

Study board

Studies on the biological effects of artificial electromagnetic fields and radiation

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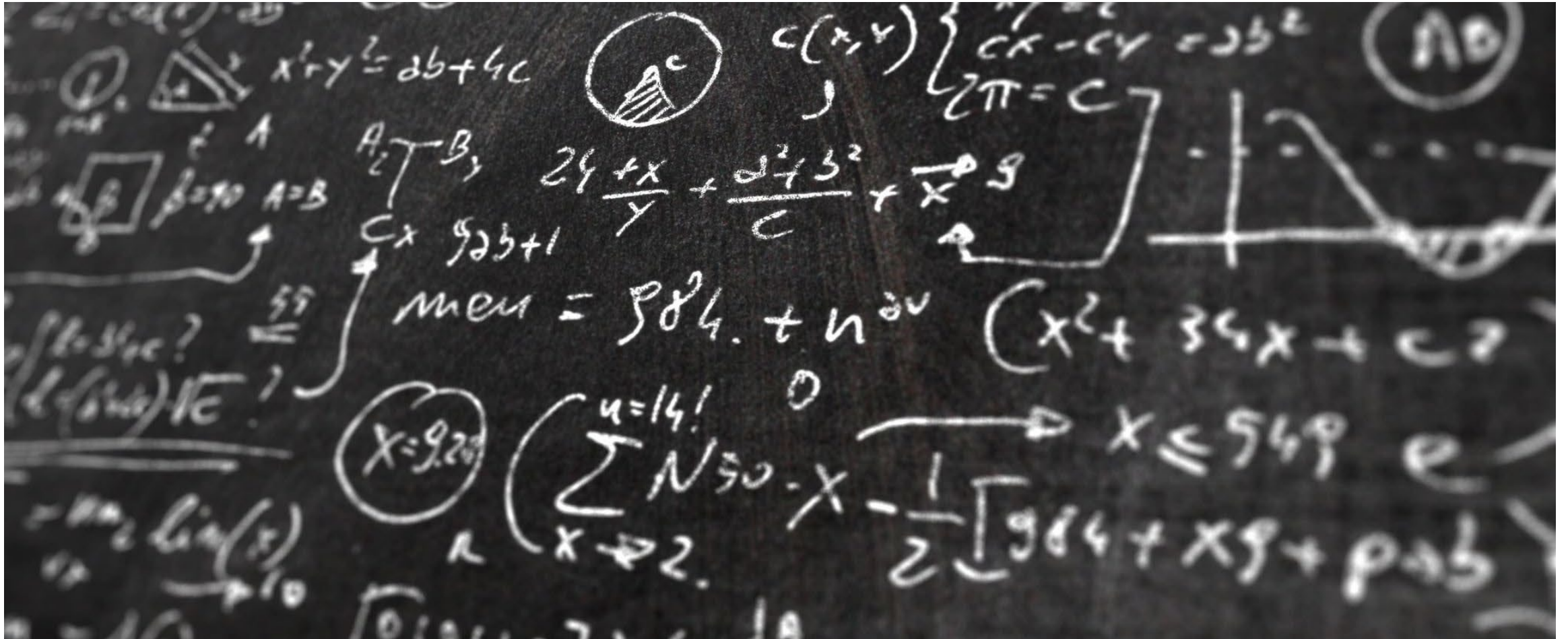


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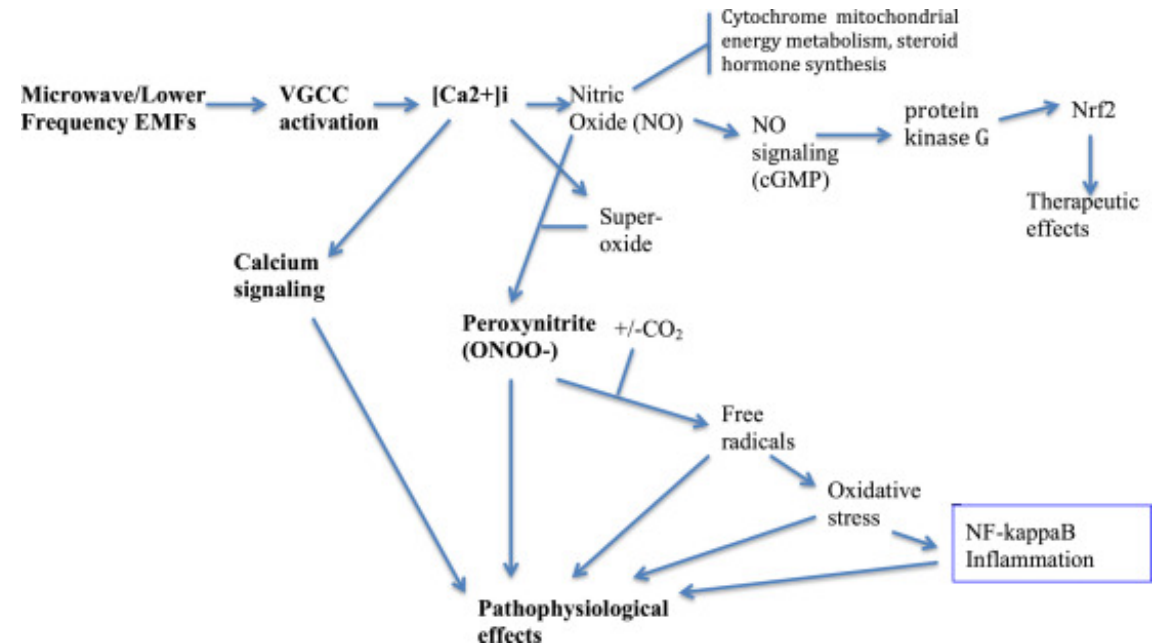
Study – WLAN

WLAN is a major threat to human health

Martin L. Pall

<https://doi.org/10.1016/j.envres.2018.01.035>

Known WLAN effects include apoptosis and the development of oxidative stress, testicular and sperm disorders, DNA changes; hormone changes; Ca²⁺ increase in the cell; WLAN acts via voltage-controlled calcium channel activation



Scientific assessment of the study situation on 5G

Adverse health effects of 5G mobile networking technology under real-life conditions

Kostoff RN, Heroux P, Aschner M, Tsatsakis A.
Research Affiliate, School of Public Policy, Georgia
Institute of Technology, Georgia. International
Published in: Toxicol Lett. 2020 May 1;323:35-40

The authors conclude that most laboratory experiments to date have not set out to detect harmful effects of radiation that reflect the real conditions of mobile phone technology in everyday life.

Neither the currently widespread mobile phone technology 4G nor the following 5th generation have been tested for harmful effects on health under the conditions of normal life before being introduced. On the contrary, many studies that were conducted in rather harmless environments indeed show harmful effects.

High-frequency radiation is meant to provide better communication. Evidence from laboratory experiments and epidemiological studies demonstrates that previous and current generations of wireless network technology have significant adverse health effects. When real conditions – such as additional signals to the carrier frequencies or toxic substances – are considered, the harmful effects increase considerably. If 5G is added to the harmful radiation already out there, the pre-existing health damage will get worse.

Study – Connection between diabetes and radiation

The correlation between the radiation of high-frequency electromagnetic fields from mobile communications basis stations and glycated haemoglobin (HbA1c) as well as the risk of diabetes mellitus type 2 has been confirmed.

This study was able to prove that – measured in primary schools – a connection exists between increased markers for the development of type 2 diabetes and exposure to artificial electromagnetic radiation from mobile phone transmitters.

By: Meo SA, Alsubaie Y, Almubarak Z, Almutawa H, AlQasem Y, Hasanato RM; published in: Int J Environ Res Public Health 2015; 12 (11): 14519

– 14528

Study – WLAN radiation

2.45 GHz radiation degrades learning and spatial memory via oxidative/nitrosative stress-induced p53-dependent/independent apoptosis in hippocampus

The study was conducted as an animal experiment. The frequency used represents WLAN of the 1st generation.

By: Shahin S, Banerjee S, Singh SP, Chaturvedi CM; published in: Toxicological Sciences 2015, 148 (2): 380–399

Study – Blood-Brain Barrier

Effects of GSM modulated radio-frequency electromagnetic radiation on permeability of blood-brain barrier in male & female rats.

This study showed that electromagnetic radiation influences the permeability of the blood-brain barrier.

By: Sırav B , Seyhan N; published in: J. Chem. Neuroanat. (2016)

Study – ATHEM2

ATHEM-2 –Untersuchung athermischer Wirkungen elektromagnetischer Felder im Mobilfunkbereich” [“ATHEM-2 – Examination of athermic effects of electromagnetic fields in mobile communications”]

By: Mosgöller W, Knasmüller S, Kundi M.

Published in: AUVA-Report 2016, volume 70 Athem-2

The UMTS radiation leads to behavioural changes in people; their reaction time is shorter, their error rate is higher and their power of recall is impaired. In the case of sensitive cells, UMTS radiation also causes damage to cells and to DNA. The damage caused by the radiation is intensified in stress conditions.

Study

Effect of low-intensity subchronic microwave radiation on the rat brain

This work is the first to study the effect of three frequencies (900 MHz, 1800 MHz, 2450 MHz) over a period of 90 days at low field strengths on brain performance, HSP (heat shock proteins) and DNA damage in vivo.

The results of this study indicate that sub-chronic exposures to low-intensity 900, 1800 and 2450 MHz radiation could lead to significant deleterious effects in the brain, as evidenced by DNA damage and increased HSP70 concentrations in hippocampal tissue of male rats, leading to reduced brain functions.

By: Deshmukh PS, Megha K, Nasare N, Banerjee BD, Ahmed RS, Abegaonkar MP, Tripathi AK, Mediratta PK.

Published in: Biomed Environ Sci, 2016; 29 (12), 858–867

Study – WLAN and mercury

WLAN releases more mercury than tooth fillings

The increasing use of WLAN worldwide, including in schools and public places, is raising questions of whether it can cause health problems. Amalgam fillings in teeth contain a great deal of mercury.

This study is the first that examines and confirms the effect of 2.4 GHz radiation on the mercury emission from amalgam into the saliva.

By: Paknahad M, Mortazavi SMJ, Shahidi S, Mortazavi G, Haghani M (2016): Effect of radio frequency radiation from Wi-Fi devices on mercury release from amalgam restorations.

Published in: Journal of Environmental Health Science and Engineering 14, article 12, 6 pages

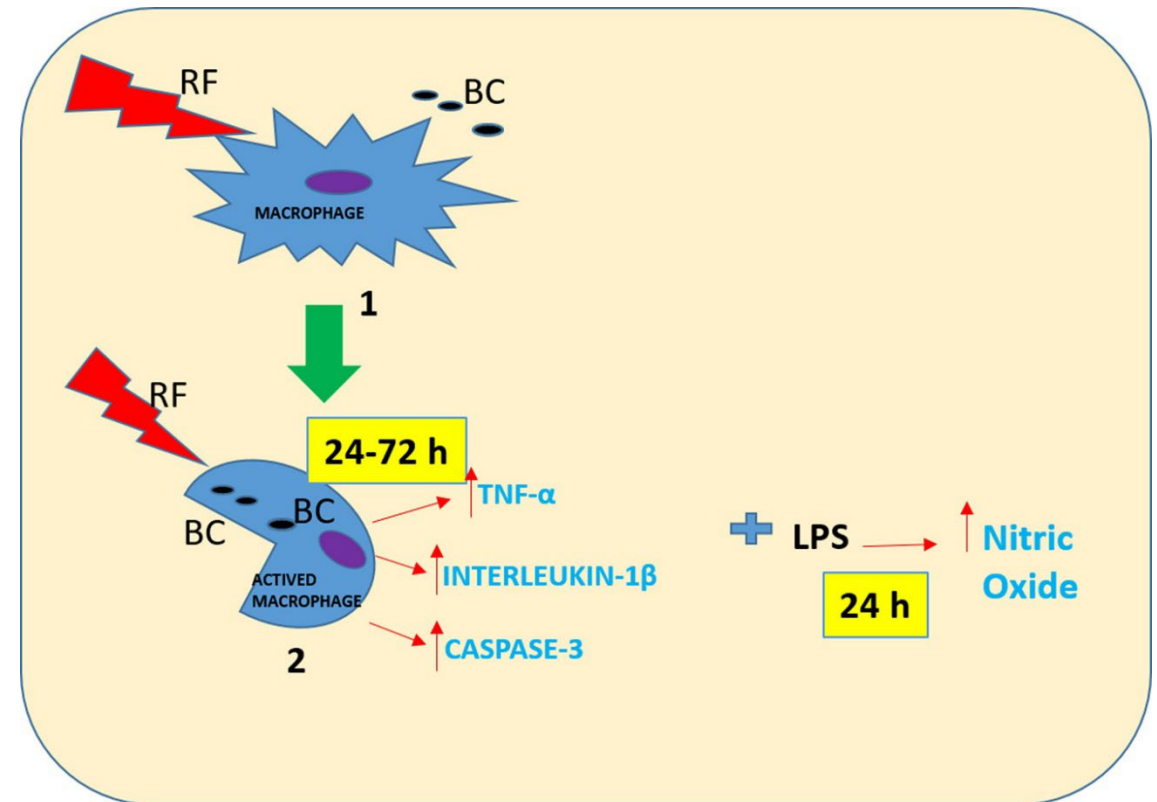
Study – High Frequency at 2.45 GHz Increases Toxicity, Pro-inflammatory and Pre-apoptotic Activity Caused by Carbon Particles in RAW 264.7 Macrophage Cell Line – Part 1

Authors: Rosa Ana Sueiro-Benavidesa, Jose Manuel Leiro-Vidala, Aarón Ángel Salas-Sánchez, Antonio Rodríguez-González, Francisco J. Ares-Penab, Elena López-Martín

Published:

<https://doi.org/10.1016/j.scitotenv.2020.142681>

The authors investigated a macrophage cell line that was exposed to a combination of carbon particles and 2.45 GHz mobile phone radiation (WLAN).



Study – High Frequency at 2.45 GHz Increases Toxicity, Pro-inflammatory and Pre-apoptotic Activity Caused by Carbon Particles in RAW 264.7 Macrophage Cell Line – Part 2

Following 24 h of irradiation and exposure to 150 µg/ml of carbon, survival in the carbon-affected group (67 ± 3.7 %) and the combined group (37 ± 2 %) fell significantly.

After 72 h of irradiation, survival was significantly reduced in all groups compared to the control group.

In addition, a prolonged phagocytosis plus an increased inflammatory reaction of the macrophages was measured, indicating a negative interaction between mobile phone radiation and carbon particles. In the context of particulate matter pollution, these results are of key importance.

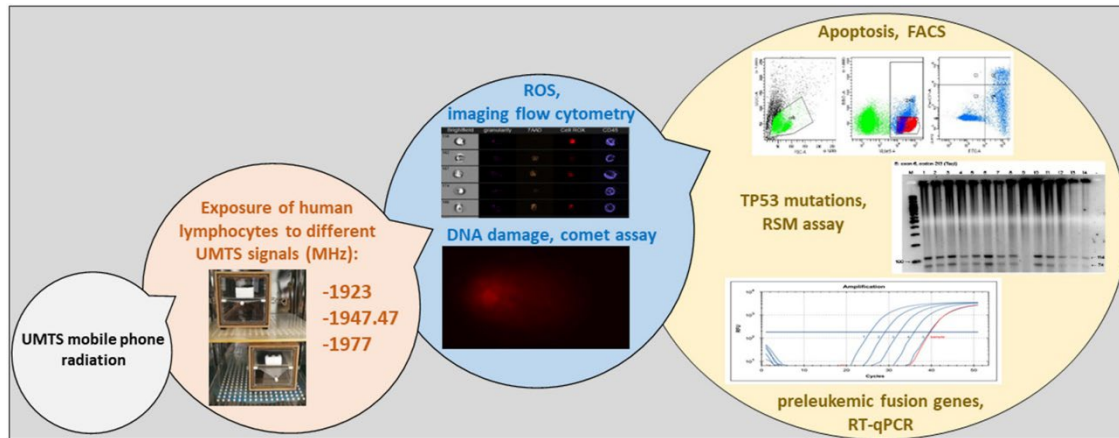
Effects of various UMTS signals from mobile phones on DNA, apoptosis and oxidative stress in human lymphocytes – Part 1

Authors: Gulati S., Kosik P., Durdik M., Skorvaga M., Jakl L., Markova E., Belyaev I.

Published: <https://doi.org/10.1016/j.envpol.2020.115632>

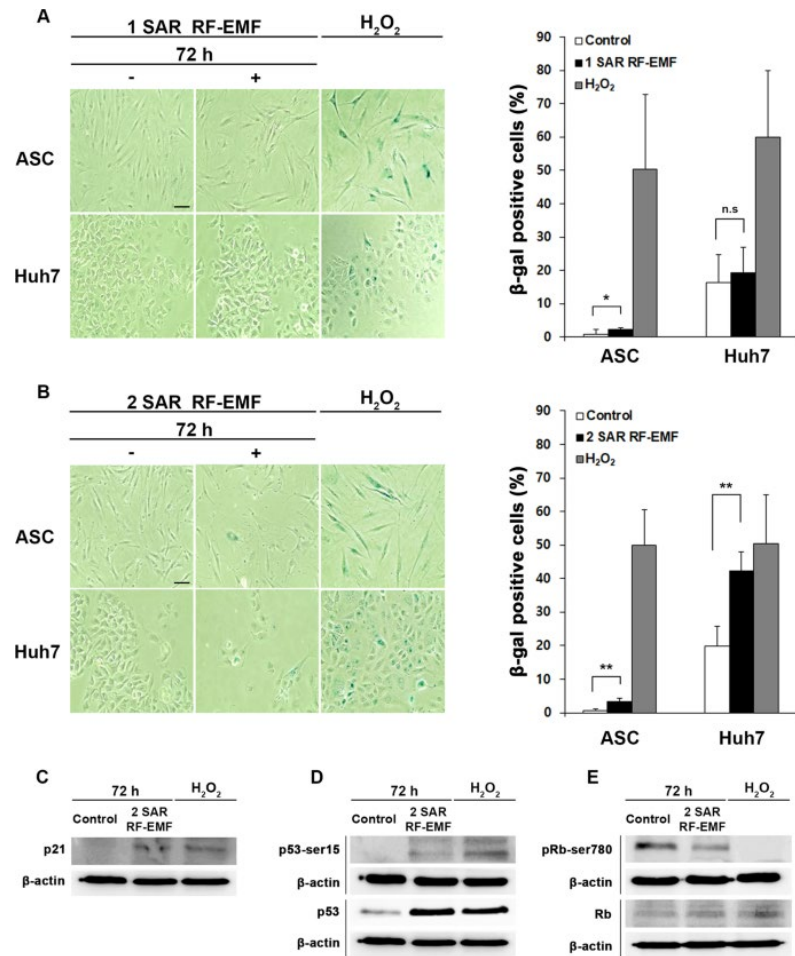
The study was conducted on human lymphocytes in vitro. A Nokia 6650 (0.25 W) served as the radiation source. Three UMTS frequency channels were tested at average frequencies of 1923, 1947.47 and 1977 MHz. Both irradiation and sham irradiation of the controls was performed simultaneously over 1 and 3 hours. The determined SAR value of 40 mW/kg fell clearly below the currently accepted value of 2 W/kg. The irradiation did not increase the temperature of the samples.

Effects of various UMTS signals from mobile phones on DNA, apoptosis and oxidative stress in human lymphocytes – Part 2



A statistically significant increase in DNA damage was found at the highest UMTS frequency band of 1977 MHz. This increased DNA damage was not time-dependent (no difference between 1 h and 3 h of irradiation). The other two frequency bands 1923 and 1947.47 MHz did not achieve a statistically significant increase in DNA damage. This could indicate that the mobile phone effect observed is frequency-dependent. This is the first report to suggest that non-thermal mobile phone effects can influence overall RNA formation.

Study – Continuous exposure to 1.7 GHz LTE electromagnetic fields increases intracellular reactive oxygen species, leading to reduced cell division of human cells and inducing senescence – Part 1

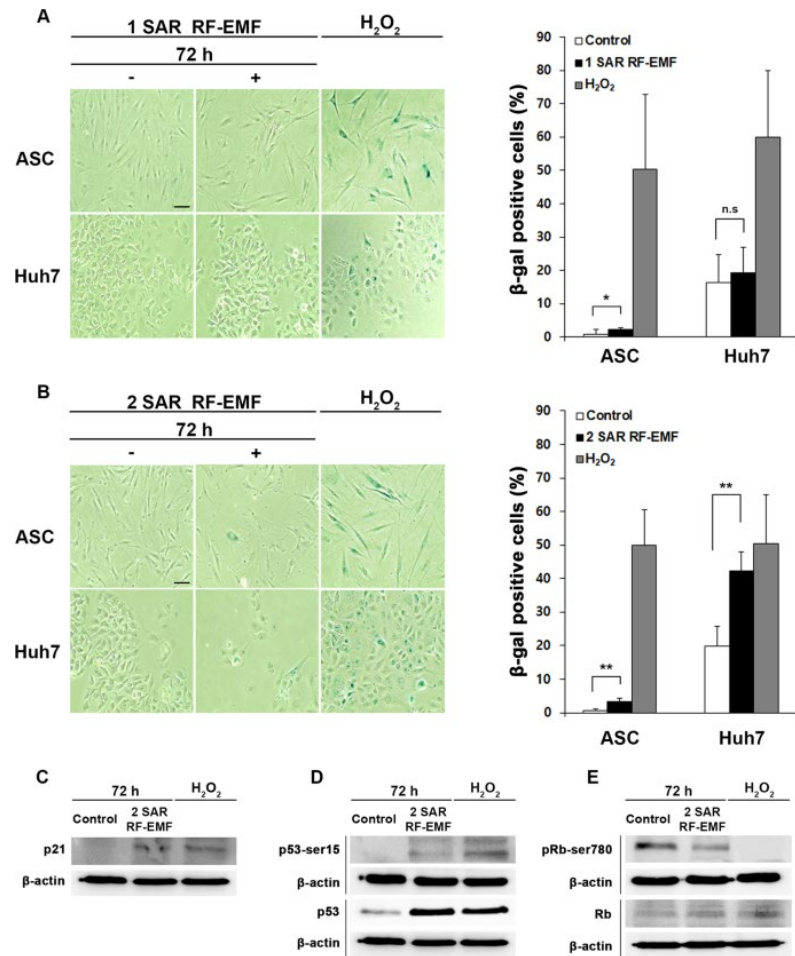


Authors: Choi J., Min K., Jeon S., Kim N., Pack JK, Song K.

Published: doi:10.1038/s41598-020-65732-4

The study investigates the **non-thermal** effects of 1.7 GHz LTE radiation on the growth of various human cells in vitro. These cells include adipose-derived mesenchymal stem cells (ASC), liver cancer stem cells (CSC), the liver cancer cell lines Huh7 and Hep3B, the neuroblastoma cell line SH-SY5Y, the uterine cancer cell line HeLa and the normal fibroblasts IMR-90.

Study – Continuous exposure to 1.7 GHz LTE electromagnetic fields increases intracellular reactive oxygen species, leading to reduced cell division of human cells and inducing senescence – Part 2



The study found that continuous exposure to 1.7 GHz LTE radiofrequency for 72h at a SAR₁ = 1 W/kg and a SAR₂ = 2 W/kg resulted in a decrease in cell division in all cell types studied. The cell origin (tissue type, normal cell, cancer cell) was not significant. The SAR value was directly related to the manifestation of reduced cell division. Furthermore, it was demonstrated that the reduced cell division was caused by ROS-induced cell senescence, and not by DNA damage or apoptosis. According to the authors, it is noteworthy that significant ROS formation was detected in the mitochondria of the cells, suggesting that radiofrequency exposure can negatively affect the efficiency of the electron transport system of the mitochondria.

Review - Genetic effects of non-ionizing electromagnetic fields – a review by H. Lai from 08.02.2021

1. Cells with an active metabolism are more sensitive to EMF effects and see an increase in the production of free radicals in the mitochondria.
 2. Cells with higher antioxidant activity are less sensitive.
 3. Elements such as iron could play a role via the Fenton reaction* (brain cells are more sensitive, they have a relatively high content of free iron, stored in DNA molecules).
 4. The cell cycle is often arrested by EMFs, possibly as a reaction of DNA repair following damage by EMF. If repair is not possible, cell death occurs, mostly through apoptosis, which often follows EMF damage.
 5. If genetically damaged cells survive, cancer can develop; if they die, the risk of cancer is reduced. But other damage can occur, e.g. the death of brain cells after exposure to electromagnetic fields can lead to neurodegenerative diseases (Alzheimer's, Parkinson's, amyotrophic lateral sclerosis, dementia, and to functional disorders of the muscles).
- * Oxidation of organic substrates catalysed by iron salts with hydrogen peroxide in acidic medium

Study – Electromagnetic fields can lead to immunosuppression via calcineurin inhibition, thereby increasing the risk of opportunistic infection

Johansson O.

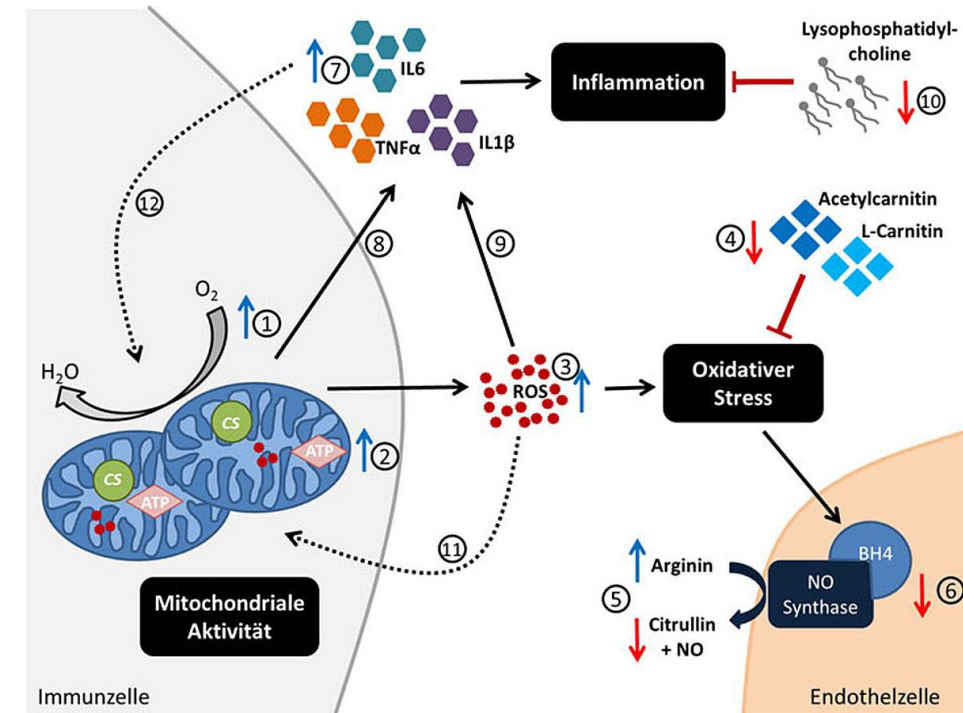
Doyon Independent Research, 1428 7th Ave., Santa Cruz, CA 95062, United States

Published in:

Med Hypotheses 2017; 106: 71–87

One possible way electromagnetic fields could influence the immune system would be via Ca^{2+} signalling cascades and the enzyme calcineurin. Calcineurin is a serine-threonine phosphatase found in a number of tissues with vital functions such as nerves, heart, skeleton and muscle. Calcineurin plays a central role in the immune response and is involved in a variety of signalling pathways related to cellular development. With regard to the immune system, calcineurin is crucially involved in the activation, cell division and differentiation of T lymphocytes.

Various studies show that even low-frequency electromagnetic fields, by opening voltage-dependent calcium channels, can cause a Ca^{2+} influx. The activation of T lymphocytes is recognised to be linked, among other things, to an influx of Ca^{2+} . An excessive pathological influx of Ca^{2+} , however, could lead to a production of ROS in excess, which in turn would inhibit calcineurin and so weaken the immune response.



Study Exposure to RF-EMF Alters Postsynaptic Structure and Hinders Neurite Outgrowth in Developing Hippocampal Neurons of Early Postnatal Mice

Kim JH*, Chung KH, Hwang YR, Park HR, Kim HJ, Kim HG, Kim HR.

* Department of Pharmacology, College of Medicine, Dankook University, Cheonan 31116.

South Korea

Published in: Int J Mol Sci 2021; 22 (10): 5340, doi:10.3390/ijms22105340

The results of this study indicate that exposure to radiofrequencies during early brain development following birth can reduce synaptic density and functional synapse formation in the hippocampus.

These events can lead to impaired memory function. The data indicated that radiofrequency exposure could inhibit the development of synapse formation in the young brain and impair physiological function.

Study Exposure to 2.45 GHz Radiation Triggers Changes in HSP-70, Glucocorticoid Receptors and GFAP Biomarkers in Rat Brain

Othman H*, López-Furelos A, Leiro-Vidal JM, Ammari M, Sakly M, Abdelmelek H, Salas-Sánchez AÁ, Ares-Pena F, López-Martín E.

* Laboratory of Integrative Physiology, Faculty of Sciences of Bizerte, University of Carthage, 7021 Jarzouna, Tunisia.

Spain

Published in: Int J Mol Sci 2021; 22 (10): 5103, doi:10.3390/ijms22105103

The study authors conclude that repeated exposure to 2.45 GHz (WLAN) causes dysregulation of HSP-70 (heat shock proteins) and GCR (glucocorticoid receptors). This triggers a state of stress that can reduce an anti-inflammatory response without promoting glial cell division. Further studies are needed.

Meta-Study – Exposure to low-frequency magnetic fields and childhood cancer: a systematic review and meta-analysis

Seomun G*, Lee J, Park J.

* College of Nursing, Korea University, BK21FOUR R&E Center for Learning Health Systems, Korea University, Seoul. South Korea

Published in: PLoS One 2021; 16 (5): e0251628, doi:10.1371/journal.pone.0251628

The meta-study involving more than 85,000 children with cancer (leukaemia, lymphoma and brain tumours) in 15 countries investigated the relationship between childhood cancer and low-frequency magnetic fields. The analysis with more than 36,000 children diagnosed with childhood leukaemia revealed a statistically significant association between magnetic fields and childhood leukaemia. Moreover, a dose-response relationship exists. Statement: The cancer risk from low-frequency magnetic fields, which have been classified as possibly carcinogenic in humans, is established. This study revealed a higher risk for childhood leukaemia than previously known.

Meta study – Exposure to radiofrequency radiation increases the risk of breast cancer: a systematic review and meta-analysis

Shih YW*, O'Brien AP, Hung CS, Chen KH, Hou WH, Tsai HT.

* School of Nursing, College of Nursing, Taipei Medical University, Taipei 11031.

Taiwan (Republic of China)

Published in: <https://www.spandidos-publications.com/10.3892/etm.2020.9455>, doi:10.3892/etm.2020.9455

The link between exposure to RF radiation and breast cancer risk was statistically significant. The analysis provides evidence of a statistically significant increased risk of breast cancer from exposure to radiofrequency radiation. This is true in particular for women over 50 who use electronic devices such as computers or mobile phones. As a possible mechanism for how RF irradiation could increase the risk of breast cancer, the authors cite the formation of reactive oxygen species.

Study: Chromosome damage in human cells by UMTS mobile phone radiation

Panagopoulos DJ.

* National Center for Scientific Research “Demokritos”, Athens.

Greece

Published in: Gen. Physiol. Biophys. (2019), 38, 445–454, doi:10.4149/gpb_2019032

The chromosomal damage detected in this study is due (probably) to DNA damage caused by mobile phone radiation. This DNA damage could not be repaired by cellular mechanisms and indicates the gene-damaging/bioactive effect of mobile phone radiation. It was proven that thermal effects do not play any role.

Meta study: The Effect of Continuous Low-Intensity Exposure to Electromagnetic Fields from Radio Base Stations to Cancer Mortality in Brazil

Rodrigues NCP*, Dode AC, de Noronha Andrade MK, O'Dwyer G, Monteiro DLM, Reis INC, Rodrigues RP, Frossard VC, Lino VTS.

* Sérgio Arouca National School of Public Health, Oswaldo Cruz Foundation, Rio de Janeiro 21041-210.
Brazil

Published in: Int J Environ Res Public Health 2021; 18 (3): 1229, doi:10.3390/ijerph18031229

The study authors point out that electromagnetic pollution continues to increase and that the positioning of base stations remains the subject of legal controversy. Several epidemiological studies suggest a link between cancer risk and proximity to MBS.

Study: Radiofrequency radiation emitted from Wi-Fi (2.4 GHz) causes impaired insulin secretion and increased oxidative stress in rat pancreatic islets

Masoumi A*, Karbalaei N, Mortazavi SMJ, Shabani M.

* Department of Physiology, Faculty of Medicine, Shiraz University of Medical Sciences, Shiraz.
Iran

Published in: International Journal of Radiation Biology, doi:10.1080/09553002.2018.1490039

This study shows that 2.4 GHz WLAN radiation leads to lower weight gain in rats, impaired glucose tolerance and insulin secretion, high blood sugar and poorer insulin secretion. There is also increased oxidative stress in the pancreas and islet cells.

Study – Oxidative Stress and NADPH Oxidase: Connecting Electromagnetic Fields, Cation Channels and Biological Effect

Georgiou CD*, Margaritis LH.

* Department of Biology, Section of Genetics, Cell & Developmental Biology, University of Patras, 10679 Patras. Greece

Published in: Int J Mol Sci 2021; 22 (18): 10041, doi:10.3390/ijms221810041

Based on the authors' findings, EMFs influence mechanisms that result in ROS formation, as these electromagnetic fields impair the function of membranes and voltage-dependent cation channels, leading to stress activation and increased expression of heat shock proteins. This is accompanied by behavioural and physiological changes such as permeability of the blood-brain barrier, impaired memory, changes in gene expression, autophagy, apoptosis, shortened life expectancy, DNA damage, and cancer.

Review – Human-made electromagnetic fields: Ion forced-oscillation and voltage-gated ion channel dysfunction, oxidative stress and DNA damage

Panagopoulos DJ*, Karabarbounis A, Yakymenko I, Chrousos GP.

* Laboratory of Health Physics, Radiobiology and Cytogenetics, Institute of Nuclear and Radiological Sciences and Technology, Energy and Safety, National Center for Scientific Research ‘Demokritos’, Patr. Grigoriou E’ and 27 Neapoleos Street, Agia Paraskevi, 15310 Athens, Greece

Published in: Int J Oncol 2021; 59 (5): 92, doi:10.3892/ijo.2021.5272

If electromagnetic fields (EMF) affect biological organisms – especially in the extremely low frequency range (“extra-low frequency”, or ELF, e.g. 50 Hz mains current) and in the microwave/radio frequency range, which is always combined with ELF – then DNA damage may result. DNA damage is associated with cell death, infertility and other diseases, including cancer. ELF exposure from power lines and complex RF exposure from wireless communication antennas/devices are associated with an increased risk of cancer.