

## **Short report on the national activities on EMF**

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### **➤ General research activities in India related to EMF health –**

- i. Prasad M, Kathuria P, Nair P, Kumar A, Prasad K (2017). Mobile phone use and risk of brain tumours: a systematic review of association between study quality, source of funding, and research outcomes. Neurol Sci. May; 38(5): 797-810.**

Mobile phones emit electromagnetic radiations that are classified as possibly carcinogenic to humans. Evidence for increased risk for brain tumours accumulated in parallel by epidemiologic investigations remains controversial. This paper aims to investigate whether methodological quality of studies and source of funding can explain the variation in results. PubMed and Cochrane CENTRAL searches were conducted from 1966 to December 2016, which was supplemented with relevant articles identified in the references. Twenty-two case control studies were included for systematic review. Meta-analysis of 14 case-control studies showed practically no increase in risk of brain tumour [OR 1.03 (95% CI 0.92-1.14)]. However, for mobile phone use of 10 years or longer (or >1640 h), the overall result of the meta-analysis showed a significant 1.33 times increase in risk. The summary estimate of government funded as well as phone industry funded studies showed 1.07 times increase in odds which was not significant, while mixed funded studies did not show any increase in risk of brain tumour. Metaregression analysis indicated that the association was significantly associated with methodological study quality ( $p < 0.019$ , 95% CI 0.009-0.09). Relationship between source of funding and log OR for each study was not statistically significant ( $p < 0.32$ , 95% CI 0.036-0.010). We found evidence linking mobile phone use and risk of brain tumours especially in long-term users ( $\geq 10$  years). Studies with higher quality showed a trend towards high risk of brain tumour, while lower quality showed a trend towards lower risk/protection.

- ii. Chauhan P, Verma HN, Sisodia R, Kesari KK. (2017). Microwave radiation (2.45 GHz)-induced oxidative stress: Whole-body exposure effect on histopathology of Wistar rats. Electromagn Biol Med. 2017; 36(1): 20-30.**

Man-made microwave and radiofrequency (RF) radiation technologies have been steadily increasing with the growing demand of electronic appliances such as microwave oven and cell phones. These appliances affect biological systems by increasing free radicals, thus leading to oxidative damage. The aim of this study was to explore the effect of 2.45 GHz microwave radiation on histology and the level of lipid peroxide (LPO) in Wistar rats. Sixty-day-old male Wistar rats with  $180 \pm 10$  g body weight were used for this study. Animals were divided into two groups: sham exposed (control) and microwave exposed. These animals were exposed for 2 h a day for 35 d to 2.45 GHz microwave radiation (power density,  $0.2 \text{ mW/cm}^2$ ). The whole-body specific absorption rate (SAR) was estimated to be  $0.14 \text{ W/kg}$ . After completion of the exposure period, rats were sacrificed, and brain, liver, kidney, testis and spleen were stored/preserved for determination of LPO and histological parameters. Significantly high level of LPO was observed in the liver ( $p < 0.001$ ), brain ( $p < 0.004$ ) and spleen ( $p < 0.006$ ) in samples from rats exposed to microwave radiation. Also histological changes were observed in the brain, liver, testis, kidney and spleen after whole-body microwave exposure, compared to the control group. Based on the results obtained in this study, we conclude that exposure to microwave radiation 2 h a day for 35 d can potentially cause histopathology and oxidative changes in Wistar rats. These results indicate possible implications of such exposure on human health.

- iii. **Pandey N, Giri S, Das S, Upadhaya P. (2017). Radiofrequency radiation (900 MHz)-induced DNA damage and cell cycle arrest in testicular germ cells in swiss albino mice. Toxicology and Industrial Health. 2017 Apr; 33(4): 373-384.**

Even though there are contradictory reports regarding the cellular and molecular changes induced by mobile phone emitted radiofrequency radiation (RFR), the possibility of any biological effect cannot be ruled out. In view of a widespread and extensive use of mobile phones, this study evaluates alterations in male germ cell transformation kinetics following RFR exposure and after recovery. Swiss albino mice were exposed to RFR (900 MHz) for 4 h and 8 h duration per day for 35 days. One group of animals was terminated after the exposure period, while others were kept for an additional 35 days post-exposure. RFR exposure caused depolarization of mitochondrial membranes resulting in destabilized cellular redox homeostasis. Statistically significant increases in the damage index in germ cells and sperm head defects were noted in RFR-exposed animals. Flow cytometric estimation of germ cell subtypes in mice testis revealed 2.5-fold increases in spermatogonial populations with significant decreases in spermatids. Almost fourfold reduction in spermatogonia to spermatid turnover (1C:2C) and three

times reduction in primary spermatocyte to spermatid turnover (1C:4C) was found indicating arrest in the premeiotic stage of spermatogenesis, which resulted in loss of post-meiotic germ cells apparent from testis histology and low sperm count in RFR-exposed animals. Histological alterations such as sloughing of immature germ cells into the seminiferous tubule lumen, epithelium depletion and maturation arrest were also observed. However, all these changes showed recovery to varied degrees following the post-exposure period indicating that the adverse effects of RFR on mice germ cells are detrimental but reversible. To conclude, RFR exposure-induced oxidative stress causes DNA damage in germ cells, which alters cellcycle progression leading to low sperm count in mice.

- iv. **Das S, Chakraborty S, Mahanta B. (2017). A study on the effect of prolonged mobile phone use on pure tone audiometry thresholds of medical students of Sikkim. J Postgrad Med. 2017 Mar 3. [Epub ahead of print].**

Mobile phones have become indispensable for daily activities, and people are exposed to them from an early age. There is, however, concern about the harmful effect of the electromagnetic radiation emitted from the mobile phones. The objective of the study was to study the effect of mobile phone on average pure tone audiometry (PTA) threshold of the person and to study the changes in the pure tone threshold at high frequencies such as 2 kHz, 4 kHz, and 8 kHz among the students with prolonged exposure to mobile phones. A cross-sectional study was conducted among the medical students who have been using mobile phones for the past 5 years. The effect of mobile phones on the PTA threshold in the exposed ear and the nonexposed ear was assessed. The study shows that there is a significant difference in average air conduction (AC) and bone conduction (BC) hearing threshold among the exposed and the nonexposed ears ( $P < 0.05$ ). A significant rise of both AC and BC threshold at individual frequencies between the exposed and the nonexposed ear is also noted in this study.

The study conducted shows changes in the hearing threshold of the exposed ear when compared with the nonexposed ear. There are however lot of unanswered questions which provide an interesting avenue for further research. Till concrete evidence is available the only feasible way to control its exposure is to limit the duration of usage of mobile phones.

- v. **Hemant Bhargav, TM Srinivasan, Suman Bista, A Mooventhana, Vandana Suresh, Alex Hankey, HR Nagendra. (2017). Acute effects of mobile phone radiations on subtle energy levels of teenagers using**

**electrophotonic imaging technique: A randomized controlled study. International Journal of Yoga. Vol. 10(1); pp 16-23.**

Mobile phones induce radio frequency electromagnetic field (RF-EMF) which has been found to affect subtle energy levels of adults through Electrophotonic Imaging (EPI) technique in a previous pilot study.

We enrolled 61 healthy right-handed healthy teenagers (22 males and 39 females) in the age range of  $17.40 \pm 0.24$  years from educational institutes in Bengaluru. Subjects were randomly divided into two groups: (1) (mobile phone in "ON" mode [MPON] at right ear) and (2) mobile phone in "OFF" mode (MPOF). Subtle energy levels of various organs of the subjects were measured using gas discharge visualization Camera Pro device, in double-blind conditions, at two points of time: (1) baseline and (2) after 15 min of MPON/MPOF exposure. As the data were found normally distributed, paired and independent samples t-test were applied to perform within and between group comparisons, respectively. The subtle energy levels were significantly reduced after RF-EMF exposure in MPON group as compared to MPOF group for following areas: (a) Pancreas ( $P = 0.001$ ), (b) thyroid gland ( $P = 0.002$ ), (c) cerebral cortex ( $P < 0.01$ ), (d) cerebral vessels ( $P < 0.05$ ), (e) hypophysis ( $P = 0.013$ ), (f) left ear and left eye ( $P < 0.01$ ), (g) liver ( $P < 0.05$ ), (h) right kidney ( $P < 0.05$ ), (i) spleen ( $P < 0.04$ ), and (j) immune system ( $P < 0.02$ ).

Fifteen minutes of RF-EMF exposure exerted quantifiable effects on subtle energy levels of endocrine glands, nervous system, liver, kidney, spleen, and immune system of healthy teenagers. Future studies should try to correlate these findings with respective biochemical markers and standard radio-imaging techniques.

- vi. **Kavindra Kumar Kesari, Qazi Mohd. Sajid Jamal, Archana Sharma, Parul Chauhan, Anupam Dhasmana, Mohd. Haris Siddiqui, Rashmi Sisodia, H. N. Verma. (2017). LPO and ROS Production in Rat Brain Exposed to Microwaves: Computational Elucidation of Melatonin in Repair System Perspectives in Environmental Toxicology, Part of the series Environmental Science and Engineering pp 31-46.**

It is widely accepted that non-ionizing electromagnetic fields are present in the environment and are alarming as a major pollutant or electro-pollutant for health risk. The present study aimed to investigate the protective measures of melatonin against exposure of microwave radiations. Study also explored the mechanistic correlation among microwave radiation, melatonin and biological effects by computational method. For this, 60-day-old male Wistar rats were

divided into four groups ( $n = 4/\text{group}$ ): sham exposed (control), Melatonin (Mel) treated (2 mg/kg), 2.45 GHz microwave (MWs) exposed and MWs + Mel treated. Exposure took place in Plexiglas cages for 2 h a day for 35 days where, power density (0.2 mW/cm<sup>2</sup>) and specific absorption rate (SAR-0.14 W/kg) were estimated. Results show that melatonin prevent oxidative damage biochemically by significant decrease ( $p < 0.01$ ) the levels of lipid peroxide (LPO) and reactive oxygen species (ROS) in the brain. However, exposure of microwave individually shows significant changes in LPO and ROS level. The effective dose of melatonin was validated by in silico method and which reveals the interaction of acetylcholinesterase (AChE) and butyrylcholinesterase (BuChE) Eenzmyes of Central Nervous System (CNS) with melatonin. Where, AChE showed better interaction with the binding energy of  $-9.01$  kcal/mol and inhibition constant  $3.11$   $\mu\text{M}$  by comparing with BuChE. These results concluded that the melatonin has strong antioxidative potential against microwave radiation, which could be achieved by an implementation of computational approach..

- vii. **Sukhdeep Kaur, Jaipreet Kaur, Manjit Sandhu (2016). Effects of Mobile Radiations and its Prevention. International Journal of Computer Science and Mobile Computing. Vol. 5, Issue. 2, February, pp. 298 – 304.**

The number of mobile users is increasing as the time passes and the technology keeps on evolving to meet the requirement of higher data rates than the previous generation. This in turns leaves a huge harmful biological impact on the biodiversity. The microwave mobile communication systems include the TV, FM and AM broadcasting station which use large amount of power to transmit the signals at a greater amount of distance. WiFi and WiMAX are used in most of the developed parts of the world where there is a need of greater data rates. Both of these communication technologies have operating frequencies of some multiples of GHz which is the higher end of the microwave frequency band. The microwave frequencies used in the cellular communication causes the thermal and non-thermal effects. There is a lot of damages that is done by the non-thermal effects as compared to the thermal effects. The electromagnetic radiations are also recognized as the major cause of cancer. The EMR emitted by the mobile antennas used at the base stations effects the cell structure of the living beings. Also the mobile devices used by users have a rating of specific absorption rate (SAR), it is a measure of the power that a human body absorbs using the mobile device which should be safe radiation level absorbed by the human. All the above broadcasting and communication technologies have brought the revolutionary change in the wireless system and are also responsible for the most of the devastating effects on the living beings. This paper discusses various problems caused by

the wireless communication technologies and expected methods to reduce the effects. This paper has also reviewed long-term and short-term effects of mobile phones. Long-term usage of mobile phones cause health hazards such as cancer, high blood pressure, miscarriages, DNA damage, hormonal imbalance etc. while their short term uses can cause conditions like insomnia, depression, headaches, sleep disorders, etc. There are international exposure limits and guidelines for radio frequency fields. There is need of an hour to understand health problems from radio frequency radiations and implementation of the guidelines.

**viii. Singh K. (2015). Effect Of Electromagnetic Waves Emitted From Mobile Phone On Brain Stem Auditory Evoked Potential In Adult Males. Indian J Physiol Pharmacol. 59(4):402-406.**

Mobile phone (MP) is commonly used communication tool. Electromagnetic waves (EMWs) emitted from MP may have potential health hazards. So, it was planned to study the effect of electromagnetic waves (EMWs) emitted from the mobile phone on brainstem auditory evoked potential (BAEP) in male subjects in the age group of 20-40 years. BAEPs were recorded using standard method of 10-20 system of electrode placement and sound click stimuli of specified intensity, duration and frequency. Right ear was exposed to EMW emitted from MP for about 10 min. On comparison of before and after exposure to MP in right ear (found to be dominating ear), there was significant increase in latency of II, III ( $p < 0.05$ ) and V ( $p < 0.001$ ) wave, amplitude of I-Ia wave ( $p < 0.05$ ) and decrease in IPL of III-V wave ( $P < 0.05$ ) after exposure to MP. But no significant change was found in waves of BAEP in left ear before vs after MP. On comparison of right (having exposure routinely as found to be dominating ear) and left ears (not exposed to MP), before exposure to MP, IPL of III-V wave and amplitude of V-Va is more ( $< 0.001$ ) in right ear compared to more latency of III and IV wave ( $< 0.001$ ) in left ear. After exposure to MP, the amplitude of V-Va was ( $p < 0.05$ ) more in right ear compared to left ear. In conclusion, EMWs emitted from MP affects the auditory potential.

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

Recently Hon'ble Supreme Court of India in a W.P. raised concerned about the radiations emitted from cell phone and cell tower in the country and directed to undertake research in this area. Hon'ble Supreme Court also commented on the Dept. of Telecommunication Experts Committee report submitted under the direction of Hon'ble Allahabad High Court.

➤ **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 as well as Supreme Court of India 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 activist have raised the various types of health hazards being faced by the people living near the cell phone towers.

➤ **New public information activities**

Recently the Department of Telecom (DoT), Ministry of Communication &IT, Govt. of India Launched a web Portal called Tarang Sanchar for Information sharing on Mobile Towers and EMF Emission Compliance. The EMF Portal is designed to provide a public interface where an easy map-based search feature has been provided for viewing the mobile towers in vicinity of any locality. Any person can request for EMF emission measurement at a location by paying a nominal fee of Rs 4000/- online. The tests will be conducted by the local Telecom Enforcement Resource and Monitoring (TERM) field unit of DoT and the test report will be provided to the requestor. The portal also has 'EMF Overview' and 'Learn' Sections, which provide numerous articles, booklets and videos, to further educate the citizens about EMF and coverage of telecom services. In addition to Government to Citizen (G2C) services, portal also facilitates Government to Business (G2B) service delivery in a transparent and eco-friendly manner.

Web link: Tarang Sanchar Learn Section at <http://tarangsanchar.gov.in>