Insomnia – Sleep

Neurosci Behav Physiol. 2005 Feb;35(2):165-70.

Actions of pulsed ultra-broadband electromagnetic irradiation on the EEG and sleep in laboratory animals.

Petrova EV, **Gulyaeva NV**, **Titarov SI**, **Rozhnov YV**, **Koval'zon VM**.

Institute of Higher Nervous Activity and Neurophysiology, Russian Academy of Sciences, 117865 Moscow, Russia.

Irradiation of animals with ultrashort impulses of ultra-broadband magnetic irradiation with an impulse repetition frequency of 6 Hz for 1 h induced changes in the spectral composition of cerebral cortex electrical activity in rats, measured over the 5 min immediately after irradiation, as compared with controls. In particular, there was suppression of frequencies close to the impulse sequence frequency, along with a decrease in interhemisphere coherence. Continuous recording of polygrams for 22 h from rabbits after irradiation revealed a "delayed" effect--a significant increase in paradoxical sleep, starting 16 h after the end of irradiation and persisting to the end of the recording period. It is suggested that irradiation has a direct action both on the mechanisms of generation of the theta rhythm (septohippocampal) and on the system controlling circadian rhythms (the suprachiasmatic nucleus-epiphysis system).

Pulsed Magnetic Field Therapy For Insomnia: A Double-Blind, Placebo-Controlled Study

Uni der Bundeswehr Munich, Germany.

This 4-week double-blind, placebo-controlled study assessed the efficacy of impulse magnetic-field therapy for insomnia. One hundred one patients were randomly assigned to either active treatment (n = 50) or placebo (n = 51) and allocated to one of three diagnostic groups: (1) sleep latency; (2) interrupted sleep; or (3) nightmares. Efficacy endpoints were intensity of sleep latency, frequency of interruptions, sleepiness after rising, daytime sleepiness, difficulty with concentration, and daytime headaches. In the active-treatment group, the values of all criteria were significantly lower at study end ($P < .00001$). The placebo group also showed significant symptomatic improvement ($P < .05$), but the differences between groups were highly significant ($P < .00001$). Seventy percent (n = 34) of the patients given active treatment experienced substantial or even complete relief of their complaints; 24% (n = 12) reported clear improvement; 6% (n = 3) noted a slight improvement. Only one placebo patient (2%) had very clear relief; 49% (n

= 23) reported slight or clear improvement; and 49% (n = 23) saw no change in their symptoms. No adverse effects of treatment were reported.

Influence of Time-Varying Magnetic Field on the Release of Neurotransmitters in Raphe Nuclei of Rats I

Jie Zhang , Xuemin Wang , Mingshi Wang

Corresponding information: zhang132@umn.edu; Mayo Clinic Rochester

Abstract: A specially designed time-varying magnetic field was developed to treat insomnia. Clinical results showed that this method could shorten the time to go to sleep and prolong the sleep duration. However, the mechanism of this method is still not well understood. In this study, the effect of magnetic stimulation on the release of serotonin (5-HT), noradrenaline (NE), dopamine (DA) in raphe nuclei of rats, which are known to play an important role in the sleep-wake regulation, was investigated. It was shown that there was a significant difference in the release of serotonin between control group and experimental group ($p<0.01$). The release of serotonin of the experimental group increased significantly. No obvious release changes of NE and DA are found ($p>0.05$). The results indicate that one possible mechanism of inducing sleep using specially designed magnetic field is to change the release of sleep-related neurotransmitters.

Bioelectromagnetics. 1998;19(3):199-202.

Human sleep under the influence of pulsed radiofrequency electromagnetic fields: a polysomnographic study using standardized conditions.

Wagner P, **Roschke J**, **Mann K**, **Hiller W**, **Frank C**.

Department of Psychiatry, University of Mainz, Germany.
wagner@mail.psychiatrie.klinik.uni-mainz.de

To investigate the influence of radiofrequency electromagnetic fields (EMFs) of cellular phone GSM signals on human sleep electroencephalographic (EEG) pattern, all-night polysomnographies of 24 healthy male subjects were recorded, both with and without exposure to a circular polarized EMF (900 MHz, pulsed with a frequency of 217 Hz, pulse width 577 micros, power flux density 0.2 W/m2. Suppression of rapid eye movement (REM) sleep as well as a sleep-inducing effect under field exposure did not reach statistical significance, so that previous results indicating alterations of these sleep parameters could not be replicated. Spectral power analysis also did not reveal any alterations of the EEG rhythms during EMF exposure. The failure to confirm our previous results might be due to dose-dependent effects of the EMF on the human sleep profile.

Neuropsychobiology. 1996;33(1):41-7.

Effects of pulsed high-frequency electromagnetic fields on human sleep.

Mann K, **Roschke J**.

Department of Psychiatry, University of Mainz, Germany.

In the present study we investigated the influence of pulsed high-frequency electromagnetic fields of digital mobile radio telephones on sleep in healthy humans. Besides a hypnotic effect with shortening of sleep onset latency, a REM suppressive effect with reduction of duration and percentage of REM sleep was found. Moreover, spectral analysis revealed qualitative alterations of the EEG signal during REM sleep with an increased spectral power density. Knowing the relevance of REM sleep for adequate information processing in the brain, especially concerning mnestic functions and learning processes, the results emphasize the necessity to carry out further investigations on the interaction of this type of electromagnetic fields and the human organism.

Neurosci Lett. 1999 Nov 19;275(3):207-10.

Pulsed high-frequency electromagnetic field affects human sleep and sleep electroencephalogram.

Borbely AA, **Huber R**, **Graf T**, **Fuchs B**, **Gallmann E**, **Achermann P**.

Institute of Pharmacology and Toxicology, University of Zurich, Switzerland. borbely@pharma.unizh.ch

To investigate whether the electromagnetic field (EMF) emitted by digital radiotelephone handsets affects the brain, healthy, young subjects were exposed during an entire night-time sleep episode to an intermittent radiation schedule (900 MHz; maximum specific absorption rate 1 W/kg) consisting of alternating 15-min on-15-min off intervals. Compared with a control night with sham exposure, the amount of waking after sleep onset was reduced from 18 to 12 min. Spectral power of the electroencephalogram in non-rapid eye movement sleep was increased. The maximum rise occurred in the 10-11 Hz and 13.5-14 Hz bands during the initial part of sleep and then subsided. The results demonstrate that pulsed high-frequency EMF in the range of radiotelephones may promote sleep and modify the sleep EEG.

Neuroreport. 2000 Oct 20;11(15):3321-5.

Exposure to pulsed high-frequency electromagnetic field during waking affects human sleep EEG.

Huber R, **Graf T**, **Cote KA**, **Wittmann L**, **Gallmann E**, **Matter D**, **Schuderer J**, **Kuster N**, **Borbely AA**, **Achermann P**.

Institute of Pharmacology and Toxicology, University of Zurich, Switzerland.

The aim of the study was to investigate whether the electromagnetic field (EMF) emitted by digital radiotelephone handsets affects brain physiology. Healthy, young male subjects were exposed for 30 min to EMF (900 MHz; spatial peak specific absorption rate 1 W/kg) during the waking period preceding sleep. Compared with the control condition with sham exposure, spectral power of the EEG in non-rapid eye movement sleep was increased. The maximum rise occurred in the 9.75-11.25 Hz and 12.5-13.25 Hz band during the initial part of sleep. These changes correspond to those obtained in a previous study where EMF was intermittently applied during sleep. Unilateral exposure induced no hemispheric asymmetry of EEG power. The present results demonstrate that exposure during waking modifies the EEG during subsequent sleep. Thus the changes of brain function induced by pulsed high-frequency EMF outlast the exposure period.

Neuropsychobiology. 1998 Nov;38(4):251-6.

No effects of pulsed high-frequency electromagnetic fields on heart rate variability during human sleep.

Mann K, **Roschke J**, **Connemann B**, **Beta H**.

Department of Psychiatry, University of Mainz, Germany.

The influence of pulsed high-frequency electromagnetic fields emitted by digital mobile radio telephones on heart rate during sleep in healthy humans was investigated. Beside mean RR interval and total variability of RR intervals based on calculation of the standard deviation, heart rate variability was assessed in the frequency domain by spectral power analysis providing information about the balance between the two branches of the autonomic nervous system. For most parameters, significant differences between different sleep stages were found. In particular, slow-wave sleep was characterized by a low ratio of low- and high-frequency components, indicating a predominance of the parasympathetic over the sympathetic tone. In contrast, during REM sleep the autonomic balance was shifted in favor of the sympathetic activity. For all heart rate parameters, no significant effects were detected under exposure to the field compared to placebo condition. Thus, under the given experimental conditions, autonomic control of heart rate was not affected by weak-pulsed high-frequency electromagnetic fields.