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Impact of Various Electromagnetic Radiations on Human Health and Biodiversity

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Abstract: ***We use advanced technology in almost every aspect of life to make it simpler and more comfortable without knowing the cons. The focus of this paper is to present the side effects of Electromagnetic Radiations caused by such technologies on human health. Our life is surrounded by devices which constantly emits Electromagnetic Radiation. The serious health hazards are still unknown to the common people who use such devices. Radiation caused by 3G or 4G mobile towers, Wi-Fi Networks, Bluetooth protocols, household devices like microwave ovens and other wireless devices harm all living species. The study and detailed analysis of such radiation effect on human's physical and mental health is carried out in this paper.***

Keywords: Electromagnetic Radiation, Health Hazards of EMR, Electromagnetic Radiation Side Effects, EMR Fallouts, Repercussion of Electromagnetic Radiation

1. Introduction

The long and near exposure of human body or any living species to Electromagnetic Radiation (EMR) can be hazardous. This paper presents how different kinds of EMR affect human health and biodiversity. There is a wide range of Electromagnetic Radiations to which we are exposed knowingly or unknowingly, including visible light and ultraviolet frequency range too. But, the radiation caused by wireless electronic devices like Wi-Fi routers, cell phones and cell towers and microwave ovens have more dangerous effects those become noticeable after few years only. The analytics and details about how EMR can deteriorate the physical and mental health like a slow poison are discussed here. The possible solution for protection from such radiation exposure is also narrated in this paper.

2. Electromagnetic Radiation and its Effect on Bio Mechanism

Electromagnetic Radiations are produced by almost all electronic and electrical devices including electrical wiring and transmission lines, computers and laptops, all kind of broadcasting including SW, AM, FM and TV etc. Visible light as well as invisible forms such as infrared and ultraviolet, X-Rays and Gamma Rays are EMF. All these different types of EMF (Electromagnetic Frequency) are part of the electromagnetic spectrum. Electromagnetic waves consist of a very wide frequency range from ELF (Extremely low frequency) of less than 1 Hz to hard gamma rays at over 300 EHz. Every Electromagnetic Frequency is associated with a wavelength and an inherent level of quantum energy. The quantum energy is the energy of the individual light particles known as photons. Low frequencies have long wavelengths and low photon energy. Higher frequencies have shorter wavelengths and higher photon energy.

Table 2 shows the Wavelength and Energy associated with every frequency in electromagnetic Spectrum.

Table 1: Frequency vs. Wavelength and Energy

Region	*Frequency (Hz)*	*Wavelength (m)*	*Energy (eV)*
Radio waves	$< 10^9$	> 0.3	$< 7x\ 10^{-7}$
Microwaves	10^9 - $3x10^{11}$	0.001 - 0.3	$7x10^{-7}$ - $2x10^{-4}$
Infrared	$3x10^{11}$ - $3.9x10^{14}$	$7.6x10^{-7}$ - 0.001	$2x10^{-4}$ - 0.3
Visible	$3.9x10^{14}$ - $7.9x10^{14}$	$3.8x10^{-7}$ - $7.6x10^{-7}$	0.3 - 0.5
Ultraviolet	$7.9x10^{14}$ - $3.4x10^{16}$	$8x10^{-9}$ - $3.8x10^{-7}$	0.5 - 20
X-rays	$3.4x10^{16}$ - $5x10^{19}$	$6x10^{-12}$ - $8x10^{-9}$	20 - $3x10^{4}$
Gamma Rays	$> 5x10^{19}$	$< 6x10^{-12}$	$> 3x10^{4}$

It is easily identifiable from the table above that if the frequency increases, the wavelength decreases and the corresponding energy increase.

Our body naturally uses electrical impulses for many metabolic processes like controlling heartbeats, conveying sensory information, initiating muscular movement and also for thinking. The chemical processes cells, blood and body tissues depend on electric charges inside the body for their proper function. So an external EMF that creates electric currents within your body can interfere with many biological processes. Some of these biological effects can actually be beneficial for relieving pain or healing bone tissue. But the radiation that penetrates our bodies every day is too dangerous. Initially it may just cause unpleasant symptoms, but if action is not taken to limit radiation exposure, a more permanent health hazards may occur later.

Some of the initial health issues due to EMR penetration in body are anxiety, concentration difficulties, depression, memory impairment, nausea, palpitations and sleep disturbance. Symptoms due to EMF exposure generally get worse over long period of time. The most common health condition caused by EMR is Electro-Hyper-Sensitivity. Some other health issues recognized in scientific study with EMF pollution includes leukaemia, brain Cancer and breast Cancer, Alzheimer, nervous system damage, autism, blood pressure abnormalities, fertility impairment, hormonal

imbalance, miscarriage, sleeping disorders and stress disorders.

3. Various EMR effects on Human Health

Basically, there are three scientific mechanisms according to which EMF radiation can cause health effects. The three mechanisms are as follows;-

- Induced voltage or current in the body
- Thermal effects and
- Ionizing radiation effects.

3.1 Due to Induced Voltage or Current in the Body

Induced voltage or currents in the body are the only known health effects in the presence of strong electric and magnetic fields at low frequencies in the range of 0 - 3 KHz. These limits are established to stay below the excitation thresholds of various tissues. Excessive excitation may result in electrical shock or burns. Radio Frequency shock and burns are also possible at frequencies up to 30 MHz, the safe limits for electric and magnetic fields are set by the IEEE and FCC and other public health bodies according to frequency ranges.

3.2 Due to Thermal Effects Caused by High Frequency

These effects occur when a living tissue absorbs the EMF power which can cause heating. This effect is mainly observable in the RF frequency range of 30 MHz to 300 GHz. Harmful effects from induced voltages and currents may still occur, but at power levels above those for heating effects. The total EMF power absorbed by the tissue is determined by the photon energy multiplied by the number of photons per second being absorbed. In real practice, the method utilized is based on the measurement of the SAR (Specific Absorption Rate) value. The SAR safety limits are specified in units of W/kg of body tissue. Existing regulations like FCC, WHO, and International Commission on Non-Ionizing Radiation (ICNIR) have set safety limits for all commercial products that are well below the level where harmful heating effects may occur.

3.3 Due to Ionizing Radiation Effects

The Electromagnetic Radiation is called ionizing radiation when its inherent photon energy reaches the level where it can break the electron bonds that hold molecules together. It is totally different mechanism than the heating effect. Figure 1 shows the frequency range of Ionizing and Nonionizing Radiation. Ionizing radiation starts from Ultraviolet wavelength range which causes sunburn can increase the risk of skin cancer. Ionizing radiation can cause many other types of cancer. X-rays and Gamma rays have shorter wavelengths and higher photon energy. They are considered the most dangerous ionizing radiation. The energy level of the photons produced by cell phones is far more below than the lowest energy ultraviolet ionizing radiation.

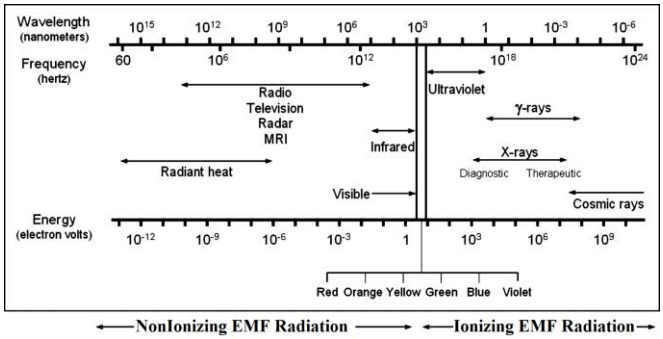

Figure 1: Ionizing vs. Nonionizing Radiation Freq. Range

More research is being carried out to analyze the ionizing and nonionizing radiation effects in epidemiological, vitro and vivo studies.

Under the exposure of EMF Radiation, Blood cells become distorted in shape and may get clumped together. Cells start producing stress proteins, which is a sign that cells are under threat. Hormone production like melatonin and serotonin is observed to be reduced. Mobility of sperm cells is reduced. DNA repairing processes work less efficiently. And the most of the damage caused by EMF will probably only appear after many years of exposure. How electromagnetic radiation causes damage may not be fully understood yet, but there are several promising results from study which includes

- **Damage to DNA Structure**: Metabolism of cells has mechanisms to repair DNA damage to a limited extent, but study shows that EMF radiation may disrupt these mechanisms. Damaged DNA is implicated in several diseases including various types of cancer.
- **Disturbance in Melatonin and Serotonin production:** EMR interfere with the production of a hormone named melatonin. Low melatonin levels have already been linked to several diseases, including cancers. Even serotonin hormone production can also be affected by EMR.
- **Disturbance in Cell structure:** Living cells communicate by means of electrical signals. These signals can be affected by EMF radiation, which causes electrical current interference within the body causing changes in cellular activity and even cell structure.
- **Damage in Neurons:** A study of the effects of mobile phone on rat brains showed damage to the neurons in different brain parts, including the cortex, hippocampus and basal ganglia. It may cause lacunar infarcts in elderly brain by disturbing blood supply mechanism in brain.
- **Damage to Developing Embryo in Pregnant Woman:** Study suggests that pregnant women are at risk of miscarriage if they encounter with strong EMFs during pregnancy. Lower EMF levels may still damage the embryo, even if they do not cause an actual miscarriage.

4. EMR effects of Household Devices

We use almost all devices wireless at our home and office to make our life more comfortable without giving a second thought how the EMF radiation affects our overall health. The list of such devices includes Wi-Fi routers, Cordless phones, Bluetooth speakers, Wireless intercom and wireless gaming equipment. Even Microwave ovens used in the

kitchen can adversely affect the human health. Moreover, we all are exposed to satellite microwave frequency radiations used for TV dish antenna. But intensity of EMR from satellites cause the least harm as the source distance is too far from earth. ANSI standards for safe EMR exposure levels due to RF and microwave radiation are set to a SAR level of 4 W/kg, the threshold before hazardous biological effects occur due to energy absorption in the body. Research and experiments have shown that short-term exposure to high levels of RF radiation (100-200 mW/cm²) can cause cataracts in rabbits. It may even cause temporary sterility, changes in sperm motility exposure of the testes to high level EMF radiation. Some researchers have expressed the concern from study that even low level exposure to non-ionizing radiations like Wi-Fi (having 2.4 GHz frequencies) cause changes to chromosomes may cause reduced melatonin, free radicals, and mass cell degranulation.

5. EMR Effects on Plants, Birds and Animals

The EMF radiations affects the all living cells the same as they do in human being. Plantations have been reported to have growth problem which were exposed to a very high or long term electromagnetic radiations. Research analytics show that migrating birds are sensitive to 0.5 MHz to 5 MHz of radio frequencies. They often lose the sense of direction due to mixing of earth's magnetic field and man-made electromagnetic field.

The experiment was conducted at Global Quantech, Inc., San Diego, USA on plant seeds, beans, and yeast microorganisms to verify the efficacy of EMF protection technologies. The significant difference was observed in the growth of the beans. The review of literature by natural society shows that the EMRs are interfering with the biological and there had already been some warning bells sounded in the case on bees and birds, which probably heralds the seriousness of this issue and indicates the vulnerability of other too.

6. Several Useful Methods for EMR Protection

Although full protection from EMF radiation is very much difficult, we may still apply some techniques for least exposure to such radiations.

- Use wired devices instead of wireless.
- Switch off the Electronic and Electrical devices when they are not in use.
- Stay away from Cell phone towers and keep mobiles phones away from body.
- Make sure there are not elevated Electromagnetic fields.
- Do not use metal beds and do not keep Electronic devices near bed.
- Avoid Wi-Fi routers and use Ethernet cable instead.

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