



# The Effect of Electromagnetic Radiation On Health And Measures To Prevent Its Negative Effects

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**ABSTRACT**

The article is based on a system-dialectical, spatial, and integrated approach, in which the electromagnetic field's effects on the human body have been deeply and comprehensively explored. The main ways to protect against the electromagnetic field have been rationally defined, as well as preventive measures to reduce its negative impact.

**Keywords:**

In the modern world, it is difficult to imagine life without using various technical devices that generate electromagnetic fields. These devices, besides providing convenience and comfort, may also pose certain risks to human health. Therefore, it is essential to be able to monitor and control the amount of exposure to electromagnetic fields.

The amount of energy exposure from an electromagnetic field can be measured in terms of cotton wool per kilogram (c/kg). This parameter allows us to determine the impact of the field on a living organism. The measurement is performed using specific devices - dosimeters - that can determine the intensity and duration of the exposure to the electromagnetic field. When measuring the energy exposure to an electromagnetic field, it is necessary to take into account not only the power but also the frequency range at which a device operates. Different frequency ranges have different effects on the human body, so exposure

assessment should be conducted for each range individually. In addition, it is essential to consider the duration of exposure and the distance between the source of the field and the organs or area of the body. Exposure to electromagnetic radiation at an intensity lower than that established by thermal safety standards is associated with non-thermal biological effects including damage to cells and DNA and changes to them [1]. This review provides evidence for such effects using the example of the hematopoietic, nervous, immune, reproductive, skin, and muscle systems, cardiovascular system, glucose metabolism, and electrohypersensitivity. Preventive measures have been proposed to mitigate these effects. The effect on DNA has demonstrated that after exposure to 60 Hz extremely low frequency (UHF) radiation for two hours, there was an increase in single- and double-stranded breaks in rat brain cell DNA, as well as a finding that this effect can be blocked

by melatonin. There was also a significant increase in micronucleus formation in liver and peripheral blood samples from newborn mice after in utero exposure to 50 Hz radiation at 650MT electromagnetic field. Significantly ( $p < 0.0001$ ), the occurrence of micronuclei was higher in peripheral blood lymphocytes from people living within 80 meters of mobile base stations than from those living 300 meters away from the source of RF radiation. The hematopoietic system was affected. In workers exposed to microwave radiation at their workplace, hematological changes in their peripheral blood were observed, depending on their exposure time. Significantly, changes were noticed in the concentration or activity of glutathione, catalase, and superoxide dismutase. There was also a rise in lipid cross-oxidation in peripheral blood cells from people living nearby mobile communication base stations. The author reviewed and summarized data from numerous studies showing changes to the activity of free radicals, such as reactive oxygen and nitrogen species and endogenous antioxidant enzymes, caused by exposure to extremely low-frequency radiation. The nervous system: Multiple effects on the nervous system were discussed, including apoptosis of nerve cells, changes in myelin of nerve tissue and ion channels. The effect of calcium leaching from brain tissue was used when exposed to high frequency radiation at certain frequencies and amplitudes. Experiments on rats demonstrated the effects of radiation exposure at 900 MHz on the permeability of the blood brain barrier and damage to neurons. Experimentally it was shown that low frequency pulsation from mobile phones caused spikes in volunteers' electroencephalograms. The effect HCV has on neurodegenerative disease is illustrated by the example of Parkinson's, where a significant decrease in redox potential, thiol content and protein carbonylation was observed.

Similar phenomena have been described, which have noted changes in spatial memory and brain Amyloid- $\beta$  in two animal models of Alzheimer's Disease. The review sums up the additional neurodegenerative effects of these phenomena. Symptoms of Attention Deficit and Hyperactivity Disorder in children were linked

to prolonged use of a mobile phone. There are many health risks linked to Wi-Fi Exposure, as well as Neuropsychiatric Effects as a result of Exposure to CNG The Immune System. Short-Term Exposure to Weak Radiofrequency Radiation can temporarily stimulate Certain Humoral or Cellular Immune Functions, while Long-Term Exposure Suppresses These Same Functions. The Effects of HF and RF Mobile Phones on Immunoglobulin Levels (IgA, IgE, IgM, and IgG), as Well as on Total Levels of Leukocytes, Lymphocytes, Eosinophils, Basophils, Neutrophils, and Monocytes. The effects of electric smog on the vitamin D receptor and 1,25-dihydroxy vitamin D (1,25 - D), which are linked to many inflammatory and autoimmune conditions [3]. Repeated exposure to extremely high frequency electromagnetic radiation at low intensity (frequency: 42.0 GHz, energy density: 0.15 MW / ct<sup>2</sup> for 20 minutes daily), affects the immune response of mice. In patients, there is some inflammation and an autoimmune reaction involving antibodies to myelin, and in 80% of patients with electrosensitivity, several markers of oxidative stress have been found in the peripheral blood. Pathophysiological changes have been noted in the testes of rats exposed to radio frequencies (2.45 GHz) for three hours daily. In men who regularly carry a mobile phone in their pocket, there has been an increase in the percentage of spermatozoa with abnormal morphology, and luteinizing hormone levels have decreased. SkinHe was one of the first to publish a study on "screen dermatitis" - the effect of shortwave radiation on the skin. He reported an increase in the number of mastocytes in skin samples from patients with electrohypersensitivity during prolonged exposure.

Short-term exposure to the skin causes only minor changes in epidermal homeostasis, but these can still lead to a deterioration of its protective functions. They found a longer response time for the protective reaction of skin on the face and head - about 200 milliseconds - when exposed to radiation from a cell phone. Skin lesions were mainly found on patients' hands, especially on the hand used to hold a mobile phone. It was discovered that the glomerular sweat glands functioned similarly to

a group of solar panels, with a resonant frequency in the terahertz range, which influenced the absorption of millimeter and submillimeter waves of radiofrequency energy by human skin muscle. Changes in the biosynthetic structures of muscle cells exposed to CNG are similar to those caused by other known stresses, such as heat stroke. It has been demonstrated that in response to these changes, muscle cramps occur. The cardiovascular system has also been evaluated. The long-term effects of occupational exposure to HCV have been assessed, and it has been found that electromagnetic radiation at radio frequencies is associated with an increased risk of hypertension and dyslipidemia.

Another study of worker health compared the health data of radio frequency plastic seal operators (RF operators), a professional category highly exposed to electromagnetic fields in the radiofrequency range, with that of non-exposed workers. This study found that time-integrated exposure parameters have an impact on symptoms such as fatigue, headaches, and a feeling of warmth in the hands. The heart rate of RF operators was lower than that of the comparison group, and bradycardia phenomena were more common. In rats exposed to powerful microwave radiation, the heart rate was lower compared to non-exposed animals (30 MW/cm<sup>2</sup> for 15 minutes – the effect is very strong, but the main goal was to demonstrate pathological changes in myocardium).

Histological and structural changes were found in the myocardium of exposed rats, including swollen and irregularly arranged myocytes, as well as condensation of chromatin and dark areas in the nuclei. These changes occurred in rats exposed to intermediate frequencies (150–155 kHz) in a chronic renal disease model.

It was assumed that the radiation would remove calcium from heart valves, but this turned out to be the exact opposite. The study was repeated with 50 Hz high frequency (HF) exposure using mobile phone chargers, and similar results were obtained, although the results were not published. Studies of long-term RF exposure have found clear evidence of a relationship between long-term exposure to low-intensity radiofrequency radiation and tumors of the

heart (and brain) in male rats. Glucose metabolism. Groups of rats were compared after exposure to mobile phone radiation. In rats exposed for more than 15 minutes per day, within three months, there were higher levels of fasting blood glucose ( $p < 0.015$ ) and serum insulin ( $p < 0.05$ ) compared to non-exposed animals and their insulin resistance was significantly increased ( $P < 0,003$ ). In exposed rats there was an increase in level of proteins triglycerides creatinine alat asat and iron in blood plasma a decrease in uric acids levels electro hypersensitivity formerly known as microwave disease many of the symptoms described by patients suffering from this diseases are the result of damage to nerves fibers and hypersensitiv nervous reactions In about 30% of patients from their impressive sample of 2,000 people, multilateral chemical sensitivity is combined with electro-hypersensitivity. Typical symptoms in these patients include "headache, tinnitus, hyperacusis, dizziness, balance disorders, superficial and deep sensory disorders, fibromyalgia, autonomic nervous system disorders, as well as cognitive impairment including loss of immediate memory, difficulty concentrating, and spatiotemporal disorientation." These symptoms are associated with chronic insomnia, fatigue, depressive tendencies, emotional instability, and sometimes irritability.[4]

In an extensive study involving a patient with electro-hyper sensitivity, it was found that during 100 seconds of EMF exposure ( $p < 0.05$ ), the patient experienced somatic reactions including nervous symptoms (headache with temporal pain), muscular symptoms (seizure), and cardiovascular symptoms (extra systole). The symptoms appeared after field transitions (on / off, off / on) and were not solely caused by its presence. The patient was unable to consciously determine whether the field was on or off. Studies of the mechanical effects of electromagnetic fields have been described. Many studies describe non-thermal interactions between electromagnetic fields and biological tissues.

It was assumed that the vibrations of an external pulsating field release ions on the

surface of cell membranes in plasma and affect electro-sensitive channels in the plasma, which leads to a violation of the electrochemical balance in the cell and affects its functioning. Based on the evidence presented that exposure to electromagnetic fields (EMF), both common and chronic, has certain health effects, we propose the following preventive and protective measures, adapted in accordance with recommendations published by international groups of scientists, medical organizations, environmental activists, and mutual aid. Many of these groups are calling for a reduction in the acceptable levels of EMF and the abandonment of the introduction of 5G networks, which would lead to increased levels of exposure. Increasing distance and reducing time of use are important factors in decreasing

exposure and therefore health risks. Proximity to the source is the most significant factor in exposure. Radiation levels significantly decrease with distance from the source. Figure 1 compares the permissible exposure levels of RF radiation (including cell towers) in different countries. Reducing exposure caused by cellular communication towers is quite possible, and in some countries this has been implemented better than others [6]. It is extremely important to maintain a significant distance between these facilities and schools and kindergartens, as children are the most vulnerable population group to environmental influences. Additionally, it is essential to place the antennas of mobile devices away from sleeping areas in order to prevent harmful effects during sleep.

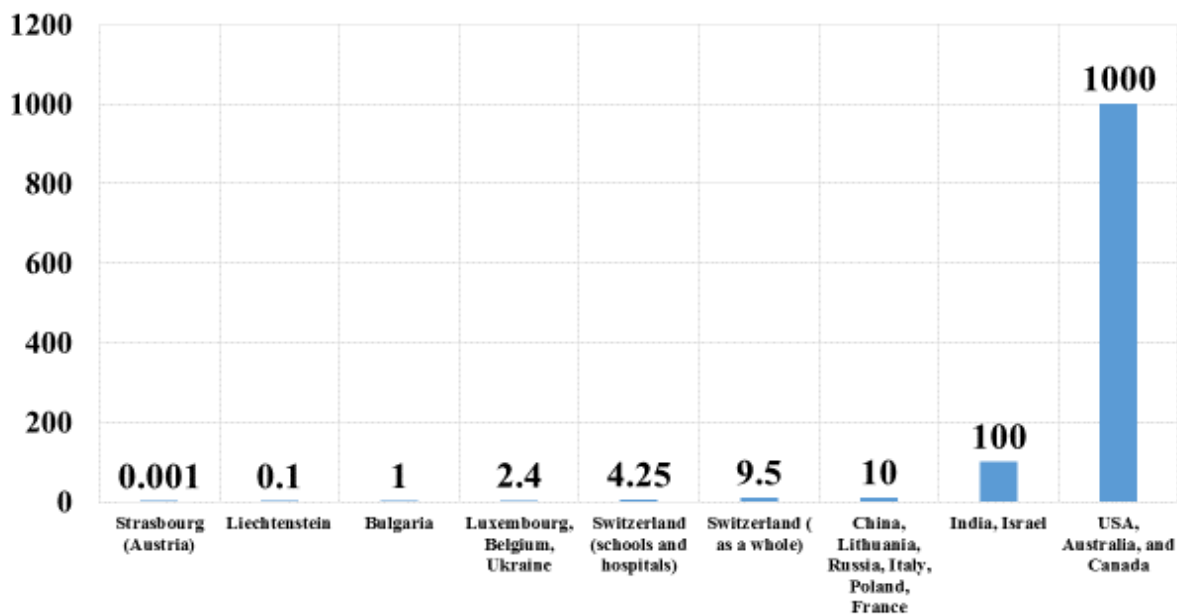


Fig. 1. A comparison of countries by the exposure level of pulsing RF EMF in the open air, MW/cm<sup>2</sup>

Wireless meters and devices used in public spaces may be sources of low-intensity EMFs, but they also create biologically significant pulsing effects, which are considered more harmful, even at a low intensity. In addition, EMF intensity is often incorrectly measured, since it uses devices that do not have the required measurement speed. To avoid using Wi-Fi in schools, always prefer safe wired technologies that do not emit radio frequency electromagnetic fields.

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