

Impact Analysis of EMR Exposure to the Human Health: A Review

*Vandana Dubey

ABSTRACT:

Electro Magnetic Radiation has two types: non-ionization radiation below the ultraviolet wavelength range of sunlight spectrum and radiation from fission products of some nuclides in soil, and ionization radiation from UV wavelength to higher wavelength of sunlight spectrum and from fission products. Nuclear bomb explosions and nuclear power plant incidents. This article describes everyday non-ionization EMR radiation exposure. Man-made and natural non-ionization radiations exist. The body adapts to tiny quantities of natural radiation daily. Radon gas from rocks, soil, groundwater, and visible light, invisible non-ionization EMR of sunlight spectrum, including IR, MW, RF, VLF, and ELF, and thermal radiation from hot things are natural radiations. Electronic devices like mobiles, mobile towers, wifi, cordless phones, television waves, laptops, computers, and more emit non-ionization EMR. Electronic devices enhance exposure to man-made non-ionization EMR. Radiation exceeding threshold has health effects. Preventive actions, technical solutions, and shield material can reduce the impact. DoT, GoI, U.S. EPA, and many countries, including India, have set standards and recommendations 10 times harsher than International Standards for EMR from mobiles and mobile towers, distance between towers and buildings, and electronic device manufacturers.

KEY WORDS: EMR, Ionizing Radiations, Natural radiations, Ultra Violet Radiations

INTRODUCTION:

In recent years, there has been a rise in the utilization of telecommunication devices, which has resulted in an easier means of communication. This trend may be attributed to the convenience that these gadgets have brought about. The use of mobile phones has become more obvious over the course of the past decade, which has resulted in the construction of transmission towers in a large number, both in urban and rural areas, including other sparsely populated areas. These towers are located in both densely populated and less densely populated areas. Transmission towers rely on electromagnetic waves, which, when used for extended periods of time, can have negative effects not just on humans but also on other forms of flora and animals. There is a growing body of evidence demonstrating that electromagnetic radiation, such as that emitted by mobile phones and communication towers, can have detrimental impacts on human health. The International Agency for Research on Cancer of the World Health Organization (WHO) has just recently classed the electromagnetic fields that are emitted by mobile phones and other sources as "potentially carcinogenic to human" (IARC). On the other hand, an exact association between the radiation from communication towers and the effects on animals has not yet been particularly thoroughly investigated. However, there have been growing concerns regarding the effects that mobile towers have on wildlife, and a couple of studies that have been undertaken in India and throughout the world indicate that there may be negative effects of radiation. A lossy sphere containing the loop current can be utilized for the validation of this SAR computation in the same way that a lossy sphere was used for the validation of the FDTD code. Recent advances in science and technology have increased human meddling with the natural environment and associated physical, biological, and

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ecological processes, causing many unintended and undesirable environmental repercussions. Economic, social, and scientific development has opened new environmental contamination routes. Hyperthermia treatment planning and surgical optimization use theoretical models. The computation requires detailed physical parameters of the magnetic field in live tissue, which is difficult to obtain. Hence, we simulated thermal distribution in arterial remobilization hyperthermia (AEH) driven by the external ferrite-core applicator and assessed magnetic nanoparticle SAR in the magnetite-gelled composite model. Pharmaceutical, genetic, nano-particle, and electromagnetic pollutions have been in the news lately for bad causes. Manmade electromagnetic radiation has become so widespread that it is increasingly being recognised as a sort of hidden and insidious pollution that may perniciously impact life forms in many ways. Electro-magnetic fields as "electro-smog" are unique. Electro-magnetic radiations are not observable by human sense organs, unlike most other pollutants. Its effects may be long-term and subtle. But, other living beings may perceive these fields and become agitated or tragically mistaken. EMR pollution's recent origin, predicted long-term effects, and lack of research on its effects on species make it a pollutant.

Electromagnetic radiation is waves of electric and magnetic energy travelling at light speed. EMF indicates electromagnetic radiation. Frequencies classify electromagnetic radiation. EMF is commonly utilised. EMF indicates electromagnetic radiation. Frequencies classify electromagnetic radiation. EMF is commonly utilised. EMF indicates electromagnetic radiation. Frequencies classify electromagnetic radiation. EMFs cover fields below 300 gigahertz (GHz), where giga means a thousand million. EMF comprises electromagnetic fields from power frequencies (50 Hz in Malaysia) and radiowaves from TV, radio, mobile phones, radar, and satellite communications. Cordless phones and radio-controlled toys emit EMF at home.

VARIOUS SOURCES OF RADIATIONS CELL PHONES AND MOBILE TOWERS:

Since the 1990s, there has been a dramatic increase in the total number of cell towers across the globe. The number of major cell towers in the United States increased from approximately 900 in 1985 to over 308,334 in 2016; this is a significant increase. While 5G smaller towers continue to expand and private individuals build access points on their homes, which are not considered in the numbers, a new industry study has compiled a list of over 500,000 and is continuing to add to it. According to the Cellular Telecommunications Industry Association (CTIA), which was founded in 1984 right before the introduction of mobile towers, this is the case. The telecommunications industry not only installs cell towers in urban areas, but it also leases rooftops on schools, churches, companies, and apartment buildings so that antennas can be installed there for one or more carriers. This co-location can result in clusters of antennas operating at different frequencies being placed in close proximity to people's homes, places of employment, educational institutions, and recreational areas. Residents are subjected to exposures that affect their entire bodies as a result of the constant flow of microwave radiofrequencies emitted by these base stations. If there are no obstructions in the way, the range of a cell tower can extend up to 25 to 30 miles; nevertheless, in crowded urban situations, cell towers can be positioned every one to three miles. Antenna Search can be used to identify the locations of cell antennas around the United States. Throughout the past 30 years, the frequencies that cell towers broadcast have evolved from analogue to 2G, 3G, 4G, and now 5G, adding more bands with each generation with low, mid, and now high band frequencies. In addition, the analogue frequencies were replaced with digital ones (5G). As the wavelengths travel only short distances, more cell towers are being proposed throughout the United States now on both the state and federal levels in order to accommodate the recently adopted 5G high frequency telecommunications. Cell towers are proposed to be placed approximately every 250 metres (about 750 feet), as the wavelengths do not travel very far.

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HEALTH IMPACT ON HUMAN FROM VARIOUS TYPE OF CELL PHONES AND MOBILE TOWERS RADIATIONS:

The frequency, power, network capacity, and terrain all play a role in determining how far a cell tower's signal can travel. Cell towers are now able to transmit low frequencies (ranging from 600 to 850 MHz and reaching up to 25 miles), mid frequencies (ranging from 2.5 to 3.45 GHz and reaching between 1 and 12 miles), and high frequencies (ranging from 24 to 47 GHz or small millimetre waves and reaching between 50 and 2,000 feet). Studies indicate that a buffer of at least 500 metres from cell towers is recommended due to reported health effects and to limit cities' liability. This is the case even though some people have reported experiencing health symptoms even when cell towers were more than a mile away. Using strategic placement to limit liability and minimise the deleterious effects of cellular phone towers on human health (Peace 2020) In addition, the health and safety implications of the 5G millimetre wave technology have not been investigated. There is No Basis for Us to Believe That 5G Is Safe. (Moskowitz 2019) There have not been any studies that look at the mix of frequencies that we are now regularly exposed to but which disrupt our biology. Numerous studies have examined the health effects of electric and magnetic fields. Particularly RF fields' biophysical effects on biological systems are controversial. General health effects reviews consider carcinogenic, reproductive, and neurological effects. Radar traffic devices, cellular phones, radio transmission, and magnetic resonance imaging have caused health problems (MRI). Mobile telephony has been linked to a variety of illnesses, but brain tumours are the main concern. Several epidemiological studies have linked non-specific complaints like headache, tiredness, sleep disturbance, memory loss, and dizziness. These findings, which are consistent with other radiofrequency (RF) radiation-related illnesses (1), relate to mobile phone use and residence near mobile phone base stations (2). Hutter et al. provide additional evidence (3). They found that people with higher potential exposures to radiation from nearby base stations had more headaches, fatigue, and difficulty concentrating, even after controlling for possible confounders like mobile phone use.

In vivo and in vitro studies have shown non-thermal biological effects from pulsed, low-intensity microwave radiation. In vitro studies show increases in chromosome aberrations and micronuclei in human blood lymphocytes (4), ornithine decarboxylase activity, single and double-strand DNA breaks (5), cell proliferation, hsp70 levels, and nonthermal activation of the hsp27/p38MAPK stress pathway (6). (7). In vivo models show increased blood-brain barrier permeability in rats, promotion of lymphoma in transgenic mice (8), and pathological effects from embryonic and post-natal EMF radiation from cellular phones (NPRB). Although biological effects are well-established, the possibility of adverse health effects from GSM cell phone radiation is still under discussion (9). Based on the body's thermoregulatory mechanisms, GSM cellular phone safety guidelines limit radiation intensity to prevent tissue heating. However, it is now clear that GSM phones' low-intensity pulsed microwave radiation affects living organisms before heating. ELF and RF fields activate pathways that are temperature-insensitive, so EM fields must activate them. ELF stimulation has shown that the hsp70 promoter has two distinct regions—one responds to EM fields and the other to thermal stimulation (10).

BLOOD CELL ABNORMALITIES:

Zothansiamia 2017 – A research conducted in India by Zothansiamia et al (2017) (11) examined blood samples taken from individuals living at varying distances from cell towers to see whether or not abnormalities were present. Comparing people who lived less than 80 metres from a cell tower to those who lived more than 300 metres away from a cell tower, they found that those living closer to the cell towers had significantly more damaged blood cells. They found 1) A significant increase in micronuclei, which are small remnants of DNA nuclear material appearing within blood cells and a

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sensitive indicator of nontoxicity and chromosomal abnormalities; 2) A significant increase in chromosomal abnormalities; 3) A significant increase in chromosomal abnormalities; 4) A significant increase in chro 2) An rise in lipid peroxidation, which is indicative of the generation of free radicals and damage to cell membranes 3) A decrease in the levels of the antioxidant capability that the body produces internally (glutathione, catalase and superoxide dismutase). The conclusion reached by the author was as follows: "The present study indicated that being close to mobile base stations and continuous usage of mobile phones harm the DNA, and it may have a detrimental effect in the long run." The continued presence of DNA damage that has not been repaired leads to genomic instability, which in turn may lead to a variety of health problems, including the development of cancer. It will become increasingly challenging to locate control groups that have not been considerably exposed as more base stations are installed at a higher density and as more wireless devices become commonplace in homes. Anyone are able to determine the location of registered cell towers in their area by using the Antenna Search website.

CANCER RISK ASSOCIATED WITH CELL PHONE TOWERS:

Wolf and Wolf 2004 conducted research in which they compared the rates of cancer in small towns in Israel to the distance from cell towers. He discovered that the rate of cancer incidence was 129 cases per 10,000 people per year in those who lived within 350 metres of a cell tower, whereas the rate was 16-31/10,000 in those who lived further than 350 metres away from the cell tower. Eger (2004) discovered that residents who lived within 400 metres of a cell tower had an increased risk of developing new cancer cases within a period of 10 years. This risk was found to be significant. According to their findings, the relative risk of developing cancer increased by a factor of three within five years of the operation of a transmitting station in residents living in close proximity to cell towers when compared to residents living outside the area (12).

Santini 2002, in a French study, reported an increase in fatigue at 300 metres from the cell towers and remaining symptoms at 200 meters. A follow up study by Santini in 2003 revealed that older subjects reported more symptoms and were more sensitive. Duration of exposure of 1 to 5 years did not have an effect on frequency of symptoms but after 5 years there was a significant increase in irritability reported (13).

Navarro (2003) indicates much lower levels of exposure cause adverse health symptoms. The Navarro (2003) study on cell towers and "Microwave Syndrome" in Spain found that in those living near cell towers symptoms occurred at low power. He looked at distance from the towers and electromagnetic field exposures and concluded, "Based on the data of this study the advice would be to strive for levels not higher than 0.02 V/m for the sum total, which is equal to a power density of 0.0001 $\mu\text{W}/\text{cm}^2$ or 1 $\mu\text{W}/\text{m}^2$, which is the indoor exposure value for GSM base stations proposed on empirical evidence by the Public Health Office of the Government of Salzburg in 2002(14)."

An Austrian researcher named Hutter (2006) conducted a study in which he compared the cognitive performance, insomnia, and overall well-being of people living in rural versus urban settings for a period of more than a year in relation to the power density of radiofrequency radiation. His research demonstrated that a greater exposure to radiofrequency results in a greater risk to one's health. Important conclusions were that these complaints were independent of patients concern over health effects and that at levels well below current safety standards (15).

CELL PHONE / CELL TOWER RADIATION AND NEUROPSYCHIATRIC SYMPTOMS:

Abdel-Rassoul (2006) The neurologic effects of residents living under or across from cell tower base stations were compared to the effects of residents who lived a significant distance away. They found

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"The prevalence of neuropsychiatric symptoms such as headache (23.5%), memory changes (28.2%), dizziness (18.8%), tremors (9.4%), depressive symptoms (21.7%), and sleep disturbance (23.5%) were significantly higher among exposed inhabitants than controls: (10%), (5%), (5%), (0%), (8.8%) and (10%)." In addition to this, "the exposed inhabitants exhibited a significantly lower performance than controls in one of the tests of attention and short-term auditory memory." Additionally, "the inhabitants opposite the station exhibited a lower performance in the problem solving test (block design) than those under the station." Every single reading was well within the parameters of the norm. They recommend revision of standard guidelines for public exposure to RER from mobile phone base station antennas.

Sivan and Sudarsanam 2012 Review of Literature- The Inter-Ministerial Committee (IMC) covered scientists to review the literature of the effects of RF-EMF radiations on wildlife, humans and the biosphere. In their 2010 MOEF Report they found that out of the 919 research papers collected on birds, bees, plants, other animals, and humans, 593 showed impacts, 180 showed no impacts, and 196 were inconclusive studies(16)

They came to the following conclusion: "It is justified to conclude, based on current available literature, that exposure to RF-EMF radiation can change neurotransmitter functions, the blood-brain barrier, morphology, electrophysiology, cellular metabolism, calcium efflux, and gene and protein expression in certain types of cells even at lower intensities." They noted as well that, "Identification of the frequency, intensity, and duration of non-ionizing electromagnetic fields causing damage to the biosystem and ecosystem would evolve strategies for mitigation and would enable the proper use of wireless technologies to enjoy its immense benefits, while ensuring one's health and that of the environment (17)

PERCENTAGE OF STUDIES THAT REPORTED HARMFUL EFFECT OF EMR IN VARIOUS GROUPS IN MOEF REPORT

Human Effects: 62% of the samples showed an effect, 13% showed no effect, and 25% of the samples were inconclusive.

Plant Effects- 87% showed effects and 13% were inconclusive

The effects on wildlife were determined to be 62% positive, 4% negative, and 36% inconclusive.

Bee Effects: 85% of the samples exhibited the expected effects, while 15% did not. 77% of the samples showed effects, 10% showed no effect, and 13% gave inconclusive results.

Shinjyo and Shinjyo 2014 conducted an independent study on the effects of cell towers on the health of residents living in a condominium complex in Japan between the years 1998 and 2009. The researchers took note of residents' health symptoms before the installation of cell towers, while the towers were in operation, and after various antennas installed on the rooftops were removed. They discovered a significant increase in symptoms following the installation of the cell towers, which was followed by a significant decrease in symptoms following their removal. Fatigue, a lack of motivation, headaches, eye pain, deteriorated eyesight, sleep disturbances, dizziness, jitteriness, rapid heart rate, muscle aches, and nasal bleeding were the most common symptoms. 2014 Significant Decrease of Clinical Symptoms after Mobile Phone Base Station Removal –An Intervention Study PDF. Shinjyo T. and Shinjyo A (18).

CONCLUSION AND FUTURE SCENARIO:

Radiations of electromagnetic fields are a significant contributor to the contamination of the working environment. The effects on human health are cumulative, and it may take some time before these effects become apparent. The pathogenetic mechanisms involved in microwave \sdisorders development are still under investigation. It has been indicated that some measures are necessary, and taking a preventive approach is strongly encouraged, because there are many parts of the biological impacts that are unknown. More studies are required in order to provide more knowledge regarding the effects of microwave radiation on our health, particularly in occupational settings and among people who are professionally exposed to the radiation.

***Research Scholar
Department of Applied Sciences
University of Technology, Jaipur (Raj.)**

REFERENCES:

1. National Radiological Protection Board. Health effects from radiofrequency electromagnetic fields. Chilton: National Radiological Protection Board 2003; 14(2):107-10.
2. Chia SE, Chia HP, Tan JS. Prevalence of headache among handheld cellular telephone users in Singapore: a community study. Environ Health Perspect 2000;108:1059-62.
3. Hutter H-P, Moshammer H, Wallner P, Kundi M. Subjective symptoms, sleeping problems, and cognitive performance in subjects living near mobile phone base stations. Occup Environ Med 2006;63: 307-13.
4. Lai H, Singh NP. Single and double strand breaks after acute exposure to radiofrequency radiation. Int J Radiat Biol 1996; 69: 513-21.
5. DePomerai D, Dawe A, Djerbib L, Allan J, Brunt G, Daniells C. Growth and maturation the nematode *Caenorhabditis elegans* following exposure to weak microwave fields. Enzyme Microbial Technol 2002; 30: 73-9.
6. Leszczynski D, Joenvaara S, Reivinen J, Kuokka R. Non-thermal activation of the hsp27/p38MAPK stress pathway by mobile phone radiation in human endothelial cells: Molecular mechanism for cancer- and blood-brain barrier-related effects. Differentiation 2002; 70:120
7. Repacholi MH, Baster A, Gebiski V, Noonan D, Finnie J, Harris AW. Lymphomas in E7-Pim 1 transgenic mice exposed to pulsed 900 MHz electromagnetic fields. Radiat Res 1997; 147: 631-40.
8. Rothman KJ. Epidemiological evidence of health risks of cellular telephones. Lancet 2000; 356: 1837- 40.
9. Weisbrot D, Lin H, Ye L, Blank M, Goodman R. Effects of mobile phone radiation on reproduction and development in *Drosophila melanogaster*. Journal of Cellular Biochemistry 2003; 89(1): 48-55.
10. .AGNIR (2003). Health effects from radiofrequency electromagnetic fields. Report of an Advisory Group on Non-ionising Radiation. Doc NRPB 2003; 14(2):1-177.

11. Zothansiam, Zosangzuali M, Lalramdinpui M, Jagetia GC. Impact of radiofrequency radiation on DNA damage and antioxidants in peripheral blood lymphocytes of humans residing in the vicinity of mobile phone base stations. *Electromagn Biol Med.* 2017;36(3):295-305.
12. Wolf, R., Wolf, D. Increased incidence of cancer near a cell-phone transmitter station *International Journal of Cancer Prevention* Vol 1, Number 2, April 2004.
13. Santini R, Santini P, Danze JM, Le Ruz P, Seigne M. Investigation on the health of people living near mobile telephone relay stations: I/[Incidence according to distance and sex]. *Pathol Biol (Paris)*. 2002 Jul;50(6):369-73.
14. Joe Navarro M.A., Four-Domain Model for Detecting Deception: An Alternative Paradigm for Interviewing . *FBI Law Enforcement Bulletin* (2003)Volume: 72 (6)
15. Hutter H, Moshammer H, Wallner P, et al Subjective symptoms, sleeping problems, and cognitive performance in subjects living near mobile phone base stations. *Occupational and Environmental Medicine* 2006;63:307-313.
16. Abdel-Rassoul G, El-Fateh OA, Salem MA, Michael A, Farahat F, El-Batanouny M, Salem E. Neurobehavioral effects among inhabitants around mobile phone base stations. *Neurotoxicology.* 2007 Mar;28(2):434-40.
17. S Sivani*, D Sudarsanam., Impacts of radio-frequency electromagnetic field (RF-EMF) from cell phone towers and wireless devices on biosystem and ecosystem – a review. *Review Article Biology and Medicine*, 4 (4): 202–216, 2012
18. <https://mdsafetech.org/wp-content/uploads/2021/10/shinjyo-t-and-shinjyo-a.-2014-significant-decrease-of-clinical-symptoms-after-mobile-phone-base-station-removal-e28093an-intervention-study.-.pdf>