CHAPTER 1: INTRODUCTION

1.0 INTRODUCTION

With over 5.9 billion reported mobile phone users worldwide, the level of electromagnetic radiation to which a large section of human population is exposed is growing exponentially. Mobile phones emit radiofrequency electromagnetic field (MPEMF), a high energy field, of which a major portion is absorbed in the user's head (Schonborn et al., 1998). Accumulating evidences suggest that MPEMF may alter brain physiology. Modulating effects of MPEMF on the human electroencephalogram in wakefulness and sleep have repeatedly been demonstrated in recent years, while results on cognitive performance are inconsistent (Regel & Achermann, 2011). The lack of a validated tool, which reliably assesses changes in cognitive performance caused by MPEMF exposure, may contribute to the current inconsistency in outcomes (Regel & Achermann, 2011). Some behavioral studies have suggested that EMF might have a facilitative effect on cognitive performance (Preece et al., 2005; Smythe and Costall, 2003), although more recent studies primarily revealed an impairment of mental abilities or no effect at all (Haarala et al., 2003, 2004; Regel & Achermann, 2011). Results of a meta-analysis suggested that MPEMF might have a small impact on human attention and working memory (Barth et al., 2010). All these studies have chiefly been performed on adults and children. Studies on teenage group are lacking. This age-group is among the most prolific users of mobile phones which puts them at high risk for MPEMF exposure related effects (Aydin et al., 2011).

In this study, we have used functional near-infrared spectroscopy (fNIRS), Electro photonic imaging and Stroop Task for assessment and OM chanting as intervention for MPEMF. These are briefly presented hereunder.

Functional near-infrared spectroscopy (fNIRS) is a new non-invasive optical method that can measure real time changes in oxygenated hemoglobin (oxyHb) and deoxygenated

hemoglobin (deoxyHb) concentrations and their sum, i.e., total hemoglobin (totalHb) or blood volume in brain areas, suggesting activation (increase in oxygenation) or deactivation (reduction in oxygenation) of a particular brain area (Ferrari & Quaresima, 2012). An fNIRS device has excellent temporal resolution and fNIRS results are physiologically comparable to fMRI and PET results (Obrig & Villringer, 2003). In a study, using fNIRS, local cerebral blood flow (CBF) on short term exposure to MPEMF was measured in 26 boys, aged 14-15 years. Temperatures were also measured from both ear canals, and skin temperatures at several sites of the head, trunk and extremities. It was found that local CBF and ear canal temperature did not change and autonomic nervous system was not interfered by MPEMF (Lindholm et al., 2011). The study showed the utility of fNIRS for EMF related research. Compared to previous studies using PET, fNIRS provides a much higher time resolution, which allows investigation of the short term effects of EMF non-invasively, without the use of radioactive tracers and with high sensitivity.

Electron photo imaging (EPI) or Gas discharge visualization (GDV) is based on the well-known Kirlian effect (Korotkov, 2002). EPI consists of an electrode covered with dielectric, generator of electrical field of a high voltage (12 KV, with a frequency of 1000 Hz), and low current and applied for less than 1 millisecond; it uses a CCD video camera to record the discharges (Korotkov, 1998). Investigating these images of finger tips, which change dynamically with emotional and health states, one can identify areas of congestion or energy balance in the whole system. (Korotkov, 2012). We did not come across any study that assessed the effect of MPEMF exposure on subtle energy levels using Electron Photo Imaging.

Stroop task is a useful test of selective attention and inhibition and involves frontally mediated cognitive processes such as response inhibition and interference resolution (Stroop, 1935). Functionally, neuro-imaging studies have found several areas of prefrontal cortex that

appear to be specifically activated during performance of Stroop task. Stroop task has been used in several PET, fMRI and fNIRS studies (Taylor et al., 1997).

OM is a cosmic sound that has a harmonizing effect on the human system (Kumar et al., 2010). An fMRI study assessed neuro-hemodynamic correlates of OM chanting and found significant deactivation in bilateral orbito-frontal, anterior cingulate, para-hippocampal gyri, thalami and hippocampi and right amygdala as compared to vocalizing of the sound 'SS' . Since the changes observed during OM chanting are similar to vagus nerve stimulation treatment used in depression and epilepsy management, the study findings argue for a potential role of OM chanting in clinical practice (Kalyani et al., 2011). Another recent study used fNIRS to assess immediate effect of 20 minutes of OM meditation (mental chanting with effortless defocusing on syllable OM) on Stroop task and found better performance and efficiency (deactivation of pre-frontal cortices) after OM meditation (Singh et al., 2014).

1.1. Rationale for the study

Very few studies have assessed the effect of MPEMF exposure on cognitive functions and brain hemodynamics in adolescent population using fNIRS (Kwon et al., 2011). No study till date has seen effect of MP EMF exposure on subtle energy levels (Electron photo imaging) and no study has assessed effect of an intervention (OM Chanting) that may have a balancing effect in MPEMF subjects. Further, the present study is also designed to compare the cognitive responses and subtle energy changes in children and adolescents, which are not done earlier. Similarly, the effect of OM chanting on above variables after mobile phone exposure has not been assessed earlier. We hypothesized that MPEMF exposure of 30 minutes would affect Stroop task performance and pre-frontal hemodynamics during the task in teenagers and OM chanting of 5 minutes following MPEMF exposure will have a balancing effect on changes induced by MPEMF. This is thesis is in two parts; one presenting

scriptural texts (Chapter 2) that are relevant to environmental protection; the second part is related to the scientific study narrated above.