

RF EMF AND BRAIN PHYSIOLOGY: INCREASING EVIDENCE OF EFFECTS ON THE WAKING AND SLEEP EEG

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In recent years the use of mobile phones has steadily increased, with total connections to the Global System for Mobile Communications (GSM) network now in excess of 4 Billion worldwide [1]. Mobile phones have proven to be an effective and valuable communications tool, however, this increasing use has also led to considerable public concern regarding the possibility of health effects from exposure to the radiofrequency (RF) electromagnetic fields (EMF) emitted by mobile phone handsets or base stations.

Due to this widespread use and concern, numerous studies have been conducted and there now exists quite an extensive amount of literature specifically related to the investigation of the possible effects of mobile phone-related emissions on human health, with a particular focus on potential effects on the brain.

The use of the electroencephalogram (EEG) has emerged as a promising technique for assessing effects of pulse-modulated RF EMF, such as those emitted by mobile phones, on human health. The advantage of using the EEG as a measure of biological effects induced by exposure to mobile phones is that the EEG is well characterised and there is a high stability in intra-individual EEG recordings across time in both sleep [2] and wake [3] states, making it a useful tool to investigate bioeffects from RF EMF exposures.

Recent well-controlled studies have consistently shown exposure-related effects on brain activity, with changes in EEG spectral power observed during waking and also within the non-rapid eye movement (non-REM) sleep phase. In particular, increases in resting alpha power have been found both during [4-7] and following exposure [8, 9], and exposure-related increases in EEG power during sleep in the spindle frequency range have also been shown [8, 10-14]. A number of studies have shown that pulse modulation of the RF EMF is crucial to induce these changes in brain activity [8, 9], that the effects may be dose-dependent [14], and particularly in regards to sleep, that the effects on the EEG outlast exposure. Importantly, these changes have been replicated both within single laboratories and also by researchers working independently at other laboratories, providing strong evidence for an effect of mobile phone pulse modulated RF EMF on human brain activity.

Despite this increasing evidence that mobile phone-like emissions influence brain physiology, conclusions about the presence or absence of possible adverse effects of RF EMF exposure on human health remain premature. Therefore, to further understand the potential causal association between RF EMF exposure and brain function and to help draw conclusions about possible health consequences of RF EMF, research addressing the

mechanisms and functional significance of these observed effects should therefore be the priority in the future.

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