglecting the temperature effects.

The comparison model used in this study involved experimentally based specific absorption rates (SAR) taken by electromagnetic detector of variety of portable devices placed at 0.001m from the human ear. This enables us to compare the experimentally observed differentials of empirically observed SARs with the ICNIRP's exposure limits to suite tropical behavioural responses to RF dose. In various Phone models or species experimentally confirmed with empirical SARs, tolerance characteristic differences were noted. The specific absorption rate (SAR) given in dosimetric measure for our tropical broadband frequencies 900/1800MHz. (Alao et. al., 2020). Specific absorption rate SAR and power density are relevance in our low percentage % in the limit of recommendations taken for ≤ 1.5mW/kg while in the upper limit > 1.5mW/kg. These helped to quantify our inferences in terms of parameter of the ICNIRP's safety guide in terms of the parameter as applicable to dosimetry measure. At higher frequencies, many interactions are due to the rate of energy per unit mass.

This study concentrates on broadband frequencies band associated with tropics observed with tolerance limit for SARs at lower limits of < 1.5mW/kg and the upper limits of ≥ 1.5 mW/kg, for the conductivity and mass density as shown in Table 1. It is rarely observed that the 900MHz compared same mass density with 1800MHz but at conductivities of 0.7665/1.1531 $\Omega^{-1}m^{-1}$ for 900/1800MHz respectively. Table 2 featuring the relative data for the frequencies used in the tropics to the advantage close to unity of the tolerance for ICNIRP's recommendations. It can be observed from the table that a factor of 5 is the rationalization coefficient for the body head SAR and whole body SAR. Only the power densities measured for broad and frequencies are different. (Table 2).

Table 1: Characteristic dielectric parameter for human brain tissue

Frequency (MHz)	Conductivity, σ (Ω^{-1}/m)	Mass density, ρ (kg/m)
900	0.7665	1030.0
1800	1.1531	1030.0

Table 2: ICNIRP's recommended frequency tolerance for portable cellulose

Frequency (MHz)	Power density, σ (μW/m^2)	Whole body, SAR (W/Kg)	Body Head, SAR (W/Kg)
900	0.7665	0.08	2.000
1800	1.1531	0.08	2.000

ICNIRP's recommended frequency tolerance for portable cellulose

3. Results and Discussion

The data of study used in our analysis are the measured specific absorption rate (SAR) and relative power density from an electromagnetic detector placed a distance of 1.0×10^{-2}m from the human ear diaphragm. These were at random used on different phone types commonly associated with the tropical southern, Nigeria (Kuboye et. al., 2011). The phone models include, Nokia 3310, Nokia 3330, Motorola, C 117, Motorola, L6, Sagem MYX7, Sagem C 17, Sony, Sony Ericson and I- Tel mobile phone (Table 3 and 4).

Table 3: SAR- Power density measured from portable cellulose

Phone Model	SAR (mW/Kg)	Power Density (μW/m^2)
Nokia 3310	1.100	0.300
Nokia 3330	1.100	0.300
Motorola L7	1.500	0.400
Motorola L9	1.500	0.400
Sagem C 17	1.500	0.400

Table 4: Measured Localised (body) head SAR compared with ICNIRP's safety guide

Mobile Phone Type	Body Head SAR (W/Kg)	Calculated Relative ICNIRP's SAR tolerance (W/Kg)
Nokia	0.0011	1.9989
Sony	0.0011	1.9989
Sagem	0.0011	1.9989
Motorola	0.0015	1.9985
Sagem	0.0015	1.9985
I - Tel	0.0015	1.9985

The radio frequency separation between matching the uplink and downlink carrier for 900MHz is 45MHz while that of 1800MHz is 90 MHz (Kuboye et al , 2011) for all type of portable cellulose observed . As shown in Tables 5 and 6, there is less than unity characteristic to favour tolerance as reported by International Commission on Non Ionizing Radiation (ICNIRP) on recommendation.

Table 5 : Measured SAR- Power density from portable cellulose

Phone Model	SAR (W/Kg)	Power Density (μW/m^2)
Motorola L6	0.0018	0.500
Motorola L7	0.0017	0.400
Sagem MYX7	0.0018	0.500
Nec 616	0.0018	0.500
Novo	0.0017	0.400

Table 6: ICNIRP's Relative Tolerance limit calculated for SARs >1.5mW/kg

Mobile Phone Type	Body Head SAR (W/Kg)	Calculated Relative ICNIRP's SAR tolerance (W/Kg)	Tolerance advantage percentage (%) Inference
Motorola	0.0017	1.9983	< 1
Sagem	0.0017	1.9983	< 1
Novo	0.0017	1.9983	< 1
Motorola	0.0018	1.9982	< 1
Sagem	0.0018	1.9982	< 1
Nec	0.0018	1.9982	< 1

4 Conclusion

It is recommended that precise precisions for design of cell phones considerably higher than 1.5mW/Kg specific absorption rate (SAR) in order to check luxury addictive attitude of the use of mobile cellulose in the tropics. Health endpoints or hazard associated with exposure to electromagnetic radiations are yellow labeled on user's guide. This will set a temperate- tropical criterion for the usage of portable machines by considering environmental compliance with stated observations for the users of non-ionizing transverse electromagnetic wave machines and making potable probes likable to check SAR levels for the public.

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