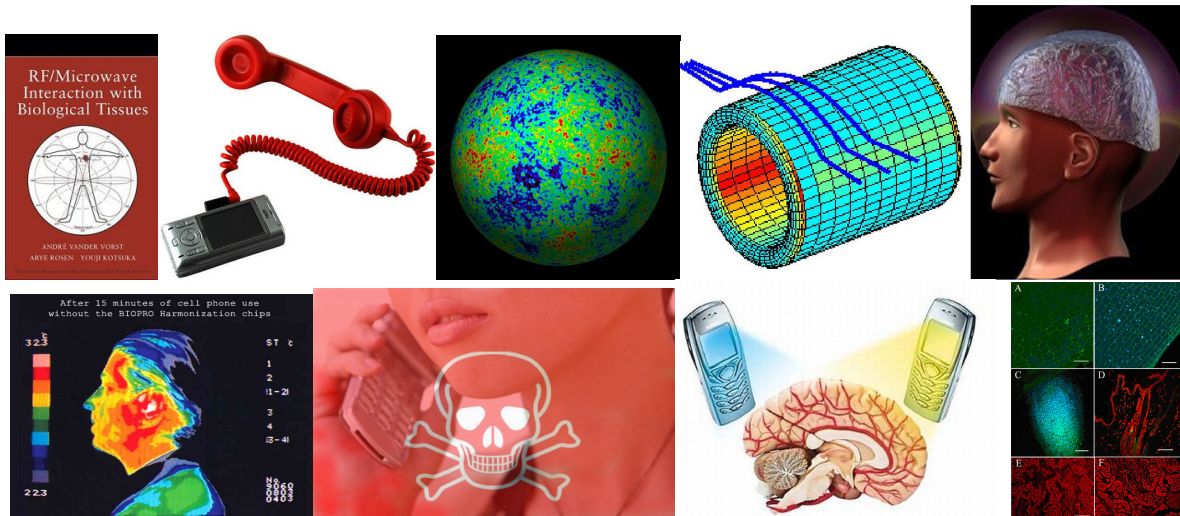


Biological Effects of Electromagnetic Radiation



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Preface

I have been working in the area of antennas for nearly three decades. During this period, I have written more than 150 papers in national and international journals and conferences and also written a book entitled “Broadband Microstrip Antennas” published by Artech House, USA in 2003. I have probably designed, fabricated and tested more than 1000 antennas. In 2001, when I was writing my book, I used to spend around 80 to 90 hours per week in the Antenna Lab at IIT Bombay, I started having strange health problem that my fingers would swell and I would feel hot even when AC was ON though my student’s would feel very cold. Initially, doctors gave me medicine for skin treatment and later on, I was referred to Neurologist and after several weeks of medicine, there was still no relief. Meanwhile, I also consulted Homeopathy doctor, who after one month of doing experiment on me with his various medicines, told me that he has tried every possible thing and he can not do anything to cure me. Just around that time, I measured the radiation level in my office and lab, and found it to be very high. There were so many computers around me and there was radiation from all the computers and laptops. Also, we were always doing experiments with microwave circuits and antennas (occupational hazard). So, without realizing, my body was absorbing electromagnetic radiation from all these sources. The solution was simple: we re-arranged all the computers, partly isolated my office from the antenna lab, and I partially recovered in about 3-4 months of time.

Around that time, mobile phones had started coming to India on a mass scale, and cell towers started appearing on top of the residential buildings. I knew that sooner or later, people will start having problems due to microwave radiation. It took me nearly 6 years to develop “Radiation Shield”, which absorbs microwave radiation in the frequency range of 800 to 4000 MHz. It is small, light weight, portable and low cost solution to ever increasing radiation pollution emitted from cell phone towers, cell phones, Wi-Fi, WLAN, 3G, WiMax, microwave oven leakage, computers, lap-tops, wireless phone, etc.

In 2008, we carried out radiation measurement in the academic area of IIT Bombay, where several cell operators had installed transmitting towers, and found the radiation level to be very high. Thereafter, followed series of emails to our learned faculty members at IIT Bombay, and to my surprise, many of them did not know about harmful effects of microwave radiation on human body. They had so many questions that I had to do lot of research, collected hundreds of papers, saw several hundreds of websites, studied biological effects, and so on. Finally, I decided to ask my daughter, Neha Kumar, who has done B.Tech. in Bio-Technology from Anna Univ., Chennai to prepare this report.

I sincerely hope that people will find this report useful and they will take immediate precaution to safeguard themselves and their families from undesired microwave radiation.

- Prof. Girish Kumar

Acknowledgement

As a growing up teenager, I hardly used to see my father, Prof. Girish Kumar, at home because most of the time he was working in the antenna lab at IIT Bombay. Suddenly in 2001, I saw him spending lot of time at home as he started suffering from absorption of too much electromagnetic radiation. It was really strange and worrying as doctors were unable to diagnose his problem. He used to explain us about microwave radiation effect and how he got cured but I was too young at that time to understand all the details. I want to thank him for providing me this opportunity to study this vast subject of electromagnetic radiation effect on human body. He provided lots of material, encouraged me and also gave me valuable inputs at various stages, and full freedom to prepare this report.

I also want to thank all the researchers working in this area, whose work has been included in the report. There is so much information available that it is impossible to cover all the material and some important findings might not have been mentioned here. It is neither intentional nor personal, and any suggestions or recommendations for the improvement of the report, is most welcome.

I would like to thank all the professors of the Biotechnology department at Anna University, Chennai for providing education to me in this fascinating area. I am grateful to Prof. Swati Patankar, Biotechnology, School of Biosciences and Bioengineering, I.I.T Bombay for training me to do independent thinking, maintain lab notebook systematically and writing a proper report.

A special note of thanks to my friends at Anna University for the enthusiastic discussions, which made the learning even more interesting.

Finally, I want to thank my family, who helped in more than one way to complete this work, especially, my mother, Mrs. Neerja Kumar for looking closely at the final version of the report, correcting and offering suggestions for improvement. My sincere regards to them for their constant motivation and support.

- Neha Kumar

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1. FUNDAMENTALS

All the transmitting towers, such as AM and FM towers, TV towers, cell towers, etc. emit RF/microwave radiation continuously. Also, Wi-Fi (wireless Internet), wireless computers, cordless phones and their base units, cell phones and all other wireless devices emit microwave radiation. A cell phone that is ON but not in use is also radiating.

Cell phones operate within the frequency band of 800 MHz, 900 MHz and 1800 MHz and the latest 3G technology works between 1900 -2200 MHz. Computers and laptops operate within the frequency range of 1000 – 3600MHz, and most Wi-Fi systems and some cordless phones operate around 2450 MHz, which is same frequency as that of a microwave oven! The growing use of wireless communication in the last decade has introduced concerns about health risks from the so called man made electro smog. Various epidemiological and experimental studies have been carried out and the results have shown to have a close relation between biological effects and Electromagnetic radiation (Sage Cindy et al 2009).

Microwave radiation effect can be classified as - thermal and non-thermal. The thermal effect has been largely studied and refers to the heat that is generated due to absorption of microwave radiation. Being exposed to the thermal effect could cause fatigue, cataracts and reduced mental concentration. Research is going on to study the non-thermal effects of radiation, and it has been associated with affecting the cell membrane permeability. Sadly the current exposure safety standards are purely based on the thermal effect while ignoring the non-thermal effects of radiation.

Principle of microwave heating is similar to that of a microwave oven where the water in the food content is heated first. Likewise microwave absorption effect is much more significant by the body parts which contain more fluid (water, blood, etc.) like the brain which consists of about 90% water. Effect is more pronounced where the movement of the fluid is less, for example, eyes, brain, joints, heart, abdomen, etc. The effect has shown to be much more severe for children and pregnant women.

Of late there are lots of reports coming out on how radiation through mobile towers causes cancer, though cell phone companies maintain that there is nothing conclusive on this subject.

The effectiveness or seriousness of the issue has not been realized among the common man yet as one can not see or smell or hear microwave and its effect on health is noted after a long period of time. Therefore, majority of the people tend to have casualness towards personal protection. Unfortunately, ignorance and non-awareness adds to this misery and all of us are absorbing this slow poison unknowingly.

The purpose of this report is to create awareness amongst people of the possible health hazards which microwave radiation could lead, and the urgency to take necessary precautions to avoid major public health consequences, or else the impact could be worse than Cancer, AIDS, World War, Tsunami, etc.

2. Evidence Raises Concerns about Cell Phones and Microwave Exposure

There are Millions of websites on microwave radiation hazard, only a few are reported here:

- **WHO study in 13 countries confirm increased risk for brain tumors**

The Telegraph (16.10.2008):

Study by the International Agency for Research on Cancer, part of the World Health Organization (WHO) discovered that the chances of developing a malignant tumor are "significantly increased" for people who use cell phones for ten years. They also found that a type of brain tumor called glioma is more likely in long-term mobile users.

- **Alarming report - fivefold increased risk for brain tumors in children**

The Independent (21.09.2008):

Research from Sweden reports that children and teenagers are five times more likely to get brain cancer, if they use mobile phones. This study, as experts say, raises fears that today's young people may suffer an "epidemic" of the disease in later life.



- **Germany warns citizens to avoid using Wi-Fi.**

The Independent (9.09.2007):

The Environment ministry of the German government in September 2007 said that people should avoid using Wi-Fi wherever possible because of the risks it may pose to health. The official radiation protection body also advised its citizens to use landlines instead of mobile phones, and warns of "electro smog" from a wide range of other everyday products.

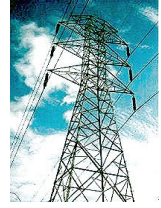
- **Base stations affect health negatively.**

Among people living closer than 300 m away from the base station, a French study found an increased incidence of tiredness within 300m, of headache, sleep disturbance, discomfort, etc. within 200 m, and of irritability, depression, loss of memory, dizziness, libido decrease, etc. within 100 m.

Women were found to complain significantly more often than men of headache, nausea, loss of appetite, sleep disturbance, depression, discomfort and visual perturbations. This study, based on the symptoms experienced by people living in vicinity of base stations recommend that the minimal distance of people from cellular phone base stations should not be < 300 m. (Santini R, et al 2002)

- **New Austrian research confirms health effects of base station radiation.**

Another study where tests were done on subjects living within 20-600 meters from Mobile Phone Base stations were found to have sleeping problems and effect on cognitive performance. (Hutter et al 2006)



- **Building Top Floors under the Antenna Closed After Brain Tumor Alert**

The Australian UK (5.13.2006)

After a seventh case of brain tumor observed among workers in the top floors of a Melbourne office building, the top floors were closed down and 100 people were evacuated. The mobile phone towers on the roof of the 17-storey RMIT University building were thought to be linked to the recurrent cancer cluster.

- **Three groups find danger of tumors**

Sun Sentinel, Florida (1.2.2006)

Three European research groups in separate studies have found an increased risk of brain tumors in people who have used the phones for 10 years or more. Two of the studies found a correlation between the tumor's location and the side of the head where people reported they held the phone (Hardell et al 2003).

One also suggests the greatest risk is in people who began using the phones before age of 20. Lennart Hardell found that the use of cell phones before age of 20 increased the risk of brain tumors by 5.2, compared to 1.4 for all ages.

- **Brain cancer risk increased at the side one holds the phone**



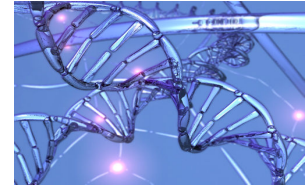
A study by Jonas Hardell, professor of Oncology, Sweden suggests that the risk for developing brain tumors increases significantly for the people who use the phone more intensely and for more years. Also a significantly increased risk of brain cancer was observed on the same side as one held the phone, but not on the other side.

In addition, the risk was increased by 30% for developing Acoustic Neurinoma, a benign tumor in the brain on a nerve related to hearing that may cause permanent deafness if not removed in time. (Hardell L 2009)

- **DNA is damaged by mobile phone radiation.**

In 1995, Professor Henry Lai and N.P. Singh published a paper that documented DNA damage in the brain cells of rats exposed to radiation similar to that emitted by cell phones (Lai H et al 1995), but the study was ignored by the mobile phone industry stating that his findings had not been confirmed.

The research was later corroborated by other studies. In December 2004, results of work by 12 groups in seven European countries, the "REFLEX Study", found that radiation at some cell phone levels damages DNA and the damage could not always be repaired by the injured cell (REFLEX, 2004). In a BBC report, the leader of the four-year REFLEX study, Franz Adlkofer, said "people should use landlines, rather than cell phones, wherever possible. We don't want to create a panic, but it is good to take precautions".



According to Dr Lai "This does not mean it's the beginning of the end of cell phones. If the results are confirmed in further studies, we can engineer our way out of the problems, just as we engineered the technology in the first place".

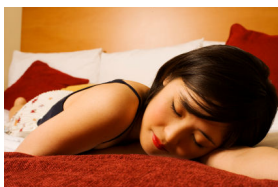
A study from Israel further confirms DNA-damaging effects of mobile phone irradiation, demonstrating the cause to be a non-thermal effect of electromagnetic radiation.

- **Association of mobile phone radiation with human health in Saudi population**

Omega-News (7.8.2004)

A Saudi Arabian study found a relationship between headache, fatigue, dizziness, tension and sleep disturbances in subjects exposed to mobile phones emissions (Thamir Al-Khlaiwi et al 2004). The use of mobile phones was considered to be a risk factor for health hazards suggesting avoidance of excessive use of mobile phones.

- **Mobile phone radiation wrecks your sleep**



The Independent (20.1.2008)

According to research by mobile phone makers own scientists, use of the handsets before bed, delays and reduces sleep, and causes headaches, confusion and depression.

The findings were especially alarming for children and teenagers, as it may lead to mood and personality changes, ADHD-like symptoms, depression, lack of concentration and poor academic performance.

- **JJ Hospital Mumbai, says no to Mobile towers**

Mumbai Mirror (24.2.2009)

JJ Hospital in Mumbai, India said no to installation of mobile towers inside the premises. VVIPs in JJ Hospital had complained of poor network inside main building, but experts said electromagnetic signals would adversely affect medical equipment and powerful antenna tower inside the campus could be hazardous too.



- **Mobiles cut sperm count, says report**

The Guardian (28.6.2004),

Hungarian scientists have found 30% sperm decrease in intensive mobile phone users, in addition to damage of sperms. They found that not only did using the phone affect a man's sperm count and the motility (speed of movement) of the sperm, but simply having it switched ON in a pocket was enough to do damage as mobile phones periodically but briefly transmit information to cell towers to establish contact.

- **Physicist theory - mobile microwave interfere with the body and may cause harm**

The Guardian UK (10.4.2004)

Communication within the human body occurs through a highly complex system of electrical signals. According to this theory, exposure to pulsing microwave radiation from microwaves and phones interferes with our bodies and disrupts the intercellular communication in the same way that phones interfere with airplane or hospital equipment. This may cause impairs in body function and could lead to illness.

- **Effect of TV and FM Towers on health**

A study in Australia found that children living near TV and FM broadcast towers (similar to cell towers) had more than twice the rate of leukemia as children living more than seven miles away from these towers (Hocking, B et al 1996).



In another study, TV signal exposed workers were observed to have increased IgG and IgA and decreased lymphocytes and T8 cells, resulting in a decrease in immune response (Moszczynski, P et al 1999).

- **French High Court verdict against Telecom Company**

In February 2009, the telecom company Bouygues Telecom was ordered to take down a mobile phone mast due to uncertainty about its effect on health. Residents had sued the company claiming adverse health effects from the radiation emitted by the tall mobile phone antenna (Versailles Court of Appeal, 4 February 2009).

- **Don't spend hours on mobile: Indian Health minister**

Mumbai Mirror (23.7.2009)

Excessive use of mobile phones can lead to problems like deficient hearing and tinnitus (ringing in the ears). Study done by Indian scientists indicates that sorineural deafness (loss of hearing due to damage to sensors in inner ear) can occur in 25-30% of people using mobile phones for more than two hours a day over a two-year period, besides causing burning sensation in the ear and headaches. In addition, DNA damage, low sperm count leading to infertility and reduction in testis size in rats has also been reported. The health minister therefore advices for not using mobile phones for more than one hour a day.

CASE STUDY:

- **German study: 3 times increased cancer risk**

Several doctors living in Southern Germany city of Naila conducted a study to assess the risk of mobile phone radiation. Their research examined whether population living close to two transmitter antennas installed in 1993 and 1997 in Naila had increased risk of cancer.

Data was gathered from nearly 1,000 patients who had been residing at the same address during the entire observation period of 10 years. The social differences are small, with no ethnic diversity. There is no heavy industry, and in the inner area there are neither high voltage cables nor electric trains. The average ages of the residents are similar in both the inner and outer areas.

What they found is quite telling: the proportion of newly developed cancer cases was three times higher among those who had lived during the past ten years at a distance of up to 400m from the cellular transmitter site, compared to those living further away. They also revealed that the patients fell ill on average 8 years earlier.



Computer simulation and measurements used in the study both show that radiation in the inner area (within 400m) is 100 times higher compared to the outer area, mainly due to additional emissions coming from the secondary lobes of the transmitter.

Looking at only the first 5 years, there was no significant increased risk of getting cancer in the inner area. However, for the period 1999 to 2004, the risk for getting cancer was 3.4 times greater in the inner area compared to the outer area. Breast cancer topped the list, and the average age of contracting this disease was considerably lower, 50.8 years compared to 69.9 years in the outer area, but cancers of the prostate, pancreas, bowel, skin melanoma, lung and blood cancer were all increased

- **Mumbai facing Radiation**

Cell Tower Radiation: LiveIndia.com (05.8.2008)

A recent study revealed that the electromagnetic radiations emitted from phone towers in Mumbai were way beyond safety levels. According to the study, the safe limit of radiations for human beings is up to $50 \mu\text{W}/\text{m}^2$ microwatts per square meter and the upper limit is 100 microwatts per square meter. The study revealed that the radiation readings in several residential areas were more than 1000 microwatts per square meters.



Mumbai has witnessed a spurt in the number of phone towers in the recent past exposing people to dangerously high levels of radiations. Being exposed to such radiation, this leads to problems like loss of appetite, irritation, fatigue, difficulty in concentrating, headaches, problems in vision, infertility and deformity of foetus. Medical experts feel it is a ‘slow and invisible killer’.

“If you are using a headset or hands free close to your ear while talking or put it in the pockets, the radiation is directly affecting this tissue and because it is heating up, even though very minimally, the cellular tissue is being heated,” said Dr Pratima Rajan, Department of Cardiac Rehabilitation and Preventive Cardiology, Jaslok Hospital.

So while technology invasion has happened at a rapid pace in India, stringent laws are still to be in place against the risks that they come with.

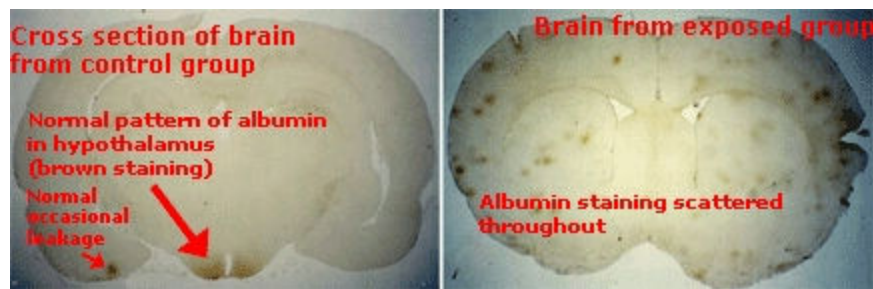
3. Scientific evidences on how cell phones affect health

There are several scientific reports, which clearly mention how cell phones affect health. Some of these are described below:

- **The Blood Brain Barrier**

The brain is protected by tight junctions between adjacent cells of capillary walls by the blood-brain barrier, which selectively lets nutrients pass through from the blood to the brain, but keeps toxic substances out. Since 1988, researchers in the laboratory of a Swedish neurosurgeon, Leif Salford, have been running variations on this simple experiment: they exposed young laboratory rats to either a cell phone or other source of microwave radiation, and looked for albumin in their brain tissue. Albumin is a protein that is a normal component of blood but that does not normally cross the blood-brain barrier. The presence of albumin in brain tissue is a sign that blood vessels have been damaged and that the brain has lost some of its protection.

Comparison of brains from unexposed and exposed rats



Experiments conducted found that the exposed animals were much more likely to have albumin leaking from blood vessels in inappropriate locations, shown as dark dots in the exposed brain above on the right. Control animals, in contrast, showed either no albumin leakage or occasional isolated spots, as seen in the figure on the left.

A closer look at the cells within the brain also revealed that exposed animals had scattered and grouped dark neurons often shrunken with loss of internal cell structures. Neuronal damage of this kind may not have immediate consequences but in the long run, it may result in reduced brain reserve capacity that might be unveiled by other later neuronal diseases.

These experiments have been repeated and the same results were obtained, consistently for 18 years, confirming microwave radiation, at doses equal to a cell phone's emissions, causes albumin to be found in brain tissue. It must be noted that the blood-brain barrier is the same in a rat and a human being.

In another research, a single two-hour exposure to a cell phone, just once during its lifetime, permanently damaged the blood-brain barrier and, on autopsy 50 days later, was found to have damaged or destroyed up to 2 percent of an animal's brain cells, including

cells in areas of the brain concerned with learning, memory and movement (Salford et al, 2003). It is known that this barrier is damaged in Parkinsons disease and in Alzheimers dementia. So there is a risk that disruption of this protection barrier may damage the brain.

In fact similar mechanisms protect the eye (the blood-vitreous barrier) and the fetus (the placental barrier), and the work of Allen Frey and others indicates that microwave radiation damages these barriers also (Allan et al 1988). The implication: No pregnant woman should ever be using a cell phone and if at all they have to use in emergency, it should be for minimal duration.

- **Radio-Wave Sickness**

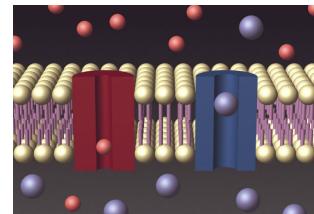


Unfortunately, cell phone users are not the only ones, whose brains and ears are getting affected. Organs such as the lungs, nervous system, heart, eyes, testes and thyroid gland have been shown to be especially susceptible to radio waves.

Diseases such as asthma, sleep disorders, anxiety disorders, attention deficit disorder, autism, multiple sclerosis, ALS, Alzheimer's disease, epilepsy, fibromyalgia, chronic fatigue syndrome, cataracts, hypothyroidism, diabetes, malignant melanoma, testicular cancer, heart attacks and strokes in young people have increased remarkably in the last couple of decades, and have shown to be connected with the massive increase in radiation in our environment. Radiation changes sleep rhythm, affect's body's cancer-fighting capacity by harming immune system, and changes nature of electrical and chemical signals communicating between cells. These changes lead to functional changes in the nervous system. It also causes red blood cells to leak hemoglobin, leading to heart disease and kidney stones.

- **Calcium ion release from cell membranes**

Studies by Carl Blackman (Blackman et al. 1982) have shown that weak electromagnetic fields remove calcium ions bound to the membranes of living cells, making them more likely to tear, develop temporary pores and leak.



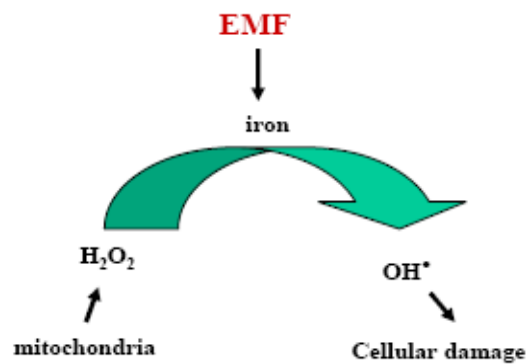
Leakage of calcium ions into the cytosol (the fluid found inside cells) acts as a metabolic stimulant, which accelerates growth and healing, but it also promotes the growth of tumors. Leakage of calcium ions into brain cells generates spurious action potentials (nerve impulses) accounting for pain and other neurological symptoms in electro-sensitive individuals. It also degrades the signal to noise ratio of the brain making it less likely to respond adequately to weak stimuli. This may be partially responsible for the increased accident rate of drivers using mobile phones.

- **DNA damage**

Microwave exposure at levels below the current FCC exposure standard, produces single and double strand breaks in DNA (Lai et al).

As mentioned above, EMR causes membrane leakage due to loss of calcium ions. Leaks in the membranes of lysosomes (small bodies in living cells packed with digestive enzymes) release DNAase (an enzyme that destroys DNA), which explains the fragmentation of DNA seen in cells exposed to mobile phone signals.

Another possibility of DNA damage is via free radical formation inside cells. Free radicals kill cells by damaging macromolecules, such as DNA, protein and membrane. Several reports have indicated that electromagnetic fields (EMF) enhance free radical activity in cells (e.g., Lai and Singh 1997a, b; Simko et al 2007), via the Fenton reaction (Lai and Singh 2004), as shown in the figure below. The Fenton reaction is a catalytic process of iron to convert hydrogen peroxides, a product of oxidative respiration in the mitochondria, into hydroxyl free radical, which is a very potent and toxic free radical. Thus EMF affects the DNA via an indirect secondary process.



THE FENTON REACTION

Damage to DNA is a central mechanism for developing tumors and cancer. When the rate of damage to DNA exceeds the rate at which DNA can be repaired, there is the possibility of retaining mutations and initiating cancer

- **Irreversible infertility**

Magras and Xenos (1997) have reported that mice on exposure to cell phone signals from an antenna park become less reproductive. After five generations of exposure, the mice were not able to produce offspring, showing that the effect of Radio frequency radiation can pass from one generation to another.

Use of cell phones by men is associated with decrease in semen quality, sperm count, motility, viability and normal morphology and is related to the duration of cell phone use. Studies have found that using a mobile phone for more than four hours a day is associated with reduction in sperm viability and mobility of around 25 percent (Agarwal et al 2006).

- **Risk to Children**



In May 2000, a report by the Independent Expert Group on Mobile Phones (IEGMP) in the U.K., known as The Stewart Report, was the first to draw greater attention to the possibly higher sensitivity of children to RF radiation from cell phones. Their smaller head and brain size, thinner cranial bones and skin, thinner, more elastic ears, lower blood cell volume, as well as greater conductivity of nerve cells, were found to contribute to greater absorption of RF in the child's head compared to the adult's head.

In a study (Foliart et al 2006), children recovering in high-ELF environments had poorer survival rates (a 450% increased risk of dying if the ELF fields were 3 mG and above). Another attention-grabbing study reported that children who are raised in a home within 300 meters of a high-voltage electric power line have a five-fold increased risk of developing some kinds of cancers sometime in later life (Lowenthal 2007).

Radiation Penetration in the head of an adult, ten-year and five-year old



When radiation hits the head, it penetrates the skull. The pictures above are the result of an experiment done by Dr Om Gandhi back in 1997. He showed how radiation penetrates the skull of an adult (25%), 10 year old (50%) and a 5 year old (75%). The younger the child the deeper the penetration due to the fact their skulls are thinner and still developing.

Study by Dr. Om Gandhi explains why, children are in much bigger danger of getting a brain tumor from EMR ; Brain tumors have now taken over leukemia as the biggest cause of death amongst children.

- **Risk to Pregnant Women**

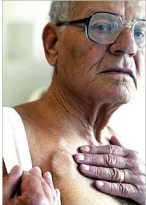
A pregnant woman and the fetus both are vulnerable because of the fact that these RF radiations continuously react with the developing embryo, increasing cells, because of thermal heat also. Allan Frey and others described in their work that microwave radiation damages the placental barrier; the membrane which prevents the passage of some materials between



the maternal and fetal blood, protecting the foetus, implying that no pregnant woman should ever be using a cell phone.

In a recent finding, an association was found between a mother's cell phone use during pregnancy and greater likelihood for behavioural problems in their children at age 7 (Divan et al., 2008). It is believed that the eggs, which form the embryo, are affected and the damage will become apparent after the child reaches puberty.

- **Risk to Patients Carrying Pace Makers**



The RF Exposure can adversely affect the heart: Pace Maker, Implantable Cardiovascular Defibrillators (ICDs) and Impulse Generators and become arrhythmical (Altamura G et al 1997). These radiations may stop Pace Maker from delivering pulses in a regular way or may generate some kind of external controlling pulse putting the patient to death.

- **Occupational Hazard**

Studies of people who are exposed in their work (occupational exposure), have shown to have elevated levels of health risks. Those employed in electrical occupations are 10% to 20% more likely to get brain cancer (Kheifets et al 1995) and show elevations in non-Hodgkin's lymphoma (Villeneuve et al 2000). Another study reveals that workers who are in the highest 10% category for EMF exposure are twice as likely to die of prostate cancer as those exposed at lower levels (Charles et al. 2003).

A 1998 survey by the California Department of Health Services indicated that at that time 120,000 Californians - and by implication 1 million Americans - were unable to work due to electromagnetic pollution. These so-called electrically sensitive individuals are increasing in almost every country in the world, marginalized, stigmatized and ignored.

As said by Dr. Olle Johansson "These people are acting as a warning for all of us. It could be a major mistake to subject the entire world's population to whole-body irradiation, 24 hours a day."

- **Auditory perception of microwaves**

"Ringxiety"- the psychological disease of hearing phantom sound and sensation of cell phone ring has appeared in Japan (also reported in India) among cell phone users (James C et al 2002).

This auditory perception has been shown to occur when a person's head is illuminated with microwave energy (Foster et al 1974). The microwave pulse, upon absorption in the head, launches a thermo-elastic wave of acoustic pressure that travels by bone conduction to the inner ear. There it activates the cochlear receptors via the same process involved for normal hearing, which explains the "clicks" heard by people exposed to microwave radiation.

- **Salivary gland tumor**



An epidemiology study in Tel Aviv University by Dr. Sadetzki, a physician, found that those who held a mobile handset against one side of their head for several hours a day had 50% more risk for tumor formation in the parotid gland -The largest salivary gland (Sadetzki et al 2008).

- **Melatonin Reduction**

Melatonin is a powerful antioxidant, antidepressant and immune system enhancer that regulates our circadian rhythm. When availability of melatonin is impaired, a whole range of disorders including sleep disturbances and psychological imbalances such as depression can occur (Abelin et al 1999).

Various studies show that exposure to EMR reduce melatonin levels in people (Wilson et al. 1990, Wood et al 1998). Melatonin protects the brain against damage leading to Alzheimer's disease; hence degenerative diseases such as Alzheimer's and Parkinson's disease as well as cancer have been linked to suppressed melatonin production in the body.

- **Neurodegenerative Diseases**

Exposure to electromagnetic fields has shown to be in connection with Alzheimer's disease, motor neuron disease and Parkinson's disease (WHO ELF Health Criteria Monograph 2007). All these diseases are involved with the death of specific neurons and are classified as neurodegenerative diseases. An increased risk, about four times for Alzheimer's disease (Hakansson et al 2003) and three times for amyotrophic lateral sclerosis (ALS) (Savitz et al 1998) has been reported for those exposed to ELF, compared to the control group.

Besides, inhabitants 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. (Abdel-Rassoul 2006, R. Santini et al 2003). More severe reactions include seizures, paralysis, psychosis and stroke.



- **Effects on Stress Proteins (Heat Shock Proteins)**

Heat shock proteins (HSPs), also called stress proteins, are a group of proteins that are found in virtually all living organisms. Expression of these proteins is increased when a cell undergoes various types of environmental stresses like heat, cold, heavy metal poisoning and oxygen deprivation.

It has been observed that very low-level ELF and RF exposures can cause the cells to produce stress proteins (heat shock proteins) (Leszczynski et al 2002), which means that the cells recognizes ELF and RF exposures as harmful. Hence ELF and RF exposures add to the list of environmental stressors that cause a physiological stress response. This further demonstrates that ELF and RF exposures can be harmful, and it happens at levels far below the existing public safety standards.

An additional concern is that if the stress goes on too long, there is a reduced response, and the cells are less protected against the damage. This is why prolonged or chronic exposures may be quite harmful, even at very low intensities.

- **Sleep Disorders**

Electromagnetic fields have been shown to affect the brain physiology. Use of mobile phones disturbs Stage 4 sleep, the stage important for full recuperation of brain and body (Regel S.J et al 2007).

Number of mobile phone calls, SMS messages per day and high combined use of computer have been associated with sleep disturbances. Use of SMS service has also been linked with symptoms of depression (Thomee et al 2007).



- **Interference with other gadgets**

Cell phone radiation interferes with navigational equipments; therefore its use is banned in airborne flights, and also in hospitals near ICUs using life-line Electronic gadgets.

- **Serious health concerns regarding current Safety Thresholds**

In most countries the mobile radiation safety standards are based on the assumption that the only biological effect of microwave (mobile phone) radiation is heating, the so called thermal effect. However ample evidence demonstrates that non-thermal effects do exist and may occur at a significantly lower radiation level than what causes heating.

Papers by Dr. Henry C Lai report that non-thermal effects of Radio frequency radiation (RFR) accumulate over time; Phillips et al. (1998) reported DNA damage in cells after 24 hours of exposure to low intensity RFR; increased risk for glioma and acoustic neuroma (tumor of the nerve connecting ear to brain) after 10 years of mobile phone use with the current exposure standards (Hardell et al 2009). All point to the fact that the current exposure standards for microwaves are not safe for long-term exposure.

The Bioinitiative Report (610 pages long) has been prepared by a group of independent scientists after thorough and very careful survey of the literature and they concluded that the existing standards for public safety are inadequate to protect public health and needs

to be revised. The Bioinitiative report can be viewed at:
<http://www.bioinitiative.org/report/docs/report.pdf>

4. How Do Cell Phones Effect the Environment?

There are significant environmental effects of cell tower radiations. Some of these are:

- **Effect on Birds**

Research shows that when birds are exposed to weak electromagnetic fields, they disorient and begin to fly in all directions, which explains migratory birds undermining navigational abilities.



- **Effect on farm animals**

Some farmers have observed that cows grazing near cell towers are more likely to experience still births, spontaneous abortions, birth deformities and behavioral problems, and general declines in overall health. Moving cattle herds away from such towers has reportedly led to immediate health improvements.

According to Dr. W. Löscher of the Institute of Pharmacology, Toxicology and Pharmacy of the Veterinary School of Hannover in Germany, dairy cows that were kept in close proximity to a TV and cell phone tower for two years had a reduction in milk production along with increased health problems and behavioral abnormalities. In an experiment, one cow with abnormal behavior was taken away from the antenna and the behavior subsided within five days. When the cow was brought back near the antenna, the symptoms returned.

- **Mobile Phones and Vanishing Bees.**

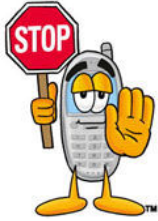


A study in England showed that bees refused to return to their beehives where there was a DECT cordless phone station. The DECT-station is a simple cordless phone base, widely used in homes and offices. It continuously emits the same radiation as mobile phones. It is discussed that the extensive use of mobile phones may be one reason why bee colonies are vanishing at a huge scale in Europe and the US.

Bees are vital pollinators for agriculture. With the vanishing of bees, a major food crisis could ensue.

Another study conducted by Punjab University, India found that electromagnetic radiations from cell phone towers can lead to diseases in plants and animals, and is the reason for the vanishing butterflies, some insects and birds like sparrows

5. What is safe radiation?



Rate at which radiation is absorbed by the human body is measured by specific absorption rate (SAR), measured in units of watts per kg (W/kg) of tissue. If the heat generated is small, the body's thermoregulatory mechanism can dissipate it without causing adverse effects. If the temperature exceeds this capacity, about 1 to 2 degree Celsius, tissue damage may occur.

Every mobile phone comes with a SAR rating (although some manufacturers try to hide it). Regulating agencies has set its maximum levels for handsets. Radiations depend on its design, antenna, how it is held and used. Institute of Electrical and Electronics Engineers (IEEE) Committee on Man and Radiation, national and international organizations have established safety guidelines for exposure to RF energy.

Testing has shown a wide range in radiation exposure to the user of various brands and models of cellular phones. The SAR values of a few cell-phone models are tabulated below:

Manufacturer	Model	SAR Output (W/Kg)
Motorola	V195s	1.6
Nokia	E710x	1.53
LG	Rumor 2	1.51
Sony Ericsson	W350a	1.48
Samsung	Instinct	1.46
Samsung	Soul	0.24
Nokia	9300	0.21
Output is expressed in Watts per Kilogram Current UK Standard = 1.0W/Kg Current US Standard = 1.6W/Kg		

Increase in thermal effects occurs when whole-body energy absorption exceeds a SAR of 4 W/kg. Taking this value as threshold for harmful effects, the International Commission on Non-Ionizing Radiation Protection (ICNIRP) applies a safety factor of 50 to derive safe limits for exposure to general public. However, studies, as mentioned above in previous sections, have shown that exposing humans to cell phone radiation can change brainwave activity, affect memory and learning at SAR levels as low as 0.1 watt per kilogram (W/Kg) in comparison to the US allowable level of 1.6 W/Kg and the ICNIRP allowable level of 2.0 W/Kg. SAR value for various mobile phones can be viewed at: http://reviews.cnet.com/cell-phone-radiation-levels/?tag=rb_content%3brb_mtx or <http://www.mmfa.org/public/sar.cfm>

6. How safe is your Cell phone?

Many cellular phones have microwave output signal strength of 1 to 2 Watts. The SAR limit of 1.6W/Kg is only for 6 minutes usage per day. A fact, most of the mobile operators do not tell the users. It has been reported that approximately 20 minutes of continuous talking on mobile phones raises ear lobe temperature by roughly 1.5⁰C. A 1.5⁰C rise in temperature is equivalent to 2.7⁰F, implying normal body temperature increasing from 98.4⁰F to fever of 101.1 ⁰F. Only then, brain realizes that ear temperature has gone up and body thermal regulatory mechanism starts functioning.

7. Some Interesting Facts About Cellphones

Did You Know?

- Nearly 30% to 50% of the radiation emitted by a typical cell phone, (enough to cause heating), is absorbed by the user's head?
- That a cell phone operating with good reception and at low power, produces a near-field plume (an area of intense radiation which forms around the center of the transmitting antenna of your cell phone) radius of 6-7 inches, which results in radiation penetrating 3 inches into your head.
- That talking on cellular phone for more than 20 minutes raises ear lobe and brain temperature by up to 2 degrees.
- Thermal measurements taken at cell phone base stations have ranged as high as 900 W/KG, whereas the permissible SAR level for cell phone base station antennas is 100W/Kg.
- Cell phones connect with the base station as frequently as every minute so as to relay information about your location, which generates a near-field plume by your phone even when you are not making a call.

8. Advice on use of microwave devices

A. Minimize time and intensity

- **Minimize the time you speak.** Preferably use the mobile phone only for very short duration, of a few minutes length, and never for several minutes. Mobile phones were invented for emergency use but unfortunately they have now become part of our daily lifestyle.
- **Minimize the intensity of the irradiation.**

Always check the signal intensity and don't call when the signal is weak, because then your mobile will irradiate maximally.

Hold the phone as far away as possible from the body while calling.

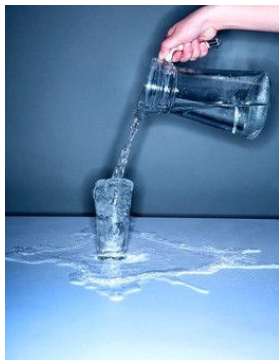
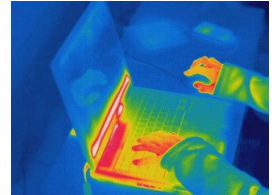
For this reason:



- **Use safe headsets.** The kind having a plastic tube between the earpiece and the phone are best. Search on Google for tube + headset (or airtube) and you will find several alternatives.
- **Use a loudspeaker phone,** as your headset may not always be available. But be careful, your face should be as far away as possible from the phone to reduce absorption of radiation by the face.

B. Avoid other sources of microwave radiation

- **Keep out of Wi-Fi fields.** If you have Wi-Fi based internet at home, get rid of it and use cable connection or switch it off when not in use. Some studies indicate that the Wi-Fi irradiation is stronger than the producers maintain. Don't stay long in Wi-Fi cafés as its radiation is continuous.
- **Avoid using cordless phones** in your home. Their base station, the charger/antenna, emits strong and continuous microwave radiation throughout the whole house. Use ordinary landlines only.
- **Keep out of Mobile phone towers / base stations.** Studies indicate an increased rate of diseases, including cancers, within about 400 m from them.



Until now, man has been absorbing the harmful, unseen electromagnetic radiations without even being aware of it, but now, with the rapid advent in technology, this RF Radiation pollution has started having ill effects on human health, health of animals, functioning of normal household, medical investigatory equipments and even on food products being consumed by everybody. Hence, there is an urgent need to take precautionary steps. Example, when a glass is filled with water, it holds up to a certain level, but once it reaches the rim, it starts spilling. Similarly, our bodies can also absorb radiation up to a certain limit.

It is a well known fact that automobiles create pollution, but have we stopped driving/using automobiles? Instead, people came up with solution of unleaded petrol, CNG driven vehicle, catalytic converters, hybrid vehicles, etc. Not all people get clean drinking water at their homes, hence Aqua Guard, Zero B and other water purifiers were invented.

We recommend mobile companies to accept the fact that radiation causes serious health problem, only then people all over the world, will carry out research to come out with solutions, like the Radiation Shield developed by Prof. Girish Kumar from Indian Institute of Technology (I.I.T), Bombay, India.

Videos to Watch

- **Cell Phone Use and Tumors: What the Science Says**

A committee was held on September 25, 2008 to discuss the exponential growth of cell phone and its link to health problems like tumors. Scientists, Doctors, and a member from the Federal Communications Commission (FCC) presented various aspects of their study. The video of approx. 2 hours of this Congressional Hearing can be viewed at:
<http://domesticpolicy.oversight.house.gov/story.asp?ID=2199>

- **Invisible Dangers of Cell Phone Radiation**

This video of approximately 10 minutes shows the dangers and possible hazards from electromagnetic radiation, and the necessity to take immediate precautions
<http://www.youtube.com/watch?v=eVo2maA7h1E&feature=related>

9. RADIATION SHIELD FROM WILCOM TECHNOLOGIES PVT. LTD

WILCOM provides a product to protect you and your family from the harmful effects of electromagnetic radiation.

The 'Radiation Shield' developed after 6 years of extensive research by Prof. Girish Kumar of IIT Bombay absorbs the harmful radiation from various electronic gadgets to produce a safe radiation free environment. The product is the first of its kind and sold by Wilcom Technologies Pvt. Ltd., Navi Mumbai, India for INR 1449 (approx. USD \$30).

The 180 mm x 90 mm x 30 mm device requires no electrical power supply to operate, no battery and is 100% maintenance free. It can be placed on table, hanged on wall or fixed on a window glass.

It consists of two orthogonally polarized broadband antennas to cover the frequency range of 800 MHz to 4.0 GHz. The antennas will receive the radiation from all the sources, such as, mobile phones, mobile phone towers, wireless phones, computers, laptops, microwave ovens, forthcoming 3G and Wi-MAX systems and dumps it into the matched load, which is built inside the radiation shield. Another version of this Radiation Shield has a LED, which glows when an operating mobile phone is brought close to its vicinity. For details, please see www.wilcom.co.in

Conclusion

There are a large number of contradictory reports which confuse the common man. But there are certain facts which cannot be argued with.

- Besides thermal effects on the human body, non-thermal effects of Electromagnetic Radiation have been observed and are associated with brain tumors, acoustic neuroma, lymphomas, decrease in immune function, sleep disorders, anxiety disorders, autism, multiple sclerosis, ALS, Alzheimer's disease, cataracts, hypothyroidism, diabetes, malignant melanoma, testicular cancer, heart attacks and strokes in young people.
- Children are more vulnerable to radio frequency radiation emissions as their skulls are thinner, their nervous system still developing and myelin sheath is yet not developed, and tests have shown that they absorb more radiation than adults.
- According to safety rules in the US, no residential complex should exist at a radius of 50 meters from the cell phone towers, as serious health concerns have been linked with public health and the base stations. A report has been prepared by the WHO- World Health Organization on Electromagnetic fields and public health: mobile telephones and their base stations in 2000, and is available at:

<http://www.who.int/mediacentre/factsheets/fs193/en>

- In countries like Sweden, Denmark, France, Germany, Italy, Switzerland, Austria, Greece, and Israel, where wireless technologies are fairly mature and widely distributed, these complaints are widespread and the cause of significant public concern. For example, the advent of the new 3rd Generation wireless phones (and related community-wide antenna RF emissions) caused almost immediate public complaints of illness in the Netherlands (TNO Physics and Electronics Laboratory, The Netherlands. 2003).
- The fact that the use of mobile phones etc. is prohibited in hospitals further affirms the fact that mobile phones are not completely safe.
- Wilcom Technologies has come up with a solution, a "Radiation Shield", designed by Prof. Girish Kumar at IIT Bombay, which absorbs radiation in the frequency range of 800 to 4000 MHz. Multiple radiation shields can absorb 60% to 90% of undesired radiation.

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