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Environmental Health Ecosystem Sustainability in The Era of Electromagnetic Radiation Contamination

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Abstract

The primary environmental health sub-disciplines that address the best approaches to environmental health, ecosystem sustainability, and natural habitats are environmental science, toxicology, environmental epidemiology, and occupational and environmental medicine. The intimate connection between environmental toxins and human health gained increased public attention at the beginning of the new millennium. Radiation, chemical, and biological agents are the three primary ecological contaminants. There is contamination in the soil, water, food, and air. The increasing adoption of 5G wireless networks has recently raised interest in its potential to support several digital and critical infrastructures. However, concerns have been raised over the potential health risks associated with fifth-generation wireless networks due to the claims that the electromagnetic radiation in the 5G carrier signal is more potent than in any prior networks. As a subject of public health, environmental health studies the whole range of effects that artificial technology and natural environments have on the general well-being of society-wide space. It establishes the prerequisites for a wholesome atmosphere as essential in managing factors that may negatively impact the sustainability of ecosystems and the environment's well-being. This study observed that the multistage carcinogenic process, which includes carcinogen activation, oxidative DNA damage, and tumor growth, is aided by hydrogen peroxide formation during the breakdown of water molecules due to 5G electromagnetic frequency radiation as an environmental contaminant.

Keywords: Electromagnetic Frequency Radiation, Chemical Polarization, Dipolar Moment urtication, DNA Oxidative Damages, Electromagnetic Field Weaponization, 5G Spectrum Infrastructure

Introduction

As electromagnetic radiation (EMR) travels, protons and electrons in its carrier signal interact as fields in any surrounding due to its ionizable (gamma rays and x-rays) and non-ionizable (ultraviolet, infrared, microwave, radio frequency, and shallow frequency) chemical properties **[1]**. Exposure to hazardous organic and inorganic environmental contaminants and disruption of ecosystems that support life have been demonstrated to influence human health due to environmental dangers significantly they constitute **[2]**. In recent times, the fastest-growing waste stream in the world is inorganic waste, which contains toxic ionizable and nonionizable chemical influences that may hurt the environment and public health **[1]**. When it comes to the sustainability of the environmental ecosystem, environmental health is a branch of public health that focuses on the interactions between humans and their surroundings, mainly how they affect public health. Numerous research studies have examined the connection between human health and environmental factors. Environmental conditions worldwide seriously endanger people's health due to acute daily contamination from organic, inorganic, and electronically radiative dispersions **[3]**. The consequences of environmental degradation are already having a severe influence on human health, and things might grow a lot worse quickly.

However, numerous research investigations on epistemology have put forward a thorough plan to lessen the amount of hazardous environmental pollutants deposited due to both natural and artificial technological advancement. Ecological and health policies should be tightly related given their close relationship in addressing the environmental healthy ecosystem sustainability. By basically affecting deoxyribonucleic acid (DNA) expression, prolonged exposure to minuscule contaminant quantities can change the functionality of cells, tissues, and organs over time **[4],[5]**. Sorry to say, many contaminants still have unknown absolute limits to their toxicity and tolerance. The World Health Organization (WHO) reports that environmental variables attributes have a role in over 24% of global health challenges and over 33% of abnormalities in children under the age of five **[6]**. Children are considerably more vulnerable to the effects of environmental contaminants than adults. Compared to adults, children under five, who make up only 12% of the population, suffer from more than 40% of all ailments **[7]**. Over time, it has been evident how environmental pollutants contribute to the pathophysiology of many diseases.

Contaminants in the air, water, food, and soil can expose humans to environmental health risks with the possibility of stemming several biological complications. Three main types of environmental contaminants can be distinguished: electromagnetic radiation, chemical agents, and natural agents **[8]**. Toxicological, epidemiological, and exposure science data can be combined to assess a particular pollutant risk and determine whether exposure poses a significant danger to human health**[9],[10].** This makes it possible to create and carry out environmental health laws that establish reasonable hygiene requirements or restrict the amount of chemicals released into the air.

Public health policymakers can work together to provide risk management, which comprises reducing, tracking, and managing the effects of exposure through various coordinated interventions to safeguard public health and achieve environmental ecosystem sustainability. The current study evaluated the 5G electromagnetic frequency radiation contamination. In light of the ongoing broadband regime intensification, the present study examined the electromagnetic radiofrequency terrestrial transmission already in use and suggested a trend for the future electromagnetic spectrum rationalization for a healthy natural ecosystem. Shallow frequency (ELF), ultra-low frequency (ULF), low frequency (LF), medium frequency (MF), ultra-high frequency (UHF), and extreme high frequency (EHF) are among the 5G mobile spectrum estimations that the study shed light on. The 5G electromagnetic spectrum compatibility assessment was given with an emphasis on current mobile technology development below 20GHz, where environmentally friendly 5G technologies are currently expected to be produced. According to a recent study, the radio frequency spectrum, a synthetic national resource, will eventually become more and more competitive for use in telecommunications-related corporate operations. The study concluded that to maintain the sustainability of ecosystems and promote environmental health, future telecommunication infrastructure development must reduce the effects of electromagnetic frequency radiation. To provide the reader with the following of the paper: the current study is structured into an introduction, the objective of the study, the research question, the literature review, the methodology, the research findings, and the conclusion.

Objective of the Study

i. To demonstrate that a magnetic field's interaction with matter—whether it be an inorganic particle, a DNA molecule, or a biomolecule modifies the distribution of electric charges within the matter by reorienting the particle's molecule through chemical polarization or by moving electrons about.
ii. In light of the most current developments regarding electrometric frequency radiation activities, to renegotiate the agreement with the International Commission on Non-Ionizing Radiation Protection.
iii. To establish that understanding electromagnetic interactions has a critical role in advancing technology applications in the intersection of chemistry, physics, and biology.
iv. To report electromagnetic frequency radiation as a potential environmental contaminant.
v. To establish epistemological evidence that implicated electromagnetic radiation from telecom installation as an active environmental contaminant.
vi. To raise public consciousness on maintaining environmental safety as an obligatory requirement in the Public health practice.

Research Question

i. What are the implications of EMR environmental contaminations?
ii. What are the health effects of temperature increase when EMR polarizes a matter?
iii. What is the safety approach to EMR environmental ecosystem pollution?
iv. What are the implications of EMR Weaponization?

Literature Review

Over several decades, authorities, agencies, and organizations in Europe and worldwide have acknowledged the importance of developing scientific methods for evaluating the health consequences of cumulative exposure to various environmental contaminants on humans **[9]**. Human health risk assessments of organic and inorganic contaminants are particularly pertinent when discussing environmental ecosystem sustainability because humans are exposed to a wide range of contaminants (such as solid, liquid, and electromagnetic radiation) that emerge in mixes **[11],[12]**. Regardless of the sources and routes of exposure, a more modern definition of organic and inorganic contaminants includes any group of pollutants to which an organism may be jointly exposed, and which may potentially have a negative combined health effect. New contaminants in the air, water, and soil have garnered much attention due to their harmful impact on human health and the environment. There are several techniques to identify their origins, which include technology, industrial processes, automation, and homecare manufacturers **[11]**.

Most new environmental poisons have poor degradation capability and environmental persistence due to their lipophilic nature, which causes high bioaccumulation **[13],[14]**. Disposing medication and personal hygiene products in the environment can lead to microbial and bacterial resistance. At the same time, plasticizers change many characteristics of manufactured materials, such as their pliability, but they can interfere with hormone function and cause cancer **[15]**. Flame retardants can be added to many materials to reduce their flammability. Nevertheless, these substances can bioaccumulate in living organisms and disrupt the endocrine system if discharged into the environment **[16]**. The goal of environmental epidemiology scientific inquiries is to examine the relationship between environmental risk factors and detrimental health outcomes. Exposure assessment is essential to epidemiological research since it requires establishing direct connections between actual human exposure and health outcomes **[17]**. Different criteria can describe chemical pollutant exposure in both occupational and environmental situations. It is ideal to estimate the precise quantity of chemical contaminants that a person is exposed to throughout their lifespan while performing an epidemiological study or risk assessment. Estimating the intake of the contaminant(s) of concern via various environmental media, such as air, water, and soil, as well as exposure pathways (ingestion, inhalation, and skin absorption), would be one way to do this.

By incorporating additional quantitative exposure components, these studies can efficiently determine appropriate exposure levels by applying conventional risk assessment techniques. From instances of the studies on occupational health and the environment where these techniques have been used to increase understanding of exposure to certain chemical toxins found in the environment, a few insights gained from conducting exposure evaluations for epidemiological research and health risk assessments are also included in this literature. The majority of the body of knowledge on environmental health is included in the five primary domains of environmental epidemiology, toxicology, environmental engineering, environmental law, and exposure science **[18]**. To explain the problems with environmental health and ecosystem sustainability as well as potential remedies, different data from each of these five areas are used, notwithstanding some overlaps.

(a.) Environmental Epidemiology

The study of environmental epidemiology looks at the relationship between exposure to many environmental elements and human health, including chemicals, radiation, microbiological agents, and other things with a high potential for spreading disease **[19]**. Observational studies, which record exposures people have previously encountered, are commonly used in environmental epidemiology due to the ethical objections to exposing persons to substances known or suspected to cause disease. Environmental epidemiology studies the wide-ranging effects of the external environment on human health with all existing relationships between the ecological ecosystem's physical, biological, or chemical components **[20]**. The field of environmental epidemiology focuses on how environmental exposures affect people's health **[21].** This area of study aims to comprehend how different environmental risk factors can protect against or predispose individuals to disease, poor health, harmful cohabitation, and abnormal development with the possibility of death **[21]**. These elements could be present in the surroundings where people live, work, and play or be introduced as synthetic agents (organic or inorganic).

Environmental standards development, risk management initiatives, and policy changes can all benefit from ecological epidemiology research on the prevailing circumstances of environmental ecosystem sustainability **[22]**. The totality of risk and protective variables that ultimately decide whether a person or a subpopulation suffers from adverse health effects from exposure to an environmental agent is known as vulnerability **[23]**. Sensitivity is the enhanced response to the exposure of an individual or subpopulation, mainly due to biologically activated contagious factors. A person's developmental stage, underlying medical issues, acquired variables, and genetic makeup can influence biological sensitivity. Additionally, socioeconomic factors are important in modifying vulnerability and sensitivity to environmental factors that are mediated by the environment because they raise the probability of being exposed to harmful agents, interact with biological factors that mediate risk, and result in variations in the capacity to anticipate or manage exposures or early stages of illness.

(b.) Evidence-Based Environmental Toxicology

The broad field of toxicology studies how substances affect living things and how to identify and control exposure to toxins and toxicants. In toxicology, we investigate substances' harmful health impacts and the environmental factors that contribute to those effects. The term "evidence-based toxicology" refers to the creation or implementation of methods for study and publication that help improve the utilization of evidence in assessing and addressing the health effects of environmental exposures on humans **[24]**. The study of environmental causes in populations and how these risks change with exposure time, intensity, and other factors, including genetic predisposition, is known as ecological toxicology. Government regulatory bodies indeed base their definition of standards to safeguard ecosystems and the populace from environmental hazards on this fundamental science. The study of how chemicals adversely influence living organisms, and the identification and management of toxicant and toxin exposure are known as toxicology in the scientific domains of biology, chemistry, pharmacology, and medicine **[25]**. The relationship between a dose and how it affects the organism exposed to it is essential to toxicology.

(c.) Exposure Science

Identifying and quantifying exposures are practical in exposure science to study how human exposure to environmental pollutants can be managed concerning its severity **[26]**. Exposure science can support environmental epidemiology through improved descriptions of environmental exposures that may result in specific health outcomes, identification of common exposures whose health outcomes may be better understood through toxicology studies or use in risk assessments to ascertain whether current exposure levels exceed recommended levels. In contrast to environmental epidemiology or toxicology, which produce information regarding health outcomes, exposure science can very precisely quantify exposures to individual substances.

The possibility and extent of receptors' actual or potential exposure to a chemical danger can be ascertained through exposure assessment, a critical analytical technique in any epidemiological investigation and health risk assessment **[27]**. As a general rule, exposure assessments have only looked at the exposure pathways and routes that connect receptors (objects of interest like humans, for example) to the environment. They have also evaluated the degree of connection and hazard source-to-concentration relationship between them while considering behavioral factors. Environmental epidemiology refers to studies investigating the connection between environmental risk factors and adverse health consequences concerning electromagnetic radiation in the current study.

(d.) Environmental engineering

Using scientific and engineering concepts, environmental engineering protects human populations from harmful environmental variables, protects environments from potentially adverse effects of human and natural activity, and improves the overall quality of the ecological ecosystem through generic, novel, and greening approaches **[28],[29]**. Environmental engineering applies scientific and engineering principles to safeguard and enhance the environment for the sake of human health, the preservation of nature's priceless ecosystems, and the improvement of environmental aspects of human life quality. Plans for wastewater management, pollution control of the air and water, recycling, waste disposal, and public health are provided by environmental engineers.

In addition, they create plans to enhance sanitation in urban, rural, and recreational areas and avoid waterborne diseases. They also build industrial wastewater treatment plants and municipal water distribution systems. They assess the level of risk associated with hazardous waste management systems, offer suggestions for treatment and containment, and set rules to avoid accidents. They employ environmental engineering law to evaluate the potential environmental impact of construction projects. Studying how technology affects the environment, environmental engineers work on regional and global ecological problems such as acid rain, water pollution, ozone depletion, global warming, and air pollution from industrial and vehicle exhaust.

Research Methodology

The methodology of the current paper was developed along the standards for the 100 kHz to 300 GHz electromagnetic radio frequency range published by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) in 1998, 2010, and 2020 to understand the implication of electromagnetic spectrum interactions on the environmental ecosystem sustainability. In addition to policy documents concerning spectrum utilization across nations, the latest scientific biomedical and epistemological research on electromagnetic frequency radiation was also reviewed. The exposure to the EMF causes the body to heat more superficially as its frequency rises above around 6GHz, the skin being the primary area where this heating occurs **[30],[31]**. To determine the reference levels for ICNIRP (1998), only a small study was conducted below 30MHz. As a result, extremely conservative reference levels were used.

Compared to ICNIRP (1998), the electric and magnetic field reference levels decreased to 10 MHz from 100 kHz in the ICNIRP (2010) low-frequency guidelines, including reference levels for EMF frequencies up to 10MHz. These adjustments had minimal practical applications in the case of the electric field and were founded on comparatively flimsy science. ICNIRP (2020) has revised the electric and magnetic field reference levels to consider our increased understanding of the relationships between fundamental constraints and these reference levels. Nevertheless, research has now more clearly established these relationships.

Although the primary constraints remain unaffected, the reference levels have been raised by our new understanding that higher reference level values are required to meet the basic restrictions. As a result, ICNIRP (2020) has greater E-field and H-field reference levels than ICNIRP (1998) in the frequency range of 100 kHz to 30MHz. Furthermore, studies have indicated that to align with the whole-body fundamental limits, the increase in the E- and H-field reference levels should begin at 30 MHz rather than the 20 MHz reduction in frequency reported in ICNIRP (1998). Thus, starting at 30 MHz, ICNIRP (2020) exhibits a monotonic increase in both the E- and H-field reference level values with decreasing frequency. (**Figure 1)** shows no difference in the whole-body average reference level values from ICNIRP (1998) and ICNIRP (2020) beyond 30MHz. Nevertheless, even with the same reference level numbers, an individual will experience different exposure levels due to the differences in the reference level application criteria between the two standards. Put another way, rather than establishing separate reference level values for exposures in the far- and near-field zones, ICNIRP (1998) allowed the use of the far-field zone reference level values for fields inside the near-field zone.

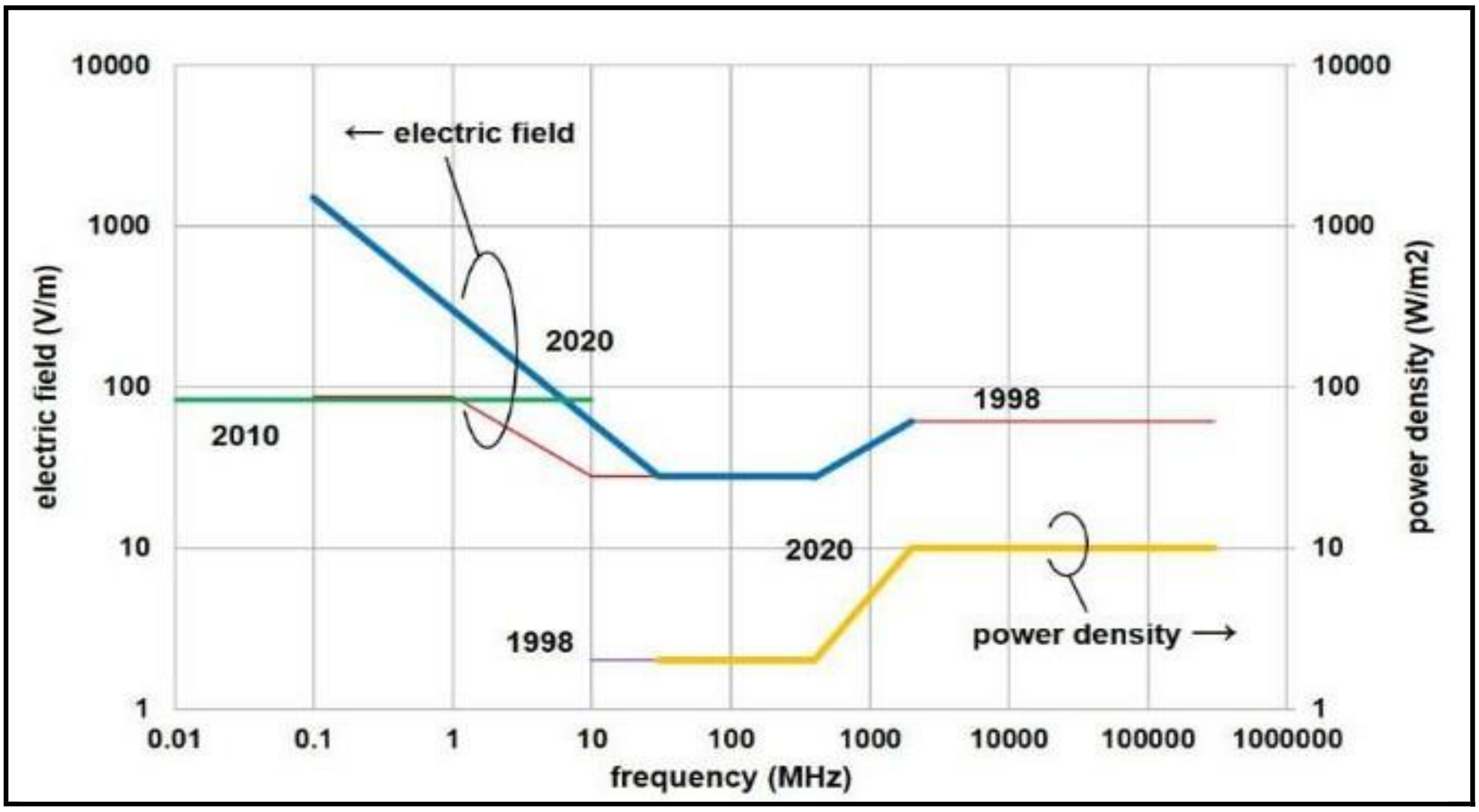

Figure 1: ICNIRP (1998), ICNIRP (2010), and ICNIRP (2020) have produced guidelines that provide whole-body average reference levels in the frequency range of 100 kHz to 300 GHz for the general population.

The ICNIRP (2020) established guidelines for applying reference levels independently in the near- and far-field based on new scientific findings. This will guarantee that exposures within the near-field zone do not lead to excessive exposure. Furthermore, even though E-field and H-field can be used for whole-body average reference levels over the whole frequency range of 100 kHz to 300 GHz (ICNIRP, 1998), this method is not allowed under the new guidelines because it may lead to errors for frequencies above roughly 2 GHz within the near-field zone; instead, measures of power density must be used.

Table 1: Electromagnetic Frequency Radiation Distribution based on ionizable and non-ionizable characterization.

Name	Class	Division	Energy
Extremely low frequency	ELF	Radio Waves	Non-Ionizing
Super low frequency	SLF	Radio Waves	Non-Ionizing
Ultra-low frequency	ULF	Radio Waves	Non-ionizing
Voice frequency	VF	Radio waves	Non-Ionizing
Very low frequency	VLF	Radio waves	Non-Ionizing
Low frequency (radio)	LF	Radio waves	Non-Ionizing
Medium frequency	MF	Radio waves	Non-Ionizing
High frequency	HF	Radio waves	Non-Ionizing
Very high frequency	VHF	Radio waves	Non-Ionizing
Ultrahigh frequency	UHF	Microwaves	Non-Ionizing
Super-high frequency	SHF	Microwaves	Non-Ionizing
Extremely high frequency	EHF	Microwaves	Non-Ionizing
Far-infrared	FIR	Infrared	Non-Ionizing
Mid-infrared	MIR	Infrared	Non-Ionizing
Near-infrared	NIR	Infrared	Non-Ionizing
Visible light	NUV	Ultraviolet	Non-Ionizing
Near-ultraviolet	NUV	Ultraviolet	Non-Ionizing
Extreme-ultraviolet	EUV	ultraviolet	Ionizing
Soft X-Rays	SX	X-ray	Ionizing
Hard X-rays	HX	X-ray	Ionizing
Gamma rays	Γ	Gamma rays	Ionizing
Source: Nigeria Communication Commission (NCC): Deployment of Fifth Generation (5G) Mobile Technology in Nigeria, August, 2020			

To protect people from radiofrequency electromagnetic fields in the frequency range of 100 kHz to 300 GHz, the ICNIRP guidelines on limiting exposure to electromagnetic fields have been developed. The recommendations encompass various applications, including base stations, mobile phones, WiFi, Bluetooth, and 5G technologies. The ICNIRP (1998) radiofrequency guidelines for frequencies between 100 kHz and 300 GHz and the ICNIRP (2010) low-frequency guidelines for frequencies between 100 kHz and 10 MHz are superseded and replaced by this publication. The radiation spectrum includes X-ray, microwave, radio, ultraviolet, and gamma rays. The electromagnetic spectrum comprises seven separate zones defined by the wavelength and frequency of electromagnetic radiation.

Table 2: Different frequency photon energies represented in the electromagnetic spectrum.

Class	Frequency	Wavelength	Energy
ELF	3 Hz	100 Mm	12.4 feV
SLF	30 Hz	10 Mm	124 feV
VF/ULF	300 Hz	1 Mm	1.24 peV
VLF	3 KHz	100 km	12.4 peV
LF	30 KHz	10 km	124 peV
MF	300 KHz	1 km	1.24 neV
HF	3 MHz	100 m	12.4 neV
VHF	30 MHz	10 m	124 neV
UHF	300 MHz	1m	1.24 ueV
SHF	3 GHz	1 dm	12.4 ueV
EHF	30 GHz	1cm	124 ueV
FIR	300 GHz	1 mm	1.24 meV
MIR	3 THz	100 um	12.4 meV
NIR	30 THz	10 um	124 meV
Visible light	300 THz	1 um	12.4 eV
NUV	3 PHz	100 nm	124 eV
EUV	30 PHz	1 nm	1.24 keV
SX	3 EHz	100 pm	12.4 keV
HX	30 EHz	10 pm	124 keV
Γ	300 EHz	1 pm	1.24 MeV
Source: Nigeria Communication Commission (NCC): Deployment of Fifth Generation (5G) Mobile Technology in Nigeria, August, 2020			

Concerning Tables 1 and 2, modulating radiofrequency transmitters' electromagnetic spectrum emissions requires compliance with regulations in every country. "Type-approvals" and "conformance testing" laws are recognized as being dynamically applied worldwide to meet the requirements for installation on radio receiver equipment that can broadcast radio frequency signals and survive within the internationally recognized safe limits for the country's citizens**[1]**.

Research Findings

Concern over electromagnetic pollution is growing on top of the other forms of pollution already present within the environment. Even though they are invisible, electromagnetic fields exist everywhere when the carrier signals are propagated. While it is impossible to prevent them due to the need for electromagnetic spectrum infrastructures, steps may be taken to mitigate their harmful effects on daily life and the workplace. Respecting the regulations set forth by the authorities and conducting ongoing monitoring is essential to minimizing its impacts, but there are additional commendations that should be considered. Electromagnetic frequency pollution is demonstrated in the combined electric and magnetic fields created by power lines, wireless or cell phones, electrical equipment, and domestic appliances like microwaves, radios, computers, and electric watches **[32]**. Extended periods of exposure to these fields have the potential to be harmful to living things.

It can be rather unusual because electromagnetic radiation exposure can have a role in a medical forensic inquiry. Without a complete understanding of the phenomenon, it might be challenging to determine the cause of a disability or death because the effects of electromagnetic radiation exposure don't often manifest as cuts or bruises **[33]**. In terms of forensics, electromagnetic radiation exposure would likely result from the intentional use of an electromagnetic weapon as a deterrent. The purpose of electromagnetic weapons, commonly called "E-bombs," is to discourage or attack a target by unleashing a powerful burst of microwaves or radio waves, which has a significant health impact on the ecosystem **[34]**. The electromagnetic pulse's effects can vary in intensity, from physiological repercussions in persons exposed to it to electronic circuitry rendered inoperable. An electromagnetic weapon's pulse has a very brief duration of approximately 100 picoseconds or one ten-billionth of a second. The recipient is overwhelmed when this high-energy burst is absorbed by everything that can transmit electrical charges, such as nerves and neurons **[35]**.

Apart from the disintegration of some subatomic particles and the splitting apart of radioactive atomic nuclei, mutual annihilation that resulted in the disappearance of an electron and its antiparticle, a positron also produces gamma rays when two photons are formed. The electron–positron annihilation and the production of dynamic photons result from the collision of an electron (e−) with its antiparticle, a positron (e+) **[36]**. The combined energy transfer of several photons causes heating effects, which mainly cause these radiation's impacts on chemical systems and living tissue. On the other hand, high-frequency ultraviolet, X-ray, and gamma radiation are referred to as ionizing radiation because individual photons of this frequency are powerful enough to break chemical bonds or ionize molecules. In addition to causing harm from simple heating, these radiations have the potential to initiate chemical reactions and pose a risk to human health.

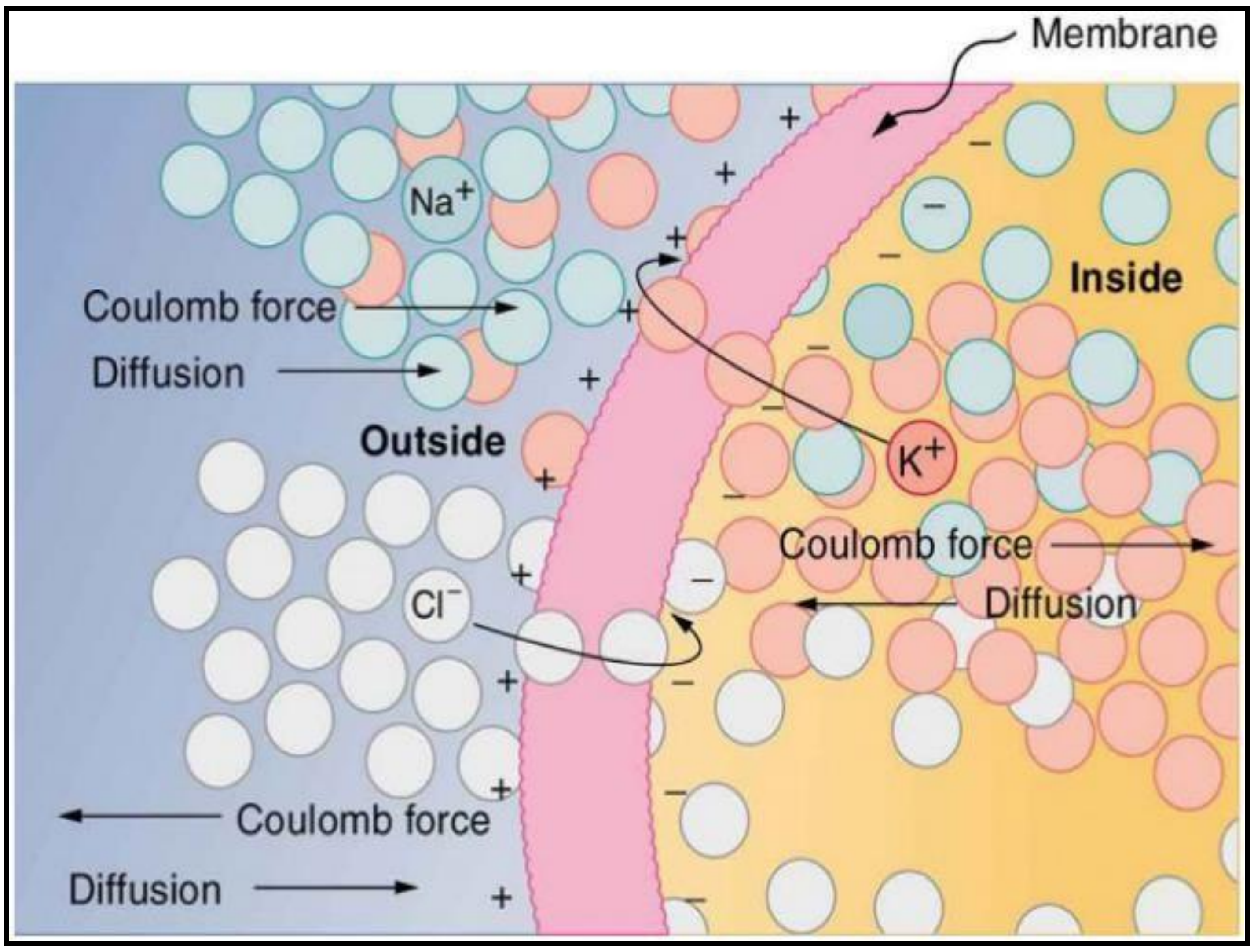

Figure 2: ionic polarization due to environmental contamination on human cells from absorbed electromagnetic radiation **[35]**.

Referring to **Figure 2,** the electrically charged particles (ions) were present in specific concentrations inside and outside the human cell's semi-permeable membrane. Potassium (K+) and chloride (Cl-) ions diffuse through the semi-permeable membrane until the Coulomb force stops them from transmitting further. This arrangement results in the concentration of the negatively charged ionic particle layer inside the body and the positively charged ionic particle layer outside, creating a voltage across the body's cell membrane that becomes typically resistive to sodium (Na+) ions. The result of relative dislocations caused by electromagnetic stimulation between positively and negatively charged particles in an ionic crystal is ionic polarization **[37]**. That clarifies the cause of the centers of negatively (-) and simply (+) charged particles shifting, changing the equilibrium and raising the possibility that vibrations of molecules or lattices may have contributed to some of the atom dislocations **[38],[39]**. Ionic crystal elements like sodium chloride (NaCl), potassium chloride (KCl), and lithium bromide (LiBr) polarize spontaneously during this process.

Since the positively charged (+) and negatively charged (-) ions in the human body have dipole moments that balance each other out to maintain equilibrium, net polarization is frequently unachievable in the absence of an external electromagnetic field **[40]**. However, in practice, external electromagnetic fields are applied to the ions, shifting them, and resulting in induced polarization. As an external electromagnetic field was present, **Figure 2** showed how ions could dislocate. An ion produces a net average dipole moment when positively (+) charged particles move with the field and negatively (-) charged particles move against it **[41]**. The body cell membranes allow current to flow to enter and exit the cell, making them effectively charged capacitors with vital activities linked to the potential difference across the membrane. Chemical elements like calcium, magnesium, sodium, and potassium can produce energy because of the electrical charges called ions already present in the human body. The electromagnetic field's external impulses will shift and alter the electrical body's equilibrium **[42]**, resulting in potential metabolic urtication.

Referring to **Figure 3,** the process of chemical polarization, also known as ionizing radiation, causes molecules within the cells to split apart and create free reactive radicals, which in turn affects the body's immune system. As a result of unpaired electrons that occur from the breaking up of water molecules within the cells during this process, it will trigger another chemical formation. The free radicals can harm DNA, proteins, and cell membranes, among other vital components of cells, and can be hazardous to the body in high concentrations. The emergence of cancer and other disorders can be caused by free radicals' propensity to damage cells, especially DNA. The hydrogen peroxide compounds that the free radical produces will initiate harmful chemical reactions inside the cells that may result in conditions like pulmonary edema or a buildup of fluid in the lungs. According to this study, hydrogen peroxide produced during the disintegration of water molecules due to electromagnetic frequency radiation aids in the multistage carcinogenic process, which involves carcinogen activation, oxidative DNA damage, and tumor formation.

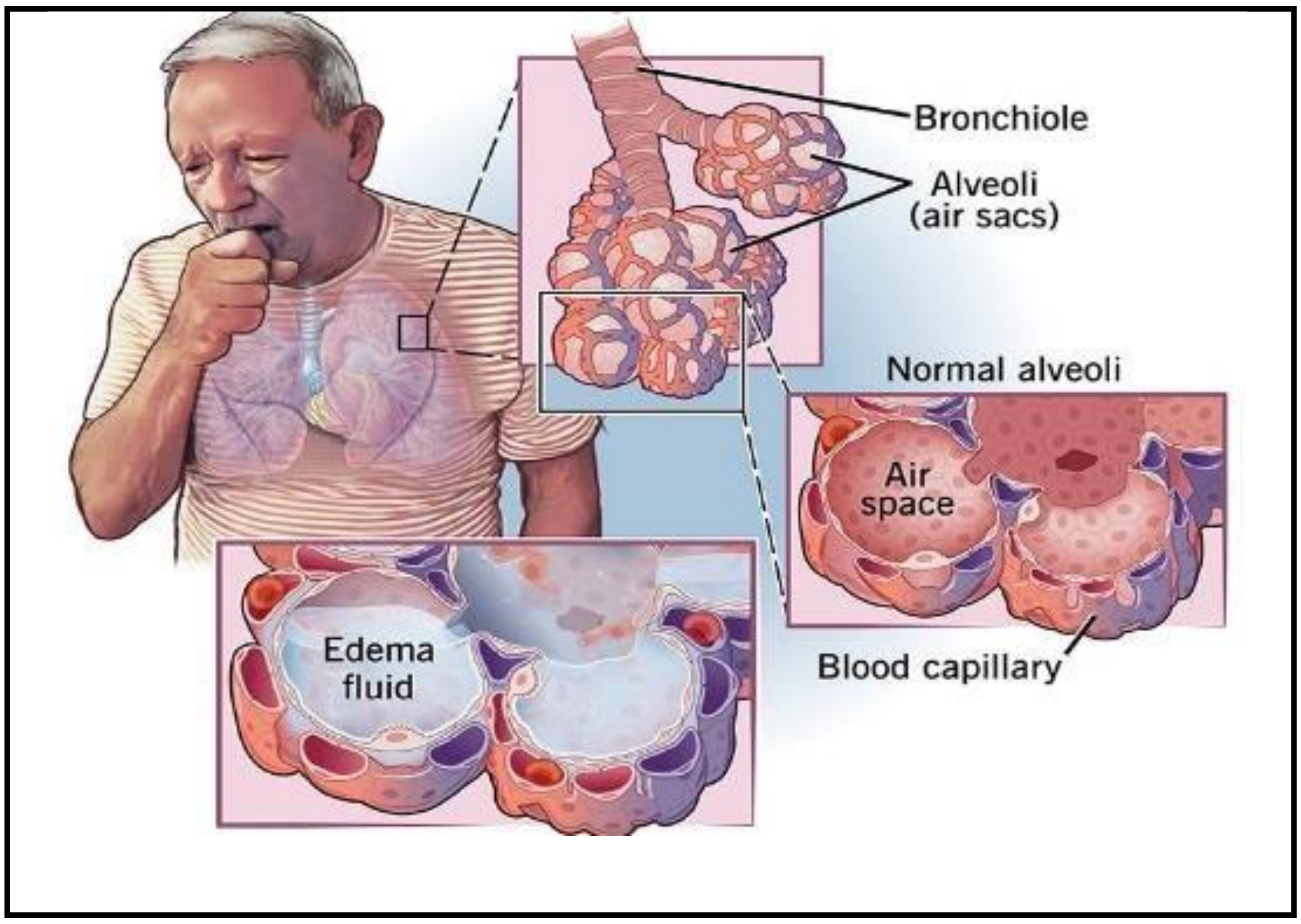

Figure 3: Pulmonary edema complications from hydrogen peroxide reactive oxidative species formation due to electromagnetic radiation inducement **[43]**.

The advancements in wireless technology have led to an increase in the utilization of high-frequency electromagnetic fields (HF-EMFs), which are characterized by radio frequencies and microwaves (MWs) released by radio stations and wireless household appliances, with mobile phones being the most often used type **[44,45]**. These interfere with complex electric circuits in the human body, such as the brain, by operating near natural biological frequencies. The consequences of the combined energy transfer on several photons cause heating effects, which are the leading cause of these radiation's impacts on chemical systems and living tissue. On the other hand, high-frequency ultraviolet, X-ray, and gamma radiation are referred to as ionizing radiation because individual photons of this frequency are powerful enough to break chemical bonds or ionize molecules. These radiations pose a risk to human health because they can harm living things in ways that go beyond essential heating. They can also trigger chemical reactions on induced radiofrequency MWs, which have been demonstrated in vitro to produce DNA damage and be carcinogenic **[46,47]**. Significant non-thermal effects caused by exposure to HF-EMFs have been shown even in basic organic systems accompanied by changes in the secondary protein's structure, manifesting as protein aggregation and alignment towards an applied HF-EMF **[48,49]**.

It has been observed that significant changes occur even at frequencies lower than the guidelines established by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). In this case, a newly disclosed method provides an innovative way to protect organisms from electromagnetic radiation pollution and ecosystem stability. In winding up, new research demonstrates the significant effects of low-frequency electromagnetic radiation exposure at human-typical intensities on cellular functions. This is evidenced by the studies included in this theme issue. Preparing electromagnetic systems and devices that operate at frequencies far from the natural resonant frequencies of biological systems or designing shielding protection against exposure to electromagnetic fields is the best course of action, given the possibility that these measured changes could lead to human disease and environmental pollution.

Conclusion

In the current environmental and public health study, the entire spectrum of impacts that both natural and artificial settings have on society's overall well-being has been examined. It has proven that maintaining the conditions for a healthy environment is crucial to controlling elements that could harm ecosystem sustainability and environmental health. This work found that producing hydrogen peroxide during the disintegration of water molecules due to 5G electromagnetic frequency radiation as an environmental contaminant contributes to the multistage carcinogenic process, which involves carcinogen activation, oxidative DNA damage, and tumor growth. Because electromagnetic fields weaken significantly with increasing separation, the biological effects of microwave radiation vary depending on source distance. It has been demonstrated that shallow-frequency electromagnetic radiation causes the brain to produce molecules that either release histamine or encourage sleep. When radiation is discontinued, the flu-like symptoms that histamine release causes in human volunteers disappear. A weapon that targets people with microwaves creates heat by vibrating atoms. Furthermore, electromagnetic weapons that use microwaves can shock a target due to peripheral nerve stimulation. When numerous nerves fire simultaneously, the brain cannot process the information and may become unconscious.

Conflict of Interest

There is no conflict of interest in this publication. U&J Digital Consult Limited, an it and Education Consulting Firm based in Nigeria, supported the research.

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