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## STUDY OF RADIATION EXPOSURE DUE TO MOBILE TOWERS AND MOBILE PHONES

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### Abstract:

*Use of mobile phone is increasing tremendously every year globally due to facility to connect any where and at any time. For better connectivity numbers of mobile towers in the populated and residential zones are erected. Mobile Phones and Mobile Towers emit electromagnetic radiations continuously all the time which are very harmful. Most of the people were unaware about health hazard of continuous emission of radiation. Today, there is an upsurge in public concern about the possible health hazards of this new technology. In addition, the studies on mobile phone radiation risk have received widespread public interest. In this paper, effects of mobile phone towers and mobile phones are discussed. The paper is divided in to two sections. In first section, effects of mobile towers radiation have been summarised and in the other section effects of mobile phone on heart rate is presented.*

### KEYWORDS:

Mobile Phone Radiation, Mobile Tower Radiation, Heart Rate, Health Hazards .

### INTRODUCTION

On 30<sup>th</sup> April 2013, the number of mobile phone users in India are 867.8 millions (second highest in world) [1] and mobile towers are more than 6 lac. It is estimated that number of mobile phone will exceed world population in 2014. It is difficult to imagine everyday life without a mobile phone both in house and office. Since mobile prices are slashing out every body is using for mobile voice or data communication. Due to its extensive use and awareness about radiation exposure, people started showing keen interest in the scientific findings. Network is established to sends and receives radio frequency signals with number of cell site base stations (BTS) fitted with microwave antennas. These sites are usually mounted on a tower, pole or building. Many towers are located throughout populated areas. The cell phone has a low power transmitter that transmits voice and data to nearest cell sites, normally not more than 8 to 13 km away.

Scientific studies have investigated the possible health effects of mobile phone and its tower radiations. These studies are occasionally reviewed by some scientific committees to assess overall risks [2-3]. A cell phone is low power radio frequency devices that transmit radio frequency radiation in the microwave region of 900-1800 MHz through an antenna used closure to users head. Radio frequency radiation from cell phone is expressed in terms of SAR (Specific Absorption Rate) value. In USA, SAR limit for cell phones is 1.6 W/Kg, which is actually for 6 minutes per day use. It has a safety margin of 3 to 4, so a person should not use cell phone for more than 18 to 24 minutes per day. It has been reported that after use cell phones for more than 20 minutes, ear lobes get warmed due to heating of blood by microwave energy of cell phones. The problem begins with a pain in the ear that gradually develops into tinnitus or a ringing sensation which finally leads to hearing loss and ear tumor. Also, over use of cell phones leads to

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drying of the skin and fluid in the eyes, sleep disorder, lack of concentration, memory loss, and even induction of cancer [4-6].

The radiation given out by mobile phones and mobile phone towers is non-ionizing radiation. Unlike ionizing radiation (as emitted by X-ray machines), RF energy from cell phones and other wireless devices cannot break chemical bonds in the human body. Cell phones emit low-levels radiofrequency (RF) energy, some of which is absorbed into body. The amount of energy absorbed depends on many factors, such as how close you hold the cell phone to your body and the strength of the signal. The transmitting power of a cell phone varies, depending on the type of network and its distance from the cell phone tower. The power generally increases further you move away from the nearest cell phone tower [7].

### **What are biological effects?**

The electromagnetic hazards can be classified into thermal effects and non thermal effects. In thermal effects radio wave induces polar molecules that generate dielectric heating letting the live cell to die. That is why while receiving the message through radio waves some part of head experiences increase in temperature damaging nerve fibres. Non thermal effects are related to genotoxic effects, i.e. brain cancer and interference with cardiac pacemakers.

### **Impacts on Human**

Since its beginning, there have been concerns about the adverse effects of the mobile towers and mobile phones. Electromagnetic radiation and their negative impacts on biological systems and environment have already been reported by several studies [8-10]. Radiation from cell phone towers causes larger increase in brain tumor [11]. This is due to the damage in the blood brain barrier and the brain cell. Studies by Carl Blackman et al. have indicated that weak electromagnetic fields release calcium ions from cell membranes [12]. Loss of calcium ions causes leaks in the membranes of lysosomes releasing DNAase that causes DNA damage. As human body contains 70% of liquid, it absorbs radiation when body is exposed to the EMR. The human height is much greater than the wavelength of the cell tower transmitting frequencies, so there will be multiple resonances in the body. This creates localized heating inside the body causing boiling, drying up the fluids around eyes, brain, joints, heart, abdomen, etc. [13].

It has been reported that for some people, short term effects from cell tower radiation exposure is observed. This includes headaches, sleep disorders, poor memory, mental excitation, confusion, anxiety, depression and appetite disturbance [14]. The response to similar levels of electromagnetic radiation differs individually. A study by doctors from Naila city (Germany) monitored 1000 people residing in an area around two cell phone towers for 10 years. They found that those living within 400 meters of tower had a newly-diagnosed cancer rate three times higher than those who lived further away. In the observed cases breast cancer topped in the list, but cancers of the prostate, pancreas, skin melanoma, lung and blood were also increased [14].

Investigators reported a study of radiation exposure of cell phones & its impact on human health with special reference to South Asia. Report included headaches, bad sleep, earaches, short-term memory loss, hair loss, burning sensation, blurring of vision [15]. Some investigators had observed effect of GSM phone radiation on human pulse rate (Heartbeat Rate). It was found that pulse rate do not change significantly when subjects were exposed to phone radiation. However, the percentage decreases recorded by people of age 40 years and above. [16]. Even a cell phone in the pocket or on a belt may damage sperm DNA and impair fertility in men [17]. Phones used by pregnant women may modify brain development of the fetus. This has been linked in both animal and human studies to hyperactivity, learning and behavior problems. There is now much more evidence of risks to health affecting billions of people world-wide. Health effects include damage to DNA and genes, effects on memory, learning, behavior, attention, sleep disruption, cancer and neurological diseases like Alzheimer's disease also. Children are more vulnerable to radio frequency radiation emissions as their skulls are thinner Children are more vulnerable to radio frequency radiation emissions as their skulls are thinner [3]. 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% [18].

### **Significant environmental effects of cell tower radiations.**

Researchers reported biological effect of Electromagnetic radiation. Studies showed that when birds are exposed to weak electromagnetic fields, they disorient and begin to fly in all possible directions [19]. Honey bees appear to be very sensitive to EMR and their behavioral responses, if scientifically documented, could be used as a marker of EMR pollution. Recently, a sharp decline noticed in bee population in Kerala having the highest density of Mobile Towers posing a serious threat to honey bees

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[20]. Bees are vital pollinators for agriculture. With vanishing of bees, a major food crisis could ensue. Some farmers have observed that cows grazing near cell towers are more likely to experience still births and spontaneous abortions giving birth deformities and behavioral problems. It has been also observed that moving cattle herds away from such towers has led to immediate health improvements. And near cell phone tower there was reduction in milk production along with increased health problems and behavioral abnormalities [21].

Exposure to EMR field showed to evoke diverse responses varying from aversive behavioral responses to developmental anomalies and death in many of the studied groups of animals such as bees, amphibians, mammals and birds [22-23]. When birds like pigeon, sparrows and swans are exposed to weak electromagnetic field, they disorient & begin to fly in all directions. Activity of bats is reduced in areas with Electro-magnetic fields.

### MATERIALS AND METHOD

For the experiment purpose, 40 healthy subjects (20 males & 20 female) of age groups 20-30 and 30-40 years were selected. They were informed about the procedure of study and their consent is taken. The experiments were performed for non-stress zone (without mobile) and stress zones (with mobile in various modes). Mobile phone of specification Nokia 5030 is used for sending signal(transmitter) and Nokia 1200 is used as receiver and kept near chest (Receiver) approved for use on the EGSM 900 and 1800 MHz were used for experiments. Receiving mobile is kept at the position of front pocket of shirt. ECG machine -BPL CARDIART 108T-DIGI (Fig. 1) was used to record the ECG. One can calculate the heart rate by knowing chart speed of paper used and measuring distance between R-R peak of ECG waveform. The changes in the amplitude of R wave and periods of various wave in the pattern is also observed.

Cardiart 108T- DIGI



Fig 1. ECG machine



Fig.2 Limb and chest electrodes

Conducting jelly is used to facilitate a more intimate contact between the subject's skin and the recording electrodes. The recording site is cleaned at the beginning. Four limb electrodes were used for both hands and legs. These are rectangular surface electrode made of German silver, an alloy of Zinc, Copper and Nickel. They are reusable. One electrode was used as suction cup type chest electrode (Fig 2). Electrocardiogram (ECG) recorded by a machine for a subject. Blood pressure of object is recorded to check whether he is in normal condition or not. The subject is asked to lie down on a bed for 5 minutes. ECG jelly was applied at the position of electrode over there. Limb electrodes were placed on the hands and legs and suction cup electrode on chest near the SA node of heart. Then ECG of an subject under normal condition (N- non stressed condition- without mobile phone) is recorded. We studied the effect of various stresses of cellular phone by keeping it on vibrating(V), vibrating plus ring tone (V+R), ring tone(R) and silent mode(S) on ECG. We have compared these results with normal ECG. The procedure was repeated for 40 subjects.

### RESULTS AND ANALYSIS

Electrocardiograms are almost invariably recorded on graph paper with horizontal and vertical

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lines at 1 mm intervals with a thicker line at 5 mm intervals. Time measurements and heart rate measurements are made horizontally on the electrocardiograms. For routine work, the paper recording speed is 25 mm/sec. Amplitude measurements are made vertically in mV. The sensitivity of an electrocardiograph is typically set at 10 mm/mV. Electrodes placed in contact with the skin of the object. Electrode jelly is used for good contact between skin and electrode. Five electrodes placed at positions, two limb electrodes on legs(LL,RL), two limb electrodes on hand(LA, RA) and a chest electrode near chest as per standard used in hospitals by cardiologist are used with proper application of jelly. Electrocardiograph is recorded with the machine discussed earlier. Graphs of these results are plotted for two age groups for male and female.

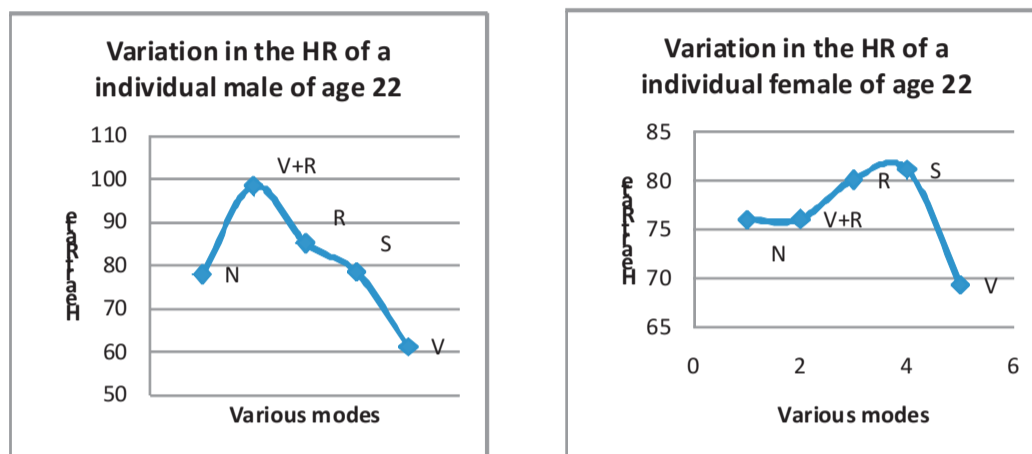


Fig. 3. Variation in the HR in bpm of individual for different modes of mobile phone

Heart rate of individual changes significantly from 78 to 61 for a male of age 22 years showing change of 21.8%, while for a female of same age it is 8.73%(Fig.3). We have taken average of the readings for male and female, Fig.4 shows variation in HR using different modes of mobile phone for age group 20-30 yrs, while variation in HR using different modes of mobile phone for age group 30-40 yrs is shown in Fig 5.

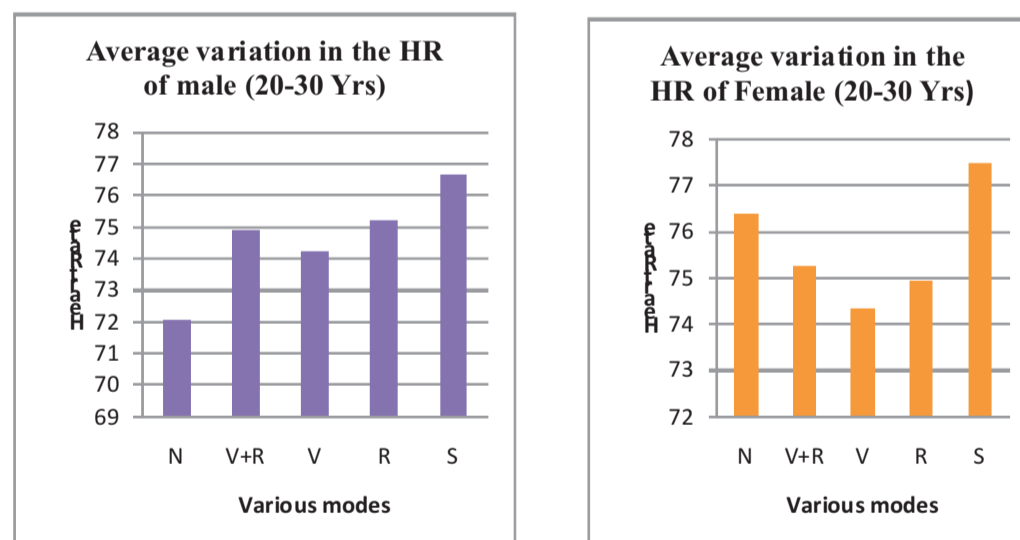


Fig.4. Variation in HR using different modes of mobile phone for age group 20-30 yrs

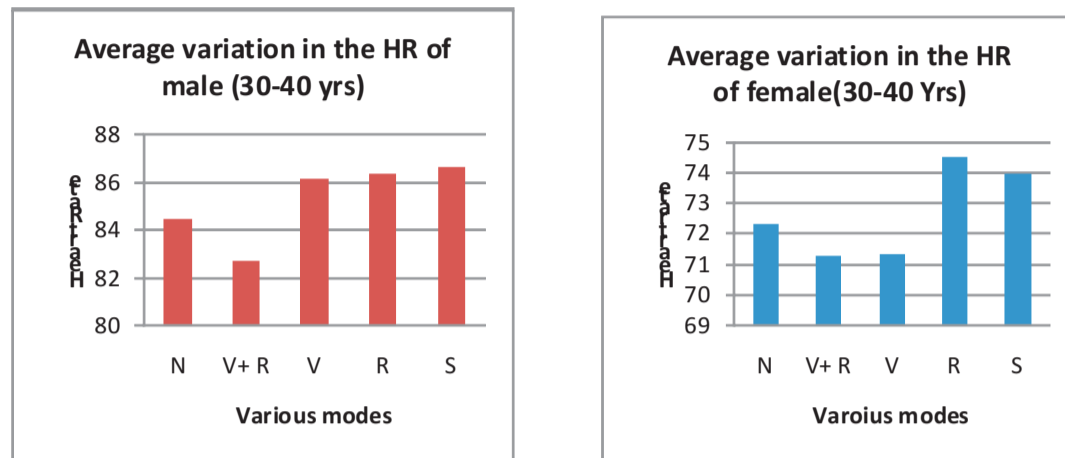


Fig.5.Variation in HR using different modes of mobile phone for age group 30-40 yrs

Data was further analyzed based on percentage difference (increase or decrease) in comparison to the normal rate which served as the reference value. The calculation was based on the average values given in Table I. This average value in other word, the mean, and since it is regarded to be the best indication of central tendency. It is applied here to the different age groups in the calculation of the percentages. Defining Rc as percentage difference of the ratio of the discrepancy between the normal value (Ro) and value of heart rate in exposed condition (Re), to the normal (Ro). Variation is shown in Table I.

Table I Variation in the heart rate

| Age group-20-30 years |       |       |       |       |       | Age group 30-40 years |       |       |       |       |       |
|-----------------------|-------|-------|-------|-------|-------|-----------------------|-------|-------|-------|-------|-------|
| Av.HR→                | N     | V     | V+R   | R     | S     | AvH R→                | N     | V     | V+R   | R     | S     |
| <b>Male</b>           | 72.06 | 74.24 | 74.09 | 75.2  | 76.68 | <b>Male</b>           | 84.45 | 86.16 | 82.73 | 86.4  | 86.63 |
| <b>% Rc</b>           | -     | 3.02  | 2.81  | 3.94  | 6.41  | <b>% Rc</b>           | -     | 2.2   | -2.04 | 2.31  | 2.64  |
| <b>Female</b>         | 76.38 | 74.35 | 75.27 | 74.96 | 77.2  | <b>Female</b>         | 72.31 | 71.34 | 71.3  | 74.53 | 73.93 |
| <b>% Rc</b>           | -     | -2.65 | -1.45 | -1.85 | 1.46  | <b>% Rc</b>           | -     | -1.34 | -1.4  | 3.07  | 2.24  |

**CONCLUSION**

For ECG study, two groups of subjects of age 20 to 30 and 30-40 year were selected. It is observed that for male of age group 20-30, Rc varies from 2.81% to 6.41% showing significant change of 6.4% bpm in heart rate in silent mode. This is because in silent mode all the signals are totally electromagnetic radiation which is very harmful to our heart and in other modes some signal is utilized for vibration or ringing. For female of same group the variation in HR is -2.46 to 1.46%. It is also noted that the change varies from person to person. The variation for age group of 30-40 years is as shown in the table I. It is also noted that some people are more susceptible to mobile phone radiation.

**FUTURE SCOPE AND SUGGESTIONS**

ECG study indicated changes in blood pressure and heart rate when exposed to cell phone radiation. The study presented here was conducted on limited volunteers. We feel that it is done on large scale quantity of various groups and sex. Then, the effect will be more precise and accurate. These changes should be correlated with other potential like electroencephalogram, biopotential due to brain cell. The experiments near base station is in progress and then results will be correlated

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No doubt electromagnetic fields are harmful and can have adverse effect on human body depending upon the intensity and frequency of electromagnetic field of cell phone. It is always a good idea to avoid the unnecessary exposure to electromagnetic fields whenever possible. This can be achieved by avoiding playing music and games on the mobile phone for long timer, keeping the mobile phone away from the head during the telephone connection and during sleep and using it during necessity minimizing talk. It is also suggested that no mobile tower should be erected in populated area. It is also suggested that no body should reach less than 4 m from the tower. Though the technology makes our life very comfortable but at the cost of our health, it is our prime duty to save our lives. Thus, we should use technology wisely so that we can save our self as well as mother earth.

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