

ELECTROMAGNETIC RADIATION FROM ELECTRONIC APPLIANCES

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ABSTRACT: Electromagnetic (EM) radiation is a self-propagating wave in space or through transparent matter. EM radiation has an electric and magnetic field component which oscillate in phase perpendicular to each other and to the direction of energy propagation. Electromagnetic radiation includes radio waves, microwaves, terahertz radiation, infrared radiation, visible light, ultraviolet radiation, x rays and gamma rays. The electromagnetic spectrum extends from below the frequencies of radio waves at the long-wavelength end through gamma radiation at the short wavelength end. The Electro Magnetic Radiation generated by the electronic appliances such as desktop computers, laptops, personal grooming appliances, kitchen appliances, televisions, mobile phones and their towers, and their related health effects, reason for health effects along with the measures to reduce the radiation are proposed. Zero radiation emission cannot be achieved in the technological world. But by following safety measures protection from harmful radiation is possible.

Keywords: electromagnetic, mobile phone, television, laptop

I. INTRODUCTION

Electromagnetic waves are emitted by many natural and man-made sources and play an important part in our lives. We are warmed by the electromagnetic emissions of the sun and we see using the part of the electromagnetic spectrum that our eyes detect as visible light. Electromagnetic (EM) radiation is a self-propagating wave in space or through transparent matter. EM radiation has an electric and magnetic field component which oscillate in phase perpendicular to each other and to the direction of energy propagation.

Electromagnetic radiation includes radio waves, microwaves, terahertz radiation, infrared radiation, visible light, ultraviolet radiation, x rays and gamma rays. The electromagnetic spectrum extends from below the frequencies of radio waves at the long-wavelength end through gamma radiation at the short wavelength end.

Human body is exposed to different kinds of EM radiation that includes the natural radioactivity in the earth, cosmic rays from outer space and also manmade radiations coming from electric and electronic instruments. Diagnostic X ray machine, television sets, computers, microwave oven, radar devices, laser devices, mobile phones etc, generates radiations of different frequencies which exists in our environment as electronic smog.

II. ELECTROMAGNETIC RADIATION FROM COMPUTERS

If we are a computer user, computer radiation may be our largest single source of electromagnetic radiation. Although the intensity of radiation from computers may be far less than from a high voltage power line, but it produces health problems due to the fact that people get much closer to their PC's. Many of the people spend most of their days in front of computer monitors, surrounded by its related electronic appliances, each of them emit radiation. Because of the duration of this exposure say, many hours a day, computer radiation is a real hazard.

The radiation coming from computer is known as Extremely Low Frequency (ELF) Electromagnetic radiation. This type of radiation is also emitted from power lines, Electrical sub-stations and Television.

Another type of dangerous electromagnetic radiation found near computer is microwave radiation. Microwaves are used to provide radio communication between wireless networked equipment, including computers, printers, modems, routers and cordless or Wi-Fi devices.

A typical computer user, who is not careful about equipment choice and placement are exposed to two type of radiation. They are Extremely Low Frequency (ELF) Electromagnetic radiation from computers and Microwave radiation from nearby devices.

Table: 1 Electromagnetic radiation from computers

Sl. No	Type of radiation	Field strength
1.	Extremely Low Frequency (ELF) Electromagnetic radiation from computers	3-6 milligauss
2.	Microwave radiation from nearby devices.	100-200 $\mu\text{W}/\text{m}^2$

Each of these levels is individually far from safe. When they are taken together they create a serious health hazards.

1.1.1 Computer radiation health effects

ELF radiation can cause, or contribute to, various health problems ranging from sleep interference and allergic reactions, through to heart disease, cancer and Alzheimer's disease. Using CRT screens for long by pregnant women associated with higher rates of miscarriage and possibly birth defects.

1.1.2 Reason for Health effects due to Computer Radiation

Normally we sit a foot away from computer screen, with a Central Processing unit and printer on the Desk next to us, and a power supply that is an Uninterruptable Power Supply (UPS) near the feet, and we sit near all this for several hours every day, for many years, absorbing more ELF radiation which is greater than we sit near a high voltage power line.

Computer contains power supplies, fans, drivers and other electrical units which generate ELF radiation strong enough to cause concern at distance up to about 60 cm. The desktop PC's produce computer radiation of 1 milligauss (borderline safe) at 60 cm, and it produces stronger radiation towards the rear of the unit. The magnetic portion of this Electromagnetic radiation is the dangerous part and it penetrates deep into the human. But this ELF radiation naturally falls away very quickly with increasing distance, because the radiation is from a low power source.

CRT monitors produce computer radiation of 3 milli gauss at 30cm, measured from the front and 4 milli gauss at the same distance from sides. Computer monitors radiation is a health hazard in itself at this distance.

UPS produces radiation of 20 milligauss at 30 cm and over 1 milligauss at 1 meter, even when apparently switched off but still connected to mains electricity and charging the battery.

Small desktop computer printers generally produce less than 0.5 milligauss at 60 cm in standby mode and up to twice the amount when printing.

Wi-Fi information networks, wireless routers, modems and other wireless devices emit Microwave and radio frequency Electro Magnetic Radiation. They are not safe and result in cell and DNA damage, Infertility and interfere with Biological process.

Large sub – woofers that are used as part of computer's sound system emit 20 milligauss of ELF radiation at 0 cm, 3 milligauss at 60 cm, 0.5 milligauss at 90 cm even though it is not producing sound and it is only powered.

1.1.3 Measures to reduce Computer radiation

Fortunately there are simple measures to reduce Computer radiation.

ELF radiation naturally falls away very quickly with increasing distance, because the radiation is from a low power source. So the simple solution is to position the computer as far away from us by means of cables (allow at least 60cm from us). Keep the CPU, Printer and other devices far away from us preferably on the floor. This is to minimize the radiation to the head and trunk.

Computer monitor radiation can be avoided by replacing the CRT screen by LCD and LED screens. LCD and LED screens radiate EMF of 0.3 milli gauss at 30 cm, from the front or back and nothing at the sides. This is a much safer level.

Connect UPS by means of cable and place it at a distance of 1.5 meters away from feet. Keep Desktop printers at a safe distance of more than 60 cm.

Some corded desktop devices are particularly harmless, including keyboards, Mouse, small speakers, modems and telephone landlines. It can be kept close to humans.

Large sub woofers must be kept at least 90 cm away from feet or body of humans. Otherwise it will deafen the ears.

III. ELECTROMAGNETIC RADIATION FROM LAPTOPS

Low frequency Electromagnetic radiation (EMF), High frequency Radio Frequency radiation and heat radiation are the three type of radiation emitted from laptop computers. These three radiations pose real danger to the health. Even though these radiations are emitted by desktop computers, Cell phones, Television and microwave oven but the exposure to this radiation is more intense in laptops because Laptops are operated directly in laps. If the Laptop is placed few feet then this radiation is harmless.

Laptop or note book are having similar radiation and it is generally lower than from desktop PC's because the components are smaller, the laptop is battery operated and its screen is invariably LCD or LED. The problem with laptop radiation is that it is operated closely especially in the laps.

Laptop radiation is 1 milligauss at 30cm, but as much as 20 milligauss at point blank range. This 20milligauss is having severe health effects.

1.2.1 Laptop radiation health effects

All the three radiation are close to the genitals, skin and muscle. This radiation creates bodily reactions such as skin rashes, muscle soreness and Infertility.

Heat and Electronic radiation exposure, particularly when prolonged at high levels, coincide with fatigue, dizziness, head ache, breathlessness and various type of cancer. When these radiations are exposed directly into the lap, more serious health conditions include cell and DNA damage, infertility and skin damage. Male fertility can be negatively affected by the heat because an increase in scrotal temperature decrease sperm count. Wi-Fi radiation leads to DNA damage and sperm motility.

1.2.2 Reason for Health effects due to Laptop Radiation

When converting energy to perform the various functions of the laptop, Electromagnetic Fields (EMFs) are created. These fields are in the low frequency range and radiate out of the outer shell of the computer from such sources as processor activity, hard drive operations, memory storage and other computing functions.

To connect to the internet laptops, iPads and other computer devices use technologies such as Bluetooth, Wi-Fi and 4G. To make these connections, laptop is equipped with a receiver and a transmitter. The transmitter produces higher frequency Radio Frequency (RF) radiation, and when placed in lap, the laptop radiates the dangerous emissions directly into the body.

Heat energy is radiated from the internal parts. Older laptops emitting the highest levels of heat radiation Laptops used directly in our laps expose us to more intense radiation that would be harmless otherwise if we were only a few feet away.

1.2.3 Measures to reduce Laptop radiation

Keep the laptop off the lap and place it at a distance of 30 cm. Laptops may have been designed for convenient lap placement, but this is obviously not best for health. Instead, use laptop on a desk or get a specially designed laptop tray or Laptop mount. Also, use a wired internet connection when possible, as it appears the radiation emitted from Wi-Fi communications are particularly harmful to sperm.

IV. ELECTROMAGNETIC RADIATION FROM PERSONAL GROOMING APPLIANCES

Personal grooming appliances like hairdryers, Electric shavers, electric toothbrushes and similar personal grooming products have 20 – 200 milligauss of magnetic fields at their normal operating distance.

To avoid this radiation use the devices for minimum duration, increase the distance of use as far as practicable. Most personal grooming devices are designed to be used only for a minute or two, so they should not add much to the daily EMF load, but people in high risk group should probably avoid them altogether.

V. ELECTROMAGNETIC RADIATION FROM THE KITCHEN APPLIANCES

Kitchens are the areas of high EMF radiation. Stoves, hotplates and hobs, Microwave ovens, serving trays and dishwashers are source of very substantial EMF's even at 30 - 60 cm. If a person is cooking in kitchen for one hour means he is exposed to EMF of 5-10 milli gauss. So if he do cooking for two to four hours means he crossed the suggested maximum daily EMF exposure of 20 milligauss.

The EMF radiation from kitchen appliances can be reduced by minimize cooking times and turn off the appliances when not in use. Don't stand next to oven and stove while we are not actually working there. Taking one pace away from an appliance will usually reduce EMF by one half or more.

Refrigerators and freezers produce most of their EMFs close to the back of the unit and usually near the floor, where the motor is situated. So place the refrigerator and freezer with its back side facing the walls. Don't stand close to them for long.

Vacuum cleaners, washing machines and dryers generally produce high EMF's. Don't stand too close to them for long. To avoid this radiation use the devices for minimum duration, increase the distance of use as far as practicable.

VI. ELECTROMAGNETIC RADIATION FROM TELEVISION

Radiation from television is Low frequency Electro Magnetic Radiation. The EMF from TV is more because of the CRT monitors and it produces radiation of 20 milligauss at 30 cm and over 1 milligauss at 1.5 meter. So it is safe to sit at 1.9 meter away from it. It will help to protect human from EMFs and eye damage. Don't sit close to the sides and back of TV. TV radiation is just as high from these angles.

LCD and LED TVs (flat screen TVs) produces much less radiation than CRT types and are preferred if possible to afford the extra cost.

VII. ELECTROMAGNETIC RADIATION FROM MOBILE PHONES

Mobile phones use electromagnetic radiation in the microwave range. Mobile Phones emit radiofrequency energy, a form of non-ionizing electromagnetic radiation, which can be absorbed by tissues closest to where the phone is held.

The amount of radiofrequency energy a cell phone user is exposed to depend on the technology of the phone, the distance between the phone's antenna and the user, the extent and type of use, and the user's distance from cell phone towers.

Part of the radio waves emitted by a mobile telephone handset is absorbed by the body. The radio waves emitted by a GSM handset can have a peak power of 2watts and a US analogue phone had a maximum transmit power of 3.6 watts. Other digital mobile technologies, such as CDMA2000 and D-AMPS, use lower output power, typically below 1 watt. The maximum power output from a mobile phone is regulated by the mobile phone standard and by the regulatory agencies in each country. In most systems the Mobile phone and the base station check reception quality and signal strength and the power level is increased or decreased automatically, within a certain span, to accommodate different situations, such as inside or outside of buildings and vehicles.

One well-understood effect of microwave radiation is dielectric heating, in which any dielectric material (such as living tissue) is heated by rotations of polar molecules induced by the electromagnetic field. In the case of a person using a Mobile phone, most of the heating effect will occur at the surface of the head, causing its temperature to increase by a fraction of a degree. In this case, the level of temperature increase is an order of magnitude less than that obtained during the exposure of the head to direct sunlight; the brain's blood circulation is capable of disposing of excess heat by increasing local blood flow. But if the temperature increases in magnitude above than that of the exposure of heat to direct sunlight, the brain cannot adjust the change and finally result in Brain Cancer However, the cornea of the eye does not have this temperature regulation mechanism and exposure of 2-3 hours duration has been reported to produce cataracts.

1.6.1 Mobile Phone radiation health effects

Burning and tingling sensation in the scalp, Fatigue, Sleep disturbances, dizziness, lack of concentration, ringing in ears finally result in hearing disorders, increased reaction time, indigestion, acute itchiness, increased heart rate, headache, loss of memory, cataracts, anxiety neurosis, glioma type of brain cancer, lung cancer and breast cancer.

1.6.2 Reason for Health effects due to Mobile Phones radiation

The number of cell phone users has increased rapidly. The number of cell phone calls per day, the length of each call and the amount of time people use cell phones has increased. Cell phone technology has also undergone substantial changes. It is advisable to talk only for six minutes per day or two hours in six months in cell phones because it is the maximum amount of heat energy which the brain cell can dissipate if the limit exceeds means split in brain cell occur.

Cell phones emit radiofrequency energy (radio waves), a form of non-ionizing radiation. Tissues nearest to where the phone is held can absorb this energy.

Children have the potential to be at greater risk than adults for developing brain cancer from cell phones. Their nervous systems are still developing and therefore more vulnerable to factors that may cause cancer. Their heads are smaller than those of adults and therefore have a greater proportional exposure to the field of radiofrequency radiation that is emitted by cell phones. And children have the potential of accumulating more years of cell phone exposure than adults do.

1.6.3 Measures to reduce Mobile Phone radiation

Break the addiction. Use only a landline. Use it only for real emergencies, never for conversations. If you must use a mobile phone, use text messages, **hands-free kits** and/or the **loudspeaker mode**.

Use hands-free to decrease the radiation to the head because hand free increase the distance between the head of user and the phone. Keep the mobile phone away from the body.

Don't allow children who are in the age group of 2-6 to use Mobile Phones.

VIII. ELECTROMAGNETIC RADIATION FROM MOBILE PHONE TOWERS

The area of concern is the radiation emitted by the fixed infrastructure used in mobile telephony, such as base stations and their antennas, which provide the link to and from mobile phones. This is because, in contrast to mobile handsets, it is emitted continuously and is more powerful at close quarters. On the other hand, field intensities drop rapidly with distance away from the base of transmitters because of the attenuation of power with the square of distance.

One popular design of mobile phone antenna is the sector antenna, whose coverage is 120 degrees horizontally and about ± 5 degrees from the vertical.

Because base stations operate at less than 100 watts, the radiation at ground level is much weaker than a Mobile Phone due to the power relationship appropriate for that design of antenna. Base station emissions must comply with safety guidelines.

In September 2012, the Government of India lowered radiation emission limits for mobile phone towers to 450 milli watts/sq m from 4,500. But even this is way above international norms.

Several surveys have found a variety of self-reported symptoms for people who live close to base stations. However, there are significant challenges in conducting studies of populations near base stations, especially in assessment of individual exposure.

However the department of telecommunication or DoT has finally woken up to the fact that there may be a correlation between cancer and exposure to radiation from cell phone towers. A comprehensive study conducted by a DoT body has documented cases of cancer deaths in areas overexposed to telecom towers in Mumbai.

1.7.1 Mobile Phone tower radiation health effects

The people who are living 50 m nearer to base stations are suffering from headaches, memory loss, low sperm count, lung cancer, breast cancer, brain cancer, birth defects, heart problems and alzheimer's.

1.7.2 Reason for Health effects due to Mobile Phone tower radiation

Mobile Phone tower wavelengths, microwaves have a significantly higher frequency than even radio waves. The higher the frequency, the more powerful the wave and the more powerful effect on biological organisms. These higher energy waves can actually destroy chemical and molecular bonds, creating chaos in our basic biochemical structures.

1.7.3 Measures to reduce Mobile Phone tower radiation

Safe Space Products actually convert harmful electromagnetic fields around by setting up corrective resonances. One such safe space product is safe space geo resonator, by planting it around the home or office near mobile Phone towers it transform the electromagnetic stress fields in the atmosphere or soil.

The way to reduce tower radiation is by reducing the transmitted power. It is done by means of the amplification of power in the cell towers be reduced by removing the power amplifier or by reducing the gain of the antenna. By reducing the power, coverage area will be reduced, which can be taken care of by using more cell towers or repeaters or in-building solutions.

The height of towers should be increased.

All towers in close proximity to schools and hospitals should be checked and removed, if too close.

IX. CONCLUSION

The Electro Magnetic Radiation generated by the electronic appliances such as desktop computers, laptops, personal grooming appliances, kitchen appliances, televisions, mobile phones and their towers, and their related health effects, reason for health effects along with the measures to reduce the radiation are proposed. Zero radiation emission cannot be achieved in the technological world. But by following safety measures protection from harmful radiation is possible.

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