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Survey of the Effect and Medical Application of Electromagnetic Radiation

Ojobeagu, A. O.[1], Vwavware, O. J.[2*], Ossai, C.[2], Akpoyibo, O.[2] and Chikwendu, A. O.[1]
[1]Department of Industrial Physics, David Umahi Federal University of Health Sciences, Uburu, Ebonyi State.
[2]Department of Physics, Dennis Osadebay University, Asaba, Delta State.
*Corresponding Author Email: judevwavware@yahoo.com

ABSTRACT
Every electronic gadget that has become a part of daily life has had its electromagnetic radiation thoroughly examined. The maximum emission level and the minimum distance at which each device has an impact have been examined. Even in remote locations far from transmitters, the radio frequency field strength meter is an incredibly sensitive tool that can detect RF background with accuracy. The meter's display shows the true power density right away. The internal detection method of this meter produces a flat response across a very large frequency range, in contrast to other inexpensive field strength meters whose frequency response is dependent on the properties of an external antenna.Accuracy between 30 MHz and 2.4 GHz for FM, TV, and cell tower frequencies is +/-25%. Between 0.5 MHz and 3 GHz, the sensitivity is 50% (-3 dB) lower. At 5 GHz, sensitivity is 25%. In other words, when detecting microwaves at that high a frequency, you have to multiply the reading by 4. The sensitivity is roughly 10% at 10 GHz.).

Keywords:
Electromagnetic Radiation,
EMF Exposure,
Human,
Health,
Environment.

INTRODUCTION

Electromagnetic fields (EMF) are divided into two distinct groups: low frequency EMF and high frequency EMF. High frequency electromagnetic fields (EMF) sources encompass cell phones and base stations, television (TV) and radio broadcast gadgets, induction heaters, radar, and anti-theft devices, according to Claudia et al. (2014). Computers, power cables, and household electrical gadgets are typical examples low-frequency producers (sources). There is a lot of controversy and public discussion about the location of black spots (BSs) and the short- and long-term effects of EM emission exposure from BSs on humans, animals, and also the natural environment (D Reid, 2009). Multiple electromagnetic fields at various (different) frequencies are experienced by humans (US Department of Transportation: NTIS, 1999).

High-frequency EMFs can be quite damaging. While electromagnetic fields (EMF) are naturally occurring, the use (introduction) of electricity and wireless technology has increased the amount of man-made EMF sources which are present in the environment or surroundings (Kovertz, 2000). Even while electromagnetic fields (EMF) occur in nature, the ambient exposition to man-made (artificial) sources of EMF has significantly increased significantly due to excessive usage of electricity and wireless technology (Kovertz, 2000).

As mobile phones have evolved from simple communication devices to ubiquitous, data-hungry smartphones that are daily part of our lives, frequent network upgrades and the construction of numerous base stations (BSs) have been necessary to meet the growing demand for bandwidth while also providing mobile users with the necessary coverage (Yusuf et al., 2018). Because mobile communication system depend on radio frequency (RF) waves to work, mobile communication ubiquitousness increases electromagnetic (EM) radiation level exposure to man. Worries concerning serious health challenges as a result of RF radiation exposure from mobile communication technology is on rise (Mohankuma, 2010). Human beings are continuously exposed to electromagnetic radiation. Man is surrounded by electromagnetic fields in a lot of ways we can't imagine. Human body system is biologically disturb by EM waves. When human body is exposed to more than 10mG it results in brain tumors and cancer (Aakanksha et al., 2011). Man tried to explore the electrons for ease of his survival and though he succeeded but simultaneously an environment has been created from where electromagnetic Ray's are getting radiated (Aakanksha et al., 2011).This electromagnetic radiation exists across a broad range of the electromagnetic spectrum. This radiation ranges fromvery high energy and frequency on one end of the spectrum to very low energy and frequency on the other end. Ionizing radiation consists of

electromagnetic waves thatare on the high-energyelectromagnetic spectrum. It includes gamma rays, x-rays and higher energy ultraviolet part ofthe electromagnetic spectrum. Non-ionizing radiation consists of electromagnetic radiation thathas low energy. It consists of microwaves, visible light, infrared, radio waves and lower-energyultraviolet. EM radiation effects on human health is determined by factors which includes the nature EM radiation (ionizingor non-ionizing); the amount of dose absorbed; the absorption rate of the doses thepolarization of the electromagnetic wave; and the distance from the source (Ibraheem et al., 2013). Exposure of EM radiation can lead to effect on genes, psychological stress on human body, loss of immunity, effect on pregnant ladies (Aakanksha et al., 2011). Non - ionizng electromagnetic field (EMF), from extremely - low frequency to radio frequency, have been shown to cause biological effects even at low intensity (Henry et al., 2016). Electromagnetic radiation is very useful in medicine. The electromagnetic spectrum and the associated types of light are especially used in medicine (Syed, 2013). Application of EMF is found in core areas such as, including wound healing, tissue regeneration, osteoarthritis, bone healing and nerve stimulation (Marovino, 2011). RF is also used to treat tumors in lung, kidney and bone other the generator at a high power than used for cardiology. RF is is used to soften tissues, fluid, fat and bone. It is applied to identify tumors. Heat is used to destroy cancer cells by Radio frequency ablation (RFA). The cancer cells dies and the area that is treated gradually shrinks and becomes a scar (Syed, 2013).

MATERIALS AND METHODS

Methods

Radio Frequency Field Strength Meter

The unique apparatus was utilized in this paper to calculate the strength or power of the electromagnetic field that cell phones emit. Power density ($\mu W/cm^2$) is the equivalent (equal) of field strength. The radio frequency (RF) radiation electric field, which ranges from 0.5MHz to 3GHz, is detected by this apparatus. It covers the range of 0.001-2000$\mu W/cm^2$.

Figure 1: The Radio Frequency Field Strength Meter (https://www.alphalabinc.com/product/rfm1/,2022).

Mobile Phones

Four different mobile phone brands' radiation outputs were compared. These brands include iPhone, Samsung Galaxy, Huawei, and Nokia.

Books and Journals From Enugu State University Teaching Hospital (ESUT) Library

Data were collected from books and journals in ESUT library. This data were evaluated for this research work.

Method

Even in remote locations far from transmitters, the radio frequency field strength meter is an incredibly sensitive tool that can detect RF background with accuracy. The meter's display shows the true power density right away. The internal detection method of this meter produces a flat response across a very large frequency range, in contrast to other inexpensive field strength meters whose frequency response is dependent on the properties of an external antenna. The internal detection system produces a flat response over a very wide range of frequencies.+/- 25% is the accuracy in the FM, TV, and cell tower frequency range (30 MHz – 2.4 GHz). At the frequency limits of 0.5 MHz and 3 GHz, sensitivity is low by 50% (-3 dB). At 5 GHz, sensitivity is 25%, meaning you have to multiply the reading by 4 to measure microwaves at that high of a frequency. At 10 GHz, sensitivity is approximately 10%. You can measure the whole band width (―Wide‖=0.5MHz–3 GHz) or add a high-pass filter (Narrow‖ = 6 dB/octave roll-off with a knee at 100 MHz) that essentially lets only 100 MHz to 3 GHz pass through using a high-pass selection switch. In actuality, one more parameter can be estimated using this high-pass filter or function: the average frequency of the radio frequency (if it falls between 10 MHz and 500 MHz).

A normal 9-volt battery is included with the RF Field Strength Meter. There are around ten minutes left on the battery when a low-battery indicator appears on the display. The battery uses roughly 15 milli amperes of electricity and indicates a low battery level of 7.6 volts.

Relevant studies for assessing the health risks associated with electromagnetic radiation were also assessed. Broad categories including epidemiologic research, human, animal, and cell culture experiments, as well as experimental studies, can be used to categorize this health risk assessment. Additionally, research on dosimetry, exposure assessment, and biophysical mechanisms are taken into account.A health risk assessment assesses the available data in each of these areas before combining the data from all of the areas to create a single assessment. The question of whether a hazard exists—that is, whether exposure and a negative health outcome are causally related—should be covered by this combined evaluation. The response to this query may indicate the strength of the evidence supporting the existence of a hazard rather than being a clear yes or no. Estimates of the effect of exposure on the burden of disease and a description of population exposure are also included in a comprehensive risk assessment.

RESULTS AND DISCUSSION

Salih (2021) claims that four different mobile phones brands/groups were used for the tests. The method used to obtain the radiation readings from each mobile within each group was to make a call through the mobile device, following which the electromagnetic radiation intensity/power density measuring device was measured. Nokia is the first phone brand taken into account. The radiation power density limits are displayed in Tab. 4.1 and range from 145.33 to 862.87 µW/cm². The allowable maximum, 500 µW/cm², should not be exceeded, nevertheless. The highest radiation power density number was achieved by the Nokia 7 Plus, with the Nokia 7.2 coming in last. It is evident that the three types of this group do not above the allowable limit in terms of radiation power density.

Table 1: Data for Nokia Mobile Group (Salih, 2021)

Power Density(µW/cm^2)	NokiaMobile Group
557.72	9Pview
145.33	7.2
853.45	6.2
647.74	X7
664.23	X71
638.65	6.1Plus
195.44	5.1Plus
734.92	8.3
471.31`	5.3
862.87	7Plus

The 10 mobile phones that were examined, Huawei phones fell into the second category; their findings ranged from 114.95 to 642.72µW /cm². As Table 2 illustrates, there are two varieties of these that exceed the permissible threshold. The Y9 group has been shown to be the most appropriate group, with radiation power levels of 114.95µW /cm². Y9S and Meta 30 are closely behind with power values of 235.91µW /cm² and 337.77µW /cm², respectively.

Table 2: Data for Huawei Mobile Group (Salih, 2021)

Power Density(μW/cm^2)	Huawei Mobile Group
337.77	Meta30
235.91	Y9S
633.37	Y9Prime
427.84	Y7Prime
464.28	Y6S
418.69	Y5Light
395.44	Y5
114.95	Y9
421.39	Nova5T
642.72	P40Pro

The radiation power density of the Samsung Galaxy is displayed in Table 3. This group of mobile devices releases radiation power within the range of 214.56-447.89 μW/cm². Many of the gadgets in this category fell within the authorized mobile device transmission limit. This category is recommended to be used in order to prevent radiation harm because of its low transmission power.

Table 3: Data for Samsung Galaxy Mobile Group (Salih, 2021)

Power Density(μW/cm^2)	SamsungGalaxyMobile Group
398.24	S8
266.51	A70
510.66	A50
447.89	A10
388.32	A20
431.99	S7Edge
372.12	S4
214.56	Note3
374.22	S6
321.43	S10Plus

Ten samples were ascertained for the fourth group, which is iPhone, and decipher measurements were recorded. As can be seen in Table 4, the 11Pro type has the lowest radiation power density in this group, measuring 228.43 μW/cm². All measured models operate within the acceptable standard limit. The radiation studied power is within the range of 228.43–442.72 μW/cm².

Table 4: Data for iPhone mobile group (Salih, 2021)

Power Density(μW/cm^2)	iPhone Mobile Group
228.43	11Pro
236.97	ProMax64
321.14	ProMax128
328.55	ProMax256
352.17	Xs64
316.55	XR64
377.11	Xs256
243.65	XR128
349.26	XsMax64
442.72	XsMax256

Discussion

A survey of EM radiation exposure has been performed. The result of the data from the first group which is Nokia Mobile revealed that that the limits of radiation power density is restricted to between 145.33 – 862,87 μW/cm^2. The acceptable rate should not be more than 500 μW/cm^2. Nokia 7 plus recorded the highest value of radiation power density while Nokia 7,2 has the least radiation power in this first group. According to previous calculations and recommendations of ITU the nearest distance allowable for human beings from radiation source is 6 meters (Kelvin, 2013). Ten Huawei mobile

that were tested were found to be in the range of 114.95 – 642.72 μWcm^2. Y9 of the Huawei mobiles were discovered as the most appropriate because its radiation power value is at 114.95 μW/cm^2 and the next is Y9S with radiation power of 235,91 μW/cm^2. The radiation power density of Samsung Galaxy is between 214.56 – 447.89 μW/cm^2. Most of the mobile device in this group did not exceed the acceptable standard. IPhone was the fourth category and the radiation power is between 228.43 - 442.89 μW/cm^2. All the IPhone measured worked within the permissible limit. When the results of four categories of various mobile phone types were compared, a difference in radiation power values was found. Some of the group had radiation power that was below the standard limit, some that was near it, and some that was above it. Other forms of transmission power exist that are twice as acceptable. According to the result analysis, there is a superior product in more than one area. For example, over 90% of Galaxy and iPhone devices operate under the standard limit, which is less than 0.5 mw/cm².We must take every precaution to prevent the harm that the mobile device's high capabilities do to people's health. For mobile base station, ICNRP recommends that the general public exposure should be limited to 2 W/Kg in an 10g for head and body, 4 W/Kg in any 10g for limbs and in addition 0.8 W/Kg for the whole body and all of these subject to an averaging period of 6 minutes (Sven et al., 2005)

CONCLUSION

The implications of electromagnetic waves (fields) from base stations on mobile phones for people remain unclear, according to our research. Tight adherence is required to EMF radiation restrictions. Mobile phone users' exposure to EM radiation varies depending on the technology of their phone, how far they are from the base station, how close they are to the antenna, and how long they have owned it. There needs to be more done to educate and better inform the public about EMR applications and concepts.

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