

## **Human Exposure to Electromagnetic Radiations**

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**Abstract:-** Human beings are bioelectrical systems. Our hearts and brains are regulated by internal bioelectrical signals. Environmental exposures to artificial EMFs can interact with fundamental biological processes in the human body. In some cases, this may cause discomfort, or sleep disruption, or loss of well-being (impaired mental functioning and impaired metabolism) or sometimes, maybe it is a dread disease like cancer or Alzheimer's disease.

We cannot see ELF Electromagnetic Radiation (EMR) or Radio Frequency (RF) radiation but they exist everywhere. It is only relatively recently that we are beginning to understand that long-term exposure to these radiations can cause noticeable long-term health problems. As an analogy, it took 50 years of studying the impact of common household chemicals to understand our health was at risk when we use them. But before that, we did not realize such exposures were dangerous. These chemicals made us sick and even caused disease. Like the chemical world, we are now finally beginning to understand that Electromagnetic Fields (EMFs) can be dangerous.

The use of common wireless devices like wireless laptops and mobile phones requires urgent action simply because the exposures are everywhere in daily life; we need to define whether and when these exposures can damage health, or the children of the future who will be born to parents now immersed in wireless exposures.

**Keywords:-** Electromagnetic radiations, Human Exposure, EM Radiations, effects of Em radiations, cell phones and radiation, radiations from laptop, Health Safety

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### **I. INTRODUCTION**

High power electric transmission lines, electric motors, railway engine and lines, spark plugs of vehicles, TV remotes, Computers and kitchens all emit mu UHF power. In fact, all matter at a nonzero temperature, like living animals, vegetables, electric bulb, heaters, and outer universe continuously emits a spectrum of these rays. Most members of society now have and use cordless phones, cellular phones, and Bluetooth has become very common. There is a rapid increase in electrification in developing countries, even in rural areas. In addition, most populations are also exposed to antennas in communities designed to transmit wireless RF signals. [1]

Some developing countries have even given up running land lines because of expense and the easy access to cell phones. Long-term and cumulative exposure to such massively increased RF has no precedent in human history. An outdoor precautionary limit of  $0.1\mu\text{W}/\text{cm}^2$  would mean an even lower exposure level inside buildings, perhaps as low as  $0.01\mu\text{W}/\text{cm}^2$ . Some studies and many anecdotal reports on ill health have been reported at lower levels than this; however, for the present time, it could prevent some of the most disproportionate burdens placed on the public nearest to such installations.

Communication Towers has become very common things these days. People are still not aware with the problems they are facing due to these towers if people of some areas ask to check or take any action about these towers. The telecom companies simply remove the tower from that area. Now people start facing the signal problem. So people generally don't bother about the long term problems. They just see their short term benefits and stay happy with that. These companies also pay a lot to houses on which they put a tower. So the owner and family people doesn't say anything ever. [9]

### **II. LITERATURE STUDY AND OBSERVATIONS**

Symptoms of ELF Electromagnetic Radiation and Radio Frequency Radiation Exposure Studies have shown that symptoms of Electronic Radiation (EMR) and Radio Frequency (RF) radiation can cause respiratory, cardiac, neurological, eye, skin and other health problems including:

**Respiratory:** Asthma, sinusitis and pneumonia.

**Cardiac:** Low or high blood pressure, palpitations, heart rate and shortness of breath.

**Neurological:** Fatigue, memory loss, flu-like symptoms, headaches, dizziness, difficulty concentrating, nausea, insomnia, depression or worse, seizures and paralysis.

**Eye:** Pain or burning in the eyes and pressure in/behind the eyes.

**Skin:** Itching, skin rash, and facial flushing.

**Other:** Dehydration, digestive problems, abdominal pain, altered sugar metabolism, immune abnormalities, enlarged thyroid, testicular/ovarian pain and dry lips. [5], [6], [10]

### III. ILL EFFECTS DUE TO MOBILE PHONES

Power density in mobile telephony band is between 5 to 10 watts per square meter at many congested places. Power density of 5 to 10 watts per square meter in a radius of 5 Km area cannot be created. It violates the principles of conservation of energy!!

In a market place hundreds of mobile handsets are on. The total power density in an area due to the hand sets will be thousands of times more than the power received from the towers. This is the answer from where from this power has come?

The radiation emitted by mobile phones may damage the delicate workings of the inner ear, and long-term and intensive mobile phone use for more than four years and for longer periods than 30 minutes in a day are at a higher risk of developing hearing loss, which cannot be reversed. [10]

#### Hearing loss

Today, more and more young people between 18 and 25 years of age are suffering from *hearing loss*, which doctors say is due to excessive use of mobile phones and other gadgets. Anyone who spends two to three hours on the cell phone every day runs the risk of partial deafness over three to five years. Most of the marketing and tele-consulting professionals are in their 20s, and their jobs demand long conversations on cell phones.

The problem starts with a pain in the ear that gradually develops into tinnitus or a ringing sensation which finally leads to hearing loss and ear tumour. This thing was also asked from the many youngsters who were talking on phone for several hours. It was a proper questionnaire about them. [7], [18]

#### Questionnaire Format

- Name:
- Age:
- Sex:
- Do you have phone:
- Brand of phone:
- When you start using phone (at what age):
- Average time you spend on phone in a day:
- What generally you do:  
(a) Chatting (b) voice talk (c) gaming (d) other
- Have you suffered from any ear problem? :
- If yes then what was the reason (Acc. To doctor):
- In an average day you spend time on phone for talking only:  
(a) 1-2 hour (b) 2-4 hour (c) 3-6 hour (d) 4-8 hour
- What do you use? :  
(a) Earpiece (b) loud speaker (c) Bluetooth devices
- Other minor things you observed after talking on phone:

#### Observations

- We used the tuning fork of 256 Hz for Weber vibration test; 512 Hz used for Rinne hearing test. Tuning Fork placed at midline forehead so that the sound radiates to both ears equally and after that the sound was lateralized from one ear to other. Similarly we also performed the rinne test with bone conduction and air conduction.
- We also used whispering techniques and also we used our laptop to play a list of tones that go from 8Hz all the way up to 22,000Hz. It's fairly common for people who are over 25 years of age to not be able to hear above 15 kHz and also experience some level of hearing loss or hearing damage such as tinnitus. [17]

Musicians have a much higher risk of hearing loss that most people do, and many of us don't really wear proper hearing protection. Even just listening to an iPod for an extended period of time can permanently damage your hearing. We also gradually lose our high-frequency hearing as we age.

### **Conclusion of the Survey and observations:**

We observed that 70% of the people who were talking on the phone for more than 2-3 hours a day (max. youngsters) are suffering from the ear problems. They also reported that their hearing power has also decreased and they need to press the phone at the ear some times to hear clearly and properly. Some people also reported that once in a year or in two – three years the fluid leaks out from their one ear. After showing to the doctor they don't get any particular answer why fluid leaking out from their ears. It happened to only one side of ear in a year. Even then the shocking observations came when we observe more than 30 decibel hearing loss in average up to the age group of 25 who were talking on the phones more than 2-3 hours a day. We also observed that people who are using phones more than four years up to 25-30 decibel hearing loss was observed up to the age of 45.

Finally we observed that this thing was happening due to the exposure to the phone for a long time which was affecting the ear drum. It was creating vibration in the ear's fluid which was making it to come out. *We also studied the medical history of such kind of persons and we found no hole in the ear drum. So finally we reached on the conclusion that this was happening due to electromagnetic radiation coming out from the phone.*

### **IV. AFFECT ON VISUAL SYSTEM**

Frequent use of mobile phones can also damage the visual system in many ways and cause uveal melanoma i.e. tumour of the eye. Increase in temperature close to the eye lens (as low as 30C) can result in lens opacities and increase the risk of developing cataracts in humans, a condition characterized by clouding in the natural lens of the eye and lens opacities. Prolonged exposure to microwave radiation can lead to both macroscopic and microscopic damage to the lens and part of this damage seems to accumulate over time and does not heal. [14]

#### **Observation:**

We observed that when a person talks on a phone for more than 2-3 hours normal vision get disturbed for couple of hours. This takes some time to come back to track. If this thing is happening every day or every night means person is talking to his girlfriend every night for more than 3-4 hours then in a year the power of his eye sight get disturbed by +/-0.5 to +/-0.75

This thing was concluded on the general information obtained from the people. As we know in a year a lot of reasons could be possible which can affect the eyes. But we also observed that 90% of the people who were talking in the night on a phone were facing weak eye sight problems.

### **V. LAPTOP RADIATION: SERIOUS THREAT**

Lower frequency Electromagnetic Radiation (EMR), higher frequency Radio Frequency (RF) radiation and heat radiation emitted from laptop computers can pose real dangers to our health. This exposure danger is not new. Appliances and devices such as desktop computers, cell phones, televisions and microwave ovens all emit similar radiation.

#### **What Makes Laptops Different?**

Laptops used directly in our laps expose us to more intense radiation that would be harmless otherwise if we were only a few feet away. Laptops have internal parts that heat up and radiate. Older laptops emit the highest levels of heat radiations. Laptops generate low-frequency radiations referred to as Electromagnetic Radiation (EMR) from storage and computing processing. When laptops use Bluetooth, WI-Fi and wireless cellular connections, they emit higher frequency, Radio Frequency (RF) radiation. All three of these sources are very close to your genitals, skin and muscles. Your exposure to these dangerous radiations may create bodily reactions such as skin rashes and muscle soreness. In some cases, infertility can occur.

#### **Laptop Radiation Sources**

Laptops have fans that exhaust hot air and can greatly exceed 110° Fahrenheit. These fans keep the operating temperature stable inside the computer, insuring proper performance, but the exhausted hot air exposes users to potentially harmful health effects. When converting energy to perform the various functions of the laptop, Electromagnetic Fields (EMFs) are created. These fields are in the low frequency range and radiate out of the outer shell of your computer from such sources as processor activity, hard drive operations, memory storage and other computing functions.

To connect to the internet laptops, iPods and other computer devices use technologies such as Bluetooth, Wi-Fi and 4G. To make these connections, your laptop is equipped with a receiver and a transmitter. The transmitter produces higher frequency Radio Frequency (RF) radiation, and when placed in your lap, the laptop radiates the dangerous emissions directly into your body. [16]

### Increased Health Risks from Laptop EMR, Particularly During Pregnancy

Laptops generate Electromagnetic Radiations (EMRs), also known as a magnetic flux, that induce currents in the body. This study investigates if there are health concerns when exposed to these fields, with particular emphasis on women and their fetus. The study concluded that Swedish EMF standards were exceeded by 71–483% which, by the standard's definition, increases risk for tumour development. They also say that laptops are contacting the body in a very delicate area close to skin, bones, blood, genitals, and, in pregnant women, close to the fetus.

### Radiation Causes Erythema Ab Igne

An article was printed in the Dermatology journal that laptop heat radiation that can reach up to 50° Celsius (122° Fahrenheit). This level of heat can cause permanent patchy dark skin called Erythema ab igne. Erythema ab igne is a hyper pigmentation of skin from a heat source not hot enough to burn, but dangerous enough to harm the body. Laptop computers and other electronic devices that generate heat radiation and placed in the lap have been linked to an increase of Erythema ab igne.



Fig.1: Erythema Ab Igne

### Suggested Protection ways:

Some studies show that laptops are a health hazard while other studies, cannot find a significant link between health problems and laptop radiation. While experts are evaluating the impacts of laptop radiation on children, adults and seniors, we may want to take precautionary measures to protect ourselves. Why risk it? When used off the lap, your laptop presents little danger. When using your laptop near your body though, invest in an emf Protection device like The Defender Pad which virtually eliminates laptop radiation dangers.

## VI. WI-FI RADIATION IN CLASSROOMS

There continues to be controversy about the use of Wi-Fi in the classroom. Wi-Fi transmitters emit Electromagnetic Radiation (EMR) similar to the microwave radiations used in the design of microwave weaponry. When connected to these potential dangers, keep your distance from the source, such as your Wi-Fi router. When using your laptop, iPod, tablet or other handheld device on your lap, Be sure to use a laptop radiation shield. [13]

When visiting children in schools, we noticed that Wi-Fi exposure is causing health problems that include vision problems, nausea and headaches. *“Children have less dense bones, immature immune systems and, by virtue of their size, they can act as aerials. Females have more complex hormone based systems to be disrupted than males.”*

“Dead birds in and around communication bases, on examination these birds were found to be cooked.” Referring to powerful microwave communications having the capacity to oscillate cells sufficiently as to cook the birds alive.

### What Does All This Mean?

Laptops, tablets, and other handheld devices connected to the internet via Wi-Fi, can either rest on a desktop or a child's lap emitting Electromagnetic Radiation (EMR). Elsewhere within a building, there are access points and routers, also transmitting Electromagnetic Radiation (EMR). When directly near the router transmitters, children are exposed to the strongest signal the equipment can emit. Even moving only a few feet

away, exposure dangers quickly diminish. As a good rule of thumb, at four foot away, exposure levels and associated health dangers are greatly reduced.

Wi-Fi in our classrooms, by some, is considered as dangerous as military microwave weaponry. At the very least, we should be aware of the potential dangers and find ways to avoid them. Keep your distance from radiating sources or use laptop radiation protection when using laptop computers, tablets and other handheld devices that contain Wi-Fi transmitters that emit.

### **Effects of Radiations on Children**

This is consistent with a large body of information showing that the fetus and young child are more vulnerable than older persons are to chemicals and ionizing radiation. Many studies demonstrate that children are more sensitive to environmental toxins of various kinds. Some studies report that the fetus and young children are at greater risk than are adults from exposure to environmental toxins.

Children are disproportionately affected by environmental exposures, including cell phone radiation. The differences in bone density and the amount of fluid in a child's brain compared to an adult's brain could allow children to absorb greater quantities of RF energy deeper into their brains than adults. It is essential that any new standards for cell phones or other wireless devices be based on protecting the youngest and most vulnerable populations to ensure they are safeguarded through their lifetimes.

Yet parents place RFR baby monitors in cribs, provide very young children with wireless toys, and give cell phones to young children, usually without any knowledge of the potential dangers. A growing concern is the movement to make all students computer laboratories in schools wireless. A wired computer laboratory will not increase RFR exposure, and will provide safe access to the internet.

From the reference of A new study from Greece reports altered development of the cranial bones of the fetus from low intensity (0.6 to 0.9 W/kg) *in-utero* 900 MHz cell phone radiation. They report "our results clearly show that even modest exposure (e.g., 6-min daily for 21 days) is sufficient to interfere with the normal mouse developmental process." [5]

From the medical literature we also find that the skull of a baby is also very thick. The radiation can easily penetrate deep into the head and it can cause many severe problems in the future.

## **VII. OTHER SERIOUS PROBLEMS**

### **Reducing Melatonin**

Various studies show that exposure to EMR reduce melatonin levels in animals and humans. Melatonin, a vital natural neuro-hormone is a powerful antioxidant, antidepressant and immune system enhancer that regulates our circadian rhythm. Every night as we go to sleep, our melatonin levels rise. Studies with animals show a reduction in melatonin levels following radiofrequency radiation exposure from cell phones and cell sites. Turning off the transmitters resulted in a significant increased melatonin levels within few days. When availability of melatonin is impaired, a whole range of disorders including sleep disturbance, chronic fatigue, depression, cardiac, reproductive and neurological diseases and mortality can occur. Reduced melatonin is also associated with increased DNA damage and increased risk of cancer, arthritis, seasonally affective disorder (SAD), schizophrenia, increased eye stress, renal impairment, Alzheimer's and Parkinson's disease, miscarriage, sudden infant death syndrome (SIDS), and increased risk of childhood leukemia. [12]

### **Affect the brain physiology**

Electromagnetic fields have been shown to affect the brain physiology. Use of the cell phones before bed, delays and reduces sleep, and causes headaches, confusion and depression. The findings are especially alarming for children and teenagers as they use cell phones at night and also keep the phone next to their head; which may lead to mood and personality changes, depression, lack of concentration and poor academic performance. [5]

### **Sleep disturbance**

The percentage increase in sleep disturbance is proportional to the exposure dose. It has been reported that even at radiation density of  $10\mu\text{W}/\text{m}^2$ , disturbance in the sleep is of the order of 35%. When the transmitter was turned off, the symptoms resumed gradually Exposure to electromagnetic fields has shown to be in connection with Alzheimer's disease, motor neuron disease and Parkinson's disease. All these diseases are involved with the death of specific neurons and are classified as neurodegenerative diseases. [5], [8]

### **Another Neuropsychiatric Problem**

People living near mobile phone base stations are also at risk for developing neuropsychiatric problems as headache, memory loss, nausea, dizziness, tremors, muscle spasms, numbness, tingling, altered reflexes, muscle and joint pain, leg/foot pain, depression, and sleep disturbance. More severe reactions include seizures,

paralysis, psychosis and stroke. Heavy use of mobile phones can cause cancer. Use of mobile phones for >10 years give a consistent pattern of increased risk for brain cancer - glioma and acoustic neuroma. The risk is highest for ipsilateral (on the same side of the head where the instrument is held) exposure. 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. [3, 4, 5]

**Risk of Cancer and Brain Tumour**

It is possible that today's young people may suffer an "epidemic" of the disease in later life. Besides increase in brain tumour and acoustic neuronal, there is an increased risk of several other types of cancers following prolonged exposure to mobile phone/ tower radiation, such as, salivary gland tumours, uveal melanoma, lymphoma, facial nerve tumours, skin, blood, testicular and breast cancer.[2]

Interphone study in May 2010 has also found a 'significantly increased risk' of some brain tumours for heavy users of mobile phones (> 20 minutes per day) for a period of 10 years or more. This is later substantiated by International Agency for Research in Cancer (IARC), part of WHO (World Health Organization) in May 2011. [5]

**Effect on Immune System and alters cells**

The body's immune defence system senses danger from ELF and RF exposures, and targets an immune defence against these fields, much like the body's reaction in producing stress proteins. These are additional indicators that very low intensity ELF and RF exposures are a) recognized by cells and b) can cause reactions as if the exposure is harmful. [2]

Electromagnetic Radiation (EMR) alters calcium ion homeostasis in cells. This has been confirmed in many studies. [1]

**Evidence for Damage to Sperm and Reproduction**

Several international laboratories have replicated studies showing adverse effects on sperm quality, motility and pathology in men who use and particularly those who wear a cell phone, PDA or pager on their belt or in a pocket.

Other studies conclude that usage of cell phones, exposure to cell phone radiation, or storage of a mobile phone close to the testes of human males affect sperm counts, motility, viability and structure. There are fewer animal studies that have studied effects of cell phone radiation on female fertility parameters. A Report decreased ovarian development and size of ovaries, and premature cell death of ovarian follicles and nurse cells in *Drosophila melanogaster*. [11], [13]

**VIII. PRECAUTIONS AND PREVENTION**

When an EMR source is zero distance from the body, it's most dangerous. As you move farther away, risks are reduced. The following chart shows the benefits of distance with corresponding emission reductions related to a 90-milligauss ELF EMR source.

Distance	Source Measurement (in mill gauss)	Risk Reduction
0-6"	90	None
1 ft.	20	78%
2 ft.	7	93%
4 ft.	1	93%

**Table 1: Approximate distances of EMR from Body**

**Actions that can be considered**

- Use a cable to connect to the Internet. Turn off the Wi-Fi on your computer.
- Use shielded CAT-5 wiring in your home.
- Place your cell phone away from your ear and use the speakerphone feature or a wired headset.
- If you must use Wi-Fi, when finished, turn it off on your router and computer.
- Use cell phones only briefly to minimize exposure times.
- For longer use, use a lap shield. Make sure the shield you choose has both ELF and RF EMR shielding protection.
- Limit use of laptop computers and tablets on the lap. Short durations are not dangerous.
- Look for manufacturer-independent lab testing that confirms performance claims.

- Avoid close proximity to RF emitters such as Wi-Fi routers and cell towers. The farther you are from an EMR source, the safer you are. According to the EPA, just four feet can be enough to reduce ELF transmission by 99 percent.

#### **The Recommended public Health Safety**

- Manufacturers of devices that operate with wireless features should be required to carry SAR level information and warning labels on the outside packaging (not hidden inside).
- Cell phones and other wireless devices should be redesigned to operate only on speaker-phone mode or text message mode.
- Restrictions should be placed on the sale and advertising of cell phones and other wireless devices to children age 0 to 18 years.
- All countries should continue to provide wired services. So that less radiations will be faced by the human.
- Scientific, public health and policy option information should be provided for independent review at an affordable cost to the public.
- Research articles and prudent avoidance strategies should be made available in many languages. It should be written in the local languages and should be pasted in the public also.
- Wireless devices that create elevated RF levels for the user should be required to warn the user of possible adverse effects on memory and learning, cognitive function sleep disruption and insomnia.
- There should be proper monitoring of the radiation level from the towers and another desired location.
- International health organizations and agencies should consider this matter very seriously and new public safety limits should be developed and implemented.

### **IX. CONCLUSION**

This research is very dynamic and it's very difficult to settle to a final conclusion. And an important feature of this research is controversies among the researchers regarding the effect. In the field of RF mobile phones is such an advancement which has resulted into some drastic change in this research work. Throughout the years there has been various standards developed by eminent bodies to ensure the public interest against the threats of RF radiation.

ELF Electromagnetic Radiation (EMR) and Radio Frequency (RF) radiation, depending on intensity and duration, has a negative impact on the human body. There can be DNA and chromosome damage, cells can be transformed, and your immune system can be compromised. With the large body of scientific evidence that demonstrates the health dangers of radiation exposure, the importance of guarding yourself from the Electromagnetic Field is paramount and avoidance is encouraged.

Prolonged exposure to laptop thermal energy may not only decrease sperm count, but it can also cause severe irritation of the skin. The reducing exposure to Electromagnetic Radiation (EMR) and agree with World Health Organization (WHO) recommendations that devices, like laptops should be reengineered to lower emissions.

The most apparent biological effects of RF energy to living cells are due to heating. While it is not certain that RF radiation generally poses any risks to human health, some reasons exist for being concerned about human health effects from the cellular phones themselves. These concerns exist because the antennas of these phones deliver much of their RF energy to small portions of the user's head.

Some experts say that it takes 20 or more years before we fully understand the impact of a technology, and EMR at zero distance to the body is no exception. Only in recent times have we begun to understand that long-term exposure to this radiation can cause long-term health problems. And for our young children, the exposure can be lifelong.

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