

# Is It Possible That the Radiation Emitted from Electronic Devices Used in Daily Life Can Affect Our DNA?

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**Abstract-** *Electromagnetic waves generated by many natural and man-made sources can travel long distances and play a very important role in daily life. In particular, electromagnetic fields in the radiofrequency (RF) region are used in electronic devices. Electromagnetic radiation emitted by electronic equipment is a form of environmental pollution, many kinds of invisible electromagnetic waves are being generated in our environment. Which is divided into two categories of extremely low frequency 3 - 3000 Hz and a radio frequency 30 kHz - 300 GHz. The radiations are not strong enough to damage DNA because according to quantum physics only radiation whose frequency greater than a certain frequency called threshold frequency is able to damage DNA. The threshold frequency of DNA is 15.112 THz or energy 0.0625 eV. it can't transfer enough energy to an atom to remove an electron and it can't even break the chemical bonds in our film and it can't damage DNA at all. Hence this radiation cannot change the structure of DNA in living organisms.*

**Indexed Terms-** *Electromagnetic Radiation, Non-ionisation Radiation, SAR, Plank's Equation, Threshold Frequency, DNA.*

## I. INTRODUCTION

We have done a detailed study on different types of environmental pollution (water, air, noise, or land) and their effects on humans and animals. Also trying to stop the causes of pollution. But in just a few years a new type of pollution is being studied, which we call dirty electricity pollution, the main source of which is electromagnetic radiation. So far, various types of effects of this pollution have been studied. But till now no concrete evidence has been found regarding its effect. Many researches have been told about the

diseases caused by it and in some it has also been said that it has no side effects.

Electromagnetic waves are produced by the motion of electrically charged particles. These waves are also called electromagnetic radiation because they radiate from the electrically charged particles. They travel through empty space as well as through air and other substances. Electromagnetic waves generated by many natural and man-made sources can travel long distances and play a very important role in daily life. In particular, electromagnetic fields in the radiofrequency (RF) region are used in electronic devices. As a result of technological innovations, the use of electromagnetic fields gradually increases, and thus people are exposed to electromagnetic waves at a much higher level than exists in nature [1]–[3]. As we know that all electronics devices radiate a radio frequency wave which is an electromagnetic wave, and light is also an example of this wave. This wave is generated by the oscillations of electric and magnetic fields perpendicular to each other and wave propagation, through which energy is transmitted from one place to another. EM waves can be divided by their wavelength or frequency, with the most wavelengths being the radio wave whose wavelength ranges from a few meters to a few kilometres. Next is the microwave whose wavelength is a few centimetres, if it is concentrated in one place, it produces heat, that's why it is used in the microwave oven and then the IR wave is used in the remote, in this order is the visible light whose Wavelength is 350 to 700 nm, different colours of visible light have different wavelengths. After this there are UV rays, frequency starts to get higher from here and then X rays and Gamma rays whose wavelength is very short and frequency is very high due to which they can break the chemical bond of a molecule, hence they are called ionizing radiation. This radiation is very harmful to all living beings because it breaks the chemical bonds of

DNA by going inside our body and causing mutation in the cells which can eventually lead to cancer. As the frequency of EM waves increases, they become more dangerous. Figure (1) show the electromagnetic spectrum.

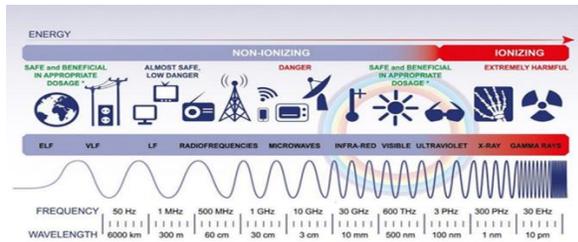


Figure (1) [4]

In the present scenario, we can easily see a person from 0 years to live playing with electronic devices and gadgets, which are not only video games but also online classes, online training, business, jobs, news, and movies. etc. can. Many electronic products and gadget advertisements are focused on very young children as parents may find it easier to keep their children in one place by giving them the gadget to play with. It means that we are in a concrete jungle covered with a blanket of electromagnetic waves. All electronic devices such as televisions, computers, mobile phones, refrigerators, heaters, washing machines, coffee makers, microwave ovens, tabs, laptop hairdryers, stereo systems, air conditioners, etc. emit low energy non-ionization electromagnetic radiation doesn't have a high enough frequency to break a chemical bond. which are low, medium, and high-frequency radio waves. it isn't going to be able to knock out an electron. According to ICNIRP (International Commission on Non-Ionizing Radiation Protection) after several decades of RF-EMF research on numerous potential health effects, the only substantiated effect of RF-EMF exposure is relevant to human health and safety is the heating of exposed tissue. RF-EMF fields can penetrate into the body (the higher the frequency, the lower the penetration depth) and cause a vibration of charged or polar molecules inside. This results in friction and thus heat. As high-frequency electromagnetic waves in a microwave oven heat up water molecules. We face many problems due to maximum use of electronic gadgets, so it is necessary that we keep some distance from these electronic gadgets as it is not possible for us to stop using them, during the lockdown of Covid-19 we

have seen how the whole world was dependent on electronic devices. Because electronic devices were the only medium for daily activities, by which we could do all our work from home while keeping a social distance, in the field of education, how the classroom could reach from the teacher's house to the students' house. Various studies show that overuse of electronic devices causes fatigue, headache, dizziness, tension, sleep disturbance, etc. Also found that low sperm count in males, and problems of fertility in women, and it was also found that it affects children the most, whose age ranges from 0 to 10 years.

## II. LITERATURE REVIEW

In particular, the dramatically increasing number of electronic devices raises significant concerns because of their potential harm to people exposed to radiofrequency waves. Since all the electronic devices are used in very close positions to the human body and also a large number of mobile towers and high-power electric cables and towers, there are question marks in the minds of the public and scientists about the impact of mobile phones networks on health [5].

Electromagnetic radiation emitted by electronic equipment is a form of environmental pollution, many kinds of invisible electromagnetic waves are being generated in our environment. Which is divided into two categories of extremely low frequency 3 - 3000 Hz and a radio frequency 30 kHz - 300 GHz. This radiation enters the body and causes health problems, especially in children, pregnant women, and patients. The value of electromagnetic radiation emitted by electronic equipment is compared to the ICNIRP and the biological limit.

The general opinion is that there is no direct evidence of hazardous effects on human health incurred by low-frequency radiofrequency waves. Studies at the cellular level, which uses relatively higher frequencies, demonstrate undesirable effects. Some studies revealed that different dimensions of electromagnetic waves have not shown any DNA damage on different cell lines [6]–[8].

On the other hand, there are a lot of contrary studies published in recent years. Most of them are concerned about evidence of biochemical or cellular effects of

electromagnetic fields. Marino and Becker have shown that static or very low-frequency electromagnetic fields may lead to biological effects associated with the redistribution of ions. Furthermore, many studies demonstrated that the biological effects of low-frequency magnetic fields may penetrate into deeper tissues [9].

EMF of very high frequency has thermal and non-thermal effects on the biological systems. This thermogenic effect is mainly associated with the intensity of EMF, which is expressed as Specific Absorption Rate (SAR) [8]. After reading a number of research, the question arises, “Do electronic devices cause cancer?” So, there are signs that they don't. Most of the research done so far indicates that all electronic devices emit non - ionisation radiation in the frequency range of 60 Hz to 5.8 GHz, which is not strong enough to damage DNA because according to quantum physics only radiation whose frequency greater than a certain frequency called threshold frequency are able to damage DNA. The threshold frequency of DNA is 15.112 THz or energy 0.0625 eV. The objective of this study is “how these non - ionisation radiations from various electronic devices can cause cancer by affecting DNA when their frequencies are less than the threshold frequency of DNA”.

Guideline by DoT, Government of India - SAR was also known as specific absorption rate absorbed by the human body when exposed to the radio frequency electromagnetic field. As per the government standards of India, all the electronic manufacturers should not exceed SAR Value beyond 1.6 watt/kg. If exceeded, the manufacturing is not accepted. When the Human uses electronic devices, the effect of radiation on human health occurs via SAR which is a measure of rate, at which the energy is absorbed by human body radio frequency electromagnetic field. What happens if the value of SAR Exceeds? The most common complications seen in people are: sleep disorder, headache, irritability, concentration problems, memory loss, depression, hearing loss, joint problems, etc. More severe reactions include seizures, paralysis, miscarriage, irreversible infertility, and cancer. Children and pregnant ladies are more vulnerable.

### III. QUANTUM PHYSICS MECHANISM OF RADIATION

When DNA is damaged by electromagnetic radiation, it can cause cancer. Our cells contain deoxyribonucleic acid (DNA). This important molecule is like your body’s instruction manual. It constantly tells your cells what to do and how to do it. Every living organism has DNA in all of its cells.

A DNA molecule is built like a twisted ladder. The long rails are made of sugar and phosphate molecules. These are called the “backbone” of a DNA molecule. Each rung is a combination of four nucleotide bases. These are adenine, guanine, cytosine, and thymine. Each nucleotide has a letter that represents it. “A” stands for adenine, “G” for guanine, “C” for cytosine, and “T” for thymine. The frequency and energy of radiation emitted from various electronic devices [1], [10]

Electronic Device	Frequency	Max Energy in joules
Computer	60 - 100 Hz	6.63×10 <sup>-32</sup> j
Power Line	50 - 60 Hz	3.98×10 <sup>-32</sup> j
TV Broadcast	54 - 700 MHz	4.64×10 <sup>-31</sup> j
Radio AM	520 -1610 kHz	1.07×10 <sup>-27</sup> j
Radio FM	87.5 - 108 MHz	7.16×10 <sup>-26</sup> j
Microwave	3 - 30 GHz	1.99×10 <sup>-23</sup> j
Mobile Phone	1.9 - 2.2 GHz	1.46×10 <sup>-24</sup> j
Wi-Fi	5 - 5.8 GHz	3.84×10 <sup>-24</sup> j
Remote Control	5.8 GHz	3.84×10 <sup>-24</sup> j

According to the Planck's Quantum theory energy is directly proportional to the frequency of radiation given by

$$E = hf$$

Where E = Energy in Joules (J), f = Frequency in Hertz (Hz), h = Planck’s Constant (6.626x10<sup>-34</sup>J.s)

The energy corresponding to the frequency of various electronic devices given in the above table is obtained from the Planck quantum formula, We know that according to Einstein's theory of the photoelectric effect, no matter how strong a beam of radiation is, its ability to eject an electron depends only on its

frequency. Electronic devices radiate very weak electromagnetic radiation. Electronic devices have to be designed in such a way that they do not exceed a Specific Absorption Rate (SAR) value of 1.6W/Kg. Recently, field exposure to mobile phones under everyday conditions has been measured. The results were surprising: often enough the real exposure was higher than assumed before. Electromagnetic fields in the frequency range used by mobile phones and similar technologies do not penetrate deeply into the body. Most of the radiation goes out in every direction and some make it to the cell phone tower. Our body absorbs some of it on hand, in-ear, skull, brain tissues, and so on. This is mostly due to the high electric conductivity of the skin. The heating of biological tissue is a consequence of microwave energy absorption by the tissue's water content. The amount of heating produced in a living organism depends primarily on the intensity (or power density) of the radiation once it has penetrated the system [11], [12]. It is clear from the following graph how the number of electronic devices has increased exponentially in world wide. Figure (2). But World Wide, according to 'Cancer' by Max Roger and Hannah Ritchie (This article was first published in July 2015; was updated in April 2018 with the latest cancer data for the year 2017 – and substantially more in November 2019). No such cancer cases have been found, which has grown with the increase in the number of electronic devices As such it is clear from various studies that higher rates of smoking lead to higher rates of lung cancer as well. Similarly, it is also clear from various studies that skin cancer has increased due to UV rays. Cases of skin cancer are very high in Australia because there is a lot of UV rays exposure.

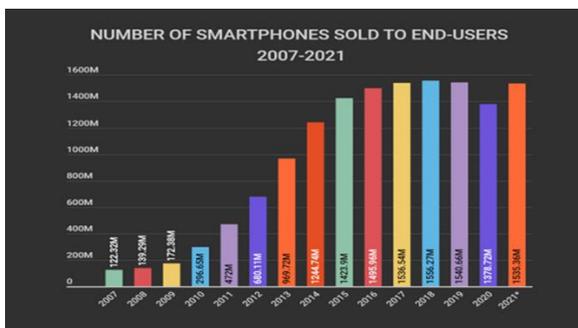


Figure (2) [13]

#### IV. DISCUSSION AND CONCLUSION

Let's say that the body absorbs one Watt of this power in those nearby tissues. Those tissues warm a bit, and the blood flowing through them warms too. The blood carries any extra heat energy throughout the rest of the body, which it eventually transfers to the air around the body.

The wavelength-dependent penetration depth of ultraviolet radiation in human skin is a fundamental parameter for the estimation of the possible photobiological impact of ultraviolet (UV) radiation. We have determine the absorption spectra of human skin in vivo in the wavelength range from 290 to 341 nm in 3-nm steps using laser optoacoustic and calculated the respective penetration depths. The penetration depth of UV radiation in human skin is highly dependent on wavelength and skin area, but no significant dependence on skin phototype could be found [14]. Phototherapy is generally defined as the use of non-ionizing radiation within the UV spectrum to treat photoresponsive disease. There are many different types of phototherapy treatments and they usually differ by the wavelength for which they are used. There are three main categories UVB (frequency range 936.9 - 1033.8 THz), UVA (frequency range 749.5 - 936.9 THz) and PUVA. The UVB is absorbed in the epidermis and upper dermis so it is generally used to target diseases like psoriasis, atopic dermatitis and vitiligo and on the other hand UVA is absorbed deeper into the dermis so it is used to treat diseases both in the epidermis and in the mid to deep dermis such as localised scleroderma and systemic sclerosis. Therefore, the radiations from various electronic devices are reflected, scattered and absorbed by the epidermis (upper part) of our skin. This radiation cannot even reach the papillary dermis of our skin. If electronic devices are placed too close to our body and used continuously for 20 to 30 minutes, the thin basal layer just below the epidermis layer of our skin will heat up and cause some pain. This pain goes away after some time after stopping the use of the electronic device.

The skin regulates body temperature through blood vessels and the process of sweating. The skin is under the influence of your body's thermostat. When you are outside in cold weather, your skin tends to tremble

which will constrict blood vessels and keep you as warm as possible. But if there is a heat wave, you will sweat to increase blood flow to the capillaries, which increases sweating. This process cools you down as the water evaporates from your skin. In this way our skin protects our internal organs from the radiation emitted by electronic devices.

So electromagnetic fields in the frequency range used by electronic devices do not penetrate deeply into the body. Most of the field energy is absorbed by the skin and the directly underlying tissue. Their absorbed energy vibrates tissue elements and creates phonons. Phonons cause temperature raising that calculated by quantum mechanics theory. The obtained results show number of photon interactions decrease versus increasing of frequency. In addition, the incident power of mobile phones plays an important role on absorbed energy and raising temperature [11].

Thus, these waves don't have enough frequency, that means it has very low energy, it can't transfer enough energy to an atom to remove an electron and it can't even break the chemical bond in our film and it can't. Only it can penetrate the upper parts of the human body and enter inside. Hence this radiation cannot change the structure of DNA in living organisms.

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