The below links are hereby incorporated by reference.

https://pubmed.ncbi.nlm.nih.gov/30025338/

Thermal and non-thermal health effects of low intensity non-ionizing radiation: An international perspective

Abstract

Exposure to low frequency and radiofrequency electromagnetic fields at low intensities poses a significant health hazard that has not been adequately addressed by national and international organizations such as the World Health Organization. There is strong evidence that excessive exposure to mobile phone-frequencies over long periods of time increases the risk of brain cancer both in humans and animals. The mechanism(s) responsible include induction of reactive oxygen species, gene expression alteration and DNA damage through both epigenetic and genetic processes. In vivo and in vitro studies demonstrate adverse effects on male and female reproduction, almost certainly due to generation of reactive oxygen species. There is increasing evidence the exposures can result in neurobehavioral decrements and that some individuals develop a syndrome of "electro-hypersensitivity" or "microwave illness", which is one of several syndromes commonly categorized as "idiopathic environmental intolerance". While the symptoms are non-specific, new biochemical indicators and imaging techniques allow diagnosis that excludes the symptoms as being only psychosomatic. Unfortunately standards set by most national and international bodies are not protective of human health. This is a particular concern in children, given the rapid expansion of use of wireless technologies, the greater susceptibility of the developing nervous system, the hyperconductivity of their brain tissue, the greater

penetration of radiofrequency radiation relative to head size and their potential for a longer lifetime exposure.

https://www.mdpi.com/1422-0067/22/7/3772

Manmade Electromagnetic Fields and Oxidative Stress—Biological Effects and Consequences for Health

Abstract

Concomitant with the ever-expanding use of electrical appliances and mobile communication systems, public and occupational exposure to electromagnetic fields (EMF) in the extremely-low-frequency and radiofrequency range has become a widely debated environmental risk factor for health. Radiofrequency (RF) EMF and extremely-low-frequency (ELF) MF have been classified as possibly carcinogenic to humans (Group 2B) by the International Agency for Research on Cancer (IARC). The production of reactive oxygen species (ROS), potentially leading to cellular or systemic oxidative stress, was frequently found to be influenced by EMF exposure in animals and cells. In this review, we summarize key experimental findings on oxidative stress related to EMF exposure from animal and cell studies of the last decade. The observations are discussed in the context of molecular mechanisms and functionalities relevant to health such as neurological function, genome stability, immune response, and reproduction. Most animal and many cell studies showed increased oxidative stress caused by RF-EMF and ELF-MF. In order to estimate the risk for human health by manmade exposure, experimental studies in humans and epidemiological studies need to be considered as well.

https://www.degruyterbrill.com/document/doi/10.1515/reveh-2023-0023/html

Cellular and molecular effects of non-ionizing electromagnetic fields

Abstract

The way that living cells respond to non-ionizing electromagnetic fields (EMF), including static/extremely-low frequency and radiofrequency electromagnetic fields, fits the pattern of 'cellular stress response' – a mechanism manifest at the cellular level intended to preserve the entire organism. It is a set pattern of cellular and molecular responses to environmental stressors, such as heat, ionizing radiation, oxidation, etc. It is triggered by cellular macromolecular damage (in proteins, lipids, and DNA) with the goal of repairing and returning cell functions to homeostasis. The pattern is independent of the type of stressor encountered. It involves cell cycle arrest, induction of specific molecular mechanisms for repair, damage removal, cell proliferation, and cell death if damage is too great. This response could be triggered by EMF-induced alternation in oxidative processes in cells. The concept that biological response to EMF is a 'cellular stress response' explains many observed effects of EMF, such as nonlinear dose- and time-dependency, increased and decreased risks of cancer and neurodegenerative diseases, enhanced nerve regeneration, and bone healing. These responses could be either detrimental or beneficial to health, depending on the duration and intensity of the exposure, as well as specific aspects of the living organism being exposed. A corollary to electromagnetic hypersensitivity syndrome (EHS) could be an inappropriate response of the hippocampus/limbic system to EMF, involving glucocorticoids on the hypothalamic-pituitary-adrenal axis.

https://www.sciencedirect.com/science/article/pii/S014765132601081X?via%3Dihub

ARTICLE:

Hypothesis: ultrasonography can document dynamic in vivo rouleaux formation due to mobile phone exposure

Carrying a cellphone against the body has become commonplace in our world replete with smartphones. Acute and chronic health effects caused by these devices emitting radiofrequency radiation from multiple antennas have not been well evaluated. In this study, the popliteal vein of a healthy volunteer was imaged with ultrasonography prior to and following the placement of an idle, but active smartphone against her knee for 5 min. Pre-exposure longitudinal sonographic images demonstrate a normal anechoic lumen to the popliteal vein. Images obtained 5 min after direct skin exposure to the smartphone demonstrate a dramatic change in the acoustic appearance of the vessel. The interior of the vessel became coarsely hypoechoic with sluggish !ow seen in real-time images, a typical sonographic appearance for rouleaux formation. A follow up examination performed 5 min after the subject walked around yielded continued rouleaux formation in the popliteal vein, albeit less dramatic than that observed immediately post exposure. This revolutionary in vivo method to assess radiofrequency radiation induced rouleaux formation should be further pursued in the general population to determine its prevalence and if its occurrence provides a unique biomarker of exposure that may predict morbidity.

https://link.springer.com/article/10.1186/s12940-022-00900-9

ICNIRP exposure limit determinations for radiofrequency radiation: implications for 5G

Abstract

In the late-1990s, the FCC and ICNIRP adopted radiofrequency radiation (RFR) exposure limits to protect the public and workers from adverse effects of RFR. These limits were based on results from behavioral studies conducted in the 1980s involving 40–60-minute exposures in 5 monkeys and 8 rats, and then applying arbitrary safety factors to an apparent threshold specific absorption rate (SAR) of 4 W/kg. The limits were also based on two major assumptions: any biological effects were due to excessive tissue heating and no effects would occur below the putative threshold SAR, as well as twelve assumptions that were not specified by either the FCC or ICNIRP. In this paper, we show how the past 25 years of extensive research on RFR demonstrates that the assumptions underlying the FCC's and ICNIRP's exposure limits are invalid and continue to present a public health harm. Adverse effects observed at exposures below the assumed threshold SAR include non-thermal induction of reactive oxygen species, DNA damage, cardiomyopathy, carcinogenicity, sperm damage, and neurological effects, including electromagnetic hypersensitivity. Also, multiple human studies have found statistically significant associations between RFR exposure and increased brain and thyroid cancer risk. Yet, in 2020, and in light of the body of evidence reviewed in this article, the FCC and ICNIRP reaffirmed the same limits that were established in the 1990s. Consequently, these exposure limits, which are based on false suppositions, do not adequately protect workers, children, hypersensitive individuals, and the general population from short-term or long-term RFR exposures. Thus, urgently needed are health protective exposure limits for humans and the environment. These limits must be based on scientific evidence rather than on erroneous assumptions, especially given the increasing worldwide exposures of people and the environment to RFR, including novel forms of radiation from 5G telecommunications for which there are no adequate health effects studies.

https://www.frontiersin.org/journals/public-health/articles/10.3389/fpubh.2022.986315/full

Wireless technology is an environmental stressor requiring new understanding and

approaches in health care

Abstract

Electromagnetic signals from everyday wireless technologies are an ever-present environmental stressor, affecting biological systems. In this article, we substantiate this statement based on the weight of evidence from papers collated within the ORSAA database (ODEB), focusing on the biological and health effects of electromagnetic fields and radiation. More specifically, the experiments investigating exposures from real-world devices and the epidemiology studies examining the effects of living near mobile phone base stations were extracted from ODEB and the number of papers showing effects was compared with the number showing no effects. The results showed that two-thirds of the experimental and epidemiological papers found significant biological effects. The breadth of biological and health categories where effects have been found was subsequently explored, revealing hundreds of papers showing fundamental biological processes that are impacted, such as protein damage, biochemical changes and oxidative stress. This understanding is targeted toward health professionals and policy makers who have not been exposed to this issue during training. To inform this readership, some of the major biological effect categories and plausible mechanisms of action from the reviewed literature are described. Also presented are a set of best practice guidelines for treating patients affected by electromagnetic exposures and for using technology safely in health care settings. In conclusion, there is an extensive evidence base revealing that significant stress to human biological systems is being imposed by exposure to everyday wireless communication devices and supporting infrastructure. This evidence is compelling enough to warrant an update in medical education and practice.

https://www.frontiersin.org/journals/public-health/articles/10.3389/fpubh.2019.00223/full

Risks to Health and Well-Being From Radio-Frequency Radiation Emitted by Cell Phones

and Other Wireless Devices

Abstract

Radiation exposure has long been a concern for the public, policy makers, and health researchers. Beginning with radar during World War II, human exposure to radio-frequency radiation[1] (RFR) technologies has grown substantially over time. In 2011, the *International Agency for Research on Cancer* (IARC) reviewed the published literature and categorized RFR as a "possible" (Group 2B) human carcinogen. A broad range of adverse human health effects associated with RFR have been reported since the IARC review. In addition, three large-scale carcinogenicity studies in rodents exposed to levels of RFR that mimic lifetime human exposures have shown significantly increased rates of Schwannomas and malignant gliomas, as well as chromosomal DNA damage. Of particular concern are the effects of RFR exposure on the developing brain in children. Compared with an adult male, a cell phone held against the head of a child exposes deeper brain structures to greater radiation doses per unit volume, and the young, thin skull's bone marrow absorbs a roughly 10-fold higher local dose. Experimental and observational studies also suggest that men who keep cell phones in their trouser pockets have significantly lower sperm counts and significantly impaired sperm motility and morphology, including mitochondrial DNA damage. Based on the accumulated evidence, we recommend that IARC re-evaluate its 2011 classification of the human carcinogenicity of RFR, and that WHO complete a systematic review of multiple other health effects such as sperm damage. In the interim, current knowledge provides justification for governments, public health authorities, and physicians/allied health professionals to warn the population that having a cell phone next to the body is harmful, and to support measures to reduce all exposures to RFR.

mating-success-and-offspring-outcomes-in-rats/

Effects of 5G frequencies on sperm parameters, mating success, and offspring outcomes in rats

Abstract

Background and objectives

The advancement of 5G technology is highly anticipated due to its faster data transmission, yet its potential impact on male fertility remains unclear. This study evaluated the effects of 5G frequencies at 3.5 GHz and 24 GHz on sperm parameters, mating success, and offspring outcomes.

Methods

A total of 18 male Sprague Dawley rats (n=18) were divided into three groups: a Control group, a 3.5 GHz group, and a 24 GHz group (n=6). The Control group was sham-exposed. In contrast, the 3.5 GHz and 24 GHz groups were exposed to their respective frequencies for 7 h daily over 60 d. Following 46 d of exposure, a 1:1 mating procedure was conducted. Female rats (n=18) were monitored until gestation d 28 to assess pregnancy rates and birth metrics. Later, the male rats were sacrificed, and sperm quality was evaluated.

Results

Both exposed groups exhibited a significant decrease in sperm concentration and motility ($P<0.001$) compared to the Control group. The 24 GHz group had a lower pregnancy rate, whereas the 3.5 GHz group showed a lower live birth rate. Congenital anomalies were

observed in the 3.5 GHz group, whereas the 24 GHz group presented significantly lower birth weights ($P < 0.001$).

Interpretation and conclusions

The findings suggest prolonged exposure to 5G frequencies may have a negative impact on male fertility, pregnancy outcomes, and the birth metrics.

5G — General, Reviews, Exposure Studies and Mixed 5G Frequencies

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