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HARMFUL EFFECTS OF 5G RADIATIONS: REVIEW

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Abstract - Increasing dependency on wireless technologies has spawned a telecommunications industrial revolution with increasing public exposure to broader and higher frequencies of the electromagnetic spectrum to transmit data through a variety of devices and infrastructure. A massive 5G interconnected telecommunications network, however, the expansion of broadband with shorter wavelength radiofrequency radiation highlights the concern that health and safety issues remain unknown. Controversy continues with regards to harm from current 2G, 3G, and 4G wireless technologies. 5G technologies are far less studied for human or environmental effects. It is argued that the addition of this added high-frequency 5G radiation to an already complex mix of lower frequencies, will contribute to a negative public health outcome both from both physical and mental health perspectives. In this paper, the harmful effect of 5G radiation is discussed for various verticals such as health, environmental issues, privacy, thermal etc.

Keywords - Public Health Issues; Environmental Issue; Thermal Effects; SAR

I. INTRODUCTION

The use of mobile wireless technologies continues to increase worldwide. A new faster 5th generation (5G) telecommunication system has recently been approved by the Federal Communications Commission(FCC) with new antennas which is already being installed and tested. While it may give us uber automation and instantaneous “immersive entertainment” a lot of questions remain with regards to public health and safety of wireless devices. 5G will include the higher millimeter wave frequencies never before used for internet and communications technology. The 5G deployment proposes to add frequencies in the microwave spectrum in the low-(0.6 GHz – 3.7 GHz), mid- (3.7GHz – 24 GHz), and high-band frequencies (24 GHz and higher) for faster communications.

As these higher frequencies do not travel far and are blocked by buildings, this system will have to use a dense network of fixed antennae outdoors every 300 meters as well as indoor systems. This radiation, like the 2G, 3G, 4G telecommunications systems, has not had pre-market testing for long term health effects despite the fact that people will be exposed continuously to this microwave radiation. Fig 1. Shows the low-frequency cell to MMW cell with a frequency range for wireless communication.

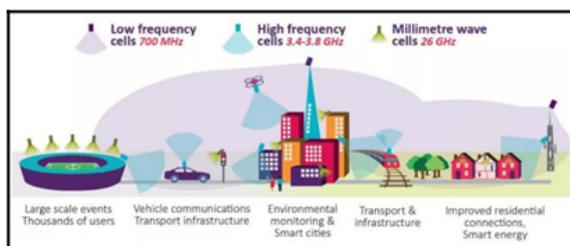


Fig. 1. Frequency cells used for wireless communication

II. PUBLIC HEALTH ISSUE

Millimeter waves (MMWs) are mostly absorbed within 1 to 2 millimeters of human skin and in the surface layers of the cornea. Thus, the skin or near-surface zones of tissues are the primary targets of the radiation. Since skin contains capillaries and nerve endings, MMW bio-effects may be transmitted through molecular mechanisms by the skin or through the nervous system.

2.1 5G radiations are Carcinogenic

5G high spectrum range can lead to mutation of cells and induces tumors which might later become cancer. Exposure to the 5G radiation increases the production of ROS. Reactive oxygen species (ROS) are a normal part of cellular processes and cell signaling. Overproduction of ROS that is not balanced with either endogenous antioxidants (superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx), glutathione (GSH), melatonin), or exogenous antioxidants (Vitamin C, Vitamin E, carotenoids, polyphenols) allows the formation of free radicals that oxidize and damage DNA, proteins, membrane lipids and mitochondria.

Mitochondria doesn't have histones as a result of which it can't repair DNA damage and is not protected from mitochondrial reactive oxygen species (Görlach et al., 2015). Excess ROS is produced due to radiation exposure, have been associated with exposure to toxic chemicals, pesticides and metals (Abdollahi et al., 2004; Sharma et al., 2014; Drechsel and Patel, 2008). Oxidative damage from ROS has been increasingly linked to the development and/or exacerbation of a number of chronic diseases and cancer. Fig.2 depicts the formation of cancer due to radiation.

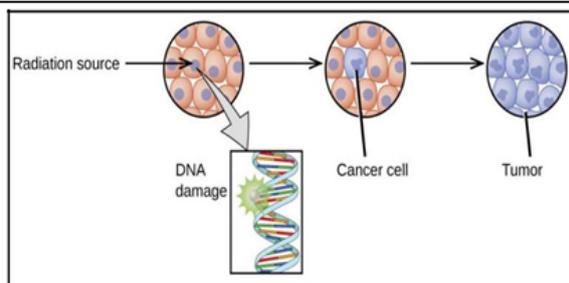


Fig.2.1 formation of cancer due to radiation

2.2 Effect on Skin

A number of experiments have shown that surface effects of low-intensity MMW can be quite substantial, inducing a number of biological changes, even at nonthermal levels, including cell membrane effects. short term application of certain frequencies stimulates a release of endogenous opioids in the skin. It appears that the 95 GHz MMW range affects the cutaneous nociceptors and act as a threatening stimulus without heating or thermal damage. Researchers have proposed the sweat glands as a target. Feldman et al. (2008;2009) demonstrated that the sweat ducts in human skin are helically shaped tubes, filled with a conductive aqueous solution. Their research indicates that sweat ducts in the skin could behave as antennas and thus respond to millimeter waves.

2.3 Effects on Eyes

Cataract has remained a leading cause for blindness. There is a particular concern for 5G applications as the eyes would also receive significant radiation especially for near field exposures. Well established risk factors in the development of cataracts are age, smoking, diabetes, and UVB exposure. Research is

pointing towards oxidative damage as a general mechanism for age-related cataracts. Ellwein and Urato, 2002). Well established risk factors in the development of cataracts are age, smoking, diabetes, and UVB exposure. Research is pointing towards oxidative damage as a general mechanism for age-related cataracts (Spector, 1995; Ye et al., 2001; Abraham et al., 2006). Microwave radiation is also a known cause of cataracts with heat being an undisputed mechanism. The eyes lack sufficient blood flow to dissipate heat effectively. There is some evidence that repeated low-level exposures to microwave radiation could cause cataracts but researchers agree that more studies are needed.

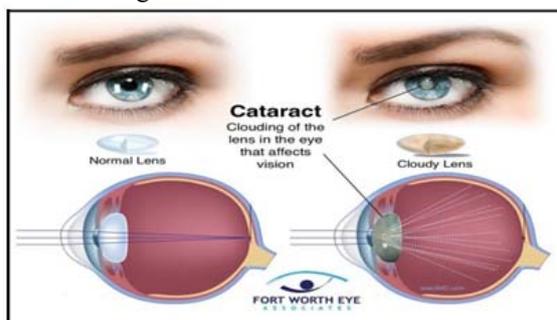


Fig.2.3 Cataract affected the eye

2.4 Effects on Immune System

5G spectrum might also induce electromagnetic sensitivity. Electromagnetic sensitivity has the following characteristics headaches, insomnia, dizziness, nausea, lack of concentration, heart palpitations, and depression.

Research work took for the effect of radiation at higher frequency band analyzed by the different researcher (worked on mice) shown in table 2.4.1

Sl.No.	Researcher Name	Year	Observation
1	Kolomytseva	2002	Exposing healthy mice to low-intensity extremely high-frequency electromagnetic radiation (EHF EMR, 42.0 GHz, 0.15 mW/cm ² , 20 min daily). The study showed 50% suppression of phagocytic activity of neutrophils after a single exposure to MMW radiation with the authors noting a profound effect on nonspecific immunity.
2	Lushnikov	2003	Investigate cell-mediated immunity and nonspecific inflammatory response in mice exposed to low-intensity extremely high-frequency electromagnetic radiation (EHF EMR, 42.0 GHz, 0.1

			mW/cm ² , 20 min daily)
3	Gapeev	2003	Investigate low-intensity extremely high- frequency MMH electromagnetic radiation in vivo causes effects on spatial organization of chromatin in cells of lymphoid organs. Chromatin is a complex of DNA and proteins that forms chromosomes within the nucleus of eukaryotic cells.

2.5 Neurological effects

When the nervous system or the brain is disturbed, by EMR, morphological, electrophysiological, and chemical changes can occur. A significant change in these functions will inevitably lead to a change in behavior. Indeed, the neurological effects of EMR reported in the literature include changes in blood-brain-barrier, morphology, electrophysiology, neurotransmitter functions, cellular metabolism, calcium efflux, responses to drugs that affect the nervous system.

III. ENVIRONMENTAL ISSUES

Birds and other wildlife are disappearing from areas that are saturated with 4G “non-ionizing” radiation. The horrific manmade frequencies emanating from our devices are literally killing innocent living creatures or causing them to flee en masse. Mankind is next. No life form will be able to withstand 5G for any amount of time. Its presence in our world is a genocidal, murderous attack against Creation.

3.1 Effects on plants

In 2010, a study on aspen seedlings determined exposure to radio frequencies caused leaves to exhibit necrosis symptoms, while Armenian-based trials revealed low-intensity millimeter waves invoke peroxidase (a stress protein in plants) isoenzyme spectrum changes of wheat shoots. In the present work, the influence of EMI EHF on peroxidase total activity and isoenzyme spectrum in wheat seedling cells has been investigated.



Fig 3.1 5G radiation effect on plants

3.2 Effects on Wildlife

Since 3G technology has arrived, there have been increased reports of birds abandoning their nests as well as health issues like plumage deterioration, locomotion problems, reduced survivorship, and death,” says researcher Alfonso Balmori. Bird species that are affected by these low levels, non-ionizing MMWave radiation are the House Sparrows, Rock Doves, White Storks, Collared Doves, and Magpies, among others. But it’s not just the birds. The declining bee population is also said to be linked to this non-ionizing EMF radiation. It reduces the egg-laying abilities of the queen leading to a decline in colony strength.

There has been an incident in Netherlands because of an 5G experiment 287 birds were killed in november 2018.

IV. THERMAL EFFECTS

- 1) When EM radiation is absorbed, it is converted into heat. A readily understandable mechanism of the effect of radiation is tissue heating (thermal effect). Biological systems alter their functions as a result of a change in temperature. When electromagnetic radiation is incident on the matter, it causes the charged particles to oscillate and gain energy. The ultimate fate of this energy depends on the situation. It could be immediately re-radiated and appear as scattered, reflected, or transmitted radiation. It may also get dissipated into other microscopic motions within the matter, coming to thermal equilibrium and manifesting itself as thermal energy in the material.
- 2) Intense radio waves can thermally burn living tissue and can cook food. In addition to infrared lasers, sufficiently intense visible and ultraviolet lasers can also easily set paper afire. Ionizing electromagnetic radiation can create high-speed electrons in a material and break chemical bonds, but after these electrons collide many times with other atoms in the material eventually most of

the energy gets downgraded to thermal energy, this whole process happening in a tiny fraction of a second.

- 3) The inverse or time-reversed process of absorption is responsible for thermal radiation. The resulting radiation may subsequently be absorbed by another piece of matter, with the deposited energy heating the material. Radiation is an important mechanism of heat transfer.

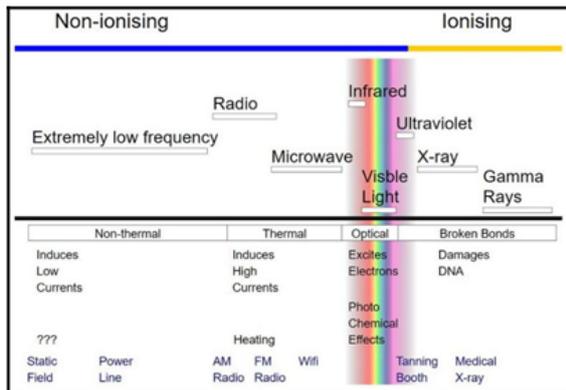


Fig 4.1 Ionising and Non-ionising Spectrum

V. SPECIFIC ABSORPTION RATE (SAR)

The rate at which radiation is absorbed by the human body is measured by specific absorption rate (SAR), measured in units of watts per kg (W/kg) of tissue. If the heat generated is small, the body's thermoregulatory mechanism can dissipate it without causing adverse effects. If the temperature exceeds this capacity, about 1 to 2 degree Celsius, tissue damage may occur. Every mobile phone comes with a SAR rating (although some manufacturers try to hide it). Regulating agencies has set its maximum levels for handsets. Radiations depend on its design, antenna, how it is held and used. Institute of Electrical and Electronics Engineers (IEEE) Committee on Man and Radiation, national and international organizations have established safety guidelines for exposure to RF energy. Testing has shown a wide range in radiation exposure to the user of various brands and models of cellular phones. The SAR values of a few cell-phone models are tabulated:

Sl No.	Model	Series	SAR(W/Kg)
1	LG	Phoenix 4	1.0
		Risio 3	1.0
		X Power 3	1.0
		Xpression Plus	1.04

		Aristo 2 Plus	1.05
2	Tambo	TA-1	1.019
3	Vivo	BLU XL4	1.03
		BLU XL3	1.04
4	Mobilstar	C1 Shine	1.037
5	Samsung	G S10+	1.04
6	Xiaomi	Mi 9	1.04

Table 5.1 SAR Values for the different cellular model

5.2 FCC Exposure limits for 5GMMWave

SAR levels are used for cell phones, tablets, and other handheld wireless devices to determine regulatory compliance. For millimeter wavelength devices and infrastructure power density above 6 GHz (FCC) and above 10 GHz (ICNIRP) needs to be measured with power density (FCC, 1997; Wu et al., 2015a) This is due to the higher energy absorption in a shallow area that causes heating more rapidly resulting in much higher SAR levels.

The FCC maximum permissible exposure (MPE) in terms of power density for frequencies between 1.5 and 100 GHz is 10 mW/cm² over a 30 min period (FCC, 1997; Romanenko et al., 2014). Heat generated is a concern in handheld devices for 5G but is still considered the only valid measure of harm, no biological cellular alterations are considered (Wu et al., 2015a).

CONCLUSION

In this era of evolving communication technologies, it has more disadvantages than the advantages, and it has become life-threatening as well. In 5G technology, MMWave is giving high data rates and making everything IOT connected, which can be considered as a positive point but the hazardous effects of 5G MMWave on human health and wildlife is not negligible, if we try to decrease the effects by considering the value of SAR then 5G technology can be considered as fruitful.

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