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A SURVEY ON HAZARDS OF CELL PHONE TOWER RADIATIONS

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Abstract— On recent days the usages of cell phones are increased drastically in turn the number of cell phone towers also increased. The mounting of cell phone towers in residential areas, hospital and office buildings causes the health hazards to the people who live in nearby areas. The usage of mobile phone is for communicating with other people and should not be intended in reducing the life span of living things. People are using mobile phone for more than an hour in a day without realizing the health hazards due the effect of radiation. India has around 7 lakhs of cell phone towers. These cell phone towers transmit radiation 24x7 and these radiations which affect the life span of all lives. In fact, women are statistically more affected than male. This survey paper deals with harmful effects of the cell tower radiation which affects the lives of plants, birds and human beings.

Keywords — : Radio frequency Electromagnetic Field (RF-EMF), Base Transceiver Stations (BTS), , Global System For Mobile Communication(GSM), Federal Communications Commission (FCC), Deoxyribonucleic acid (DNA).

I. INTRODUCTION

Radiation is a form of energy on the move. And propagate as electromagnetic wave in nature, i.e., it consists of waves of electric and magnetic energy moving together through space at the speed of light. We live in a radiation world and are exposed to both natural and man-made radiation. Every second of our life, we are exposed to all forms of radiation such as ultraviolet light from the sun and radio waves from radio and television broadcasts. When we go for a chest x-ray examination, we are exposed to x-rays. The electromagnetic radiations are of two types, one being ionizing radiations such as X-rays and gamma rays, and the other being non-ionizing radiations such as electric and magnetic fields, radio waves, radio-frequency band which includes microwaves, infrared, ultraviolet, and visible radiation. Ionizing radiation contains enough energy to cause ionization.Ionization is a process by which electrons are stripped from atoms and molecules. The interaction with matter can change chemical reactions in the body that leads to damage in biological tissues including effects on DNA (Deoxyribo Nucleic Acid) [1] the genetic material. Non-ionizing radiation does not have sufficient energy to cause ionization in living matter. It causes some heating effect, but usually not enough to cause any kind of long-term damage to tissues.Radio frequency energy, visible light and microwave radiation are considered non-ionizing.

A radio signal can be thought of as a wave that spreadsout from its source (the antenna). It is often referred to as an electromagnetic wave that is made up of linked electric and magnetic components. The radio frequency (RF) part of the electromagnetic spectrum includes electromagnetic waves produced by television and radiotransmitters (including base stations) and microwaves.The electric and magnetic components that form the electromagnetic wave can be referred to as radio frequency fields.

Base transceiver station of mobile phone are also known as base transceiver stations or telecommunications structures.They are low-power, multi-channel two-way radios.Antennas, which produce RF radiation, are mounted on either transmission towers or roof-mounted structures. These structures need to be of a certain height in orderto have a wider coverage.When you communicate on a mobile phone, you are connected to a nearby base station.From that base station your phone call goes into the regular fixed-line phone system. As the mobile phones and their base stations are two- way radios, they produce RF radiation to communicateand therefore expose the people near them to RF radiation. However, as both the phones and the base stations have low-power (short range) transmitters in them, the RF radiation exposure levels are generally very low.

II. RADIATION FROM THE CELL TOWER

A GSM900 base station antenna transmits in the frequency range of 935 - 960 MHz. Thisfrequency band

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of 25 MHz is divided into twenty sub-bands of 1.2 MHz, which are allocated tovarious operators. There may be several carrier frequencies (1 to 5) allotted to one operator withupper limit of 6.2 MHz bandwidth. Each carrier frequency may transmit 10 to 20W of power. So,4 one operator may transmit 50 to 100W of power and there may be 3-4 operators on the same roof top or tower, thereby total transmitted power may be 200 to 400W. In addition, directional antennas are used, which typically may have a gain of around 17 dB (numeric value is 50), so effectively, several KW of power may be transmitted in the main beam direction.

Frequency ranges of towers:

Antennas on Cell tower transmit in the frequency range of:[2]

869 - 890 MHz (CDMA)
935 - 960 MHz (GSM900)
1805 – 1880 MHz (GSM1800)
2110 – 2170 MHz (3G)

Radiation power:

Radiation norms adopted in different countries: In India, we have adopted radiation norms given by ICNIRP guidelines of 1998 for safe power density of f/200, where frequency (f) is in MHz. Hence, for GSM900 transmitting band (935-960 MHz), power density is 4.7W/m^2 and for GSM1800 transmitting band (1810-1880 MHz), it is 9.2W/m^2. The ICNIRP [3] guidelines clearly state that for simultaneous exposure to multiple frequency fields, the sum of all the radiation must be taken into consideration.

However, in India, we have applied this limit to individual carrier, so the radiation level exceeds by several times than even prescribed by ICNIRP guidelines, depending upon the total number of transmitters in that area Some of the people (especially older people, house wives, small children) living near the towers are exposed to this radiation 24 hours a day. Unfortunately, ICNIRP has considered only the thermal effects of radiation, where as scientist all over the world have found non-thermal effects of these radiations to have significant health effects and these non-thermal health effects occurs at levels much below these norms.

A base station and its transmitting power are designed in such a way that mobile phone should be able to transmit and receive enough signal for proper communication up to a few kilometers. Majority of these towers are mounted near the residential and office buildings to provide good mobile phone coverage to the users. These cell towers transmit radiation continuously, so people living within 10 meters from the tower will receive 10,000 to 10,000,000 time's stronger signal than required for mobile communication. In table I,the international radiation density limits for GSM 1800 is briefly given.

Power Density (W/m^2)	**International Exposure limits adopted by various countries**
10	FCC (USA) OET-65, Public Exposure Guidelines at 1800 MHz
9.2	ICNIRP and EU recommendation 1998 – Adopted in India
3	Canada (Safety Code 6, 1997)
2	Australia
1.2	Belgium (ex Wallonia)
0.5	New Zealand
0.1	Exposure limit in Poland, China, Italy , Paris
0.095	Exposure limit in Switzerland

Table I: International Radiation Density Limits for GSM1800[4]

III. EFFECTS OF CELL TOWER RADIATION

In India, cores of people reside within these high radiation zones.At many places, cell phone towers are mounted on the roof top of residential/commercial buildings. Even though antenna radiates less power vertically down but the distance between the antenna and top floor is usually a few meters, so the radiation level in the top two floors remain very high. There is very little available literature on the effect of electromagnetic radiation on the trees. Tops of trees tend to dry up when they directly face the cell tower antennas and they seem to be most vulnerable if they have their roots close to the water. Electromagnetic radiation emanating from cell towers can also affect vegetables, crops and plants in its vicinity. Studies show definitive clues that cell phone EMF can choke seeds, inhibit germination and root growth, thereby affecting the overall growth of agricultural crops and plants.Various studies have shown the ill-effects of radiofrequency electromagnetic field (RF-EMF) on bees, fruit flies, frogs, birds, bats, and humans, but the long-term studies of such exposures are inconclusive and scarce, and almost non-existent in India.

Radiation effects on trees:

In Assam, coconut, betel-nut is not cultivated commercially in large scale. It is reported that two factors are affecting in the production of nut, these are immature nut falling and nut cracking (splitting) due to the deficiency of micronutrient borax. This implies that

there is certain cell tower radiation effect on nut in this region. The survey was conducted with the gross production of betel nut, coconut and banana peanut in suburban area during the month of October and November 2014. In table II the year wise production of Banana, Betel-nut and Coconut is listed.

A pretested Questioner including questions regarding the number of trees, production of the fruits before and after the establishment of cell phone tower, soil condition, climate condition, deforestation, method of cultivation and management, uses of chemicals for growth and production and relative causes is prepared. Questions had also been included to know about the environmental change near the towers, the soil condition and deforestation.We meet and interact with215individuals like Farmers, People living near cell towers, local Agricultural officials, different Socio-NGO's, Social workers andFruit-Sellers of the town to know how a mobile tower affects their lives and how radiations from cell phone towers effects in production of fruits.

ITEMS	2006	2012	2013	2014
Banana (In qntls)	9800	9600	8900	8500
Betel-nut (in qntls)	8000	6500	4500	2500
Coconut (in pieces)	2500	1800	1400	800

Table II: Year wise production of Banana, Betel-nut and Coconut

Electromagnetic effects on Plant Seeds, Beans and Yeast:

The biological experiment was conducted at Global Quantech, Inc., San Diego, USA on plant seeds, beans, and yeast microorganisms [5]to verify the efficacy of EMF protection technologies. Samples of plant seeds, beans, and yeast microorganisms were located in the close proximity to cellular phones. Cellular phones were operating in stand by mode during this experiment; in other words, experiment provided effects of the 'near' field.The significant difference was observed in the growth cycle of green beans, black beans and black seeds on the twelfth day. There was not observed any significant difference in the samples of fennel seeds which did not spread out or in the growth of yeast microorganisms. Based on the results with green beans, black beans and black seeds it is reasonable to conclude that using electromagnetic protection technologies with cell phone can protect living cells against the harmful effects of electromagnetic radiation fields. Figure 2 enumerates the effect of radiation on seeds.

EM radiation effects on birds:

The study, conducted in Chandigarh, is applicable to

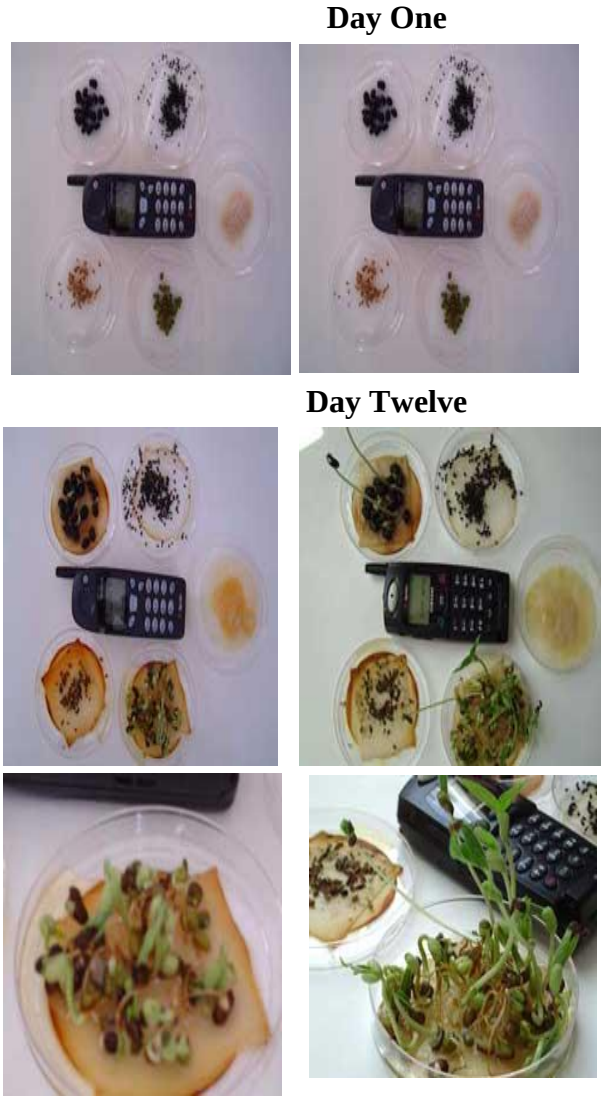

Figure 2: Effect of radiation on seeds

all Indian cities where cell phone masts are proliferating. Chennai has 20,000 cell phone towers, compared to about 200 in Chandigarh.Researchers at the Salim Ali Centre for Ornithology and Natural History (SACON), Coimbatore, say there are enough reasons to attribute bird mortality to such radiation."Cell phones and towers emit a very low frequency of 900 or 1,800 MHz, called microwaves. Studies have found that they can cause thin skulls of chicks and thin egg shells," says Dhanya R, a researcher at SACON[6].The team at the Centre for Environment and Vocational Studies of Punjab

University, headed by RK Kohli, exposed 50 eggs to EMR for durations of five minutes to 30 minutes. "All the 50 embryos were damaged. It's almost like being microwaved,".Chennai-based zoologist Ranjit Daniels says four of the 200-odd Chennai birds — house sparrow (Passer domesticus), red whiskered bulbul (Pycnonotusjocosus), brahmini kite (Haliasturindus) and spotted dove (Streptopelia chinensis) — have virtually disappeared."Birds are known to be sensitive to magnetic radiation. Microwaves can interfere with their sensors and misguide them while navigating and preying," says Daniels. So, when the centre decided to study in December 2005, the impact of electromagnetic radiations (EMR), Kohli decided to include sparrows in the list of organisms that the radiations affect. Three years later, the study found microwaves (300 MHz to 300 GHz) emitted by cell phone towers and handsets responsible for damaging eggs and embryos. And that is just one of the urban factors driving out several species of birds out of the cities. PAAzeez, senior principal scientist at Salim Ali Centre [7]for Ornithology and Natural History, concurs: "Urban birds have the habit of finding an urban analogue for their wild nests. Pigeons, which are multiplying in large numbers in cities, find ventilators an analogue to their natural rocky confines. Whichever bird finds an analogue survives." That perhaps explains the case of the disappearing brahminy kites which nest only on very tall trees.

EM radiation effects on human-being:

When a human body is exposed to the electromagnetic radiation, it absorbs radiation, because human body contains 70% of liquid. It is similar to that of cooking in the microwave oven. The human height is much greater than the wavelength of the cell tower transmitting frequencies, so there will be multiple resonances in the body, which creates localized heating inside the body. This results in boils, drying up the fluids around eyes, brain, joints, heart, abdomen, etc. Individuals differ in their response to similar levels of EMF radiation. For some people, short term effects from cell tower radiation exposure may include headaches, sleep disorders, poor memory, mental excitation, confusion, anxiety, depression, appetite disturbance and listlessness.

Radiation from cell phone towers has been associated with greater increase in brain tumor. This is due to the damage in the blood brain barrier and the cells in the brain which are concerned with learning, memory and movement. Studies by Carl Blackman have shown that weak electromagnetic fields release calcium ions from cell membranes. Leakage of calcium ions into the cytosol acts as a metabolic stimulant, which accelerates growth and healing, but it also promotes the growth of tumors. Loss of calcium ions causes leaks in the membranes of lysosomes releasing DNA's that causes DNA damage. Another possibility of DNA damage is via increased free radical formation inside cells, which further causes cellular damage in the mitochondria.

Effects on Human Health:

Every individual respond in a different way to similar levels of EM radiations. Long-term effects can be brain tumor, cancer, DNA damage, etc.

1. Cancer: According to a study performed by doctors from German city of Naila, a newly-diagnosed cancer rate is three times higher for those living within 400 meters of mobile phone towers than those living far away. Breast cancer was one of the most observed while that of prostate, pancreas, bowel, skin, lung, and blood also increases. Children and teenagers, before the age of 20 are five times more likely to get brain cancer, as their brain is not fully developed and radiation penetration is much deeper. It is possible that today's young people may suffer an "epidemic" of the disease in later life.

2. Hormonal imbalance: studies conducted by Charles Graham, PhD, physiologist at Midwest research Institute in Kansas City, shows [8]that EM radiations imbalances the hormones. Women and men were exposed to higher levels of EM radiations for a night in the laboratory which increased their serum estrogen levels in women and decreased the testosterone levels in men. The increased levels of estrogen develop the risk of cancer and decreased level of testosterone has been related to development of prostate and testicular cancers. Another hormone called, melatonin, secreted by pineal gland in brain and is responsible for sleep cycle is also effected by EM radiations. The level of melatonin is higher at night and is low during the day. It is produced almost 90 minutes after we fall asleep. When this hormone is inhibited by radiations many problems are caused like sleep disorders, insomnia, headaches, etc. The cells are repaired and rejuvenated while sleeping but lack of sleep can lead to development of cancer.

3. DNA damage: Studies by Carl Blackman have shown [9] that weak electromagnetic fields release calcium ions from cell membranes. Leakage of calcium ions into the cytosol acts as a metabolic stimulant, that is responsible for growth and healing, and also promotes the growth of tumors. Loss of calcium ions causes leaks in the membranes of lysosomes releasing DNA's that causes DNA damage. Another possibility of DNA damage can

be through increased free radical formation inside cells, which further causes cellular damage in the mitochondria.

4. Stress: Mobile phones can cause physical stress in the body in addition to mental interruptions. When the body experiences a stress event the "flight or fight" response is triggered. Certain stress hormones are released from the adrenal glands, the first of which is adrenaline. The effects of adrenaline include rapid heart rate, increased energy level, increased blood pressure, muscle contraction, rapid breathing, etc. The $A = \pi r^2$e effects are not harmful if they only occur for a short period of time but can harm the body in case of long periods. Another chemical released by the adrenal gland is a hormone called cortisol. Cortisol is the body's natural form of cortisone. When the human body is chronically stressed higher amounts of cortisol are released. These high amounts of cortisol suppress the immune system, blood sugar levels rise and insomnia can occur. Finally, after long-term continual stress responses the adrenal glands become tired and fatigued. Symptoms like Irritability, fatigue, anger, road rage, high blood pressure, loss of blood sugar control, decreased thyroid function and weight gain can result from this condition.

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

IV. CELL PHONE TOWERS IN INDIA

According to the data provided by Minister of State for Communications and IT Milind Deora, India has total 7,36,654 base transceiver stations (BTS -2G GSM and CDMA & 3G Mobile Towers).Table III gives the details on the no of base stations in different states in a particular area.

S.No.	No. of LSA	No. of BTSs
1	Andhra pradesh	60368
2	Assam	14015
3	Bihar	44613
4	Chennai	21187
5	Delhi	21992
6	Gujarat	46105
7	Haryana	17650
8	Himachal Pradesh	6933
9	Jammu &kashmir	10392
10	Karnataka	53627
11	Kerala	34266
12	Kolkatta	18546
13	Maharasthra	63604
14	Madhya Pradesh	44933
15	Mumbai	29027
16	Orissa	19819
17	Punjab	26531
18	Rajasthan	34692
19	Tamilnadu (except Chennai)	46467
20	Uttar Pradesh	84812
21	West Bengal	29353

Table III: No. of BTs per circle

V. CONCLUSION

Even cell phone technology has several advantages it is harmful to this world which ruins the life of all creature from birds to human beings. So government should take necessary action in reducing the cell phone tower and restrict the tower mount near residential, hospital, and office buildings. In this way we can protect the trees, rare kind of birds, and human life. People also need aware about the cell tower radiation and take such remedies prevent from radiation.

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