General research activities in India related to EMF health –

1. Gandhi & Singh et. al. Cytogenetic damage in mobile phone users: Preliminary data. Int J Hum Genet (2005) 5:259-265. The data revealed increased number of micro nucleated buccal cells and cytological abnormalities in cultured lymphocytes indicating the genotoxic response from mobile phone use. As exposure to radiofrequency radiations has been reported to affect physiological, neurological, cognitive and behavioral changes and to induce, initiate and promote carcinogenesis; threat to human health has been suggested for mobile phone users.

2. Gandhi & Anita et. al. Genetic damage in mobile phone users: some preliminary findings. Int J Hum Genet (2007) 11:99-104. In this study a correlation between mobile phone use and DNA and chromosomal damage in lymphocytes of individuals was observed which may have long-term consequences in terms of neoplasia and/or age-related changes.

3. Rekhadevi et. al. Genotoxicity evaluation of human populations exposed to radio frequency radiation. Toxicol Int (2009) 16:09-19. The results of this study indicated that the genetic damage of peripheral lymphocytes and buccal epithelial cells in the mobile telephone user increased significantly, as compared with control.

4. Kesari et. al. Mobile phone usages and male infertility in Wistar rats. Indian Journal of Experimental Biology (2010) 47:987-992. The results indicated significant reduction in testicular size, weight and in sperm counts. The data also indicated that the chronic exposure to Radio Frequency Radiation (RFR) emitted from cell phone causes a significant decrease in protein kinase C and total sperm count along with increase apoptosis in male rat. The study suggested that decrease in sperm count and increase in apoptosis may be a causative factor due to mobile radiation exposure leading to infertility.


6. Chaturvedi et. al. Microwave Irradiation Alters Circadian Organization, Spatial Memory, DNA Structure In The Brain Cells And Blood Cell Counts Of Male Mice. Electromagnetic Research B (2011) 29:23-42. Author examined biological effects of 2.45 GHz microwave radiation in Parkes strain mice. Microwave radiation caused an increase in erythrocyte and leukocyte counts, a significant DNA strand break in brain cells and the loss of spatial memory in mice. This report for the first time provides experimental evidence that continuous exposure to low intensity microwave radiation may have an adverse effect on the brain function by altering circadian system and rate of DNA damage.

7. Kumar et. al. The therapeutic effect of a pulsed electromagnetic field on the reproductive patterns of male Wistar rats exposed to a 2.45-GHz microwave field. Clinics (2011)66:1237-1245. Another study in male Wistar rats concluded that Electromagnetic fields are recognized as hazards that affect testicular function by generating reactive oxygen species ad reduce the bioavailability of androgen to maturing spermatooza. Thus, microwave exposure adversely affects male fertility.

8. Dhami AK et. al. Study of electromagnetic radiation pollution in an India city. Environmental Monitoring and Assessment (2011). DOI: 10.1007/s10661-011-2436-5. The study was undertaken to estimate the microwave/RF pollution by measuring radiation power densities near schools and hospitals of Chandigarh city in India. The cell phone radiations were measured using a handheld portable power density meter TES 593 and specific absorption rates were estimated from the measured values. These values of electromagnetic radiation in the environment were compared with the levels at which biological system of humans and animals starts getting affected. The values were also compared with the international exposure limits set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). The highest measured power density was 11.48 mW/m(2) which is 1,148% of the biological limit. The results indicated that the exposure levels in the city were below the ICNIRP limit, but much above the biological limit.

9. Kesari et. al. Pathophysiology of Microwave Radiation: Effect on Ran Brain. Appl Biochem Biotechnology (2012) 166:379-388. The study aims to investigate the effect of 2.45 GHz microwave radiation on wistar rats. A significant decrease (P<0.05) was recorded in the level of pineal melatonin of exposed group as compared with sham exposed. A significant increase (P<0.05) in creatine kinase, caspase 3 and calcium ion concentration was observed in whole brain of exposed group of animals as compared to sham exposed. The study concludes that a reduction in melatonin or an increase in...
caspase 3, creatin kinase and calcium ion may cause significant damage in brain due to chronic exposure of these radiations. These biomarkers clearly indicate possible health implication of such exposures.

10. **Paulraj and Behari et. al.** Biochemical change in Rat Brain Exposed to Low Intensity 9.9 Ghz Microwave Radiation. Cell Biochem Biophys (2012) 63:97-102. Present study concerns with various biochemical changes in the developing rat brain exposed to 9.9 Ghz (square wave modulated, 1 KHz) at power density 0.15 mW/cm² (specific absorption rate 1.0 W/kg) for 2 h/day for 35 days. Results of this study reveal that chronic exposure of rat to microwave radiation alter the activity of certain enzymes. There was a significant increase in calcium ion influx and the activity of ODC. On the other hand, there is a significant decrease in PKC activity. Since these enzymes are related to growth any alteration may lead to affecting function of the brain and its development.

11. **Ongoing activities:** To study the adverse effects of RFR emitted from cell phone, the ICMR has initiated a prospective cohort study in Delhi & National Capital Region (NCR) to examine whether use of cell phone is associated with neurological disorders (cognitive behavior, sleep related disorders, depression etc.), reproductive dysfunctions and promote cancer in Indian population. The efforts are also ongoing to study the effect of RFR on cardiovascular disorders and otological disorders, if any. Under this study the provision has been made to measure specific absorption rate, power density, wave length and frequency of RFR emitted from various types of cell phones used by the enrolled subjects. The physical characteristics of RFR emitted from various cell phones will be correlated with the clinical & laboratory findings.

The ICMR is also in the process of developing a protocol to study the subjective symptoms in the subjects living near mobile phone towers in comparison to subjects living away from the cell phone towers.

- **New policies and legislations regarding EMF exposure**

To develop safety limits for exposure to radio frequency energy produced by mobile hand-sets and to fix safe exposure limit from cell phone tower in the Country the Dept. of Telecommunication, Ministry of Communications & Information Technology, Govt. of India constituted a Inter-Ministerial Committee where I am a member of the Committee and representing the Ministry of Health and Family Welfare, Govt. of India and ICMR. The report and recommendations of the Inter-Ministerial Committee are available on the website of Ministry of Telecommunication. [http://www.dot.gov.in/miscellaneous/IMC%20Report/IMC%20Report.pdf](http://www.dot.gov.in/miscellaneous/IMC%20Report/IMC%20Report.pdf)

- **Areas of public concern and National response**

Both electronic and print media are regularly raising the concern of the people who are living near the cell phone towers. Even various residential welfare associations and number of independent activists have raised various types of health hazards being faced by the people living near the cell phone towers. In few cases it has been published in the news papers indicating that the incidence of cancer has increased among the people residing near the cell phone towers. Even in the Parliament the issue of health hazard due to RFR emitted from Cell Phone and Cell Phone Towers has been raised. The Govt. of India has therefore directed to conduct studies in this area.

- **New public information activities**

The following recommendations has been made in the report which will be beneficial to the public and efforts are going on to apprise about these recommendations:

1. **SAR value information is to be embossed and displayed in the handset.**
2. **Information on SAR values for mobile handsets should be readily available to the consumer at the point of sale so that one can make sure of the SAR value of the handset while buying a cell phone.**
3. **To bring awareness, the manufacturer’s mobile handset booklet should contain the following for safe use:**
   a. *Use a wireless hands-free system (headphone, headset) with a low power Bluetooth emitter to reduce radiation to the head.*
   b. *When buying a cell phone, make sure it has a low SAR.*
   c. *Either keep your calls short or send a text message (SMS) instead. This advice applies especially to children, adolescents and pregnant women.*
   d. *Whenever possible, use cell phone when the signal quality is good.*
   e. *People having active medical implants should keep their cell phone at least 30 cm away from the implant.*
4. Dept. of Telecommunication (DOT), Govt. of India should create a national data base with the information of all the base station, their emission levels and display on public domain for public information.
5. Impose restrictions on installation of mobile towers near high density residential areas, schools, playgrounds and hospitals.
6. For the future expansion of telecom network in the country use low power micro cell transmitters with in-building solutions in place of the present trend of using high power transmission over mobile towers / high rise buildings.
7. Department of Telecom may create a document "Radio waves and safety in our daily life" indicating various Dos and Don'ts related to mobile users clarifying various myths regarding deployment and use of radio waves and mandate each operator to print and issue the same to their customer at the point of sale for enhanced customer awareness. This will help in facilitating the right inputs and creating an environment where everyone can use the radio waves safely.