

## International Journal of Computer Science and Mobile Computing

A Monthly Journal of Computer Science and Information Technology

ISSN 2320-088X

*IJCSMC, Vol. 5, Issue. 2, February 2016, pg.298 – 304*



# Effects of Mobile Radiations and its Prevention

Sukhdeep Kaur<sup>1</sup>, Jaipreet Kaur<sup>2</sup>, Manjit Sandhu<sup>3</sup>

<sup>1,2,3</sup>Department of Electronics and Communication Engineering, Guru Nanak Dev University Regional Campus, Sathiala (Amritsar), India

<sup>1</sup> [sukhdeepkaur21@gmail.com](mailto:sukhdeepkaur21@gmail.com); <sup>2</sup> [jaipreet.ecesathiala@gndu.ac.in](mailto:jaipreet.ecesathiala@gndu.ac.in); <sup>3</sup> [manjit\\_sandhu67@yahoo.com](mailto:manjit_sandhu67@yahoo.com)

---

*Abstract- The number of mobile users is increasing as the time passes and the technology keeps on evolving to meet the requirement of higher data rates than the previous generation. This in turns leaves a huge harmful biological impact on the biodiversity. The microwave mobile communication systems include the TV, FM and AM broadcasting station which use large amount of power to transmit the signals at a greater amount of distance. WiFi and WiMAX are used in most of the developed parts of the world where there is a need of greater data rates. Both of these communication technologies have operating frequencies of some multiples of GHz which is the higher end of the microwave frequency band. The microwave frequencies used in the cellular communication causes the thermal and non-thermal effects. There is a lot of damages that is done by the non-thermal effects as compared to the thermal effects. The electromagnetic radiations are also recognized as the major cause of cancer. The EMR emitted by the mobile antennas used at the base stations effects the cell structure of the living beings. Also the mobile devices used by users have a rating of specific absorption rate (SAR), it is a measure of the power that a human body absorbs using the mobile device which should be safe radiation level absorbed by the human. All the above broadcasting and communication technologies have brought the revolutionary change in the wireless system and are also responsible for the most of the devastating effects on the living beings. This paper discusses various problems caused by the wireless communication technologies and expected methods to reduce the effects. There are international exposure limits and guidelines for radio frequency fields. There is need of an hour to understand health problems from radio frequency radiations and implementation of the guidelines.*

*Keywords - "Electromagnetic field (EM Field)", "Specific Absorption Rate (SAR)", "Biohazards", "Base Trans receiver system (BTS)", "safety guidelines".*

---

## I. INTRODUCTION

Mobile phones were introduced for the convenient communication. Mobile phone subscriptions have grown at very fast pace in the last 20 years. It has penetrated over 70% of the population across the globe. India has also witnessed this growth and has approximately 910 million wireless connections today. Although there are many advantages of mobile phones but it has a negative side also. The effects of electromagnetic (EM) radiations from mobile towers and mobile phone handsets have many adverse effects on health. With increasing number of mobile phones, the numbers of mobile towers have also increased multifold. The towers installed on the rooftops of houses and in densely populated areas are causing some serious health hazards. On 31 May, 2011 World Health Organization (WHO) confirmed the radiations from the mobile phones as a carcinogenic hazard for human health.

*Electromagnetic radiations:* Electromagnetic radiation is described by the flow of photons in the space. Each photon contains a certain amount of energy, and the different types of radiations are defined by the amount of energy found in the photons. The electromagnetic spectrum is the range of all types of EM radiation.

There are two types of EM radiations:

1. Ionizing radiations: These waves contain high energy that overcome the binding energy of electrons in atoms/molecules and creates ions. Examples include ultraviolet rays, X-rays, gamma rays, cosmic rays, etc. [12].
2. Non-ionizing radiations: These waves do not carry high energy per quantum to make ions from atoms/molecules. These are low-frequency radiations. Examples are radio waves, microwaves, infrared waves, etc.

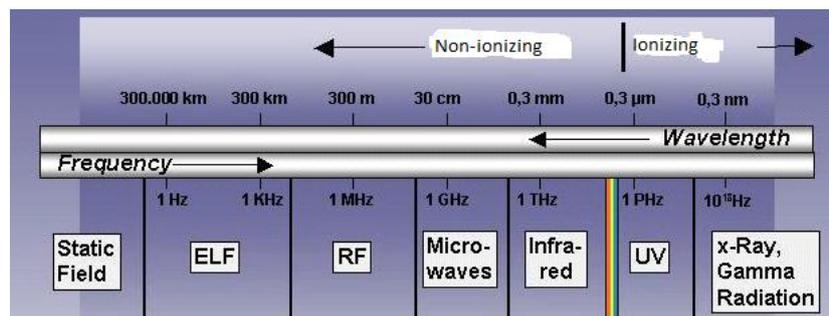


Figure 1. Electromagnetic Frequency Spectrum [12]

Effects of EMF radiation can be studied in two ways i.e. bio-effects and health effects.

1. *Bio-effects* are measured as responses to a change in the atmosphere and may not harm our health. Biological effects can be of two types i.e. Thermal and Non-Thermal effects.
  - a) Thermal Effects refers to the heat generated due to absorption of EM radiations. The heating effect can occur near head while using mobile phones which can increase its temperature. Using mobile phones for longer duration can increase the temperature of the body.
  - b) Non-Thermal Effects are produced by the electromagnetic effects inside the biological cells of the body which can harm our body.

2. *Health effects* are the changes which may be short term or long term. These effects stress the system and may be harmful to human health.

## II. SOURCES OF EM RADIATIONS

A. *EM radiations have two primary sources in case of mobile services:*

- a) Radiations from Base Transceiver Station (BTS)
- b) Radiations from mobile phone handsets

Both these radiations fall under the category of non-ionizing radiations as these are low energy waves and are unable to break the atoms into ions.

a) *Radiations from Base Transceiver Station (BTS):* A BTS provides wireless communication link between the user and the network. It has a number of radio-transmitters which are combined and fed to Base station antenna through cables. So, the total radiated power will be equal to the sum of output from each transmitter. The maximum exposure to radiations will be at the peak hour when all the channels are used and the sector having the highest call traffic will have the highest exposure to EM radiations. Gain of antennas and transmission power levels also play a vital role in assessing the exposure of EM radiations from BTS. Omnidirectional antennas have higher gain than sector antennas which provide high efficiency and coverage but the risk of exposure also increases. The primary lobes exhibit the maximum radiations in horizontal direction. Radiations from secondary lobes range from medium to low [6]. The level of radiation starts decreasing as we move away from the line of antenna to its side lobes.

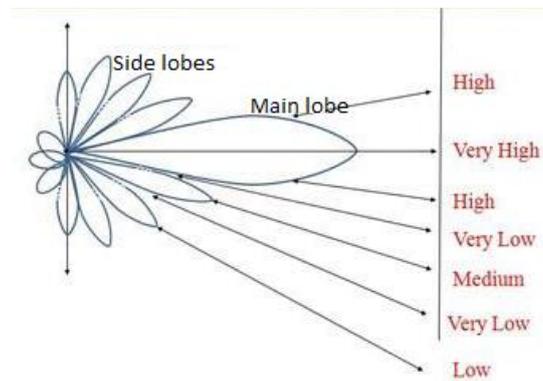


Figure 2. Radiation pattern of Base Station antenna [6]

EM radiation depends on the following: -

- i. Frequency / wavelength of RF signal being transmitted.
  - ii. Radio Frequency Power radiated from the antenna.
  - iii. Duration of Exposure of RF signal at a given distance from the antenna.
  - iv. Exposure from other antennas located in the area.
  - v. Duration/ frequency of recurrent exposure.
  - vi. Temperature and humidity.
- b) *Radiations from mobile phone handsets:* EM radiations from mobile handsets are within limits and are about 1W. It operates within prescribed Specific Absorption Rate (SAR) which gives the amount of radio waves absorbed by body tissues while using mobile phones. SAR is defined as the rate at which energy is absorbed by human body when exposed to electromagnetic frequency (EMF). It expresses the power absorbed per mass of tissue and its units are Watts per Kilogram (W/Kg). In areas of low coverage and low field strength, the prescribed values of SAR can be

reached [12]. However, it does not consider the specific transmission properties of each mobile handset. It shows only the maximum value and does not indicate the actual or average value. Although SAR is an important value to compare the maximum exposure to EM radiation but does not have sufficient information about practical EM exposure for reliable comparison of individual mobile phone handset models.

The radiations from BTS as well as mobile handsets moves invisibly through human body and plays havoc on its biochemistry. A large number of studies have been done related to exposure to EM radiations which suggests increased risk of many diseases like Alzheimer, heart diseases, miscarriage, brain tumors, leukemia, stress, fatigue, depression, memory loss, sleep disorders, DNA damage, hormonal imbalance, etc.

### III. EFFECTS OF EM RADIATIONS

- A. *Effects on Human Health*: Every individual respond in a different way to similar levels of EM radiations. There are various short-term and long-term effects from mobile radiations. Short-term effects may include sleep disorders, headaches, depression, memory loss, etc. while long-term effects can be brain tumor, cancer, DNA damage, etc.
1. *Cancer*: According to a study performed by doctors from German city of Naila [3], a newly-diagnosed cancer rate is three times higher for those living within 400 meters of mobile phone towers than those living far away. Breast cancer was one of the most observed while that of prostate, pancreas, bowel, skin, lung, and blood also increases [17]. Children and teenagers, before the age of 20 are five times more likely to get brain cancer, as their brain is not fully developed and radiation penetration is much deeper. It is possible that today's young people may suffer an "epidemic" of the disease in later life [8].
  2. *Hormonal imbalance*: studies conducted by Charles Graham, PhD, physiologist at Midwest research Institute in Kansas City, shows that EM radiations imbalances the hormones [3]. Women and men were exposed to higher levels of EM radiations for a night in the laboratory which increased their serum estrogen levels in women and decreased the testosterone levels in men [4]. The increased levels of estrogen develop the risk of cancer and decreased level of testosterone has been related to development of prostate and testicular cancers [8]. Another hormone called, melatonin, secreted by pineal gland in brain and is responsible for sleep cycle is also effected by EM radiations. The level of melatonin is higher at night and is low during the day. It is produced almost 90 minutes after we fall asleep. When this hormone is inhibited by radiations many problems are caused like sleep disorders, insomnia, headaches, etc. The cells are repaired and rejuvenated while sleeping but lack of sleep can lead to development of cancer.
  3. *DNA damage*: Studies by Carl Blackman have shown that weak electromagnetic fields release calcium ions from cell membranes. Leakage of calcium ions into the cytosol acts as a metabolic stimulant, that is responsible for growth and healing, and also promotes the growth of tumors. Loss of calcium ions causes leaks in the membranes of lysosomes releasing DNA's that causes DNA damage. Another possibility of DNA damage can be through increased free radical formation inside cells, which further causes cellular damage in the mitochondria.
  4. *Stress*: Mobile phones can cause physical stress in the body in addition to mental interruptions. When the body experiences a stress event the "flight or fight" response is triggered. Certain stress hormones are released from the adrenal glands, the first of which is adrenaline. The effects of adrenaline include rapid heart rate, increased energy level, increased blood pressure, muscle contraction, rapid breathing, etc. These effects are not harmful if they only occur for a short period of time but can harm the body in case of long periods. Another chemical released by the

adrenal gland is a hormone called cortisol. Cortisol is the body’s natural form of cortisone. When the human body is chronically stressed higher amounts of cortisol are released. These high amounts of cortisol suppress the immune system, blood sugar levels rise and insomnia can occur. Finally, after long-term continual stress responses the adrenal glands become tired and fatigued. Symptoms like Irritability, fatigue, anger, road rage, high blood pressure, loss of blood sugar control, decreased thyroid function and weight gain can result from this condition.

5. *Miscarriages and high Blood Pressure*: Exposure to mobile phone radiations can increase blood. A German study, published in The Lancet, reported that the level of blood pressure was increased in a group of volunteers when mobile phones were randomly turned on and off without the participants knowledge [15]. Another hazard linked to the EM radiations exposure is miscarriages. One of the studies conducted in this area shows a 180% increased risk for miscarriage when exposed to medium to low radiations [16].

#### IV. PREVENTIONS FROM EM RADIATIONS

- A. *Safety guidelines for preventions of health hazards from the EM radiations*: There are wireless signals all around us and these are invisible. We cannot escape the radiations but we can follow safety guidelines given by various organizations to minimize the health hazards from these radiations.

International Commission on Non-Ionizing Radiation Protection (ICNIRP) is an independent body that studies the ill-effects of non-ionizing radiations on human health. It comprises of experts from various fields such as Epidemiology, Biology, Dosimetry and Optical Radiations, etc. As per ICNIRP guidelines, the safety levels are:

TABLE 1  
SAFETY GUIDELINES BY ICNIRP

Frequency range (f)	Power density (W/m <sup>2</sup> )
400 MHz – 2GHz	f/200
2GHz – 300GHz	10

In India, monitoring of the radiation emanating from the BTS is carried out by the Department of Telecommunications (DoT). The DoT has issued instructions regarding setting up of acceptable EMF radiation limits and the testing procedure to be followed. The Telecom Enforcement Resource & Monitoring (TERM) Cells, a unit of DOT, tests upto 10% of BTS sites selected randomly by them. Additionally, BTS sites, against which there are public complaints, are also tested by TERM Cells. In 2008, DoT has adopted the ICNIRP Guidelines and prescribed limits/levels for antennas (Base Station Emissions) for general public exposure [12]. Safe radiation levels should be adopted as 0.01W/m<sup>2</sup> which will reduce the transmission power from each mobile tower. More number of repeaters and fiber optic solutions should be installed. The installation of antenna should be in such a way that it should not be installed in the direction of houses/buildings. The antennas should be installed away from the densely populated areas.

To avoid potential risks, some simple steps can be employed to minimize exposure and effects of RF radiation.

1. The time spent by a person on using mobile phones should be reduced.
2. If long conversations by mobile phone must be conducted on daily basis then distance should be placed between the body and the source of the EM radiations, which will help in minimizing the exposure level. For example, one can use headset with the mobile phone so that a distance can be maintained between the body and the mobile phone handset.
3. Devices marketed under Cell/Wave Guard were found to reduce a significant amount of radio frequency emissions could be used to prevent these emissions from entering the body. While this represents a significant reduction it is not known if it is enough to guard against all potential effects. However, it is the best technology easily available today.
4. Digital mobile phones can be used instead of analog phones as digital phones emit lower EM radiations, thus lowering potential adverse effects.
5. Mobile handsets with lower SAR value should be preferred while purchasing as most mobile phone providers give information about the SAR values on the batteries of these phones.
6. People with pacemakers should take some simple precautions to make sure that their cellular phones do not cause a problem. For example, they should hold the mobile phone to the ear on the opposite side of the body where the pacemaker is implanted. Some extra distance between the pacemaker and the phone should be maintained. Placing the mobile phone near pacemaker, i.e. in shirt pocket, should be avoided.

Practicing some of the above safe mobile phone usage habits and avoiding excessive use can lead to minimize the health hazards from the radiations of mobile phones.

## V. CONCLUSION

Mobile phones are used widely throughout the world for easier connectivity and wireless communication. Mobile phones have a darker side also as these emit the electromagnetic radiations which cause many health risks. The mobile phones handsets and the antennas used for wireless communication are studied as primary sources of electromagnetic radiations. This paper has also reviewed long-term and short-term effects of mobile phones. Long-term usage of mobile phones cause health hazards such as cancer, high blood pressure, miscarriages, DNA damage, hormonal imbalance etc. while their short-term uses can cause conditions like insomnia, depression, headaches, sleep disorders, etc. To minimize the health issues related to the exposure of radiations the safety guidelines provided by various organizations such as ICNIRP should be followed. Following some simple mobile phone usage habits such as the time, distance between the mobile and body, etc. can prevent the various health hazards from the radiations of the mobile phones.

## REFERENCES

- [1]. Wikipedia, the free encyclopedia (online): “(i) Mobile Phone radiation and health, and (ii) Electromagnetic Radiation and health”.
- [2]. World Health Organization, “Electromagnetic Fields and public health-Mobile phones: Fact sheet” June 2011, No.193
- [3]. Aruna Tyagi, Manoj Duhan and Dinesh Bhatia, “Effect of mobile phone radiation on brain activity- GSM vs CDMA. International Journal of Science, Technology and Management”. Apr 2011; vol 2(issue 2), pg 1-5 (Link: [http://www.ijstm.com/archive/aruna\\_0401.pdf](http://www.ijstm.com/archive/aruna_0401.pdf))

- [4]. Environmental Working Group, "Cell phone Radiation- Science Review on Cancer Risks and Children's Health: Do cell phones cause cancer or other illnesses". 2009,1, 8-10
- [5]. Sara Thomee, Annika Harenstam and Mats Hagberg, "Mobile phone use and stress, sleep disturbances and symptoms of depression among young adults-a prospective cohort study" *BioMed Central Public Health*, 2011, 11:66.1-11
- [6]. Dr. Girish Kumar (2010), "Report on Cell Tower Radiation", Submitted to Secretary, DOT, Delhi, [Online] Available: [http://www.indiaenvironmentportal.org.in/files/file/Kumar-Cell-Tower-Radiation-Report sent-to-DOTDepartment-of-Telecommunications.pdf](http://www.indiaenvironmentportal.org.in/files/file/Kumar-Cell-Tower-Radiation-Report%20sent-to-DOTDepartment-of-Telecommunications.pdf)
- [7]. Neha Kumar, Dr. Girish Kumar, "Biological Effects of Cell Tower Radiation on Human Body", ISMOT 2009, Dec. 16-19, New Delhi, India
- [8]. Graham C, Cook MR, Gerkovich MM, Sastre A, "Examination of the melatonin hypothesis in women exposed at night to EMR or bright light", *Environ Health Prospect* 2001 Dec; 109(supply):911-933.
- [9]. "Health impact of electromagnetic radiation from telecommunication towers located in close proximity to residential areas", Office of the Auditor General of Canada, Petition No. 255, Environmental Petition to the Auditor General, Submitted June 22, 2008
- [10]. Alleyne, R. (2012), "Mobile phones can cause brain tumours, court rules. The Telegraph", <http://www.telegraph.co.uk/health/9619514/Mobile---phones---can---cause---brain---tumours---court---rules.html>
- [11]. Blackman, C. (2009, August). "Cell phone radiation: Evidence from ELF and RF studies supporting more inclusive risk identification and assessment", *Pathophysiology*, 16(2/3), 205-216.
- [12]. "Information paper On Effects of Electromagnetic Field Radiation from Mobile Towers and Handsets" by Telecom Regulatory authority of India.
- [13]. Blackman CF, Benane SG, House DE." The influence of 1.2 microT, 60 Hz magnetic fields on melatonin- and tamoxifen-induced inhibition of MCF-7 cell growth", *Bioelectromagnetics* 2001; 22:122-8.
- [14]. IARC (International Agency for Research on Cancer). "Non-Ionizing Radiation, Part 1: Static and extremely low-frequency (ELF) electric and magnetic fields". IARC Monographs on the Evaluation of carcinogenic Risks to Humans: Volume 80. Lyon: IARC Press; 2002.
- [15]. Braune S, Wrocklage C, Raczek J, Gailus T, Lucking C. "Resting blood pressure increased during exposure to a radio-frequency electromagnetic field", *Lancet* 1998; 351:1857-1858.
- [16]. Li D, Odouli R, Wi S, et al. "A population-based prospective cohort study of personal exposure to magnetic fields during pregnancy and the risk of miscarriage", *Epidemiology* 2002; 13:9-20.
- [17]. EM Watch, [Online] Available: <http://www.emwatch.com/Cellmasts.html>.