Short report on the national activities on EMF

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(1) General research activities in India related to EMF health –

i. B.B. Lahiria, S. Bagavathiappana, C. Soumyab, T. Jayakumara, John Philip (2015). Infrared Thermography Based Studies on Mobile Phone Induced Heating. Infrared Physics & Technology. 71:242-251.

In this study, the skin temperature rise due to the absorption of radio frequency (RF) energy from three handheld mobile phones using infrared thermography technique. Experiments are performed under two different conditions, viz. when the mobile phones are placed in soft touch with the skin surface and away from the skin surface. Additionally, the temperature rise of mobile phones during charging, operation and simultaneous charging and talking are monitored under different exposure conditions. It is observed that the temperature of the cheek and ear regions monotonically increased with time during the usage of mobile phones and the magnitude of the temperature rise is higher for the mobile phone with higher specific absorption rate. The increase in skin temperature is higher when the mobile phones are in contact with the skin surface due to the combined effect of absorption of RF electromagnetic power and conductive heat transfer. The increase in the skin temperature in non-contact mode is found to be within the safety limit of 1 °C. The measured temperature rise is in good agreement with theoretical predictions. The empirical equation obtained from the temperature rise on the cheek region of the subjects correlates well with the specific absorption rate of the mobile phones. This study suggested that the use of mobile phones in non-contact mode can significantly lower the skin temperature rise during its use and hence, is safer compared to the contact mode.

ii. Pravin Suryakantrao Deshmukh, Namita Nasare, Kanu Megha, Basu Dev Banerjee, Rafat Sultana Ahmed, Digvijay Singh, Mahesh Pandurang Abegaonkar, Ashok Kumar Tripathi, Pramod Kumari Mediratta (2015). Cognitive Impairment and Neurogenotoxic Effects in Rats Exposed to Low-Intensity Microwave Radiation. International Journal of Toxicology, 34(3):284-90.

The health hazard of microwave radiation (MWR) has become a recent subject of interest as a result of the enormous increase in mobile phone usage. The present study aimed to investigate the effects of chronic low-intensity microwave exposure on cognitive function, heat shock protein 70 (HSP70), and DNA damage in rat brain. Experiments were performed on male Fischer rats exposed to MWR for 180 days at 3 different frequencies, namely, 900, 1800 MHz, and 2450 MHz. Animals were divided into 4 groups: group I: sham exposed; group II: exposed to MWR at 900 MHz, specific absorption rate (SAR) 5.953×10^{-4} W/kg; group III: exposed to 1800 MHz, SAR 5.835×10^{-4} W/kg; and group IV: exposed to

2450 MHz, SAR 6.672 × 10^{-4} W/kg. All the rats were tested for cognitive function at the end of the exposure period and were subsequently sacrificed to collect brain. Level of HSP70 was estimated by enzyme-linked immunotarget assay and DNA damage was assessed using alkaline comet assay in all the groups. The results showed declined cognitive function, elevated HSP70 level, and DNA damage in the brain of microwave-exposed animals. The results indicated that, chronic low-intensity microwave exposure in the frequency range of 900 to 2450 MHz may cause hazardous effects on the brain.

iii. Megha K, Deshmukh PS, Ravi AK, Tripathi AK, Abegaonkar MP, Banerjee BD (2015). Effect of Low-Intensity Microwave Radiation on Monoamine Neurotransmitters and Their Key Regulating Enzymes in Rat Brain. Cell Biochemistry and Biophysics, 73:1; pp 93-100.

The increasing use of wireless communication devices has raised major concerns towards deleterious effects of microwave radiation on human health. The aim of the study was to demonstrate the effect of low-intensity microwave radiation on levels of monoamine neurotransmitters and gene expression of their key regulating enzymes in brain of Fischer rats. Animals were exposed to 900 MHz and 1800 MHz microwave radiation for 30 days (2 h/day, 5 days/week) with respective specific absorption rates as 5.953 × 10−4 and 5.835 × 10−4 W/kg. The levels of monoamine neurotransmitters viz. dopamine (DA), norepinephrine (NE), epinephrine (E) and serotonin (5-HT) were detected using LC–MS/MS in hippocampus of all experimental animals. In addition, mRNA expression of key regulating enzymes for these neurotransmitters viz. tyrosine hydroxylase (TH) (for DA, NE and E) and tryptophan hydroxylase (TPH1 and TPH2) (for serotonin) was also estimated. Results showed significant reduction in levels of DA, NE, E and 5-HT in hippocampus of microwave-exposed animals in comparison with sham-exposed (control) animals. In addition, significant downregulation in mRNA expression of TH, TPH1 and TPH2 was also observed in microwave-exposed animals ($p < 0.05$). In conclusion, the results indicate that low-intensity microwave radiation may cause learning and memory disturbances by altering levels of brain monoamine neurotransmitters at mRNA and protein levels.

iv. Kanu Megha, Pravin Suryakantrao Deshmukh, Basu Dev Banerjee, Ashok Kumar Tripathi, Rafat Ahmed, Mahesh Pandurang Abegaonkar (2015). Low intensity microwave radiation induced oxidative stress, inflammatory response and DNA damage in rat brain. NeuroToxicology, 51; pp 158-165.

The study was carried out on 24 male Fischer 344 rats, randomly divided into four groups (n = 6 in each group): group I consisted of sham exposed (control) rats, group II–IV consisted of rats exposed to microwave radiation at frequencies 900, 1800 and 2450 MHz, specific absorption rates (SARs) 0.59, 0.58 and 0.66 mW/kg, respectively in gigahertz transverse electromagnetic (GTEM) cell for 60 days (2 h/day, 5 days/week). Rats were sacrificed and decapitated to isolate hippocampus at the end of the exposure duration. Low intensity microwave exposure resulted in a frequency dependent significant increase in oxidative stress markers viz. malondialdehyde (MDA), protein carbonyl (PCO) and catalase (CAT) in microwave exposed groups in comparison to sham exposed group ($p < 0.05$). Whereas, levels of reduced glutathione (GSH) and superoxide dismutase (SOD) were found significantly decreased in microwave exposed groups ($p < 0.05$). A significant increase in levels of pro-inflammatory cytokines (IL-2, IL-6, TNF-α, and IFN-γ) was observed in microwave exposed animal ($p < 0.05$). Furthermore, significant DNA

damage was also observed in microwave exposed groups as compared to their corresponding values in sham exposed group ($p < 0.05$). In conclusion, the present study suggests that low intensity microwave radiation induces oxidative stress, inflammatory response and DNA damage in brain by exerting a frequency dependent effect. The study also indicates that increased oxidative stress and inflammatory response might be the factors involved in DNA damage following low intensity microwave exposure.

v. Nath A. (2015). We are safe with our cellphones/smartphones? A comprehensive study on evil effects on Human health. International Journal of Advance Research in Computer Science and Management Studies. 3(4); pp253-262.Cell Biochem Biophys. 2014; 68(2):347-58.

This study concluded that the smart phones and mobile phones are now almost integral part almost every persons in the globe. As it is not good for health so therefore, more research work should be done on prolonged usage of smartphone/mobile phone. The time is coming when most of the household goods will be operated my smart phones. So therefore it must be full proof that there should not be any kind of risk factor of using this small electronic device. Especially the pregnant women and children are in greater danger from cell phone towers than the normal population. A recent study on pregnant women with heavy cell phone use found behavior problems in their children. According to Dr. Om Gandhi, an eminent scientist in the area of bio electromagnetics, cell phone radiation makes children more susceptible to DNA breakage, genetic damage, and incidence of cancer. It reduces their life span. However, the authors are hopeful that the manufacturer, the big industries must come forward and do extensive research work on effects of usage of smartphone/mobile phone on human health.

vi. Dhami A K (2015). Studies on Cell-phoneRadiation Exposure Inside a Car and Near a Bluetooth Device. Int. J. Environ Res. 9(3):977-980.

The authors concluded that Increase in cell-phone radiation levels inside a car were estimated in terms of power density and specific absorption rate. The same were estimated for the additional effect of Bluetooth device. This data indicated that talking on phone while driving in a car is a serious health threat. The radiation intensity was estimated to be 393% higher inside a car when cell phone is used along with a Bluetooth. The estimated SAR values are 514 times higher than the biological limit at 1800MHz. Hence, it is much higher than the levels at which biological changes start taking place inside a human body because of radiation exposure. The effect can be reduced by opening the windows while on a call or using an antenna on the roof of the car, which can dissipate the trapped energy through it and hence dilute its effects. Although driving and talking on cell-phone remains to be a dangerous combination, using a speaker and a hands free phone without an ear piece, is the safer way to talk and drive.

vii. Gandhi G, Kaur G, Nisar U (2015). A cross-sectional case control study on genetic damage in individuals residing in the vicinity of a mobile phone base station. Electromagn Biol Med. 34(4):344-354.

In this study, genetic damage using the single cell gel electrophoresis (comet) assay was assessed in peripheral blood leukocytes of individuals residing in the vicinity of a mobile phone base station and comparing it to that in healthy controls. The power density in the area within 300 m from the base station exceeded the permissive limits and was significantly ($p = 0.000$) higher compared to the area from where control samples were collected. The study participants comprised 63 persons with residences near a mobile phone tower, and 28 healthy controls matched for gender, age, alcohol drinking and occupational sub-groups. Genetic damage parameters of DNA migration length, damage frequency (DF) and damage index were significantly ($p = 0.000$) elevated in the sample group compared to respective values in healthy controls. The female residents ($n = 25$) of the sample group had significantly ($p = 0.004$) elevated DF than the male residents ($n = 38$). The linear regression analysis further revealed daily mobile phone usage, location of residence and power density as significant predictors of genetic damage. The genetic damage evident in the participants of this study needs to be addressed against future disease-risk, which in addition to neurodegenerative disorders, may lead to cancer.

viii. Indian Council of Medical Research (ICMR) is conducting a multi-disciplinary prospective cohort study to find out adverse effects of Radio Frequency Radiation (RFR), emitted from cell phone on adult Indian population. Under this study efforts are going on to examine whether use of cell phone is associated with reproductive dysfunctions, infertility, neurological disorders (cognitive behavior, sleep related disorders, depression etc.), cardiovascular disorders, Otorhinolaryngology (ENT) disorders and promote cancer. Under this study efforts are also going on to survey the health status of the people residing near the cell phone tower. In addition to the above the ICMR is also funding few more studies in different institutions of the country to address this issue.

(2) **New policies and legislations regarding EMF exposure**

Under the direction of the honorable Prime Minister of India, an Experts Committee has been established at the Department of Science and Technology (DST), Ministry of Science and Technology, Govt. of India to identify the researchable areas to study the effect of electromagnetic radiations emitted from Cell Phones and Cell Phone Towers on human health, animals, environment, plants, agriculture etc.. The Committee invited proposals in the above mentioned areas from various Institutions in the country. Numbers of proposals were received which have been evaluated and around 16 proposals have been approved to conduct research in this discipline.

(3) **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 few Court Cases have been filed under various High Courts of the country in

relation to installation of cell phone towers and their adverse effect on the health of the people. Various residential welfare associations and number of independent activists have raised the 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 paper indicating that the incidence of cancer has increased among the people residing near the cell phone towers.

(4) **New public information activities**

Numbers of public debates are being organized to obtain the views of the people and to educate them regarding the adverse effects of Radio Frequency Radiations emitted from cell phones and cell phone towers. To educate the public, the Dept. of Telecommunication, Ministry of Communication and IT, Govt. of India published about Ensuring safety from radiations: Mobile towers and handsets in National Newspapers.