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EFFECT OF RADIO WAVES ON THE HUMAN BODY

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Abstract

Technological advances of mankind through the development of electrical and communication technologies have led to the exposure of artificial electromagnetic fields. Technological growth is expected to continue; therefore, the amount of EMF exposure will continue to grow steadily. In particular, the time of use of smart phones is increasing, which has become a necessity for modern people. When considering the area where the mobile phone is used, interest in social anxiety and the effects on the cranial nervous system increases. Scientific research on the mechanism of biological effects is also required. Furthermore, RF-EMF acts as a source of stress in living beings.

Keywords: Homeostasis, thermoregulation, electromagnetic, extrapolation, restrictions, controlled environment.

Introduction

There is a substantial literature on tissue reactions to electromagnetic fields, primarily in the extremely low frequency (ELF) and microwave frequency range. In general, the effects of radiofrequency (RF) radiation on tissue and organ systems are related to thermal interactions, although the presence of non-thermal effects at low field intensity is still a subject of active research. This chapter summarizes the effects of RF on major physiological systems and assesses the threshold-specific absorption rates (SARs) required to produce such effects. The health effects of these findings will be evaluated as being related to exposure to RF fields from GWEN antennas. Many studies in rodents and monkeys have shown that exposure to thermogenic levels of RF radiation causes endocrine alterations, with the most consistent change being an increase in plasma corticosterone. Values greater than 3 W/kg would induce an increase in plasma corticosterone in rats, which is dependent on the secretion of adrenocorticotropic hormones by the pituitary gland. A decrease in thyroid hormone levels in response to thermogenic levels of RF radiation has also been observed, and this response is associated with inhibition of thyrotropin secretion by the pituitary gland. In general, the change in hormone concentration is recurrent after the end of RF exposure. These findings suggest that RF heating alters the complex interactions of the hypothalamic, pituitary, adrenal and thyroid systems that are important in maintaining homeostasis. No growth, decrease, and no change in plasma steroid hormones have been reported. Results from studies with dogs and rats show that the 60 Hz electric field required to induce changes in the blood concentration of corticosterone, or testosterone, is in excess of 10 kV/m. Results from experiments with monkeys exposed to 60 Hz electrical and magnetic monkeys at an intensity typical of those around high-voltage transmission lines showed that a decrease in neurotransmitter concentration occurred during chronic exposure. However, there were no other observations of behavioral or physiological changes in the affected animals.

The most widely studied effect of ELF fields on the endocrine system is a clear depression in the nocturnal elevation of pineal melatonin. With the return of nocturnal pineal melatonin to control values within 3 d after exposure was delayed, exposure was withdrawn. Similar exposure to pineal melatonin was observed after the rodents were exposed to a 0.05 mT static magnetic field that was turned on and off continuously in 5-minute cycles for 1 hour after the onset of darkness. Interest in this phenomenon centers around melatonin's effects on cell proliferation and its possible carcinostatic effects. A major problem in interpreting the results of the studies is the lack of quantitative data on the boundary areas needed to change melatonin concentrations. It's unclear whether ELF fields directly alter pinealotite function, or whether changes in pineal melatonin production are secondary to the domains' effects on the nervous system. Further research is needed to evaluate the effects of field-related changes in pineal melatonin on physiological regulation and endocrine-related cancer risk.

Electromagnetic waves can be classified into very low frequency (ELF-EMF), RF-EMF, and microwave radiation based on their wavelength range. Typically ELF-EMF, frequencies between 3 and 3000 Hz are generated from electronics and electrical wires used in homes and workplaces. The RF-EMF range ranges from 100 kHz to 300 GHz, generating an electromagnetic field that propagates through space when a radio frequency current is given to the antenna. RF-EMF is emitted from devices such as mobile phones, Wi-Fi systems, satellite communication systems, radios, television stations, and interactive radios. Many of these wireless devices are increasingly used in human life. When using electronic devices (mobile phones, computers, microwave ovens, etc.), mostly electromagnetic waves are generated. These waves can be absorbed by the human or animal body; The specific absorption rate is the numerical representation of the absorption waves. SAR refers to the amount of radio wave energy absorbed by the human body in unit mass (1 kg or 1 g); the unit is W/kg or mWh/g. The electromagnetic waves emitted by mobile phones have a high frequency and are capable of causing body temperature to rise; Such heat reactions are quantified by the SAR. Since RF-EMFs can enter the body and cause the vibration of charged or polar molecules, this is very important for human health and safety. The National Radio Research Agency has published the SAR standards of international organizations related to SAR and major countries with related issues.

The typical RF energy levels encountered by the general public are well below the levels needed for significant heating, but some jobs near high-power RF sources may exceed safe exposure limits. Measurement of heating effect in kilograms which has watt units for the specific suction rate, or SAR. IEEE and many national governments have set safety limits for exposure to different frequencies of SAR-based electromagnetic energy, largely based on ICNIRP guidelines that protect against heat damage.

If the impact is not determined based on data from manufacturers, comparisons with similar systems or analytical calculations and measurements should be made. The assessment results will help assess potential risks to the safety and health of workers and identify protective measures.

Since electromagnetic fields can affect workers' passive or active implants, the impact on their workplace should be taken into account separately when assessing the risk .

Some people may have significant RF exposure as part of their work. This includes people who maintain antenna towers that transmit communication signals, and people who use or maintain radar equipment. Other people who experience high levels of RF exposure include some healthcare professionals (especially those who work near MRI scanners) and people who work with devices that use RF radiation, such as plastic fillers, certain types of welding equipment, and induction heaters.

Most people are exposed to low levels of RF radiation from the RF signals around us every day. They come from radio and TV shows, Wi-Fi and Bluetooth devices, cell phones (and cell phone towers), and other sources.

When food swallows microwaves, it causes the water molecules in the food to vibrate, which produces heat. X-rays or gamma rays are not used in microwave ovens, and they do not make food radioactive.

Microwave ovens are designed to be located in the microwave ovens themselves. The oven only produces a microwave oven when the door is closed and the oven is turned on. When microwave ovens are used according to the instructions, there is no evidence that they pose a health risk. In the U.S., federal standards limit the amount of RF radiation that can leak out of a microwave oven to levels far below levels that can harm humans. However, damaged or altered ovens can allow microwave ovens to leak and pose a hazard to people nearby.

The scientific literature on the possible biological effects of RF fields is regularly monitored by Health Canada scientists. Although many additional studies have been conducted on RF fields and health, the only adverse health effects associated with RF field exposure in the frequency range of 3 kHz to 300 GHz have been associated with tissue heating and nerve stimulation (NS) from short-term (acute) exposure. Currently, there is no scientific basis for the occurrence of acute, chronic, and/or cumulative adverse health risks from RF field exposure at levels below the limits set forth in Safety Code 6. Hypotheses of other proposed adverse health effects occurring at levels below the impact limits specified in Safety Code 6 suffer from a lack of causation, biological reliability, and reproducibility evidence and do not provide a credible basis for making science-based recommendations to limit human exposure to low-density RF fields.

This safety code provides guidance in terms of the level of reference for key constraints to prevent adverse effects on human health as a result of exposure to RF fields. The main limitations are body exposure indices which should not be exceeded. These exposure rates are directly related to the negative effects on health. The main limitations in this safety code are specified in: a) internal electric field strength; and b) the absorption rate of RF energy (SAR). Because SAR, or internal electric field strength, is often difficult to measure, this safety code also specifies a reference level for maximum human exposure to RF fields. The reference level is determined in terms of careless, externally applied electric and magnetic field strength, power density, and electric currents in the body caused by contact with induction or energy-powered metal objects. They were organized using dosimetric analyses that determine the level of externally applied field strength that causes fundamental constraints on the body. At frequencies between 3 kHz and 10 MHz, NS from induced electric fields in the body must be avoided. Experimental studies have shown that electric and

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magnetic field effects can induce internal electric fields (voltage gradients) within biological tissue, which, if intense enough, can alter the "resting" membrane potential of excited tissues, resulting in spontaneous depolarization of the membrane and the formation of false impact potentials. The main limitations for avoiding NS are specified in this safety code in terms of the maximum internal electric field strength in the body.

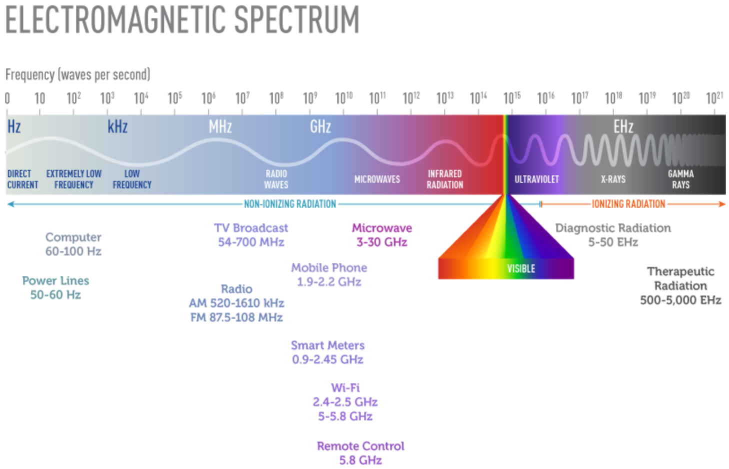
For frequencies between 100kHz and 300GHz, tissue heating can happen and must be limited. This safety code specifies basic limitations for RF field exposure in the frequency range of 100 kHz to 6 GHz in terms of maximum whole-body SAR (whole-body average) and maximum spatial mean SAR (average over small cubic volume). For frequencies above 6 GHz, RF energy absorption occurs mainly in surface tissues (e.g., upper layers of the skin), and the use of maximum SAR limits, either averaged over whole body or cubic volume, is not correct. Instead of basic constraints, reference levels are defined in terms of maximum variability, externally applied electric and magnetic field strengths, and power density to avoid thermal effects.

Studies in animals, including non-human primates, have consistently shown a threshold effect for behavioral changes and the occurrence of alterations in core body temperature of ~1.0°C, with a whole-body mean SAR of ~4 W/kg. Thermoregulation studies in human volunteers exposed to RF fields under different exposure scenarios provided supportive information about RF field-induced thermal reactions in humans. This information forms the scientific basis for the basic limitations on the average SAR of the whole body in Safety Code 6. Safety factors were included in the exposure limitations to avoid thermal exposures, resulting in mean whole-body SAR limits of 0.08 and 0.4 W/kg in unsupervised and controlled environments, respectively.

To prevent negative thermal effects in localized human tissues, basic restrictions on the highest spatial mean SAR are also established in safety code 6. The highest spatial mean SAR boundaries reflect the highly heterogeneous nature of typical RF field exposure and the different thermoregulatory properties of different body tissues. The highest spatial mean SAR limits are for discrete tissue size (1 or 10 g, cube-shaped), where thermoregulation can effectively dissipate heat and prevent body temperature fluctuations above 1°C. Thus, the highest spatial mean SAR limits for exposure in a controlled environment are 20 W/kg for the limbs and 8 W/kg for the head, neck, and torso. The highest spatial mean SAR limits for exposure in uncontrolled environments are 4.0 W/kg for the limbs and 1.6 W/kg for the head, neck, and torso.

For frequencies from 100 kHz to 10 MHz, basic constraints for internal electric field strength and SAR (calculated as whole body and peak spatial mean) must be observed simultaneously as NS or thermal effects may occur, depending on exposure conditions (frequency, duty cycle, orientation). Safety Code 6 also sets reference levels in the frequency range from 3 kHz to 110 MHz to avoid sensing (nerve stimulation), shock, or burns

While the biological basis for the basic constraints specified in this safety code has not changed since the previous version, the reference levels have been updated in recent years to take into account dosimetric definitions or, where possible, to harmonize with ICNIRP.



In order to determine if the maximum exposure level has been exceed, the following factors must be fully considered:

a. the nature of the exposure environment (controlled or uncontrolled environment);

b. Transient properties of the RF source (including ON/OFF times, duty factors, beam direction and shear time, etc.);

c. the spatial features between the source of the impact and the target (i.e., the near-field impact, the whole body, or parts of it);

d. uniformity of impact area (i.e., spatial mean).

At frequencies in the range of 100kHz – 300 GHz, a higher exposure level for a short period of time can be allowed under certain conditions if comparisons are to be made with SAR-based fundamental constraints and/or reference level. For such cases, the average field strength, power density, and body flow during any tenth-hour reference period (6 minutes) should not exceed the limits specified in Sections 2.1 and 2.2.

SI units are used throughout this instrument unless otherwise specified.

Internal electric field strength limits are designed to prevent NS from occurring. At frequencies between 3 kHz and 10 MHz, the fundamental constraints for the internal electric field strength in excited tissues are not exceeded. In conditions where it is not possible or practical to determine the internal electric field strength (e.g., by measurement or modeling), an estimate of the external undisturbing field strength is performed

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