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IMPACT OF NON-IONIZING RADIATIONS ON HUMAN NERVE CONDUCTION

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ABSTRACT

Since many years ago, there has been a growing concern over the impact that exposure to electromagnetic fields (EMFs) has on biological systems as well as the human body due to the possible risks that it poses to one's health. On the basis of current discoveries, the objective of this review is to study the biological effects of non-ionizing electromagnetic fields (EMFs) on the human body and the biological systems it consists of. The use of electrical gadgets as an artificial source of electromagnetic fields (EMFs) has led to a dramatic rise in the amount of exposure that humans get in their everyday lives in recent years. In addition, problems about protection and the consequences on biological systems are among the rising concerns for which the majority of questions have been left unresolved. Long waves or EMFs with low energy, both of which are classified as non-ionizing, are able to exert an impact on the process that cells go through and the proliferation of cells. Overall, the biological impacts of these form of electromagnetic fields (EMFs) have been called a primary problem and a source of dispute among researchers. For the purpose of determining the impacts that electromagnetic fields (EMFs) have, it has been proposed that more follow-up research with bigger samples are required. These impacts can sometimes be beneficial to one's health, but other times they can be harmful

***Keywords:* Non-Ionizing Radiations, Human Nerve Conduction**

INTRODUCTION

The International Board on Non-Ionizing Radiation Shielding (ICNIRP) is an independent committee of scientific experts that was established to evaluate the state of knowledge regarding the effects of non-ionizing radiation (NIR) on human health, and other well, and on the environment. The ICNIRP was established to evaluate the state of knowledge regarding the effects of NIR on human health, including well-being, and on the environment. The International Commission on Non-Ionizing Radiation Protection (ICNIRP) offers advice and direction on protection against the harmful effects of non-ionizing radiation that is supported by scientific evidence. This includes the giving of guidelines on how to reduce exposure. The World Health Organization (WHO), the Un Global Compact (ILO), and the European Union have all given their official endorsement to the International Commission on Non-Ionizing Radiation Protection (ICNIRP), which is a non-profit organisation concerned with non-ionizing radiation protection (EU). The appendix contains more information regarding ICNIRP that may be found here.

This document outlines the overarching principles that the International Commission on Non-Ionizing Radiation Protection (ICNIRP) adheres to when formulating recommendations for exposure limits in order to protect people from the potentially harmful effects of being exposed to non-ionizing radiation. In actual practise, the essential processes involved in implementing these overarching concepts can vary depending on the type of non-ionizing radiation being considered. The ICNIRP's procedures, which are outlined in the appendix, can be found here.

The general principles for non-ionizing radiation shielding are based, wherever it is appropriate, upon the well-established fundamentals for protection against adverse health effects from ionising radiation (ICRP 2007) and the fundamental underlying ethical values, as printed by the International Commission on Radiological Protection. This is done in order to establish a consistent framework of radiation protection across the entire spectrum of ionising and non-ionizing radiation (ICRP).

Non-ionizing radiation, also known as NIR, has a wide range of applications in the medical field. Some of these applications, such as ultrasound imaging, laser surgery, and UV light treatments, have been in use for a significant amount of time. Other applications, such as magnetic resonance imaging (MRI) and transcranial magnetic stimulation (TMS) for the treatment of depression, have been introduced more recently.

This document discusses the application of non-ionizing radiation in the medical field as well as its safety. The term near infrared radiation (NIR) refers to electromagnetic radiation with frequencies ranging from 0 Hz all the way up to 1.1 THz. These frequencies include radio waves, light waves, infrared waves, ultraviolet waves, and mechanical waves like ultrasound. In a recent statement on diagnostic devices utilising NIR, which was published by the International Commission on Non-Ionizing Radiation Protection, the same definition of NIR was adopted. In this report, we decided not to include therapeutic use of ultrasonography but we did include therapeutic use of NIR.

The near infrared region of the electromagnetic spectrum can be found directly beneath the band of ionising energy that contains x-rays. NIR is incapable of ionisation because it possesses a lower energy than ionising radiation and is unable to strip electrons from atoms (except for part of the UV band). The NIR spectrum can be broken down into a number of frequency or wavelength ranges. The various subgroups each have their own unique physiological consequences, necessitating individualised strategies for defence against them.

The biological consequences of electromagnetic radiation (EMR) can vary widely depending on the electromagnetic radiation's physical qualities, particularly its ionising potential. They have received a more in-depth discussion in the first section of our review, which can be found here.

Ionizing radiation, often known as IR, generates a stream of high-energy photons or alpha particles, protons, and neutrons. These particles, when exposed to live beings in sufficient quantities, can be fatal. Acute postradiation syndrome, which is triggered by excessive ionising radiation (IR), typically results in the failure of several organs or death. Early alterations include a lack of lymphocytes, decreased cellular immunity, anaemia, transitory infertility, acute radiation dermatitis, hair loss, lens opacity, and acute intestinal inflammation. Other early changes include acute intestine inflammation. Leukemia and other forms of cancer may develop as a consequence of the late consequences.

Atoms and molecules of matter are not ionised in a manner that is fatal when exposed to non-ionizing radiation (NIR) that has a relatively low energy level.

When they enter the body, infrared and near-infrared radiation cause damage to the nitrogenous bases of deoxyribonucleic acid (DNA) either directly or indirectly via reactive oxygen species (ROS) or nitrogen species (RNS). ROS (free radicals) include hydroxyl $(OH^{\bullet})$, hydroperoxide $(HO_2^{\bullet})$ and superoxide $(O_2^{\bullet-})$ radicals, hydrogen peroxide H_2O_2 and singlet oxygen $(^1O_2)$.

$OH^{\bullet}$ are the most reactive of all ROS, and they are the product of the Fenton reaction. $HO_2^{\bullet}$ and $O_2^{\bullet-}$ have a very short frequency but a very long half-life. In the Haber–Weiss reaction that is catalysed by iron, however, they have the potential to convert into extremely reactive OHd radicals. The RNS family includes nitric oxide (NO) and the metabolites that it produces: nitrosonium cation (NO^{+}), nitroxyl anion (NO^{-}) and peroxynitrite $(ONOO^{-})$.

Oxidative DNA damage is induced mainly by hydroxyl radicals; $O_2^{\bullet-}$ and H_2O_2 do not cause direct DNA changes. H_2O_2 penetrates easily into the nuclear membrane of the nucleus and becomes a substrate in the Fenton reaction, producing highly damaging $OH^{\bullet}$. Interaction of $OH^{\bullet}$. with DNA damages deoxyribose, breaks phosphodiester bonds between nucleotides and cross-links with nuclear proteins and DNA. The interaction of reactive species with deoxyribose residues in DNA ultimately results in the breaking of either single- or double-stranded DNA.

The amino acid residues and reductases of enzymes can be changed by hydroxyl radicals, which can also lead to the fragmentation and aggregation of proteins. The most vulnerable proteins are those that include aromatic amino acids and sulphur (such as cysteine, methionine, and others). Both reactive oxygen species (ROS) and reactive nitrogen species (RNS) contribute to lipid peroxidation, alter the physical characteristics of cell membranes as well as their liquidity, and disrupt transmembrane transport in the respiratory chain as well as intracellular signal transmission.

ROS and lipid peroxidation products have been shown to directly act on the nuclear transcription factor kB (NF-kB; REL oncogene family) in malignant cells, which results in an altered expression of Bcl-2, Bax, and p53. These chemicals not only prevent the proliferation and apoptosis of cancerous cells, but they also regulate apoptosis and the pace at which telomerase shortens telomeres. ROS are known to activate oncogenes in healthy cells while simultaneously deactivating tumour suppressor genes, a process that may trigger carcinogenesis and the growth of tumours

OBJECTIVE OF THE STUDY

1. To conduct research on the principles governing the protection against non-ionizing radiation
2. To conduct research on the effect of non-ionizing radiation on the nerve conduction of humans

1.2 WHAT IS NON-IONIZING RADIATION?

First and first, it is essential to have an understanding of the radiation itself and the characteristics it has in order to be able to identify the existence of NIR and its capacity to pose a risk. Non-ionizing radiation is a kind of energy that is created by a source (such as a machine, an instrument, a light bulb, etc.) and then travels across space as electromagnetic waves with certain wavelengths. As a result, it occurs naturally as a component of the electromagnetic spectrum and manifests itself at a frequency that is lower than that of the ionising radiation (x-rays). As can be seen in Figure 1, it starts from the lower end of the spectrum, which is extremely low frequency (ELF) electromagnetic fields (EMF), and goes a little bit higher into electromagnetic fields and microwave and much greater into infra-red (IR), visible light, and ultra-violet. This can be seen as a progression from the lowest frequency to the highest frequency (UV). Because the amount of energy that it carries is less than that which is carried by ionising radiation, it is not capable of generating an ionisation process in the subject that is exposed to it, in contrast to ionising radiation. Because of this property, it is referred to as nonionizing radiation (NIR), and the risk it poses is clearly far lower in comparison to the potential harm that may be produced by ionising radiation. Because almost all forms of radiation (with the exception of visible light) have wavelengths that are outside of the range in which the human eye can detect them, these forms of radiation cannot be seen with unaided vision. Workers are often ignorant of the existence of these hazards in their workplaces because of the fact that they are unseen

Definition of non-ionizing radiation

In this document, the term "non-ionizing radiation" refers to electromagnetic radiation and fields that have a photon energy that is lower than 10 eV. This photon energy corresponds to frequencies that are lower than 3 PHz (3 1015 Hz), and wavelengths that are longer than 100 nm. It is classified according to its frequency or wavelength, specifically as ultraviolet (UV) radiation (wavelengths 100–400 nm), reflected light (wavelengths 400–780 nm), infrared radiation (wavelengths 780 nm–1 mm), electromagnetic fields electromagnetic fields (frequencies 100 kHz–300 GHz), low frequency (frequencies 1 Hz–100 kHz), and static electric and magnetic fields. UV radiation has shorter wavelengths than visible light and in (0 Hz). Mechanical waves in the form of sound waves (frequencies below 20 Hz) and ultrasound (frequencies above 20 kHz) are also included in ICNIRP's mandate, although audible acoustic waves (sound) are excluded. Infrasound has frequencies below 20 Hz, while ultrasound has frequencies over 20 kHz

Principles for non-ionizing radiation protection

The primary goal of radiation protection efforts, whether they focus on ionising or non-ionizing radiation, is to keep people and the environment safe from damage. When it comes to people, the goal is to safeguard each and every person, but when it comes to the environment, the objective is to shield species, ecosystems, and biota from any negative consequences. Even in cases when there is a lack of complete information on the dangers associated with radiation exposure, the process of radiation protection requires making educated judgements

CONCLUSION

For the purpose of this thesis, the interaction between electromagnetic (EM) waves radiated from wireless communication devices and BSAs and the human body has been studied in order to evaluate EM power absorption in the brain and other body tissues in terms of a variety of electrical parameters, thermal parameters, and specific absorption rates (SAR). Taking into consideration a wide variety of tissue models, numerous sorts of electrical and thermal shifts that occur as a result of the interaction between non-ionizing electromagnetic waves and human people and the environment have been accounted for. For the purpose of observing the various induced energy characteristics within cells or tissue, theoretical experiments have been carried out making use of full wave EM simulation approaches. This paper also includes numerical approaches such as MoM, FDTD, and FIT based computational tools, all of which played a significant part in all of the theoretical investigations that were conducted. In order to carry out the various theoretical studies required for this study activity, a number of custom computer programmes written in-house have been built. SFDTD, which is based on FDTD, and hybrid methods, which comprise of Friis transmission equation and FDTD, are utilised in order to tackle the large-scale issues.

In addition, commercially accessible electromagnetic (EM) softwares such as Zeland IE3D, Fidelity, MDSpice, and CST Microwave Studio® are utilised extensively for a variety of investigations as well as for the validation of in-house created tools. Electrical models of biological things are also highly important contributors to theoretical analyses of living things. CAD models of various handsets, each of which comprises of an appropriate antenna, are taken into consideration in various realistic observations. In different simulations, human head models of various types, including homogeneous box types, three-layered spherical types, MRI-based heterogeneous types, and DICOM data-based voxel types, are employed.

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