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ELECTROMAGNETIC FIELDS AND POSSIBLE HARMFUL HEALTH EFFECTS

Dr. Muhsin AKBABA
Çukurova University Faculty of Medicine
Public Health Department

Dr. Mehmet GÖKDENİZ
Çukurova University Faculty of Medicine
Public Health Department

Abstract

The human body grounds electromagnetic radiation in the environment because of the electrical conductivity of our body. It is attracted to us. All living systems are based on electromagnetic energy. Every cell in your body is generating an electromagnetic field, every plant, every rock, the planet itself, the whole universe is made up of energy. It is true that man-made electromagnetic radiation is not the only source of random photons in the environment, but the problem is these frequencies which we have never encountered before are a whole different spectrum of frequencies than the living system uses. At this point, the question as to whether or not they can damage our health is important.There are substantial researches indicating severe health problems such as cancers, mental disorders, neurologic illnesses, fetal abnormalities, cardiovascular diseases etc associated with electromagnetic field exposure. Taking the actions discussed in the literature and this article can help to significantly reduce your and your family's exposure to electromagnetic fields.

Keywords: Electromagnetic fields, health effects, public health

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1. INTRODUCTION

Electromagnetic fields are all around us – for example, natural electric fields in thunderstorms cause lightning across the sky, and man-made electric fields are found in electrical tools. Magnetic fields are also well known to us; the Earth's magnetic field causes a compass needle to point North and helps us to navigate. These electric and magnetic fields are related because whenever an electric current flows in an electric field, then a magnetic field occurs. Together they form an electromagnetic field, or EMF. An example of this is found in our homes, in hi-fi systems, where an electric field, or voltage, drives a varying electric current which produces a varying magnetic field that causes the speaker cone to vibrate and reproduce sounds.

2. WHAT ARE ELECTROMAGNETIC FIELDS?

Electromagnetic fields(EMF) can be described as a series of waves that oscillate at a particular frequency and have a certain distance between one wave and the next one. **Electric fields** are created by differences in voltage: the higher the voltage, the stronger will be the resultant field. An electric field will exist even when there is no current flowing. **Magnetic fields** are created when electric current flows: the greater the current, the stronger the magnetic field.

EMFs have a very wide range of frequencies, extending from low frequency electricity supply lines with wavelengths of some hundreds of metres, through the radio and visible light frequencies, to very high-frequency medical X-rays.

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Table 1:Electric Fields and Magnetic Fields

• Electric fields arise from voltage. • Their strength is measured in Volts per metre (V/m) • An electric field can be present even when a device is switched off. • Field strength decreases with distance from the source. • Most building materials shield electric fields to some extent.	• Magnetic fields arise from current flows. • Their strength is measured in amperes per meter (A/m). Commonly, EMF investigators use a related measure, flux density (in microtesla (μT) or millitesla (mT) instead. • Magnetic fields exist as soon as a device is switched on and current flows. • Field strength decreases with distance from the source. • Magnetic fields are not attenuated by most materials.

2.1 Natural Sources of Electromagnetic Fields: Electromagnetic fields are present everywhere in our environment but they are invisible to the human eye. Electric fields are produced by the local build-up of electric charges in the atmosphere associated with thunderstorms. The earth also has its own magnetic field.

2.2 Human-made Sources of Electromagnetic Fields: The electricity that comes out of every power socket has associated low frequency electromagnetic fields. X-rays which are used in medical diagnose and various kinds of higher frequency radiowaves are used to transmit information via TV antennas, radio stations or mobile phone base stations.

2.3 Wavelength nd Frequency

The frequency describes the number of oscillations or cycles per second and measured in *Hertz(*Hz), while the term wavelength describes the distance between one wave and the next the relation between them is that:

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the higher the frequency the shorter the wavelength.

2.4 Sources of Low Frequency Fields

Generally, anything that is working off the utility grid, things you plug in to the electrical plugs in your home and office, **generate extremely low frequency**(ELF) fields up to 300 Hz.

Other technologies such as computers, monitors, stereo systems produce **intermediate frequency (IF)** fields with frequencies from 300 Hz to 10 MHz.

Radio, television, radar and cellular telephone antennas, microwave ovens, all forms of wireless communication produce **radiofrequency (RF)** fields with frequencies of 10 MHz to 300 GHz.

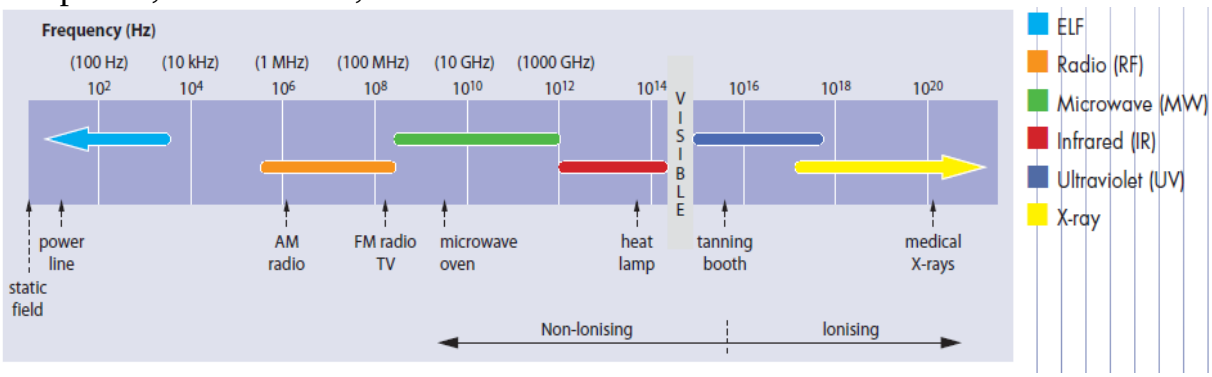

Diagram 1:The Electromagnetic Spectrum

2.5 Types of Electromagnetic Radiation

Electromagnetic radiation can be classified into two types: ionizing radiation and non-ionizing radiation, based on its capability of ionizing atoms and breaking chemical bonds.Ultraviolet and higher frequencies, such as X-rays or gamma rays are ionizing. They carry so much energy per quantum that they have the ability to break bonds between molecules. Man-made sources of electromagnetic fields that form a major part of industrialized life - electricity, microwaves and radiofrequency fields – are found at the relatively long wavelength and low frequency end of the electromagnetic spectrum and their energy are unable to break chemical bonds.

The Turkish Journal of Occupational / Environmental Medicine and Safety
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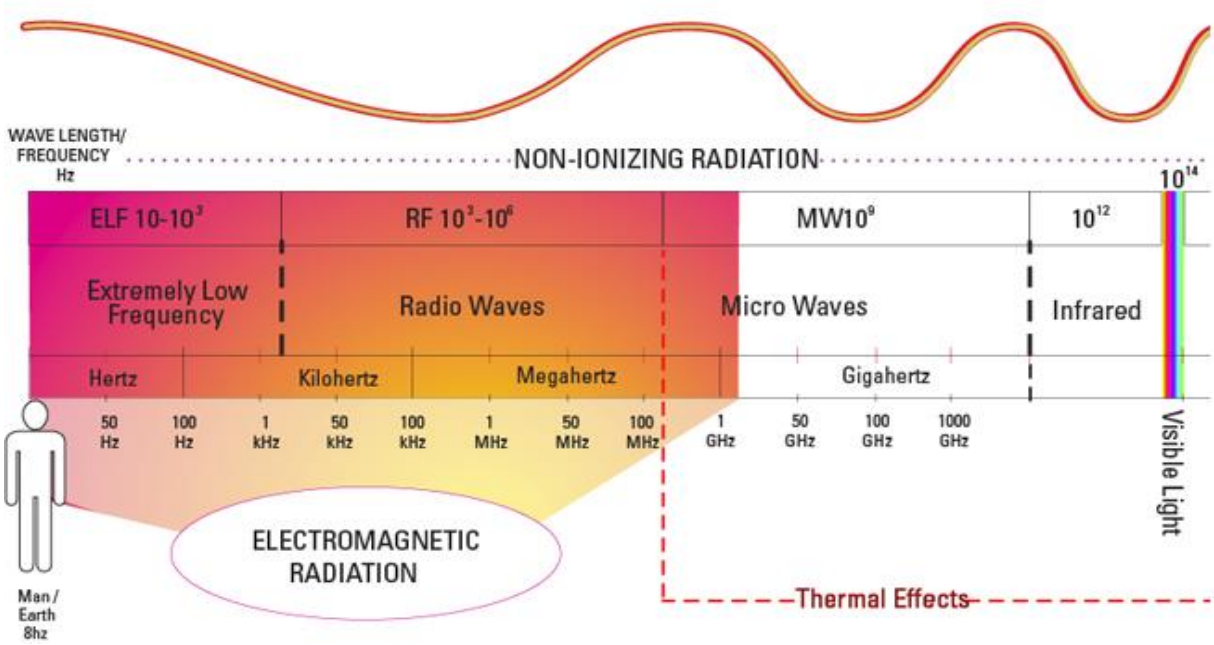

Diagram 2: Electromagnetic Radiation in Our Homes

2.6 EMF Exposure

Many people do not realize or realize but ignore that they're chronically exposed to something completely invisible, tasteless, and odorless which can deteriorate their health: exposure to electromagnetic fields(EMF). Exposure to non-ionising electromagnetic fields is unavoidable in today's society and this exposure is growing fastly.

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Table 2: Typical Magnetic Field Strength of Household Appliances at Various Distances

Electric Appliance	3 cm distance (μT)	30 cm distance (μT)	1 m distance (μT)
Hair dryer	**6 – 2000**	0.01 – 7	0.01 – 0.03
Electric shaver	**15 – 1500**	0.08 – 9	0.01 – 0.03
Vacuum cleaner	200 – 800	**2 – 20**	0.13 – 2
Fluorescent light	40 – 400	**0.5 – 2**	0.02 – 0.25
Microwave oven	73 – 200	**4 – 8**	0.25 – 0.6
Portable radio	16 – 56	1	< 0.01
Electric oven	1 – 50	**0.15 – 0.5**	0.01 – 0.04
Washing machine	0.8 – 50	**0.15 – 3**	0.01 – 0.15
Iron	8 – 30	**0.12 – 0.3**	0.01 – 0.03
Dishwasher	3.5 – 20	**0.6 – 3**	0.07 – 0.3
Computer	0.5 – 30	**< 0.01**	
Refrigerator	0.5 – 1.7	**0.01 – 0.25**	<0.01
Colour TV	2.5 - 50	0.04 – 2	**0.01 – 0.15**

(Source: Federal Office for Radiation Safety, Germany 1999) .
Normal operating distance is given in bold.

Table 3: Typical field strengths from household appliances compared to recommended limits

Electric appliance	Electrical field strength in volts/ metre at 30cm	ICNIRP recommended exposure limit in volts/metre
Stereo receiver	180	5 000
Electric iron	120	5 000
Toaster	80	5 000
Electric oven	8	5 000

Electrical appliance	Magnetic field strength in microtesla at 30cm	ICNIRP recommended exposure limit in microtesla
Electric oven	1 to 50	100
Microwave oven	4 to 8	100
Vacuum cleaner	2 to 20	100
Electric shaver	0.08 to 9	100

Source: International Comission on Non-Ionizing Radiation Protection(ICNIRP)

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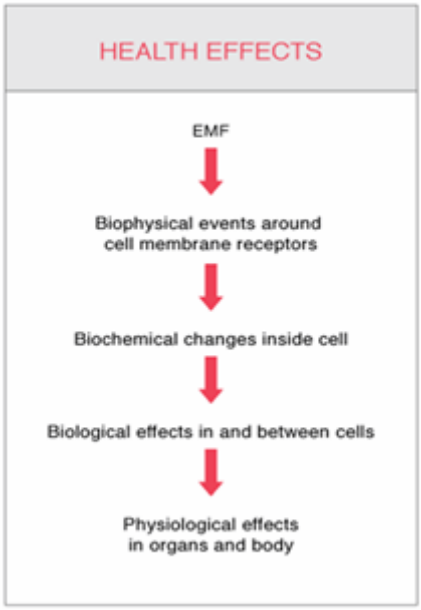
3. EMFs AND HEALTH

The exposure to EMFs is growing mainly because of mobile telephones which are held close to the head, the high density of mobile telephone antennas in our cities and usage of high technology electrical tools. The effects of electromagnetic fields on the human body depend on their field level, frequency, amplitude and energy.



Artificial EMFs change the frequency of your body's electromagnetic fields through a process called entrainment (or sympathetic resonance). EMFs overwhelm your body's own electrical fields, changing their frequency and distorting the balance of the body's electromagnetic field and its communication systems. This causes physical, mental and emotional stress.

Because of having been proven that biological systems store electromagnetic radiation within the cells in the form of electromagnetic oscillations the potential harmful effects of EMFs do not pass if you get away from them.

At this point, the question as to whether or not they can damage our health is important. The effects of long-term exposure to low-intensity EMF are not at all well known. WHO concluded that current evidence does not confirm the existence of any health consequences from exposure to low level electromagnetic fields. However, some gaps in knowledge about biological effects exist and need further research.

3.1 EMFs and General Health

General symptoms like headache, fatigue, dizziness, nausea are reported by individuals exposed to low levels of EMFs at home. These problems may be caused by noise or other factors in the environment, or by anxiety related to the presence of EMFs.

3.2 EMFs and Genesis

The effects of RF EMF on global gene and protein expression have been investigated in different biological systems, and most of the studies were focused on the mobile phone utilization frequency (800-2000 MHz) at a relatively low exposure density. Some studies reported that EMF exposure can change gene and/or protein expression and cell growth in certain types of cells, even at intensities lower than ICNIRP recommended values.

Furthermore under certain conditions of exposure, radiofrequency radiation could be genotoxic. During cell phone use, a relatively constant mass of tissue in the brain is exposed to the radiation at relatively high intensity (4-8 W/Kg). Several studies reported DNA damage at lower intensity than 4 W/Kg.

3.3 EMFs and Cancers

In addition to their potential genotoxic effect which is mentioned upwards some studies indicated that EMFs enhance free radical activity in cells particularly through the *Fenton reaction*. The Fenton reaction is a catalytic process of iron to convert hydrogen peroxides, a product of oxidative respiration in the mitochondria, into hydroxyl free radical, which is a very potent and toxic free radical. Any exposure, including prolonged low-intensity ELF and RF exposures that result in increased free radical production may be considered a plausible biological mechanism for carcinogenesis.

3.3.1 EMFs and Childhood Cancers

A number of epidemiological studies suggest small increases in risk of childhood *leukemia* with exposure to low frequency magnetic

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fields in the home. An overview of existing evidence from epidemiological studies indicates that there is a continuous increase of risk with increasing levels of average magnetic field exposure. Other childhood cancers except leukaemia have not been studied in sufficient detail to allow conclusions about the existence and magnitude of the risk. Large-scale studies are currently underway in several countries.

3.3.2 EMFs and Breast Cancer

Over the last two decades there have been numerous epidemiological studies on breast cancer in both sexes. Many of these studies report that ELF exposures are related to increased risk of breast cancer. Laboratory studies that examine human breast cancer cells have shown that ELF exposure between 6 mG and 12 mG can interfere with protective effects of melatonin for the growth of these breast cancer cells. Laboratory studies of animals that have breast cancer tumours have been shown to have more tumours and larger tumours when exposed to ELF.

3.3.3 EMFs and Brain tumours

There are severe claims that EMF exposure can cause brain tumours such as *acoustic neuroma*, *meningioma*, *glioma*. According to the results published by Hardell group there is a consistent pattern of an increased risk for *acoustic neuroma* and *glioma* after 10 years or more mobile phone use.

The WHO/International Agency for Research on Cancer (IARC) has classified radiofrequency electromagnetic fields as possibly carcinogenic to humans (Group 2B), based on an increased risk for *glioma*, a malignant type of brain cancer , associated with wireless phone use.

3.3.4 EMFs and Skin Tumours

A recent analysis in Denmark focussed on the association between mobile phone use and risk of *malignant melanoma* and non-melanoma skin cancers as *basal cell carcinoma* and *squamous cell carcinoma*, since the skin is the most exposed part of the human body to EMFs.

3.4 EMFs and Nervous System

Exposure to electromagnetic fields has been studied in connection with *Alzheimer's disease*, *motor neuron disease* and *Parkinson's disease*.It is suggested that exposure to ELF can increase the level of amyloid beta in the brain which is a risk factor for Alzheimer's disease.

One of the most sensitive part of your body to EM radiation is the *pineal gland*. The pineal gland controls all the hormonal balances in

your body. One of the most important hormones it controls is *melatonin*. Melatonin is related to the day or night sleep cycle and to jet lag. When the pineal gland is stressed, melatonin levels go down, and the first thing that occurs is sleep problems. In addition, our immune system's ability to target chemicals in the body and metabolize them safely out of the body is decreased because melatonin does that for us.

3.5 EMFs and Mental Health

Some individuals report "hypersensitivity" to electric or magnetic fields. They ask whether headaches, depression, lethargy, sleeping disorders, and even convulsions and epileptic seizures could be associated with electromagnetic field exposure. It is indicated that EMFs induce stress and affect behaviours relatively. Memory problems, depression and sleeping problems could occur in persons with chronic exposure.

3.6 EMFs and Eye

General eye irritation and cataracts have sometimes been reported in workers exposed to high levels of radiofrequency and microwave radiation.

3.7 EMFs and Pregnancy

There are some research reports of associations between EMFs exposure and health problems such as prematurity, spontaneous abortions, malformations and low birth weight and childhood behaviour problems in children of workers in the electronics industry and having maternal cell phone usage background.

3.8 EMFs and Cardiovascular System

A recent research reports elevated blood pressure and lower heart rate variability levels,which are risk factors for coronary heart diseases, in persons exposed to EMFs from radio and TV broadcasting.

3.8 EMFs and Reproductive System

Testes can be particularly susceptible to heating by RF energy because of the relative lack of available blood flow to dissipate the excessive heat load. Laboratory experiments have shown that short-term exposure to high levels of RF radiation can cause infertility, caused by such effects as changes in sperm count and in sperm motility and lack of libido.

4. CONCLUSION

Exposure to EMFs has been linked to a variety of adverse health outcomes including childhood leukemia, adult brain tumours, genotoxic effects (DNA damage and micronucleation), neurological effects and neurodegenerative diseases, immune system deregulation, allergic and inflammatory responses, breast cancer in men and women, miscarriage, infertility and some cardiovascular effects despite the necessity of more scientific evidence support. It's important to remember that all of these exposures are cumulative—it all adds up, so whatever you can do to lessen your exposure can have a beneficial impact on your overall health and well-being.

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